Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Electronics Division
Mysore Road, Bangalore - 560 026

TENDER DOCUMENT

FOR

Erection and commissioning works (BOS)

For

22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC

at

Rajiv Gandhi Combined Cycle Power Project

Kayamkulam

in

Kerala

RFQ No.: EDN:PVENG:FSPV:NTPCK22MW:BOS

Date: 23.05.2020

ISSUED BY:

PUNAM MISHRA

SR. MANAGER

SC&PV-ENGG.

BHEL-EDN, BANGALORE

❖ **PART-I OF THIS TENDER DOCUMENTS CONTAIN:**

1. Notice Inviting Tender
2. Technical-cum-commercial bid **(to be filled-up by tenderer and to be submitted with all required documents asked).**
3. Pre- Qualification Criteria
4. Instructions to Tenderer along with Enclosures
5. Special Condition of Contract along with its annexures
6. Unpriced Price Bid
7. BHEL General Conditions of Contract 2019 (**"For items billed to Nodal"- wherever state Karnataka is mentioned in GCC it has to be read as Kerala and for Items billed to EDN state Karnataka only to be referred.)**
8. Scope of Work Cum Technical Specification

❖ **PART–II: PRICE BID:**

1. Bill of quantity (BOQ) cum rate Schedule for scope of work

❖ **SUBMISSION OF OFFER:**

1. BHEL is seeking the offer from all bidders in two-part bid system in soft copies and same can be sent to our company email ID **finpvse1@bhel.in** [finpvse1(at the rate)bhel(dot)in] by two emails.

- The bids shall be submitted to only the said email ID and **no copy shall be marked to anybody else**, to protect the secrecy of the bid. Any risk associated with violation of this instruction shall be entirely on the bidder.

- The documents shall be accepted in **PDF** format only and the maximum allowed size of the document is **8 MB** only. The documents should not be password protected.

- ONE email subject header indicating " Bidder name (Principal)–NTPCK22MW:BOS- Technical bid" consisting of technical offer, PQC documents, commercial terms and conditions. If the size of email is bigger than allowed limit, kindly send email in parts clearly indicating in the subject header as part-1,2,3…..of Total no. of mails.

- To reduce the size of Technical offers by bidder, Bidder has to fill and submit **Annexure-J** for deviation sheet against sealed and signed copies of technical and commercial terms of NIT. All other documents required in technical cum commercial bid format shall be submitted along with technical bid.

- Another email subject indicating "Bidder name (Principal)–NTPCK22MW:BOS- Price bid" where in the price bid to be submitted as an attachment (format available in the tender document).

- In case both the offers (Technical cum commercial and Price bid) are received in a single mail, offer may be treated as single part bid and both technical cum commercial and price bid be opened. Hence, bidders to exercise caution and send the two offers (technical cum commercial and price bid) in separate mails.

- **EMD SUBMISSION**: In case total amount of EMD is being submitted through SBI Collect, then electronic receipt of SBI collect to be submitted along with technical bid. In case the EMD shall be submitted in other forms (viz. BG/FDR etc.) as allowed in tender enquiry, the **scanned copy of the EMD document shall be mandatorily submitted** with technical bid and original EMD shall be sent to following address through speed post/courier/other available means:

  Office of AGM (SC&PV- PCG, M)
  SC & PV- ENGG., 5th Floor New Engineering Building
  Bharat Heavy Electricals Limited
  Electronics Division Mysore Road, Bangalore -560 026

  Offers without EMD shall be liable for rejection. The date of EMD document shall be not later than the Bid submission due date and the original EMD should reach us before price bid opening/RA. In case, it would not have reached before price bid opening/RA, the offer shall be rejected.

2. Email is password protective and will be opened by tender opening committee of BHEL on due date and time indicated in NIT.

3. **Note: Please ensure submission of offer before the due date and time. No other mode of submission is permitted. Late offers will be rejected.**

4. All other terms and conditions will be as per tender conditions indicated in NIT.

5. Offer submission is bidder's responsibility, any issue arising while submitting the offer may be brought to the notice of BHEL well before tender due date and time so that BHEL has sufficient time to take suitable action, if any.

6. Firms banned by BHEL are not eligible to participate in the tender. The offer submitted by such a firms will not be opened for evaluation and no communication in this regard will be entertained. The list of firms is available on web site www.bhel.com.

❖ **CONTACTS FOR CLARIFICTIONS:**

Sr. No.	Name of BHEL Representative	Contact No.	E-mail ID
1	Vijay K Choudhary	080-26998046 / 9415041583	vijayk.choudhary@bhel.in
2	Punam Mishra	080-26998991	punammishra@bhel.in
3	Saravana Bhavan	080-26998095/ 9095041612	ravana@bhel.in
4	Vipindas C P	080-26998389	vipindas.cp@bhel.in

NIT ISSUED BY:
Punam Mishra
Sr. Manager-SC&PV (Engg.)

Seal and sign of Bidder

Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Electronics Division
Mysore Road, Bangalore - 560 026

NOTICE INVITING TENDER

Tender Enquiry No. /RFQ No.:EDN:PVENG:FSPV:NTPCK22MW:BOS Date: 23.05.2020

BHEL-EDN Bangalore invites sealed bid in two part bid system (Part-I: Techno-commercial Bid; Part II: Price Bid) for following work from experienced and financially sound bidder who fulfil the qualifying criteria contained in the enclosed tender document**:**

1. **Description of work**: Erection and commissioning works (BOS) for 22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Kayamkulam.

2. **Estimated Cost:** Rs. 10.34 Crores Plus Applicable GST

3. **EMD Amount:** Rs. 20,34,000/- (**Mandatory for MSME also)**

4. **Security Deposit:** Applicable as per GCC Clause 1.9.

5. **Tender Monitoring Authority (IEM):** Mr. A C Verma, IPS (Retd.) & Mr. V B Singh, IPS (Retd.)

6. **Due Date and Time for Submission of Bid: 05.06.2020 (1:00 PM)**

7. **Due Date and Time for Opening of Techno-Commercial Bid**: **05.06.2020 (1:30 PM)**

8. **BHEL** reserve the right to accept or reject any of the bid/all bids or cancel/withdraw invitation for bid without assigning any reason whatsoever and in such case no bidder/intending bidders shall have any claim arising out of such action by BHEL.

9. The offers of the bidders who are on the banned list as also the offers of bidders, who engage the services of the banned firms, shall be rejected.

Note:

1. The contractors should understand the scope of work before submitting their bids.

2. For relevant details please visit our website “www.bhel.com”. All subsequent corrigendum/amendment shall be published only on website and not in press. Hence, bidders are advised to always be in touch with our said website until the tender is finally opened.

3. The Bidder along with its associate/ collaborators/ sub-contractor / sub vendors /consultants /services providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website www.bhel.com and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice.

NIT ISSUED BY:
Punam Mishra
Sr. Manager-SC&PV (Engg.)

Seal and sign of Bidder

TECHNICAL-CUM-COMMERCIAL BID

(To be furnished by the Bidders)

Sl. No.	Description	Please Fill
1	Name of the Firm (Bidder)	
2	Address of the Firm (Registered Office)	
3	Name of Contact Person	
4	Contact Numbers	
5	Email ID	

DOCUMENTS TO BE SUBMITTTED BY BIDDER

Sl. No.	Description	Status	Remarks
1	Earnest Money Deposit (EMD)	Submitted/ Not submitted	
2	Techno-Commercial Deviation Sheet	Submitted/ Not submitted	Signed and stamped Copy of **annexure-J** as a token of acceptance of all terms and conditions of the tender
3	Un-Priced bid (Price bid format without prices)	Submitted/ Not submitted	Bidder to sign and seal and give the concurrence of understanding the unpriced price bid. Bidder should not write anything other than his sign and seal on the Unpriced price bid. This unpriced bid to be submitted with the techno-Commercial bid.
4	Documents against pre-qualifying Criteria of Tender Documents	Submitted/ Not submitted	Signed and stamped copies of all documents as asked under qualifying criteria of the tender to be enclosed
5	Authorization for signing Tender Documents	Submitted/ Not submitted	Valid copy of power of attorney / authorized signatory to be enclosed as a proof of authorized representative of the firm
6	Signed and stamped copies of all Annexures to NIT	Submitted/ Not submitted	Duly filled, signed and stamped Copies of all Annexures, as applicable to be submitted
7	PF Code Number	Submitted/	Copy of the Certificate to be enclosed

		Not submitted	
8	ESI Code Number	Submitted/ Not submitted	Copy of the Certificate to be enclosed
9	PAN Number	Submitted/ Not submitted	Copy of the PAN Card to be enclosed
10	Income Tax Return (of last 3 yrs)	Submitted/ Not submitted	Copy of the ITR to be enclosed
11	GSTN No. & State Code	Submitted/ Not submitted	Copy of the Certificate to be enclosed
12	List of machineries/equipment available with bidder	Submitted/ Not submitted	A list of machineries/equipment available with bidder to be submitted
13	Electronic Funds Transfer (EFT) form	Submitted/ Not submitted	Fill the EFT form enclosed with tender and submit it in original
14	Integrity Pact	Submitted/ Not submitted	Duly filled Integrity pact to be submitted as per format attached
15	Constitution of Firm	_____	Individual/Sole Proprietorship Concern/Partnership Firm / Public Ltd. Company/Pvt. Ltd. (Proof to be submitted)

ACCEPTANCE OF BIDDER

Sr. No.	**Description**	**Status**	**To be filled by Bidder**
1	Validity of Offer (90 days from the date of tender Opening)	Accepted/ Not Accepted	
2	Accept to pay statutory payments like ESI, PF, BOCW, etc., as per terms and conditions of BHEL and Govt. guideline's	Accepted/ Not Accepted	
3	Penalty as per BHEL General conditions of contract 2019 clause 2.7.9	Accepted/ Not Accepted	
4	BHEL reserves right to conduct reverse auction.	Accepted/ Not Accepted	
5	In order to complete the project in the specified months schedule, bidder to deploy separate Four gangs/teams (or) more as per site requirement for each individual activities along with tools and machineries.	Accepted/ Not Accepted	
6	Scope of Work cum technical specification as per PS-439-1334 Rev. 00	Understood and accepted/ Not accepted	
7	Acceptance to execute the order in Total	Accepted/ Not Accepted	

8	BHEL Payment terms acceptance as specified in Special Conditions of Contract	Accepted/ Not Accepted	
9	The bidder should encourage to use local labor that has the necessary skills as per the requirement of work.	Accepted/ Not Accepted	
10	Before engaging the labour in to work, Contractor should get the NOC from labours' native police station as well as NOC from local police station (If applicable). Contractor is required to comply with NTPC's CLIMS system for identification and movement of labour in their work site.	Accepted/ Not Accepted	
11	Completion period of work awarded: 5 (five) Months from date of placement of order/handing over of site.	Accepted/ Not Accepted	

Note: The above techno-commercial bid shall be duly filled properly and required documents, as asked shall be attached by bidder.

PRE-QUALIFICATION CRITERIA

1. Bidders should have executed works of similar nature of works during last Ten (10) years as per below, as on the date of opening of Technical Bid.

One similar work of value not less than **4 crores** (Excluding all taxes).
OR
Two similar works of value each not less than **2.5 crores** (Excluding all taxes)
OR
Three similar works of value each not less than **1.5 crores** (Excluding all taxes)

Note:

I. The term "Similar works" means works experience of any of the following categories:

- Bidder to have any kind of experience in the execution of Land mounted or Roof top Solar plants for 5 MW or above.

OR

- Bidder should have successfully executed work order for execution of Floating Solar plants for 200kw or above.

OR

- Bidder should have work experience in field of reservoir/lake/river water activity or any water works such as dredging /silt removal/construction /cable or pipe laying works or works in the water reservoirs of thermal plants.

II. For the above activities the term **'executed'** means the bidder should have achieved the criteria specified above even if the total contract has not been completed or closed.

Copy of orders and performance report/completion certificate/tax invoice copies or delivery challans/other relevant documents of successful execution of the order is to be submitted.

2. Average annual financial turn over during the last 3 years, ending 31st March of the previous financial year, should be **Rs 3.10 crores**. Audited Profit & loss account and balance sheet to be submitted for last 3 financial years. CA Certificate for turnover to be submitted along with Balance sheet.

BHEL reserves the right to verify the documents submitted by the contractor. During verification, if it is found fake/forged/manipulated, suitable penal action shall be taken against bidder as per extent guidelines of BHEL for suspension of business dealing.

Suspension of business dealings with Suppliers/Contractors shall be dealt as per the guidelines available on BHEL website www.bhel.com.

In case the Tenderers not fulfilling the above conditions, the offer is liable for rejection.

INSTRUCTIONS TO TENDERER

1. All entries in tender documents should be in one ink (preferably blue ink). Erasing and overwriting is not permitted. All corrections should be duly signed by tenderer concerned.

2. Tenderers shall fill in all the required particulars in the blank space provided for this purpose in the tender documents and also sign in each and every page of the tender document s attached before submitting tender.

3. Unit rate/percentage above or below estimate should be quoted in figures as well as in words in Indian Currency only i.e. Rupees and Paisa with reference to each item and for the items shown in the rate schedule. These rates shall be for the finished work at site. The rate shall include all taxes and duties payable on account of Octroi, Sales Tax, tax on work contract etc., and also expenses towards PF and ESI contributions and all other expenses related to work.

4. In case the rate quoted in figures differs from those quoted in words, the lower of the rates quoted will be taken as the tendered rate and shall be binding on the tenderer.

5. In Price bid bidders are advised to quote their best prices (% over the estimate +/_) as no further price bids will be accepted in case BHEL decides to open price bids instead of reverse auction.

6. Bidders to submit the unpriced copy of the price schedule for compliance to the terms and quantities indicated in the price schedule along with the technical bid duly stamped according their acceptance. (Mandatory requirement).

7. The tenderer shall note that, No Claim for variation of rates, on the ground that existing statutory levies have been increased / decreased or those new statutory levies have come into effect after tender, or on any other ground, will be entertained.

8. The rate quoted in the tender shall remain valid for a period of 'THREE MONTHS' from the date of opening tender.

9. Tenderer shall not increase quoted rates, once the tenderer has submitted offers/quotation/price and during execution of contract in case tender is accepted.

10. Successful bidder should execute the work strictly in accordance with Tender schedule quoted rates as accepted by BHEL.

11. The rates quoted should be exclusive of all taxes arising on the transaction. Tax shall be indicated separately as applicable.

12. Before tendering, the tenderer is advised to inspect the site of work and its environments and be well acquainted with the actual working and other prevailing conditions, position of material and labor. They should be well versed with BHEL Conditions of Contract, instruction to the tenderers, technical specification, schedule of works and all other documents which form part of the agreement to be entered into subsequent to award of work.

13. The tenderer should be specially note that it is tenderers responsibility to provide any items which is not specifically mentioned in the specifications and scope, but which is necessary to complete the work and tenderers shall make his own arrangements for the transport of personnel and equipment to the site and for the stay and boarding facilities of their team at site during the course of work. Bidder shall ensure safety of the operating team and personnel at site during the execution of work.

14. Details and quantities of each item of work shown in the bill of quantities attached here to only approximate. They are given as a guide for the purpose of tendering only and are liable for variation and alteration at the discretion of the competent authority. The work under each item as executed shall be measured and price at the corresponding rates to be quoted by the Contractor in the bill of quantities attached hereto.

15. In the event of the tender being submitted by a firm the tender must be signed separately and legibly by each partner or member of the firm or in their absence, by the person holding the power of Attorney on behalf of firm concerned. In the later case, a copy of the power of Attorney duly attested by the Gazetted Officer must accompany the tender.

16. The BHARAT HEAVY ELECTRICALS LIMITED reserve the right to reject any or all the tenders received or accept any tender or part thereof without assigning reason thereof. In the case of acceptance of a part of tender, the time for completion may also be reduced to the extent considered necessary by the accepting authority.

17. Conditional and Unsigned tenders, tenders which are incomplete or otherwise considered defective, tenders which are not in accordance with the tender conditions laid down by the accepting officer and tenders not submitted in the prescribed forms are liable to be rejected.

18. The Contractors responsibility under this contract shall commence from date of receipt of the order or acceptance of tender.

19. Tenders submitted by speed post or courier service shall be posted with due consideration of any delay in postal delivery. Tenders received after the due date and time of opening tenders are liable to be rejected.

20. Scope of works of tenderers includes deployment of manpower, equipments etc. to carry out the given work and submission of test reports drawing etc. as per condition of contract, Technical specification and schedule of works. BHEL shall not provide any equipment/ manpower / material for the work.

21. Any covering letter and comments of the tenderer should be submitted along with the offer.

22. Should a tenderer or a contractor has a relative or in the case of firm or company, any of its shareholders relative is employed in Bharat Heavy Electricals Limited, the authority inviting tenders shall be informed of this fact at the time of submission of the tender, failing which tender may be disqualified or if such fact subsequently comes to light.
23. Contractor shall insure all his labourers and material. Any claim by his Employees for damages shall be settled by the Contractor even if action is against BHEL or to reimburse the legal expenses incurred by BHEL.

24. Any action brought in by anybody on BHEL regarding patent, right etc., used by Contractor in execution of work shall be defended by the Contractor and / or reimburse BHEL the cost of the same.

25. Contractor shall produce necessary records, documents; explanation whenever he is called upon to do by any Government Agencies.

26. No extra items of work shall be carried out by the contractor other than those authorized to do so in writing by the Engineer-in-charge. For any such items of work executed as per instructions of Engineer-in-charge, the rates will be fixed on the basis BHEL terms and condition.

27. In case, work is not completed as per the BHEL scope due to any unforeseen reasons, contractor has to complete the job at later stage without any extra charge. No overturn charges shall be paid in case of extension of work schedule.

28. Bidders should study the prevailing Market trend of Construction materials/laborers/other relevant requirement before quote and submit the competitive price.

29. The bidders should carry out preliminary survey at proposed work site before submission of offer to ensure that the rate quoted for the relevant schedule of items are correct.

30. Tenders without Earnest Money Deposit receipt are liable to reject. No interest will be paid on the earnest money deposit.

31. The Earnest money deposit may be furnished in the following modes of deposit:

a) Banker's cheque/ Pay order/Demand draft in favour of BHEL EDN, Bangalore – 560026.

b) Through online from SBI Collect.

c) Electronic Fund Transfer credited in BHEL account (before tender opening)

d) Fixed Deposit Receipt (FDR) issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL)

e) In addition to above, the EMD amount in excess of Rs Two lakh may also be accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for at least six months. The format of BG for EMD submission is attached with tender documents.

Guidelines for payment of EMD Fee through SBI Collect

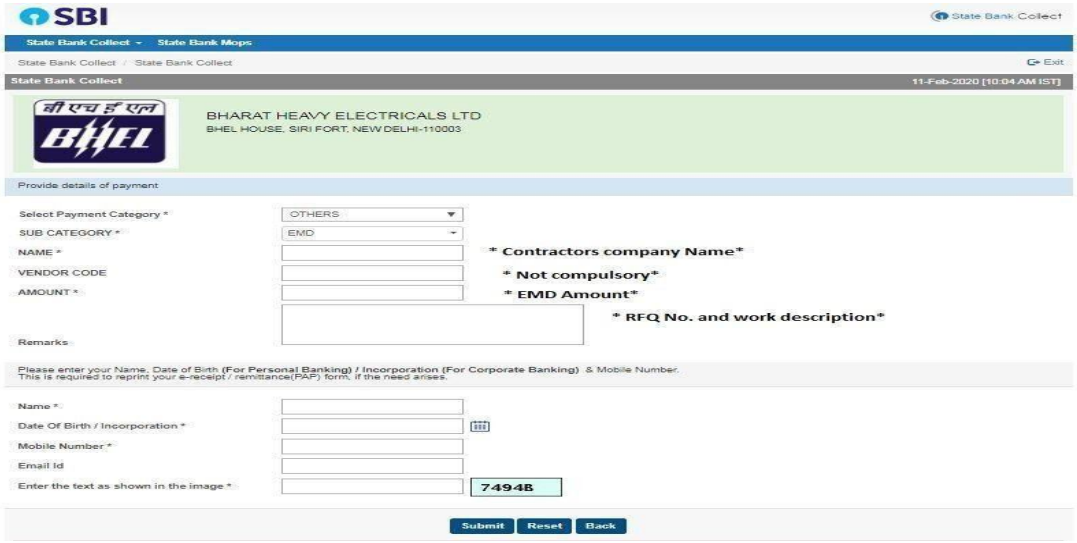
- Step-1: Please enter the following link in your internet address browser or click on the following link. https://www.onlinesbi.com/sbicollect/icollecthome.htm. Please click on “proceed” after Clicking “Check Box” to proceed for payment

- Step-2 : Now the SBI’s SB-Collect site gets opened. Please select State of Corporation as “Karnataka” and type of Corporation as “PSU-Public Sector Undertaking” and then click on “Go” appearing on the screen.

- Step-3 : Now select “ Bharat Heavy Electricals Ltd. ” from the dropdown table appearing against “Industry Name” and click Submit.

- Step-4: Now select “Others ” from the dropdown table appearing against “Category” and click Submit

- Step-5: The below screen (similar) will appear. Please select sub category “EMD” and fill up other details and transfer money.



32. For refund of Earnest Money Deposit, the tenderer should fill the enclosed EFT form, obtain the Banker’s signature and also enclose a photocopy of cancelled cheque leaf.

33. Bidder whose tender is accepted signs contract agreement within fifteen days (15 days) of the date of the order directing to do so, the amount of Earnest Money already deposited by bidder will be forfeited and acceptance of the tender withdrawn.

34. If after opening of tenders a tenderer revokes the tender or increase of earlier quoted rates or after acceptance of his tender does not commence the work in accordance with the instruction of Engineer- in-charge, the Earnest Money Deposited by bidder will be forfeited and acceptance of bidder’s tender withdrawn.

35. If only a part of work included in the tender had been awarded to the tenderer, the amount of Earnest Money to be retained will be based on value of the contract so awarded.

36. The tenderers should enclose relevant documents regarding constitution of firm i.e. Individual / Sole Proprietorship Concern / Partnership Firm / Public Limited Company / Private Limited.

37. Tenders submitted by speed post or courier service shall be posted with due consideration of any delay in postal delivery. Tenders received after the due date and time of opening tenders shall be rejected.

38. If proprietor or partner of a firm expires after the submission of tender or after the acceptance of tender, BHEL reserves the right to cancel the contract if the character of the firm undergoes a substantial change.

39. THE BHARAT HEAVY ELECTRICALS LIMITED will not be bound by any power of Attorney granted by the tenderer or changes in the composition of firm made subsequent to signing of the contract. They may however recognize such power of Attorney and changes after obtaining proper legal advice.

40. If the tenderer deliberately gives wrong information on tender regarding past unsatisfactory performance with BHEL sister units, BHEL reserves the right to reject such tender at any stage including contract execution period.

41. Words imparting the singular number shall also be deemed to include the plural number and vice-versa where the context so require.

42. The General and Special Conditions are complementary to each other and where they are in conflict, the special condition shall prevail.

43. The expenses for completing the stamping agreement shall be paid by the contractor.

44. Unless or otherwise stated above tendered work includes men, material, machine and commissioning of equipment as agreed to in the contract.

45. After completing of the job, the contractor has to furnish actual drawings of work done in consultation with Engineer-in-charge.

46. Any covering letter and comments of the tenderer should be submitted along with the offer.

47. Cement and steel for carrying out Civil Works will have to be procured by the Contractor. Steel for Materials shall be accompanied with Test certificates and connected dispatch documents for proof of source from approved manufacturer's works or stockyard. The Contractor shall provide all the materials needed for trial run, testing including chemicals, consumables etc. In quoting their rates, the Contractors are advised to take into account the cost of the above materials. All the construction materials should be approved by BHEL before commencement of work. All structural steel and Reinforcement steel to be procured from SAIL, JSW Steel Ltd, Jindal Steel & Power, Tata steel Ltd. (for Reinforcement steel/TMT, RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Essar Steel India Ltd. (for Flat products/ Steel Plates), Electrosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars).

48. Should a tenderer or a contractor has a relative or in the case of firm or company, any of its shareholders relative is employed in Bharat Heavy Electricals Limited, the authority inviting tenders shall be informed of this fact at the time of submission of the tender, failing which tender may be disqualified or if such fact subsequently comes to light.

49. These 'INSTRUCTIONS TO TENDERER' & GENERAL CONDITIONS OF CONTRACT OF BHEL' shall be deemed to form an integral part of the Contract agreement for the work to be entered into. The Contractor has to scrutinize the same, and when submitting his tender, indicate his acceptance of both. In cases of variation between the two in any matter, the conditions in the 'THE INSTRUCTIONS TO TENDERER' shall prevail.

50. All operations to be carried out by the Contractor during the execution of the contract such as module assembling, earthing wiring etc., shall be done with proper equipment to be brought by the tenderer. Contractor shall make his own power and water supply.

51. The Contractor shall comply with the provision of Employees Provident Fund's and miscellaneous Provisions Act 1952 and rules, regulations and other orders issued there under. He as an employer shall be liable to pay employer's contribution/deductions towards PF under the PF Act in respect of all labour employed by him for the execution of the contract in accordance with the provisions of the Employees' Provident Funds and Miscellaneous Provisions Act, 1952 as amended from time to time. For this purpose he shall indicate the code number obtained from the Regional Provident Fund Commissioner or he should obtain a code number if he has not and produce the Photostat copy of the challan receipt of monthly remittance of the contribution made by him to the Commissioner. He shall also furnish such returns such returns as are due, under the Act, to be sent to the appropriate authorities through the Principal Employer".

52. The Contractor should get himself registered with the E.S.I Authorities as an independent Employer, obtain a separate code number and remit the dues in respect of the Labour employed by him for the work and produce the challan/Receipts of remittance of the ESI contributions due under the E.S.I Act to the Company authorities. He shall also furnish such returns, as are due, under the Act, to be sent to the appropriate authorities' through the Principal Employer. The contractor can remit their ESI & PF through a sub-agent who processes the ESI & PF code and agrees to enter an MOU with the contractor.

53. If any action is brought in by P.F. Commissioner/ESI authorities on BHEL for the work done by the Contractor for his labourers regarding PF/ESI amount due, short remittances, non-remittances etc., the Contractor shall defend the case on behalf of BHEL and / or reimburse BHEL the expenses so incurred.

54. The Contractor shall apply and obtain license under Contract labour (R&A) Act 1970 and comply the relevant provisions of this Act in respect of the labour employed by him for executing this contract. The contractor shall furnish necessary returns to the authority through the Principal Employer.

55. Contractor shall insure all his labourers and material. Any claim by his Employees for damages shall be settled by the Contractor even if action is against BHEL or to reimburse the legal expenses incurred by BHEL.

56. Any action brought in by anybody on BHEL regarding patent, right etc., used by Contractor in execution of work shall be defended by the Contractor and / or reimburse BHEL the cost of the same.

57. Contractor shall produce necessary records, documents; explanation whenever he is called upon to do by any Government Agencies.

58. Contractor should obtain "Workmen Compensation Policy" for their Employees.

59. **Boat, Safety Jacket, Tools etc.:**

    Unless otherwise specified in the tender schedule, the rates for all items will be deemed to include boat, safety jacket for worker involved in the work.

No separate payment will be made for dewatering (including seepage, surface drainage and monsoon water) desludging and allied operations at any stage of the work, and the cost of such operations will be deemed to be included in the contract rates.

No separate payment will be made for curing including pumping of curing water where ever necessary.

60. **Extra Items**

No extra items of work shall be carried out by the contractor other than those authorized to do so in writing by the Engineer-in-charge. For any such items of work executed as per instructions of Engineer- in-charge, the rates will be fixed on the basis indicated as per terms and conditions of BHEL.

61. **Participation in the tender:**

In event of multiple Bids of related parties like sister concern, common representative, same signature or same phone nos. on the bids or any other documents which can prove that the two companies are related to each other, the same shall be treated as Cartel formation and BHEL will not accept such multiple bids .Hence bidders are advised to submit only one bid from among the related parties.

62. **Reverse Auction:**

BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non-consideration of their bids, in case BHEL decides to go for RA.

Those bidders who have given their acceptance to participate in Reverse Auction will have to necessarily submit 'Process compliance form' (to the designated service provider) as well as 'Online sealed bid' in the Reverse Auction. Non-submission of 'Process compliance form' or 'Online sealed bid' by the agreed bidder(s) will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

The bidders have to necessarily submit online sealed bid less than or equal to their envelope sealed price bid already submitted to BHEL along with the offer. The envelope sealed price bid of successful L1 bidder in RA, if conducted, shall also be opened after RA and the order will be placed on lower of the two bids (RA closing price envelope sealed price) thus obtained. The bidder having submitted this offer specifically agrees to this condition and undertakes to execute the contract on thus awarded rates.

If it is found that L1 bidder has quoted higher in online sealed bid in comparison to envelope sealed bid for any item(s), the bidder will be issued a warning letter to this effect. However, if the same bidder again defaults on this count in any subsequent tender in the unit, it will be considered as fraud and will invite action by BHEL as per extant guidelines for suspension of business dealings with suppliers/ contractors (as available on www.bhel.com).

63. **Information to The Tenderer:**

I. Successful Bidder should establish their Site office at Construction site, including common facilities such as toilet, water, electricity etc. in consultation with BHEL. Contractor has to arrange water and power as required for completing the job in the stipulated time frame at their own cost.

II. The bidders should furnish “Certificate of Declaration Confirming the Knowledge Of Site Condition” in Annexure enclosed herewith.

III. Bidders should study the prevailing Market trend of Electrical materials/laborers/other relevant requirement before quote and submit the competitive price.

IV. The bidder should encourage to use local labor that has the necessary skills as per the requirement of work.

V. Before engaging the labour in to work, Contractor should get the NOC from labours’ native police station as well as NOC from local police station (If applicable).

VI. The bidders should carry out preliminary survey at proposed construction site before submission of offer to ensure that the rate quoted for the relevant schedule of items are correct.

VII. Contractor to note BHEL reserves the right to get any part of the work done through other agency or deploy BHEL’s own/hired/otherwise arranged resources, at the risk and cost of the contractor after due notice of a period of two weeks by BHEL, in the event of:

a) Contractors continued poor progress

b) Withdrawal from or abandonment of the work before completion of the work.

c) Contractor’s inability to progress the work for completion as stipulated in the contract

d) Poor quality of work

e) Corrupt act of Contractor

f) Insolvency of the contractor

g) Persistent disregard to the instructions of BHEL

h) Assignment, transfer, sub-letting of contract without BHEL’s written permission

i) Non fulfillment of any contractual obligations

j) In the opinion of BHEL, the contractor is overloaded and is not in a position to execute job as per required schedule.

VIII. The liquidated damages/penalties arising out of Risk and Cost as explained under Sl.no (vii). BHEL shall recover the amount from any money due from Contractor, or from any money due to the contractor including security deposit, or by forfeiting any T & P or material of the contractor under this contract or any other contract of BHEL or by any other means or any combination thereof.

IX. Documents to be submitted on award of work (as applicable):

a) Security deposit in the form of Cash/DD/ NSC's / Kisan Vikas Patra / FDR / Bank Guarantee in favour of BHEL

(b) Electronic Fund Transfer Form duly signed & sealed by banker along with cancelled cheque copy

(c) Labour license of the workmen engaged valid for contract period (If applicable)

(d) Electrician qualification certificate (minimum ITI certificate/B license) for electrical work.

(d) Workmen Compensation Insurance Policy for the workmen engaged valid for contract period

(e) Deduction of statutory taxes (as applicable) at source would be enforced from the running bills at the rates prescribed unless exemption certificate is produced from the concerned authorities.

X. The following documents are to be submitted along with the Running Account Bills for process of payment

a) Tax Invoice with details of GST number of BHEL and contractor.

b) Measurement books duly filled and signed by officials of BHEL and contractor

c) Provident PF Remittance challan for the bill duration.

d) ESI Remittance challan for the bill duration.

e) Invoice submitted along with running bills to indicate the GST amount charged and bear GST NUMBER etc. as per prevailing taxes. Bill submitted subsequently to be accompanied with a declaration that GST liability on the earlier bill has been discharged.

i) by paying money to the Government (along with Tax paid Challan Copy)

ii) by utilization of Input GST Credit

f) Field quality assurance documents (as applicable) as per instruction of Engineer In-charge.

64. **Integrity Pact (IP):**

IP is a tool to ensure that activities and transactions between the Company and its Bidders/Contractors are handled in a fair, transparent and corruption free manner. A panel of Independent External Monitors (IEMs) have been appointed to oversee implementation of IP in BHEL.

The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory who signs in the offer) along with techno-commercial bid. Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification.

Details of IEM for this tender is furnished below:

SL	IEM	E-mail
1	Shri Arun Chandra Verma, IPS (Retd .)	acverma1@gmail.com
2	Shri Virendra Bahadur Singh, IPS (Retd.)	vbsinghil2s@gmail.com

Please refer Section-8 of the IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to the IEM mentioned in the tender.

No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing department whose contact details provided in the tender document.

ENCLOSURE: A

CLAUSE 20 OF GENERAL CONDITIONS OF CONTRACT

LABOUR

The Contractor shall employ labour in sufficient numbers either directly or through sub-contractors to maintain the required date of progress and of quality to ensure workmanship of the degree specified in the contract and to the satisfaction of the Engineer-in-charge. The contractor shall not employ in connection with the works any person who has not completed his eighteen years of age.
The contractor shall furnish to the Engineer-in-charge at the intervals specified by him. A distribution return of the number and description by trades of the work people employed on the works. The Contractor shall also submit on the 4th and 19th or every month to the Engineer-in-charge a true statement showing in respect of the second half of the preceding month and the first half of the current month (i) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them and (ii) the number of female workers who have been allowed maternity benefits as provided in the maternity benefit Act, 1961 or Rules made there under and the amount paid to them.
The contractor shall pay to labour employed by him either directly or through sub-contractors wages not less than fair wages as defined in the contractors Labour Regulations.
The Contractor shall in respect of labour employed by him either directly or through sub- contractors comply with or cause to be complied by with sub-contractors, labour Regulations in regard to all matters provided therein.
The Contractors shall comply with the provisions of the payment of wages Act, 1936, Minimum Wages Act, 1948, Workmen's Compensation Act 1923, Industrial Disputes Act, 1947, Maternity Benefit Act 1961 or any modifications there of or any other law relating thereto and rules made there under from time to time.
The Contractors shall be liable to pay his contribution and the employees' contribution of the State Insurance Scheme in respect of all labour employed by him for the execution of the contract, in accordance with the provision of "The Employees', State Insurance Act, 1948", as amended from time to time. The Contractors shall apply to the ESI Authorities, get himself registered with them and obtain a code Number. He shall pay the remittances under his code Number only. The Contractor shall be liable to pay his contribution and the Employees' contribution towards PF as per Provident Fund Rules and Regulations in respect of all labour employed by him for the execution of the contract.

The contractor shall apply to the PF Authorities, get himself registered and obtain a code number from them. He shall pay the remittances towards PF under his code Number only. The Engineer-in-charge shall on a report having been made by an Inspecting Officer as defined in the Contractors Labour Regulations have the power to deduct from the moneys due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the conditions of the contract for the benefit of workers, non - payment of wages or of deductions made from him or their wages which are not justified by the terms of the contract of non-observance of the said contractor's Labour Regulations.

The Contractors shall indemnify the BHEL against any payment to be made under and for observance of the regulation aforesaid without prejudice to his right to claim indemnity from these sub-contractors.

MODEL RULES FOR LABOUR WELFARE

The Contractor shall at his own expense comply with or cause to be complied with model Rules for Labour Welfare as appended to these conditions or rules framed by Government from time to time for the protection of health and for making sanitary arrangements for workers employed directly or indirectly on the works, In case the Contractors fails to make arrangements as aforesaid the Engineer-in- charge shall be entitled do so and recover the cost thereof from the contractor.

ENCLOSURE: B

SAFETY CODE

RESPONSIBILITIES OF THE CONTRACTOR IN RESPECT OF SAFETY OF MEN, EQUIPMENT, MATERIAL AND ENVIRONMENT

1. Before commencing the work, contractor shall submit a "SAFETY PLAN" to the authorized BHEL Official. The 'SAFETY PLAN' shall indicate in detail the measure that would be taken by the contractor to ensure safety of men, equipment, material and environment during execution of the work. The plan shall take care to satisfy all requirements specified hereunder. During negotiations before placing of work order and during execution of the contract BHEL shall have right to review and suggest modification in the Safety Plan. Contractor shall abide by BHEL decision in this respect.

2. The contractor shall take all necessary safety precautions and arrange for appropriate appliances as per direction of BHEL or its authorized officials to prevent loss of human lives, injuries to personnel engaged, and damage to property and environment.

3. The contractor shall provide to its work force and ensure the use of the following personal protective equipment as found necessary and as directed by the authorized BHEL Officer:

   (i) Safety life jacket to IS 6685/SOLAS
   (ii) Safety Shoes conforming to IS-1989: 1978.
   (iii) Eye and Face protection devices conforming to IS-8520: 1977 and IS-8940: 1978.
   (iv) Hand and body protection devices conforming to: IS-2573: 1975

   IS-6994: 1973

   IS-8807: 1978

   IS-8519: 1977

   All tools, tackles, lifting appliances, material handling equipment scaffolds, cradles, safety nets, ladders, equipment's etc. used by the contractor shall be of safe design and construction. These shall be tested and certificate of fitness obtained before putting them to use and from time to time as instructed by authorized BHEL Official who shall have the right to ban the use of any item.

   All electrical equipment's, connections and wiring for constructions power, its distribution and use shall conform to the requirement of the Indian Electricity Act and Rules. Only electricians licensed by the appropriate statutory authority shall be employed by the contractor to carry out all types of electrical works.

   All electrical appliances including portable electric tools used by the contractor shall have safe plugging system to source of power and be appropriately earthed. The contractor shall not use any hand lamp energized by electric power with supply voltage of more than 24 volts. For work in confined space lighting shall be arranged with power sources of not more than 24 volts.
   The Contractor shall adopt all fire safety measures as laid down in the "Code for fire Safety at Construction Sites" issued by the Safety Department of the Construction Management (HQ) of BHEL and as per directions of the authorized BHEL Official. A copy of the above referred "Code of Fire Safety at the Construction Sites" shall be made available by BHEL to the contractor for reference, on demand by the contractor, during tendering stage itself.

Where it becomes necessary to provide and/or store petroleum products, explosives, chemicals and liquid or gaseous fuel or any other substance that may cause fire or explosion, the contractor shall be responsible for carrying out such provisions and/or storage in accordance with the rules and regulations laid down in the relevant government acts, such as Petroleum Act, Explosives Act, Petroleum and Carbides of Calcium Manual of the Chief Controller of Explosives, Govt. of India. etc., prior approval to the authorized BHEL Official at the site shall also be taken by the contractor in all such matters.

The contractor shall arrange at his cost (wherever not specified) appropriate illumination at all work spots for safe working when natural daylight may not be adequate for clear visibility.

The contractor shall be held responsible for any violation of statutory regulations local, state or central and BHEL instructions that may endanger safety of men, equipment, material and environment in his scope of work or another contractor or agencies. Cost of damages if any, to life and property arising out of such violation of statutory regulations and BHEL instructions shall be borne by the contractor.

In case of a fatal or disabling injury accident to any person at construction sites due to the lapses by the contractor, the victim and/or his/her dependents shall be compensated by the contractor as per statutory requirements. However, if considered necessary, BHEL shall have the right to impose appropriate financial penalty on the contractor and recover the same from payments due to the contractor for suitably compensating the victim and/or his/her dependents. Before imposing any such penalty, appropriate enquiry shall be held by BHEL giving opportunity to the contractor to present his case.

In case of any damage to property by the contractor, BHEL shall have the right to recover cost of such damages from payments from payments due to the contractor after holding an appropriate enquiry.

In case of any delay in the completion of a job due to mishaps attributable to lapses buy the contractor; BHEL shall have to recover cost of such delay from payments due to the contractor, after notifying suitably and giving him opportunity to present his case.

If the contractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given a reasonable opportunity to do so; and/or if the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions regarding safety issued by the authorized BHEL Official, BHEL shall have the right to take corrective steps at the risk and cost of the contractor after giving a notice of not less than seven days indicating the steps that would be taken by BHEL.

The contractor shall submit report of all accidents, fires and property damage, dangerous occurrence to the authorized BHEL Official immediately after such occurrence, but in any case not later than twelve hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. In addition, the contractor to the authorized BHEL Official shall also submit periodic reports on safety from time to time as prescribed.

Before commencing the work, the contractor shall appoint/nominate a responsible officer to supervise implementation of all safety measures and liaison with his counterpart of BHEL.

If safety record of the contractor in execution of the awarded job is to the satisfaction of Safety Department of BHEL, issue of an appropriate certificate to recognize the safety performance of the contractor may be considered by BHEL after completion the job

ENCLOSURE: C

CLAUSE 58 OF GENERAL CONDITIONS OF CONTRACT

ARBITRATION:

Except where otherwise provided for in the contract all questions and disputes relating to the meaning of the specifications, designs, drawings and instructions herein before mentioned and as to the quality of workmanship or materials used on the work or has been other as to any other questions, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works, of or the execution or failure to execute the same whether arising during the program progress of the work or after the completion or abandonment thereof shall be referred to the sole arbitration of the Executive Director/General Manager of BHEL and if the Managing Executive Director/General Manager Chief Engineer is unable or unwilling to act, to a as the sole arbitration of some other person appointed by the Executive Director / General Manager, willing to act as such Arbitrator. There will be no objection if the arbitrator so appointed is an employee of BHEL EDN or an employee of any other unit of BHEL and that he had to deal with the matters to which the contract relates and that in the course of its his duties as such he had expressed views on all or any of the matters in dispute or difference. The Arbitrator to whom the to matter is originally referred being transferred or by vacating his office or being unable to act for any reason, such Executive Director / General Manager as aforesaid at the time of such transfer, vacation of office or inability to act, shall appoint account another person to act as arbitrator in accordance with the terms of the contract, such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor. It is also a term of this contract that no person other than a person appointed by such Executive Director/General Manager or an employee appointed as arbitrator as aforesaid should act as arbitrator and the arbitrator shall give reasons for the award.

Subject as aforesaid the provision of the Arbitration Act, 1940 or any statutory modification or re-enactment thereof and the rules made there under and for the time being in force shall apply to the arbitration proceeding under this clause.

It is a term of a contract that the party involving invoking arbitration shall specify the dispute or disputes to be referred to arbitration under this clause together with the amount or amounts claimed in respect of each such dispute.

The arbitrator(s) may from time to time with consent of the parties enlarge extend the time, for making the publishing the awards.

The work under the contract shall, if reasonably possible, continue during the arbitration proceeding and no payment due to or payable to the contractor shall be withheld on account of such proceedings.

The arbitrator shall be deemed to have entered on the reference on the date he issued notice to both the parties fixing the date of the hearing.

The arbitrator shall give a separate speaking award in respect of each dispute or difference referred to him.

The venue of arbitration shall be such place as may be fixed by the arbitrator in his sole discretion. The award of the arbitrator shall be final, conclusive and binding on all parties to this contract.

SPECIAL CONDITONS OF CONTRACT

1. GENERAL

The special conditions of contract and other contract documents are complimentary to each other and shall be read in conjunction with each other. In case of any conflict of meanings between the special conditions of contract and the BHEL General Conditions of Contract the provisions of the special conditions of contract shall override the corresponding provisions of the BHEL General Conditions of Contract.

2. SITE CONDITIONS

a) Before tendering the Contractor shall get themselves acquainted with site conditions such as quality of kayal water likely to be encountered during the course of the work etc,. The rates quoted by the contractor shall be deemed to have been quoted after getting acquainted with the prevailing site conditions. No claims on the pretext of ignorance of site conditions shall be entertained.

b) For understanding of site, some photographs and google map images are attached with tender documents.

3. SITE FACILITES

A. Kayal Details

100 Acres of water body (Kayal) inside plant premises of NTPC Kayamkulam.

The Employer will allot land near kayal as available free of cost to the contractor for his office stores, if available. He must maintain the areas allotted to him in a neat and clean conditions as required by the Employer. The contractor shall provide adequate storage and office facilities with approval from the Engineer. The rate quoted by the contractor shall be deemed to include for these and no separate payment will be made towards these.

On completion of work, the site shall be cleaned by the contractor of all materials, temporary debris, rubbish plants and equipment's, belonging to the contractor at no extra cost. The site and surroundings shall be handed over in a neat and clean condition. In case of any failure by the contractor, the employer will get inside cleared at risk and cost of the Contractor.

B. POWER AND WATER SUPPLY

Facilities for drawing Power and water required at site for execution of the works shall be arranged by the contractor at his expense and risk. The necessary source for power & water supply has to be organized by bidder. Necessary distribution box, extension board points duly earthed, and with armoured safe power cables to be laid across the field provided point shall be in the scope of the tenderer. Further, laying of water intake and distribution pipes across the Site to various points of work from Electricity source provided water source point shall be in the scope of the tenderer. If required.

D.G generation sets shall be provided for Power arrangement by the contractor at his own cost. The tenderer shall make provision for temporary storage of water at suitable locations with pump if required to reach the water supply to work areas. The contractor will have to make his own arrangements for the same, without claiming any extra charge for the power and water drawal and distribution equipment.

4. MACHINERY:

The Contractor shall at his own expense, supply all tools, plant and equipment (hereinafter referred to as T & P) required for execution of contract, as specified in the tender documents. whole of the works shall be executed in perfect conformity with the specifications and drawings. If contractor perform any works in a manner contrary to the specifications and drawings and without reference to the Engineer-in-charge, he shall bear all the costs arising or ensuring there from.

a) All technical documents regarding the construction of works are given in the metric system and work should be carried out according to metric system.

b) The work shall be carried out as per detailed drawings supplied by the employer. The working drawings shall be emailed progressively to the contractor free of cost. The contractor shall keep one set of drawings (duly protected from dust and wear and tear) at his own expenses always available at site for reference of Engineer-in-charge and other representatives.

c) The works shall be carried out as per detailed specifications enclosed with the tender. For items for which there is no mention in the drawings, detailed specification relevant IS specification (latest edition) shall be followed.

d) The contractor shall submit to the Employer for their approval complete drawings, of all temporary works and staging which he may require for carrying out the works shown in the drawings.

e) No T & P shall be provided by BHEL.

He shall at the same time if so required by the Employer submit his calculations relating to strength and anticipated deflection in respect of any aforesaid temporary works. He shall also submit for the approval of Employer drawings showing the methods he proposes to adopt for the erection of the various parts of the temporary works. Any modification to the drawings that may be required by the Employer shall be made by the contractor at his own cost.

However, notwithstanding the approval of modification required for temporary works, the contractor shall be fully responsible for their efficiency, security and maintenance and for all obligations and risks in regard to such works, specified or implied in this contract and be shall reinstate the same at his own cost, should any mishap or accident occur causing damage or injury there from, subject however, to such clauses of the General conditions as may be applicable in such cases.

5. BENCH MARKS AND REFERENCE POINTS

The contractor shall construct and maintain proper benchmarks and reference points at the allotted area near bank of kayal on BHEL supervision, no separate payment shall be made for this and rates quoted deemed to include this cost. Surveying where ever required is in contractor scope.

6. SAFETY PRECAUTIONS

The contractor shall at times observe the safety code and make necessary action as required in the tender. In default thereof, the employer may get this done departmentally or through other agencies and recover the cost from the contractor. The Contractors shall also abide by all the security regulations promulgated from time to time by employer.

7. RATES

The rates to be quoted are intended to provide for works duly and properly completed in accordance with the general and special conditions of contract and specifications and drawings together with such alteration and/or conditions as may be required / ordered without prejudice to the generality thereof shall include for detail of construction which are obviously and fairly intended and which may not have been specifically referred in these documents and working drawings and but are essential for execution and satisfactory completion of work including those of minor nature and shall be deemed to include and cover internal the followings.

a) Arrangements for obtaining the clearance wherever required from statutory bodies, regarding license for construction, permanent electricity, water supply, and sanitary connections including payment of necessary fees, inspection charges and obtaining financial certificates for using these services. The various items rates quoted in the schedule as applicable shall be deemed to include the above services and no separate payments shall be made towards these.

b) The cost of all superintendence and labour materials, tools, plants, equipment's, mobilizing and demobilizing equipment fuel lubricants, fixture, transport charges, temporary and permanent works and quarrying charges, testing, screening, washing, handling of materials, stacking and removal charges, of any rejected materials and water and power arrangements and satisfactory maintenance of the same satisfactory completion of the work intended.

c) All fees, duties, royalties, rent and compensation to owner for water pollution or taxes and impositions payable to local authorities, which the contractor may become liable or may be put to under any provision of the law for the purpose of in connection with the execution of the contract including levies payable on the transactions.

d) Settings out of works profiles etc., and of construction repair and up-keep of all centre lines, bench marks and levels and page there of including provisions of drilling on kayal bed for earth electrode.

e) Supply of complete, Moulds, cost of testing of materials etc.

f) Working in all conditions including in/under water liquid, conditions etc., and shall also include under water activity.

g) In the interest of completion of work within the stipulated time, certain works are to be carried out during the monsoon period also. No separate payment will be made to the contractor for such works and it will be deemed to be included in the contract rates.

h) All materials and labour required for water activity in a protection against risk of accidents and for providing necessary/life jacket, boat, safety belts etc., during the progress of work.

i) Cleaning the site after the completion of work all debris, left out construction materials machine equipment's, temporary offices, stores, works shop etc., including dressing the area neat and clean shape.

j) Such other incidental charges or contingencies as may have been provided for in the specifications.

8. LABOUR COLONIES

Labour camp will not permitted within the project premises.

9. ESCALATION

The rates to be quoted by the tenderer shall be firm and shall cover and include all statutory levies, arising from, acts passed by parliament or by state legislature, the rates shall further be deemed to include statutory levies arising from such Acts, Central or State, which may come in to force subsequent to submission of tenders. The tenderer shall note that no claim for enhancement of rates, on the ground that existing statutory levies have been increased, or that new statutory levies have come in to effect after tender, or on any other ground, will be entertained on any account.

10. QUANTITY

The probable quantities of the several items of work are furnished in the schedule of quantities. It must be clearly understood that neither the probable quantities nor the value of individual items nor the aggregate value of the entire work shall be binding on the Employer/Engineer does not in any way assure the contractor or Guarantee that the said probable quantities are correct or that the work will correspond to these. The Employer/Engineer reserve the right to omit, vary or add to the item/work described in the schedule, of quantities and no claim for compensation will be entertaining on this account.

11. VARIATION/DEVIATION IN QUANTITIES

The contractor shall not make any alteration in addition to or omission from the work as described in the tender document except in pursuance of the written instructions of the Engineer-in-charge. No such deviation from the work described in the tender documents shall be valid unless the same has been specifically confirmed and accepted by the accepting officer in writing and incorporated in the contract. The rates quoted are firm for deviation subject to minimum of (-) 20% and maximum (+) 20% of the total value of work awarded. Deviation beyond the above limits is subject to the standard terms and conditions of BHEL.

12. MATERIALS

BHEL will not supply any materials unless otherwise specified.

13. SUPPLY BY CONTRACTOR

The work is for a completed job including labour and supply of all materials except those otherwise specified in the bid document. The material and works shall be subject to inspection and test as per field quality plan (FQP) duly approved by BHEL/ NTPC.

All materials supplied by the contractor according to the contract conditions shall be subject to inspection and passing by the Engineer-in-charge or his representatives from time to time, the contractor providing all facilities for such instruction free of cost.

BHEL officers connected with the contract shall have the power at any time to inspect and examine any stores or materials intended to be used in or on the work, whether on the site or at any factory or workshop or other place where such stores or materials are being fabricated or manufactured or at any place the same are lying and the contractor shall give necessary facilities for such inspection and examination.

The Engineer-in-charge shall be entitled to have tests made of any stores or materials supplied by the contractor shall provide at his own expense all facilities which the Engineer-in-charge may require for this purpose. If at the discretion of the Engineer-in-charge an independent expert is employed to make any such tests his charges shall be borne by the contractor only if the tests disclosed that the said stores or materials are not in accordance with the provision of the contract.

Should the Engineer-in-charge consider at any time during the erection and commissioning on prior to the expiry of the Maintenance Period that the stores or materials provided by the contractor are unsound or of quality inferior to that contracted for, or otherwise not in accordance with the contract (in respect where the decision of the Engineer-in-charge shall be final and conclusive) the contractor shall on demand, in writing from the Engineer-in-charge specifying the stores or materials complained of, not with-standing that the same may have been inadvertently passed, certified that and paid forth with remove the stores or materials so specified and provide other and suitable stores or materials at his own expense, to the entire satisfaction of the Engineer-in-charge and in the event of his failing to do so within a period to be specified by the Engineer-in-charge, in his demand aforesaid, the Engineer-in-charge may replace within the other stores or materials complained of at the risk and expense in all respect of the contractor.

The liability of the contractor under this conditions, shall not extend beyond the maintenance period aforesaid except as regards stores or materials which the Engineer-in-charge shall have previously given notice to the contractor to replace (Maintenance period for any work under this organization will be six months from the date of actual completion of the particular work and handing over to BHEL).

14. INTERRUPTION TO THE WORKS

While quoting the rates/prices the Contractor should take in to account the fact that due to the design or other stipulations at site, or the necessity to follow a particular sequence of overall construction operation, or non-supply of particular drawings, or the connected work or other reasons, interruptions are likely to be encountered in a work of this nature and magnitude. No claims for such interruptions will be entertained on any account.

15. EXTENSION OF TIME OR PENALTY/LIQUIDATED DAMAGES

Extension of time or penalty/liquidated damages as the case may be will be determined as stipulated in clause No. 2.7.9 of BHEL General Conditions of Contract 2019.

16. COMPLETION OF WORK AND MEASUREMENT

a) All work shall be carried out according to authorized dimensions and measurement will be restricted to those authorized dimension even though the Contractor may for convenience of this work exceed the authorized dimensions.

b) All work shall be measured in accordance with the applicable standard method of measurements prescribed by the Indian Standard Institution (1200 latest edition) unless otherwise specified.

c) The Contractor shall admit for technical inspection, works which are likely to be embedded or covered by other works and have the necessary measurement books and certificates to this effect duly signed by the Engineer before the works are covered.

d) On completion of the work, the Contractor must submit to the Engineer the following documents for passing of works.

i) A copy of the working drawing showing there on all addition and alterations in the process of execution.

ii) A certificate for embedded and covered up works as in sub-para (C) above

e) The authorized Contractors representative and a representative of the Employer shall jointly sign a certificate of handing over any completed work and date of signature of that certificate will be that the date from which the maintenance period of that unit will reckoned.

f) Notwithstanding the above, insurance cover has to be taken by the contractor for the full value of work as also for the duration of the contract period. 50% of the Security Deposit shall be released only on the total completion of the building and handing over to BHEL to their satisfaction. Remaining 50% of Security Deposit shall be released subject to the stipulation in BHEL after 6 months from the date of completion of site activity.

17. MAINTENANCE OF WORK

The contractor will be responsible for the maintenance of works during the period of commissioning until the various items are taken over, and for a further period of six months, from the date of taking over.

If the contractor fails to maintain the building satisfactorily, it will be got done by other agency and cost towards such maintenance together with departmental charges will be recovered from his bills/dues.

18. RUNNING ACCOUNT PAYMENTS

During execution of work, monthly payments of all works in place will be made on the basic measurements recorded in measurement sheet/book in respect of items executed but no claim on the account will be entertained, if for any reason payments are not so made. PRICE VARIATION clause not applicable.

19. MOBILIZATION ADVANCE/ADVANCE PAYMENT - NOT APPLICABLE

20. INTEREST & RECOVERY - NOT APPLICABLE

21. Statutory Deduction towards Income Tax will be made as per rules.

22. In respect of all labour directly or indirectly employed on the work by the Contractor, the Contractor shall comply with the provisions of the contract labour (Regulation and Abolition) Act 1970 or any amendment thereof and all legislations and rules of the State and or Central Government or other Authority, framed from time to time governing the protection of health, sanitary arrangements, wages, welfare and safety for labour employed on building and construction works. The rules and

other statutory obligations with regard to fair wages, welfare and safety measures, maintenance of the register etc., will be deemed to be part of the contract.

23. The Contractor is required to take insurance for all workers employed on works towards payment for workmen compensation. The insurance has to be taken out within 15 days of the award of work and has to be produced at the time of signing agreement. Half (1/2%) shall be deducted for every bill if the contractor fails to produce a proof of having taken such an insurance to cover his workmen. However the contractor shall be fully responsible for all the consequences arising out of such default. This may also be read with relevant clauses of BHEL GCC 2019.

24. TIME OF COMPLETION

The date of commencement of work shall be counted from the date of handing over the site to the contractor. It may be clearly understood that time is the essence of the contract and the entire work should be completed within the time imposed in the tender document letter of intent.

25. The Contractor has to comply with Building and Other Construction worker's Welfare Cess Act (1996) BOCW.

26. The management of BHEL shall be at liberty to terminate the contract by issuing a month's notice to the contractor without assigning any reason what so ever. As regards unsatisfactory performance or noncompliance with any of the terms & conditions of the contract by the contractor. The management of BHEL shall have the right to terminate the contractor forthwith without notice & rearrange the balance work through other agencies at the risk & cost of the contractor & under such circumstances, the Earnest Money Deposit/Security Deposit paid by the contractor shall stand forfeited.

27. SPECIFIC CONDITIONS OF TENDER

i) The successful bidder should open local office for Technical staff/Administrative group at Bangalore City for easy interactions/ monitoring of work at site./ Attend meetings at Bangalore city/site as and when instructed by BHEL.

ii) Tenderers should not disclose any price bid details/discounts in the technical bids.

iii) The successful bidder should construct site office / toilets for their workmen at site in consultation with Engineer-in-charge.

28. WORKMEN COMPENSATION POLICY

The contractor is required to take Insurance for all the workers employed on the works towards payments for workmen compensation. The Insurance has to be taken out within 15 days of the award of work and has to be provided at the time of signing the agreement. Half percent (0.5%) of the amount shall be deducted from every bill if the contractor fails to produce a proof of having taken such an insurance to cover his workmen. However the contractor shall be fully responsible for the consequences arising out of such default.

29. LIST OF INDIAN STANDARD

Following is the list of various Indian Standards, Relevant to the commissioning work

A. ELECTRICAL WORK

I. IS:732 - 1989 Code of practice for electrical wiring installations.
II. IS:8061 - 1976 Code of practice for design, installation and maintenance of service lines upto and including 650V
III. IS: 11353- 1985 Guide for uniform system of marking and identification of conductors and apparatus terminals.
IV. IS: 3043 - 1987 Code of practice for earthing
V. IS:694 - 1990 PVC Insulated cables for working voltages upto and including 1100 V.

B. SAFETY CODE

I. IS: 3043 - 1987 Code of practice for earthing
II. IS: 5216(Part-1)-1982 Guide for safety procedures and practices in electrical work: General.

C. FIRE FIGHTING CODES

I. IS 4736-1986 Galvanizing G.I. Pipes
II. IS 2189-1962 Code of practice for Automatic Fire alarm system
III. IS 732-1973 Code of practice for electrical wiring installation

These standards are indicative, any additional IS standard/specification required to be followed shall be adhered to by the contractor.

30. ADDITIONAL CLAUSES FOR GST:

I. BHEL GST Number of Nodal Agency:

Nodal Unit Registered as Supplier of Goods/Services in GST: Kerala GSTIN of Nodal Unit: Will be intimated later after award of work.

II. HSN (Harmonized System of Nomenclature) / SAC (Services Accounting Code) to be mandatorily mentioned in all quotations & invoices submitted.

III. Invoice submitted should be in the format as specified under GST Laws viz. all details as mentioned in Invoice Rules like GSTN registration number, invoice number, quantity, rate, value, taxes with nomenclature – CGST, SGST, IGST mentioned separately, HSN Code / SAC Code etc.

IV. Payment of GST to bidders as applicable will be made only if it is matching with data uploaded by Bidders

V. Bidders to give undertaking that GST as mentioned in the Invoice has been paid/will be paid either through cash or admissible input credit and also file the returns

VI. For invoices paid on Reverse charge basis – that it is “payable on reverse charge basis” to be mentioned on the invoice.

VII. With respect to supplies, bidder should intimate BHEL immediately on dispatch for parallel billing on customer.

VIII. Bidder should get GST registration, if not available, in the state of Kerala immediately after placement of order.

31. List of Annexures Attached:

Annexure No.	Description of Annexure
A	Certification of Work safety by Contractor during work
B	Acceptance Of Conditions Of Contract/ Specification/Scope Of Work
C	Certificate Of Declaration Confirming The Knowledge Of Site Condition
D	Certificate regarding ban/blacklisting of bidder
E	Form of Tender
F	Certificate by Chartered Accountant
G	EFT Form
H	Integrity pact Format
I	BG Format for EMD
J	Techno-Commercial Deviation Sheet

ANNEXURE A

(To be made on Bidder's letter head)

Subject: Certification of Work safety by Contractor during work

This is to certify that, during the execution of the work as NIT undertaken by us, we shall be solely responsible for the Safety and health of our team consisting of site engineers, technicians and labour working at the site. Required statutory provisions governing Workmen safety and protection and accident compensation shall be our sole responsibility and entirely covered by us during the course of mobilization and execution of works.

Date:

Seal & Signature of the bidder

ANNEXURE B

(To be made on Bidder's letter head)

ACCEPTANCE OF CONDITIONS OF CONTRACT/ SPECIFICATION/SCOPE OF WORK

It is hereby agreed by me/us that the BHEL General Conditions of Contract, Special conditions of contract, Scope cum Technical specification of work and their subsequent amendments/ Additions/deletions to clauses if any, and conditions pertaining the settlement of disputes by Arbitration form an integral part of the tender documents and that the tender submitted by me/ us is subject to the aforesaid BHEL Conditions of Contract/ Specification/Scope for the work given in NIT which has been read, understood and accepted by me/us.

Date:

Seal & Signature of the bidder

ANNEXURE C

CERTIFICATE OF DECLARATION CONFIRMING THE KNOWLEDGE OF SITE CONDITION

I/We hereby declare and confirm that we have acquired full knowledge and information about the site conditions, wage structure, industrial climate and total quantum of work involved. We further confirm that the above information is true and correct and we will not raise any claim of any nature due to lack of knowledge of site condition.

Date:

Seal & Signature of the bidder

ANNEXURE D

(To be made on Bidder's letter head)

TO WHOM SO EVER IT MAY CONCERN

This is to certify that our firm is not blacklisted / under hold from BHEL EDN Bangalore or banned by any unit/region/office of BHEL.

This is to certify that we / our firm is not guilty by a Court of Law in India for any offence involving fraud, dishonesty and moral turpitude

Date:

Seal & Signature of the bidder

ANNEXURE E

FORM OF TENDER

Having examined the invitation to bid, Instructions to Bidder, conditions of contract, Specifications, tender schedule, and other tender documents for the above work, we the undersigned, offer to construct, erect complete and maintain the whole of the said in conformity with the said bid documents on the terms and conditions and under the provisions set out or called for in the contract documents at the rates listed in the schedule of unit prices or else wherein the contract documents. We undertake if our bid is accepted, to commence the works from the date of issue of award/handing over the site and to complete and delivery the whole of the works comprised in the contract as per the time schedule agreed to the contract document.

We agree to abide by this bid for the period of three months from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before expiry of the period.

Until and unless a formal intimation /work order, together with your award thereof shall constitute a binding contract between us.

Date:

Seal & Signature of the bidder

ANNEXURE F

(Certificate by Chartered Accountant on letter head)

This is to Certify that M/S. .....
(Hereinafter referred to as 'company') having its registered office at
.....is registered under MSMED Act 2006, (Entrepreneur Memorandum No (Part-11 .....dated: .....
Category: ..... (Micro/Small) (Copy enclosed).
Further verified from the Books of Accounts that the investment of the company as on date ..... as per MSMED Act 2006 is as follows:

I. For Manufacturing Enterprises: Investment in plant and machinery (i.e. original cost excluding land and building and the items specified by the Ministry of Small Scale Industries vide its notification No.S.O.I722(E) dated October 5, 2006 :

Rs. .....Lacs

2. For Service Enterprises: Investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service rendered or as may be notified under the MSMED Act, 2006:

Rs .....Lacs

(Strike off whichever is not applicable)

The above investment of Rs .... Lacs is within permissible limit of Rs ----------Lacs for ..... Micro/Small (Strike off which is not applicable) Category under MSMED Act 2006.

Or

The company has been graduated from its original category (Micro/ Small) (Strike off which is not applicable) and the date of graduation of such enterprise from its original category is ---------- (dd/mm/yyyy) which is within the period of 3 years from the date of graduation of such enterprise from its original category as notified vide 5.0. No. 3322{E) dated 01.11.2013 published in the gazette notification dated 04.11.2013 by Ministry of MSME.

Date:

(Signature)

Name -

Membership number

Seal of Chartered Accountant

ANNEXURE G

Electronic Funds Transfer (EFT) OR
Paylink Direct Credit Form

Please Fill up the form in **CAPITAL LETTERS** only.
TYPE OF REQUEST(Tick one): _____ CREATE _____ CHANGE

BHEL Vendor / Supplier Code:					
Company Name :					
Permanent Account Number(PAN):					
Address					
City: _____	PINCODE	_____	STATE	_____	
Contact Person(s)					
Telephone No:					
Fax No:					
e-mail id:					
1 Bank Name:					
2 Bank Address:					
3 Bank Telephone No:					
4 Bank Account No:					
5 Account Type: Savings/Cash Credit					
6 9 Digit Code Number of Bank and branch appearing on MICR cheque issued by Bank					
7 Bank swift Code(applicable for EFT only)					
8 Bank IFSC code(applicable for RTGS)					
9 Bank IFSC code(applicable for NEFT)					

A I hereby certify that the particulars given above are true, correct and complete and that I, as a representative for the above named Company, hereby authorize BHEL, EDN, Bangalore to electronically deposit payments to the designated bank account.

B If the transaction is delayed or not effected at all for reasons of incomplete or incorrect information, I would not hold BHEL / transferring Bank responsible.

C This authority remains in full force until BHEL, EDN, Bangalore receives written notification requesting a change or cancellation.

D I have read the contents of the covering letter and agree to discharge the responsibility expected of me as a participant under ECS / EFT.

Date:
Authorized Signatory:
Designation: Telephone NO. with STD Code
Company Seal

Bank Certificate

We certify that_____has an Account No_____with us and we confirm that the bank details given above are correct as per our records.

Date: (……..)
Place: Signature

Please return completed form along with a blank cancelled cheque or photocopy thereof to:
Bharat Heavy Electricals Ltd,
Attn:
Electronics Division, Mysore Road,
BANGALORE - 560 026
In case of any Querry, please call : 080-26998xxx / 2674xxxx or fax no. 080-2674xxxx

ANNEXURE H

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi – 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

And

_____ description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the

OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____

The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the

Section 1 – Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same

information and will not provide to any Bidder(s) confidential / additional

information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he / she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant IPC/ PC Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be

an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidders(s)/ Contractor(s) from the tender process or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors" framed by the Principal.

Section 4 – Compensation for Damages

4.1 If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.

4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

Section 5 – Previous Transgression

5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 – Equal treatment of all Bidders/ Contractors/ Sub-contractors

6.1 The Bidder(s)/ Contractor(s) undertake(s) to obtain from all sub-contractors a commitment consistent with this Integrity Pact and report Compliance to the Principal. This commitment shall be taken only from those sub-contractors whose contract value is more than 20% of Bidder's/ Contractor's contract value with the Principal. The Bidder(s)/Contractor(s) shall continue to remain responsible for any default by his Sub-contractor(s).

6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.

6.3 The Principal will disqualify from the tender process all bidders who do not sign this pact or

violate its provisions.

Section 7 – Criminal Charges against violating Bidders/ Contractors /Sub- contractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 –Independent External Monitor(s)

8.1 The Principal appoints competent and credible Independent External Monitor for this Pact.
The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality.

8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

8.5 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.

8.7 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.

8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC Act, and the CMD, BHEL has not, within reasonable time, taken visible action to

proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.9 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.

8.10 The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

9.1 This Pact begins and shall be binding on and from the submission of bid(s) by bidder(s). It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.

9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 – Other Provisions

10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.

10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.

10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.

10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders/ contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

For & On behalf of the **Principal**	For & On behalf of the **Bidder/ Contractor**
(Office Seal)	(Office Seal)
Date----------	Date----------
Witness:_____	Witness:_____
(Name & Address):_____	(Name & Address):_____
_____	_____

ANNEXURE I

PROFORMA OF B ANK GUARANTEE FOR EARNEST MONEY

(On non -Judicial paper of appropriate value)

Bank Guarantee No. …… .

Date: ……

To
……
(Employer's Name and Address)

……..

Dear Sirs,

In accordance with the terms and conditions of Invitation for Bids/Notice Inviting Tender No……1(Tender Conditions), M/s. …… having its registered office at.....2 (hereinafter referred to as the 'Tenderer'), is submitting

its bid for the work of **……** .3 invited by ……4.(name of the Employer) through its Unit at

……(

The Tender Conditions provide that the Tenderer shall pay a sum of Rs..... as Earnest Money

Deposit in the form therein mentioned. The form of payment of Earnest Money Deposit includes Bank Guarantee executed by a Scheduled Bank.

In lieu of the stipulations contained in the aforesaid Tender Conditions that an irrevocable and unconditional Bank Guarantee against Earnest Money Deposit for an amount of .....5 .....

is required to be submitted by the Tenderer as a condition precedent for participation in the said Tender and the Tenderer having approached us for giving the said Guarantee,

we, the .....[Name & address of the Bank]

..... having our Registered Office at

……..(hereinafter referred to as the Bank) being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums of Rs.....(in words Rupees.....) without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs._____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Vendor/Contractor/Vendors in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Tenderer shall have no claim against us for making such payment.

We …….. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Tender or to extend the time of submission of from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Tenderer and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Tenderer or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Tenderer or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Tenderer and

notwithstanding any security or other guarantee that the Employer may have in relation to the Tenderer's liabilities.

This Guarantee shall be irrevocable and shall remain in force upto and including.....6 and shall be extended from time to time for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Tenderer but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the..... 7 we shall be discharged from all liabilities under this Guarantee.

We, ……. Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.

Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…….5…..
b) This Guarantee shall be valid up to 6
c) Unless the Bank is served a written claim or demand on or before_____7 all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

We,_____Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of

(Name of the Bank)

Date…….

Place of Issue…….

ANNEXURE J

TECHNO-COMMERCIAL DEVIATION SHEET

Tender Enquiry No & Date: EDN: PVENG:FSPV:NTPCK22MW:BOS

Work Description: Erection and commissioning works (BOS) for 22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Kayamkulam

We have gone through the complete tender enquiry and its corrigendum mentioned above and read and understood the Pre- Qualification Criteria, Instructions to Tenderer along with Enclosures, Special Condition of Contract along with its annexures, scope of Work Cum Technical Specification, BHEL General Conditions of Contract 2019 etc.

We hereby confirm that, we have following deviations with technical and commercial terms and conditions of NIT:

Clause No. & NIT page no.	NIT Clause	Deviation proposed	Remarks

Mention any deviations from Tender enquiry if any, else mention "No deviation ")

We hereby confirm that except for above, there are no other Deviation from all terms and conditions mentioned in Tender documents.

Seal & Signature of Authorized
Representative /Bidder

Name: Designation:

Date:

Name of Bidder:

UNPRICED PRICE BID							
Bill of Quantity (BOQ) Cum Rate Schedule							
(BOS) of 22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at kayamkulam							
SL NO	**DESCRIPTION OF THE WORK (With Unit of Measurement)**	**Qty**	**Unit**	**Unit Rate-Rs (Excluding GST)**	**Total Amount-Rs**	**% GST**	**Item billed to EDN/Nodal**
List of Supply items							
1	Supply of cable ties, couplers, joints, bends etc. for 6 sq.mm solar cable routing from string end to SCB.(For DC cable of 2x66.5 Kms) (1 Set as required)	1	Sets	838,005.31	838,005		Nodal
2	Supply of M/s. Multi contact make MC4 connectors for string connection	1800	Pairs	87.23	157,011		Nodal
3	Supply of M/s. Multi contact make Y Connectors	1700	Pairs	398.76	677,888		Nodal
4	Supply of HDPE DWC pipe for routing of 6sqmm cables through pathways	5	Kms	60,192.45	300,962		Nodal
5	Supply of 2.5sqmm lug and M4 size screw of SS-304 grade for earth cable connection on PV module frames.	190920	Nos	12.04	2,298,389		Nodal
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	8.8	Kms	43,338.56	381,379		Nodal
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	4.4	Kms	86,677.13	381,379		Nodal
8	Supply of SCB earthing cable (25 sq.mm CU) with necessary lugs and hardware	500	M	333.04	166,522		Nodal
9	Supply of SCB support structure (Aluminium) and SS304 hardware suitable for mounting SCBs on HDPE floating pontoons	80	Nos	2,859.14	228,731		Nodal
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter	53	Kms	16,251.96	861,354		Nodal
11	Supply of Aluminum/FRP covered cable trays(300 MM wide) with clamping arrangement for running DC cables from SCBs to Hume pipes and to inverter platform along with all mounting accessories.	15000	M	737.36	11,060,363		Nodal
12	Supply of Aluminum/FRP covered cable trays(600 MM wide) with clamping arrangement for running DC cables from SCBs to Hume pipes and to inverter platform along with all mounting accessories.	1000	M	1,128.61	1,128,608		Nodal
13	Supply of double compression weatherproof metallic cable gland, bi-metallic strip or washer, SS304 hardware for 400 sq.mm cable- PCU DC side	170	Sets	812.60	138,142		Nodal
14	Supply of double compression weatherproof metallic cable gland, aluminium cable lug, bi-metallic strip washer, SS304 hardware for 400 sq.mm cable- PCU AC side and TRF LV side	140	Sets	812.60	113,764		Nodal
15	Supply of PEB rooms for placing all the Electrical equipment (dimensions - 4Mx4Mx3.0M(H))	4	Sets	665,487.73	2,661,951		EDN
16	Supply of UPS systems (3 KVA),with 30 mins backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	5	Sets	505,616.58	2,528,083		EDN
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformers for EERs	4	Sets	150,481.13	601,925		EDN
18	Supply of ACDB inside PEB rooms for electrical equipment	4	Sets	120,384.90	481,540		Nodal
19	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70	Nos	963.08	67,416		Nodal
20	Supply of indoor cable termination kit for 33KV(E),1CX240 sq.mm	70	Nos	6,019.25	421,347		Nodal
21	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	15	Nos	15,048.11	225,722		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
22	Supply of straight through joint kits for 3.3KV(E), 1CX400 sq.mm cable	6	Nos	12,038.49	72,231		Nodal
23	Supply of earthing electrodes for under water application for solar array and ESE LA for solar array	50	Sets	60,192.45	3,009,623		Nodal
23	Supply of earthing electrodes with chemical compound for all electrical equipment i.e. unarmored copper cables, termination hardware, cover with inspection lids for inverter platforms,EEPEBRs.	90	Sets	16,359.41	1,472,346		Nodal
25	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS etc. to RTU panel (All OFC cable supplies shall be in BHEL scope)	4	Sets	263,658.70	1,054,635		Nodal
26	Supply of items for LED based outdoor lighting system covering Inverter platforms	8	Nos	21,729.47	173,836		Nodal
27	Supply of weather monitoring system (WMS)	1	Sets	2,564,242.91	2,564,243		Nodal
28	Supply of safety related items including fire alarm systems for PEB, fire extinguishers, sand buckets, safety gadgets etc	4	Sets	213,623.01	854,492		EDN
29	Supply of ESE type lightning arrester including 5 meter pole, counter, base plate and hardware etc.	18	Sets	63,804.00	1,148,472		Nodal
30	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	0.5	Kms	86,075.20	43,038		Nodal
31	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1	Kms	547,125.29	547,125		Nodal
32	Supply of indoor metering cubicle with metering CT,PT,Surge Arrestor,ABT Meters as per specification	2	nos	674,155.44	1,348,311		Nodal
33	Supply of life jackets as per IS 6685.(IROS approved makes)	40	Nos	1,926.16	77,046		Nodal
34	Supply of small passenger boat for 5 persons. Boat shall be with FRP body construction and 6-8 HP outboard diesel/petrol engine motor (reputed make like Suzuki/Yamaha/equivalent). Boat shall be certified for water worthiness by concerned agency like IROS (Indian register of shipping/MMD/Govt. Department as applicable). Boat shall come equipped with 5 life jackets and shall have Nylon ropes for towing, anchoring, mooring and Air tubes (3 Nos.) for functioning in rescue work. Bidder shall provide for a boat driver till completion of contract period.	1	Nos	1,078,648.70	1,078,649		Nodal
35	Supply of miscellaneous items such as cable tags, cable ties, cable ferrules, cable route markers, hoarding board, sign boards, danger boards, display boards, plant Layout boards, electrical insulation mat, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, etc.	1	Sets	1,935,388.58	1,935,389		Nodal
36	Supply of spare items	1	Sets	790,928.79	790,929		Nodal
Total price for Supply				-	**41,890,846**		**-**
List of Works (I&C activities)				-			

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
1	I&C: excavation of isolated earthen/sand dunes,vegetation,coconut tree stumps etc in the kayal (backwater) bottom.The locations are marked in the layout and the final level required is also indicated.After excavation this earth is to be disposed at the desired location.(Disposal location shall not exceed 500m).Vendor has to mobilize his team and vessel for excavation during anchoring anf mooring work done by BHEL.Mobilization of excavation team to be done within 10 days of BHEL intimation for the arrangements for entry of dredger/excavator,power boat for moving excavator machine,barge for soil disposal into the kayal shall be part of the scope	1000	m3	3,058.67	3,058,668		
2	I&C: Installation of floating pontoons and modules as per the instructions and on-site hands-on training by the OEM of pontoons. Supply of pontoons, modules and hardware for installation is in BHEL scope. Anchoring and mooring of the floating island is also in BHEL scope. As per OEM, approximate labour required shall be 3 modules/hour/person. Total number of modules to be installed is 95460 Nos. All tools, tackles and Infrastructure like boats required for Installation of Floaters shall be in the scope of bidder. Bidder has to prepare required no of launch pads (sloped wooden platforms with support on bund) to install the floating platform in the required time duration. (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	17,506,319.99	17,506,320		EDN
3	I&C: Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	5,681,632.24	5,681,632		Nodal
4	I&C: Interconnection of SPV modules, installation of 80 Nos of SCBs, laying/ termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works.(1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	1,819,096.10	1,819,096		EDN
5	I&C: Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	5,614,466.38	5,614,466		EDN
6	I&C: Laying and termination of 1Cx400sqmm DC power cable from PCU to inverter transformer LV side (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	470,660.37	470,660		EDN
7	I&C: Earthing of 95460 nos of modules and 80 nos of SCBs using combination of earthing cables of adequate size and earthing strips. Total number of under water earth electrodes for array earthing shall be atleast 32 nos.SCB-SPD earthing cables shall be connected to array earthing grid. (1 AU= 1 earth pit)	32	AU	132,646.33	4,244,682		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
8	I&C: Installation of 18 Nos of ESE type LA on separate floating platform . LAs on pond shall be placed as per tentative layout. LAs shall be earthed to the bottom of the kayal. Supply of necessary metallic base frame for fitting LA pole to the floats along with stay wires is in scope of bidder. (1 AU=installation of one LA)	18	AU	73,636.92	1,325,465		Nodal
9	I&C: Erection of PCUs, HT panels etc. on the inverter platform including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers on the inverter platform. (1 AU= 22MWAC Block)	1	AU	1,249,684.44	1,249,684		EDN
10	I&C:Erection of 33kV transformer yard - Erection of 5.3MVA -4no.s and 2.7 MVA-1no. inverter transformers, cable trays, drain pipes and stone jelly spreading including stone jelly for drain pit. (1 AU= 22MWAC Block)	1	AU	1,498,497.73	1,498,498		EDN
11	I&C: Erection of 33kV HT power cables from transformer to HT panels to Local pooling stations to metering cubicle to final evacuation point (using trefoil clamps). Also laying of SCADA communication (OFC) cable from each RTU inside EEPEBRs to scada room. Trefoils of HT cables laid from the PV plant shall be terminated on the indoor metering cubicle room and further laid through available trenches and terminated at panels in nearby panel room of customer. Conducting of detailed route survey is in vendor scope.Based on the route study,cables shall be laid suitably (underground in trenches). (1 AU= laying of one trefoil for 1 KM)	4	AU	2,814,529.60	11,258,118		EDN
12	I&C: Erection of metering cubicle with CTs,PTs,surge arrestor,ABT measuring meters as per KSEB approval	2	Sets	218,476.30	436,953		EDN
13	I&C: Erection of PEB rooms for placing all electical equipment's.	4	sets	579,898.52	2,319,594		
14	I&C: Erection of Auxiliary transformers, ACDB, UPS/ battery bank, RTU panels etc. in PEB EER (Electrical Equipment Room) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables. This includes erection of one 3KVA (2*100%redudancy) UPS in SCADA Room of NTPC Control Room (1 AU= 22MWAC Block)	1	AU	402,714.24	402,714		EDN
15	I&C: Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment (WMS),metering point of the power plant at the data logger/ PLC panel / HMI computer control desk at SCADA(1 AU= for 22MWAC Block).	1	AU	353,244.97	353,245		EDN

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
16	I&C: Earthing system for Inverter platforms (including EEPEBRs) and 33kV transformer yards including laying of underground earth mat grids, providing electrodes with earth chambers and lids, laying/termination of earthing strips from all electrical equipment to earth mat grid etc. (1 AU= for 22MWAC Block)	1	AU	657,301.55	657,302		Nodal
17	**I&C:** Plant lighting system including outdoor cable laying, cable terminations at poles / lights as well as DB boards of inverter platforms. (1 AU= for 1 LED fixture)	8	AU	10,174.75	81,398		Nodal
18	I&C: Miscellaneous and safety items such as cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, weather monitoring system, items for remote connectivity of SCADA, identification markings using painting etc (1 AU= for 22MWAC Block)	1	AU	1,056,389.09	1,056,389		Nodal
19	I&C: Pre-commissioning inspections/ checks/tests, MRT tests, coordination/liaison with state /central departments/CEIG etc for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning (1 AU= for 22MWAC Block)	1	AU	1,961,828.00	1,961,828		Nodal
20	Deputation of Safety supervisor for duration of I&C (1 AU = 1 Month)	5	AU	35,669.60	178,348		Nodal
21	Provision of emergency vehicle/Ambulance on standby for duration of I&C (1 AU = 1 Month)	5	AU	66,880.50	334,403		Nodal
	Total I&C Works				**61,509,463**		
	Total (Supply + I & C works)				**103,400,309**		
	QUOTE PERCENTAGE (%) ABOVE/BELOW (+/-) (OR) AT PAR TO TOTAL AMOUNT				XXXXXXX		
	QUOTED PERCENTAGE (%) IN WORDS ABOVE/BELOW (OR) AT PAR TO TOTAL AMOUNT				XXXXXXX		
	GST (As applicable) To be mandatorily indicated in the column above.				Please indicate GST % in above Column		
	NOTE: 1.CONTRACTOR SHOULD QUOTE PERCENTAGE (%) ABOVE/BELOW (OR) AT PAR TO TOTAL AMOUNT						
	2. QUOTED PERCENTAGE (%) IS APPLICABLE ON ALL ITEM RATES UNIFORMLY.						

GENERAL CONDITIONS

OF

CONTRACT

2019

ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್, ವಿದ್ಯುನ್ಮಾನ ವಿಭಾಗ, ಬೆಂಗಳೂರು

भारत हेवी इलेक्ट्रिकल्स लिमिटेड, इलेक्ट्रानिक्स डिवीज़न, बेंगलुरु

Bharat Heavy Electricals Limited, Electronics Division, Bengaluru

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CHAPTER -1

1. GENERAL INSTRUCTION TO TENDERERS

1.1. DESPATCH INSTRUCTION

i) The General Conditions of Contract form part of the Tender specifications. All pages of the tender documents shall be duly signed, stamped and submitted along with the offer in token of complete acceptance thereof. The information furnished shall be complete by itself. The tenderer is required to furnish all the details and other documents as required in the following pages

ii) Tenderers are advised to study all the tender documents carefully. Any submission of tender by the tenderer shall be deemed to have been done after careful study and examination of the tender documents and with the full understanding of the implications thereof. Should the tenderers have any doubt about the meaning of any portion of the Tender Specification or find discrepancies or omissions in the drawings or the tender documents issued are incomplete or shall require clarification on any aspects, the scope of work etc., he shall contact the authority inviting the tender well in time (so as not to affect last date of submission) for clarification before the submission of the tender. Tenderer's request for clarifications shall be with reference to Sections and Clause numbers given in the tender documents. The tender specifications and terms and conditions shall be deemed to have been accepted by the tenderer in the offer. Pre requirements and conditions shall be liable for rejection.

iii) Integrity pact (IP): If NIT calls for Integrity Pact, the same shall be duly signed & stamped by the authorised signatory & submitted along with tender document.

1.2. SUBMISSION OF TENDERS

1.2.1 The tenderers must submit their tenders as per instructions in the NIT

1.2.2 BHEL takes no responsibility for delay, loss or non-receipt of tenders sent by post/courier. The tenders received after the specified time of their submission are treated as 'Late Tenders' and shall not be considered under any circumstances. Offers received by Fax/Email/Internet shall be considered as per terms of NIT.

1.2.3 Tenders shall be opened by authorised Officer of BHEL at his office at the time and date as specified in the NIT, in the presence of such of those tenderers or their authorised representatives who may be present

1.2.4 Tenderers whose bids are found techno commercially qualified shall be informed the date and time of opening of the Price Bids and such Tenderers may depute their representatives to witness the opening of the price bids. BHEL's decision in this regard shall be final and binding.

1.2.5 Before submission of Offer, the tenderers are advised to inspect the site of work and the environments and be well acquainted with the actual working and other prevalent conditions, facilities available, position of material and labour, means of transport and access to Site, accommodation, etc. No claim will be entertained later on the grounds of lack of knowledge of any of these conditions.

1.3. ***LANGUAGE***

1.3.1 The tenderer shall quote the rates in English language and international numerals. These rates shall be entered in figures as well as in words. For the purpose of the tenders, the metric system of units shall be used.

1.3.2 All entries in the tender shall either be typed or written legibly in ink. Erasing and over-writing is not permitted and may render such tenders liable for rejection. All cancellations and insertions shall be duly attested by the tenderer.

1.4 ***PRICE DISCREPANCY:***

1.4.1 Conventional (Manual) Price Bid opening:

i) If, in the price structure quoted for the required goods/services/works, there is discrepancy between the unit price and the total price (which is obtained by multiplying the unit price by the quantity), the unit price shall prevail and the total price corrected accordingly, unless in the opinion of BHEL there is obvious misplacement of decimal point in the unit price, in which case the total price as quoted shall govern and the unit price corrected accordingly

ii) If there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected;

iii) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject of (i) and (ii) above.

iv) If there is such discrepancy in an offer, the same shall be conveyed to the bidder with target date up to which the bidder has to send his acceptance on the above lines and if the bidder does not agree to the decision of BHEL, the bid is liable to be ignored.

v) In case of lump sum price, if there is any difference between the amount in figures and in words, the amount quoted by the bidder in words shall be taken as correct.

vi) In case of omission in quoting any rate for one or more items, the evaluation shall be done considering the highest quoted rate obtained against the respective items by other tenderers for the subject tender. If the tenderer becomes L-1, the notional rates for the omission items shall be the lowest rates quoted for the respective items by the other tenderers against the respective omission items for the subject job and the 'Total quoted price (loaded for omissions)' shall be arrived at. However the overall price remaining the same as quoted originally, the rates for all the items in the 'Total quoted price (loaded for omissions)' shall be reduced item wise in proportion to the ratio of 'Original' total price and the 'Total quoted price (loaded for omissions)".

1.4.2 Reverse Auction: In case of Reverse Auction, the successful bidder shall undertake to execute the work as per overall price offered by him during the Reverse Auction process. In case of omission of rates, the procedure shall be as per 'Guidelines for Reverse Auction' enclosed.
i) Offers from tenderers who are under suspension (banned) by any Unit/Region/Division of BHEL shall not be considered.
ii) Offers from tenderers who do not comply with the latest guidelines of Ministry/ Commissions of Govt of India shall not be considered.

1.5. ***EVALUATION OF BIDS***

i) Technical Bids submitted by the tenderer will be opened first and evaluated for fulfilling the Pre-Qualification criteria and other conditions in NIT/Tender documents, based on documentary evidences submitted along with the offer, BHEL reserves the right to ask for proofs/documents, clarification in relation to Technical/commercial data during tender evaluation

ii) Price Bids of shortlisted bidders shall only be opened either through the conventional price bid opening or through electronic Reverse Auction, at the discretion of BHEL

iii) Price Bids of unqualified bidders shall not be opened. Reasons for rejection shall be intimated to the vendor before the opening of Price bid.

1.6. ***DATA TO BE ENCLOSED***

The following information in full shall be furnished by the tenderer. Non-submission of this information may lead to rejection of the offer.

i) INCOME TAX PERMANENT ACCOUNT NUMBER, GSTIN, SAC, HSN Certified copies of PAN, GSTIN shall be furnished along with tender. The names, addresses and contact information of the Directors/Partners shall be furnished along with the offer.

ii) An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor.

iii) IN CASE OF INDIVIDUAL TENDERER:

His / her full name, address, PAN, GSTIN and place & nature of business to be furnished.

iv) IN CASE OF PARTNERSHIP FIRM

The names of all the partners and their addresses, a copy of the partnership deed/instrument of partnership shall be enclosed.

v) IN CASE OF COMPANIES:

Date and place of registration including date of commencement certificate in case of Public Companies (certified copies of Memorandum and articles of Association are also to be furnished). Nature of business carried on by the Company and the provisions of the Memorandum relating thereof.

*1.7. **AUTHORISATION AND ATTESTATION***

Tenders shall be signed by a person duly authorised/empowered to do so. An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor shall be submitted along with the tenders

*1.8. **EARNEST MONEY DEPOSIT***

1.8.1 Every tender must be accompanied by the prescribed amount of Earnest Money Deposit (EMD) in the manner described herein.

The EMD may be accepted only in the following forms:
(i) Electronic Fund Transfer credited in BHEL account (before tender opening)
(ii) Banker's cheque/ Pay order/ Demand draft, in favor of BHEL (along with offer)In case total EMD amount is more than Rs 20 Lakh, the amount in excess of Rs 20 lakh maybe accepted in the form of Bank Guarantee from scheduled bank. The Bank Guarantee in such cases shall be valid for at-least six months.
(iii) Through SBI collect (before tender opening)
(iv) No other form of EMD remittance shall be acceptable to BHEL

1.8.2 EMD by the bidder will be forfeited as per Tender Documents if

i) After opening the tender and within the offer validity period, the tenderer revokes his/her tender or makes any modification in his tender which is not acceptable to BHEL.
ii) The Contractor fails to deposit the required Security deposit or commence the work within the period as per LOI/ Contract.
iii) EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged in derailing the tender process by unlawful means

1.8.3 EMD shall not carry any interest.

1.8.4 In the case of unsuccessful bidders, the Earnest Money will be refunded to them within a reasonable time after acceptance of award by successful tenderer.

1.8.5 EMD of successful tenderer will be converted as part of Security Deposit

1.9. SECURITY DEPOSIT

The total amount of Security Deposit will be 5% of the contract value (including all applicable taxes) EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.

1.9.1 Modes of Security deposit:

The balance amount to make up the required Security Deposit of 5% of the contract value may be accepted in the following forms:
i) Cash (as permissible under the extant Income Tax Act)
ii) Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL
iii) Bank Guarantee from Scheduled Banks/ Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format should have the approval of BHEL
iv) Fixed Deposit Receipt issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL)
v) Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (held in the name of Contractor furnishing the security and duly endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL) (Note: BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith)
vi) 50% of the required Security Deposit, including the EMD, should be paid before start of the work. Balance of the Security Deposit can be collected by deducting10% of the gross amount progressively from each of the running bills of the Contractor till the total amount of the required Security Deposit is collected. If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the additional Security Deposit shall be immediately deposited by the Contractor or recovered from payment/s due to the Contractor. Security Deposit shall be released to the Contractor upon fulfilment of contractual obligations as per terms of the contract.

1.9.2 The Security Deposit shall not carry any interest.

1.9.3 The validity of Bank Guarantees towards Security Deposit shall be initially up to the completion period as stipulated in the Letter of Intent/Award (plus maintenance period if applicable), and 03 months claim period. The same shall be kept valid by proper renewal till the acceptance of Final Bills of the Contractor, by BHEL

1.9.4 BHEL reserves the right of forfeiture of Security Deposit in addition to other claims and penalties in the event of the Contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract. BHEL reserves the right to set off the Security Deposit against any claims of other contracts with BHEL.

*1.10. **REFUND OF SECURITY DEPOSIT***

50% of the security deposit may be refunded on completion of the work after payment of the final bill and the balance 50% of the security deposit is refunded only after the expiry of the maintenance period from date of completion of work as stipulated in the contract concerned.

***1.10.1** DEFECTS LIABILITY PERIOD:*

The contractor shall be responsible to make good and remedy at his own expenses within such period as may be stipulated by the Engineer-in-charge, any defect which may develop or may be noticed before the expiry of the maintenance period of six months or as stipulated in NIT hereto from the certified date of completion and intimation of which has been sent to the contractor within seven days of the expiry of the said period by a letter sent by hand delivery or by registered post or Email. If contractor fails to attend to the above, defect will be rectified at contractor's risk & cost and same will be deducted from the security deposit/payable amounts available with BHEL.

*1.11. **BANK GUARANTEES***

Where ever Bank Guarantees are to be furnished/submitted by the contractor, the following shall be complied with

i) Bank Guarantees shall be from Scheduled Banks / Public Financial Institutions as defined in the Companies Act.

ii) The Bank Guarantees shall be as per prescribed BHEL formats.

iii) It is the responsibility of the bidder to get the Bank Guarantees revalidated/extended for the required period (subject to a minimum period of six months), as per the advice of BHEL. BHEL shall not be liable for issue of any reminders regarding expiry of the Bank Guarantees.

iv) In case extension/further extensions of any Bank Guarantees are not required, the bidders shall ensure that the same is explicitly endorsed by BHEL

v) In case the Bank Guarantees are not extended before the expiry date, BHEL reserves the right to invoke the same by informing the concerned Bank in writing, without any advance notice/communication to the concerned bidder.

vi) Bidders to note that any corrections to Bank Guarantees shall be done by the issuing Bank, only through an amendment in an appropriate non judicial stamp paper.

vii) The Original Bank Guarantee shall be sent directly by the Bank to BHEL under Registered Post (Acknowledgement Due).

1.12. VALIDITY OF OFFER

The rates in the Tender shall be kept open for acceptance for a minimum period of Ninety (90) DAYS from latest due date of offer submission (including extension, if any). In case BHEL calls for negotiations, such negotiations shall not amount to cancellation or withdrawal of the original offer which shall be binding on the tenderers.

1.13 EXECUTION OF CONTRACT AGREEMENT

The successful tenderer's responsibility under this contract commences from the date of issue of the Letter of Intent by BHEL. The Tenderer shall submit an unqualified acceptance to the Letter of Intent/Award within the period stipulated therein.

The successful tenderer shall be required to execute an agreement in the prescribed form, with BHEL, within fifteen days (15 days) after the acceptance of the Letter of Intent/Award, and in any case before releasing the first running bill. The contract agreement shall be signed by a person duly authorized/empowered by the tenderer. The expenses for preparation of agreement document shall be borne by Tenderer.

1.14. REJECTION OF TENDER AND OTHER CONDITIONS

1.14.1 The acceptance of tender will rest with BHEL which does not bind itself to accept the lowest tender or any tender and reserves to itself full rights for the following without assigning any reasons whatsoever:-

a. To reject any or all of the tenders.

b. To split up the work amongst two or more tenderers as per NIT

c. To award the work in part if specified in NIT

d. In case of either of the contingencies stated in (b) and (c) above, the time for completion as stipulated in the tender shall be applicable.

1.14.2 Conditional tenders, unsolicited tenders, tenders which are incomplete or not in the form specified or defective or have been materially altered or not in accordance with the tender conditions, specifications etc., are liable to be rejected.

1.14.3 Tenders are liable to be rejected in case of unsatisfactory performance of the tenderer with BHEL, or tenderer under suspension (hold/banning /delisted) by any unit / region / division of BHEL or tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt of India. BHEL reserves the right to reject a bidder in case it is observed that they are overloaded and may not be in a position to execute this job. The decision of BHEL will be final in this regard.

1.14.4 If a tenderer who is a proprietor expires after the submission of his tender or after the acceptance of his tender, BHEL may at their discretion, cancel such tender. If a partner of a firm expires after the submission of tender or after the acceptance of the tender, BHEL may then cancel such tender at their discretion, unless the firm retains its character.

1.14.5 BHEL will not be bound by any Power of Attorney granted by changes in the composition of the firm made subsequent to the execution of the contract. They may, however, recognize such power of Attorney and changes after obtaining proper legal advice, the cost of which will be chargeable to the contractor concerned.

1.14.6 If the tenderer deliberately gives wrong information in his tender, BHEL reserves the right to reject such tender at any stage or to cancel the contract if awarded and forfeit the Earnest Money/Security Deposit/any other money due.

1.14.7 Canvassing in any form in connection with the tenders submitted by the Tenderer shall make his offer liable to rejection.

1.14.8 In case the Proprietor, Partner or Director of the Company/Firm submitting the Tender, has any relative or relation employed in BHEL, the authority inviting the Tender shall be informed, along with the Offer. Failing to do so, BHEL may, at its sole discretion, reject the tender or cancel the contract and forfeit the Earnest Money/Security Deposit.

1.14.9 The successful tenderer should not sub-contract part or complete work detailed in the tender specification undertaken by him without written permission of BHEL's Construction Manager/Site Incharge. The tenderer is solely responsible to BHEL for the work awarded to him.

1.14.10 The Tender submitted by a techno commercially qualified tenderer shall become the property of BHEL who shall be under no obligation to return the same to the bidder. However unopened price bids and late tenders shall be returned to the bidders after finalization of contract.

1.14.11 Unsolicited discount received after the due date and time of Bid Submission shall not be considered for evaluation. However, if the party who has submitted the unsolicited discount/rebate becomes the L-I party, then the awarded price i.e contract value shall be worked out after considering the discount so offered.

1.14.12 BHEL shall not be liable for any expenses incurred by the bidder in the preparation of the tender irrespective of whether the tender is accepted or not.

1.15 ***BHEL Fraud Prevention Policy :***

The bidder along with its associate/ collaborators/sub-contractors/ Sub-Vendors/ Consultants/service providers shall strictly adhere to BHEL Fraud Prevention Policy displayed on BHEL website http://www.bhel.com and shall immediately bring to the notice of BHEL Management about any fraud or suspected fraud as soon as it comes to their notice. Fraud prevention policy and list of Nodal officers shall be hosted on BHEL website, vendor portals of Units/Regions Internet.

CHAPTER-2

2.1 DEFINITION: The following terms shall have the meaning hereby assigned to them except where the context otherwise requires

*i) BHEL shall mean Bharat Heavy Electricals Limited, a company registered under Companies Act **1956**, with its Registered Office at BHEL HOUSE, SIRI FORT, NEW DELHI – 110 049, or its Authorised Officers or its Site Engineers or other employees authorised to deal with any matters with which these persons are concerned on its behalf.*

*ii) "EXECUTIVE DIRECTOR" or 'GROUP GENERAL MANAGER' or "GENERAL MANAGER (Incharge)" or "GENERAL MANAGER" shall mean the Officer in Electronics Division, Mysore road, Bengaluru-**560026***

iii) "COMPETENT AUTHORITY" shall mean Executive Director or Group General Manager or General Manager (In-charge) or General Manager or BHEL Officers who are empowered to act on behalf of the Executive Director or General Manager (In-charge) or General Manager of BHEL.

iv) "ENGINEER" or "ENGINEER IN CHARGE" shall mean an Officer of BHEL as may be duly appointed and authorized by BHEL to act as "Engineer" on his behalf for the purpose of the Contract, to perform the duty set forth in this General Conditions of Contract and other Contract documents. The term also includes 'CONSTRUCTION MANAGER' or 'SITE INCHARGE' as well as Officers

v) "SITE" shall mean the places or place at which the plants/equipment are to be erected and services are to be performed as per the specification of this Tender.

vi) "CLIENT OF BHEL" or "CUSTOMER" shall mean the project authorities with whom BHEL has entered into a contract for supply of equipment or provision of services.

vii) "CONTRACTOR" shall mean the successful Bidder/Tenderer who is awarded the Contract and shall include the Contractor's successors, heirs, executors, administrators and permitted assigns.

viii) "CONTRACT" or "CONTRACT DOCUMENT" shall mean and include the Work Order, Contract Agreement, the accepted appendices of Rates, Schedules, Quantities if any, General Conditions of Contract, Special Conditions of Contract, Instructions to the Tenderers, Drawings, Technical Specifications, the Special Specifications if any, the Tender documents, subsequent amendments mutually agreed upon and the Letter of Intent/Acceptance issued by BHEL. Any conditions or terms stipulated by the contractor in the tender documents or subsequent letters shall not form part of the contract unless, specifically accepted in writing by BHEL in the Letter of Intent/Award and incorporated in the agreement.

ix) "GENERAL CONDITIONS OF CONTRACT" shall mean the 'Instructions to Tenderers' and 'General Conditions of Contract' pertaining to the work for which above tenders have been called for.

x) "TENDER SPECIFICATION" or "TENDER" or "TENDER DOCUMENTS" shall mean General Conditions, Common Conditions, Special Conditions, Price Bid, Rate Schedule, Technical Specifications, Appendices, Annexures, Corrigendum's, Amendments, Forms, procedures, Site information, etc and drawings/documents pertaining to the work for which the tenderers are required to submit their offers. Individual specification number will be assigned to each Tender Specification.

xi) "LETTER OF INTENT" shall mean the intimation by a Post/Fax/email to the tenderer that the tender has been accepted in accordance with provisions contained in the letter. The responsibility of the contractor commences from the date of issue of this letter and all terms and conditions of the contract are applicable from this date.

xii) "COMPLETION TIME" shall mean the period by 'date/month' specified in the 'Letter of Intent/Award' or date mutually agreed upon for handing over of the intended scope of work, the erected equipment/plant which are found acceptable by the Engineer, being of required standard and conforming to the specifications of the Contract.

xiii) "PLANT" shall mean and connote the entire assembly of the plant and equipment's covered by the contract.

xiv) "EQUIPMENT" shall mean equipment, machineries, materials, structural, electrical and other components of the plant covered by the contract.

xv) "TESTS" shall mean and include such test or tests to be carried out on the part of the contractor as are prescribed in the contract or considered necessary by BHEL, in order to ascertain the quality, workmanship, performance and efficiency of the contractor or part thereof.

xvi) "APPROVED", "DIRECTED" or "INSTRUCTED" shall mean approved, directed or instructed by BHEL.

xvii) "WORK or CONTRACT WORK" shall mean and include supply of all categories of labour, specified consumables, tools and tackles and Plants required for complete and satisfactory site transportation, handling, stacking, storing, erecting, testing and commissioning of the equipment's to the entire satisfaction of BHEL.

xviii) "SINGULAR AND PLURALS ETC" words carrying singular number shall also include plural and vice versa, where the context so requires. Words imparting the masculine Gender shall be taken to include the feminine Gender and words imparting persons shall include any Company or Associations or Body of Individuals, whether incorporated or not.

xix) "HEADING" – The heading in these General Conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken as instructions thereof or of the contract.

xx) "MONTH" shall mean calendar month unless otherwise specified in the Tender.

xxi) Day' or 'Days' unless herein otherwise expressly defined shall mean calendar day or days of twenty four (24) hours each. A week shall mean continuous period of seven (7) days.

xxii) "COMMISSIONING" shall mean the synchronization testing and achieving functional operation of the Equipment with associated system after all initial adjustments, trials, cleaning, re-assembly required at site if any, have been completed and Equipment with associated system is ready for taking into service.

xxiii) "WRITING" shall include any manuscript type written or hand written or printed statement or electronically transmitted messages, under the signature or seal or transmittal of BHEL.

xxiv) "TEMPORARY WORK" shall mean all temporary works for every kind required in or for the execution, completion, maintenance of the work.

xxv) 'CONTRACT PRICE' or 'CONTRACT VALUE' shall mean the sum including applicable taxes mentioned in the LOI/LOA/Contract Agreement subject to such additions thereto or deductions there from as may be made under provisions hereinafter contained

xxvi) "COMMENCEMENT DATE" or "START DATE" shall mean the commencement/start of work at Site as per terms defined in the Tender

xxvii) "SHORT CLOSING" or "FORE CLOSING" of Contract shall mean the premature closing of Contract, for reasons not attributable to the contractor and mutually agreed between BHEL and the contractor

xxviii) "TERMINATION" of Contract shall mean the pre mature closing of contract due to reasons as mentioned in the contract

2.2 LAW GOVERNING THE CONTRACT AND COURT JURISDICTION

The contract shall be governed by the Law for the time being in force in the Republic of India. The Civil Court having original Civil Jurisdiction at Bengaluru, shall alone have exclusive jurisdiction in regard to all claims in respect of the Contract. No other Civil Court shall have jurisdiction in case of any dispute, under this contract

2.3 ISSUE OF NOTICE

2.3.1 Service of notice on contractor: Any notice to be given to the Contractor under the terms of the contract shall be served by sending the same by Registered Post / Speed Post/ FAX / Email to or leaving the same at the Contractor's last known address of the principal place of business (or in the event of the contractor being a company, to or at its Registered Office). In case of change of address, the notice shall be served at changed address as notified in writing by the Contractor to BHEL. Such posting or leaving of the notice shall be deemed to be good service of such notice and the time mentioned to the condition for doing any act after notice shall be reckoned from the date so mentioned in such notice.

2.3.2 Service of notice on BHEL Any notice to be given to BHEL in-charge under the terms of the Contract shall be served by sending the same by post or Email or leaving the same at BHEL address or changed address as notified in writing by BHEL to the Contractor.

2.4 USE OF LAND

No land belonging to BHEL or their Customer under temporary possession of BHEL shall be occupied by the contractor without written permission of BHEL.

2.4.1 STORES AND MATERIALS:

The contractor shall, at his own expense, supply all stores and materials required for the contract, other than those which may be provided by BHEL at the rates detailed therein subject to their availability at the place of issue indicated therein. All stores and materials to be supplied by the Contractor shall be of the best kind as described in the Specifications and the Contractor shall, if required by the Engineer –in- charge furnish him with proof to his satisfaction that the store and materials so comply with the specifications.

The contractor shall, at his own expense and without delay, supply samples of stores and materials proposed to be used in the execution of the work for the approval of the Engineer-in charge, who may reject all stores and materials not corresponding either in quality or character to the approved samples.

In the case of stores provided by BHEL, the Contractor shall bear the cost of loading, transporting to site, unloading, storing under cover as required, assembling & jointing the several parts together as necessary and incorporating & fixing these stores & materials in the work, including all preparatory work of whatever description that may be required, and closing, preparing, loading and returning empty cases or containers to the place of issue without any extra charges.
Contractor is responsible for safe & secure storage of above material.

2.4.2 PATENT RIGHTS:

The contractor shall fully indemnify BHEL, or the agent, servant, or employee of BHEL, against any action, claim or proceeding relating to infringement or the use of any patent or design or any alleged patent or design rights, and shall pay any royalties which may be payable in respect of any article/ or part thereof included in the contract.

In the event of any claims being made or action brought against BHEL, or any agent, or servant or employee of BHEL., in respect of any of the matters aforesaid, the contractor shall not apply when such increment has taken place in complying with the specific directions issued by the BHEL but the contractor shall pay any royalties payable in respect of any such use.

2.4.3 WATER :

The contractor shall allow in his tender and provide at his cost all water required for the work or his employees on the work, together with all pipes and fittings or other means that may be necessary or required to ensure a proper and ample supply of water for all purpose connected with the work.

In the event of a provision existing in the Tender documents for supply of water on payment by BHEL, water will be supplied from the BHEL supply System, or other sources at any points fixed by the Site Engineer/ Engineer-in-charge on the site of work. The contractor shall make necessary arrangement for lifting, pumping, carrying or conveying the water as required at his own cost. The levy of water charges to be borne by the Contractor in such case shall be specifically mentioned in the Tender documents.

2.4.4 TEMPORARY WORKSHOPS, STORES ETC :

The Contractor shall, during the progress of the work provide, erect and maintain at his own expense all necessary temporary workshops, store, offices, toilets etc., required for the proper and efficient execution of the work. The planning, siting and erection of these building shall have the approval of the Engineer-in-charge and the Contractor shall at all times keep them in a clean and sanitized condition to the entire satisfaction of the Engineer-in-charge.

On completion of the work all such temporary buildings shall be cleared and the site restored to its original state in a clean and tidy condition to the entire satisfaction of the Engineer-in-charge.

2.5 COMMENCEMENT OF WORK

2.5.1 Time is essence of contract and is specified in the tender document or in each individual work order.

2.5.2 The contractor shall commence the work within seven(07) days from LOI/work order or as intimated by BHEL and shall proceed with the same with due expedition without delay.

2.5.3 If the contractor fails to start the work within stipulated time as per LOI or as intimated by BHEL, then BHEL at its sole discretion will have the right to cancel the contract. The Earnest Money and/or Security Deposit with BHEL will stand forfeited without any further reference to him without prejudice to any and all of BHEL's other rights and remedies in this regard.

2.5.4 All the work shall be carried out under the direction and to the satisfaction of BHEL.

2.6 MEASUREMENT OF WORK AND MODE OF PAYMENT:

2.6.1 All payments due to the contractors shall be made by electronic mode only, unless otherwise found operationally difficult.

2.6.2 For progress running bill payments: - The Contractor shall present detailed measurement sheets in triplicate, duly indicating all relevant details based on technical documents and connected drawings for work done during the month/period under various categories in line with terms of payment as per contract. The basis of arriving at the quantities, weights shall be relevant documents and drawings released by BHEL. These measurement sheets shall be prepared jointly with BHEL Engineers and signed by both the parties.

2.6.3 These measurement sheets will be checked by BHEL Engineer and quantities and percentage eligible for payment under various groups shall be decided by BHEL Engineer. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in Measurement Book and signed by both the parties.

2.6.4 Based on the above quantities, contractor shall prepare the bills in prescribed format and work out the financial value. These will be entered in Measurement Book and signed by both the parties. Payment shall be made by BHEL after effecting the recoveries due from the contractor.

2.6.5 All recoveries due from the contractor for the month/period shall be effected in full from the corresponding running bills unless specific approval from the competent authorities is obtained to the contrary.

2.6.6 Measurement shall be restricted to that portion of work for which it is required to ascertain the financial liability of BHEL under this contract.

2.6.7 The measurement shall be taken jointly by persons duly authorized on the part of BHEL and by the Contractor.

2.6.8 The Contractor shall bear the expenditure involved if any, in making the measurements and testing of materials to be used/used in the work. The contractor shall, without extra charges, provide all the assistance with appliances and other things necessary for measurement.

2.6.9 If at any time due to any reason whatsoever, it becomes necessary to re-measure the work done in full or in part, the expenses towards such re measurements shall be borne by the contractor unless such re measurements are warranted solely for reasons not attributable to contractor.

2.6.10 Passing of bills covered by such measurements does not amount to acceptance of the completion of the work measured. Any left out work has to be completed, if pointed out at a later date by BHEL.

2.6.11 Final measurement bill shall be prepared in the final bill format prescribed for the purpose based on the certificate issued by BHEL Engineer that entire works as stipulated in tender specification has been completed in all respects to the entire satisfaction of BHEL. Contractor shall give unqualified "No Claim" Certificate. All the tools and tackles loaned to him should be returned in satisfactory condition to BHEL. The abstract of final quantities and financial values shall also be entered in the Measurement Books and signed by both parties to the contract. The Final Bill shall be prepared and paid within a reasonable time after completion of work.

*2.7 **RIGHTS OF BHEL***

BHEL reserves the following rights in respect of this contract during the original contract period or its extensions if any, as per the provisions of the contract, without entitling the contractor for any compensation.

2.7.1 To withdraw any portion of work and/or to restrict/alter quantum of work as indicated in the contract during the progress of work and get it done through other agencies to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergent reasons/ BHEL's obligation to its customer.

2.7.2 To terminate the contract or get any part of the work done through other agency or deploy BHEL's own/hired/otherwise arranged resources , at the risk and cost of the contractor after due notice of a period of two weeks by BHEL, in the event of:-

i) Contractor's continued poor progress

ii) Withdrawal from or abandonment of the work before completion of the work

iii) Contractor's inability to progress the work for completion as stipulated in the contract

iv) Poor quality of work

v) Corrupt act of Contractor

vi) Insolvency of the Contractor

vii) Persistent disregard to the instructions of BHEL

viii) Assignment, transfer, sub-letting of contract without BHEL's written permission

ix) Non fulfillment of any contractual obligations / non-compliance of statutory requirements

x) In the opinion of BHEL, the contractor is overloaded and is not in a position to execute the job as per required schedule

2.7.3 To meet the expenses including BHEL overheads of 35% & Liquidated damage/penalties arising out of "Risk & Cost" as explained above under Sl.No. 2.7.2. BHEL shall recover the amount from any money due from Contractor, from any money due to the Contractor including Security Deposit or by forfeiting any T&P or material of the contractor under this contract or any other contract of BHEL or by any other means or any combination thereof

2.7.4 To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customer are terminated for any reason, as per mutual agreement.

2.7.5 To effect recovery from any amounts due to the contractor under this or any other contract or in any other form, the moneys BHEL is statutorily forced to pay to anybody, due to contractor's failure to fulfill any of his obligations. BHEL shall levy overheads of 35% on all such payments.

2.7.6 While every endeavor will be made by BHEL to this end, they cannot guarantee uninterrupted work due to conditions beyond their control. The Contractor will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract.

2.7.7 In case the execution of works comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than two months, due to reasons not attributable to the contractor and other than Force Majeure conditions, BHEL may consider permitting the contractor to de mobilize forthwith and re mobilize at an agreed future date. Cost of such demobilization/remobilization shall be mutually agreed. ORC (Over run Charges) in such cases shall not be applicable for the period between the period of demobilization and re mobilisation. The duration of contract/time extension shall accordingly get modified suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.

2.7.8 In the unforeseen event of inordinate delay in receipt of materials, drawings, fronts, etc, due to which inordinate discontinuity of work is anticipated, BHEL at its discretion may consider contractor's request to short close the contract, provided that the balance works are minor vis a vis the scope of work envisaged as per the contract. At the point of requesting for

short closure, contractor shall establish that he has completed all works possible of completion and he is not able to proceed with the balance works due to constraints beyond his control. In such a case, the estimated value of the unexecuted portion of work as mutually agreed, shall however be reduced from the final contract value.

2.7.9 ***LIQUIDATED DAMAGES/PENALTY***

COMPENSATION FOR DELAY:

If the contractor fails to maintain the required progress in terms of condition 2.10 or to complete the work and clear the site on or before the contracted or extended the period of completion, he shall, without prejudice to any other right or remedy of the BHEL on account of such breach, pay as agreed compensation an amount calculated as stipulated below

For unfinished anticipated value of work where finished portion is fit for use

Rate of compensation as follows:

- *Completion period (as originally stipulated)not exceeding 6 months. ……@ 1 percent per week*
- *Completion period (as originally stipulated) Exceeding 6 months and not exceeding 2 years…@ 0.5 percent per week*
- *Completion period (as originally stipulated) exceeding 2 years…… @ 0.25 percent per week*

Provided always that the total amount of compensation for delay to be paid under condition shall not exceed the under noted percentage of the anticipated contract value

- *Completion period (as originally stipulated) not exceeding 6 months. ……@ 10 percent of anticipated value of work*
- *Completion period (as originally stipulated)Exceeding 6 months and not exceeding 2 years…@ 7.5 percent of anticipated value of work*
- *Completion period (as originally stipulated)Exceeding 2 years……@ 5 percent of anticipated value of work*

The amount of compensation may be adjusted or set off against any sum payable to the Contractor under this or any other contract with the BHEL.

2.7.10 ***POST TECHNICAL AUDIT OF WORK AND BILLS****: BHEL reserve the right to carry out a post-payment audit and technical examination of the work and final bill including all supporting vouchers, abstract etc., and to enforce recovery of any sums becoming due as a result thereof in the manner provided in the proceeding sub-paragraph's provided however that no such recovery shall be enforced after three years of passing the final bill*

2.8 RESPONSIBILITIES OF THE CONTRACTOR IN RESPECT OF LOCAL LAWS, EMPLOYMENT OF WORKERS ETC.

The following are the responsibilities of the contractor in respect of observance of local laws, employment of personnel, payment of taxes etc. The subcontractor shall fully indemnify BHEL against any claims of whatsoever nature arising due to the failure of the contractor in discharging any of his responsibilities hereunder:

2.8.1 The contractor at all times during the continuance of this contract shall, in all his dealings with local labour for the time being employed on or in connection with the work, have due regard to all local festivals and religious and other customs.

2.8.2 The contractor shall comply with all applicable State and Central Laws, Statutory Rules, Maternity act, Regulations etc. such as contract labour(R&A) Act 1970, Minimum wage Act 19748, Payment of wages Act 1936,ESI Act 1948, EPF Act 1952, Employees' compensation Act 1923, Provision of Companies Act 1948 & rules thereof, The interstate Migrant Workmen 1979, The Karnataka Factories Rules 1969, Payment of Bonus Act 1965, Payment of Gratuity Act 1972. Child labour Prohibition act 1986, Karnataka Minimum Wage Act , Prevention of sexual harassment at work place Act 2013, Guidelines/notification related to Safai Karamchari Act , Equal Remuneration Act 1976, The company's instructions as issued from time to time in regard to working hours, wages, leaves, holidays etc. for labour as may be enacted by the Government during the tenure of the Contract and having force or jurisdiction at Site. The Contractor shall also give to the local Governing Body, Police and other relevant Authorities all such notices as may be required by the Law.

The contractor shall produce the following registers and forms:

- *Form XIII- Register of work men employed by contractor(Rule 75)*
- *Form XIV- Employment Card issued by contractor(Rule 76)*
- *Form XVI- Muster Roll (Rule 78(1) (a)(i))*
- *Form XVII- Register of Wages (Rule 78(1) (a)(i))*
- *Form XVIII- Register of wages cum Muster Roll(in case of weekly payment)*
- *Form XIX- Wage slip (Rule 78(b))*
- *Form XX- Register of deduction for damages Or Loss Rule 78(1) (a)(ii))*
- *Form XXI- Register of files Rule 78(1) (a)(ii))*
- *Form XXII- Register of Advance Rule 78(1) (a)(ii))*
- *Form XXIII- Register of Overtime Rule 78(1) (a)(iii))*
- *Form XXIV- Return to be sent by the contractor to the Licensing officer (Rule 82(1))*

2.8.3 The contractor shall obtain independent License under the Contract Labour (Regulations and Abolition Act)as required from the concerned Authorities based on the certificate (Form-V) issued by the Principal Employer/Customer

2.8.4 The contractor shall pay all taxes, fees, license charges, deposits, duties, tolls, royalties, commission or other charges which may be levied on account of his operations in executing the contract.

2.8.5 While BHEL would pay the inspection fees and Registration fees of Boiler & explosive/Electrical Inspectorate, all other arrangements for site visits periodically by the Inspectorate to site, Inspection certificate etc. will have to be made by contractor. However, BHEL will not make any payment to the Inspectorate in connection with contractor's Welders/Electricians qualification tests etc.

2.8.6 Contractor shall be responsible for provision of Health and Sanitary arrangements (more particularly described in Contract Labour Regulation & Abolition Act), Safety precautions etc. as may be required for safe and satisfactory execution of contract.

2.8.7 The contractor shall be responsible for proper accommodation including adequate medical facilities for personnel employed by him.

2.8.8 The contractor shall be responsible for the proper behavior and observance of all regulations by the staff employed by him.

2.8.9 The contractor shall ensure that no damage is caused to any person/property of other parties working at site. If any such damage is caused, it is responsibility of the contractor to make good the losses or compensate for the same.

2.8.10 All the properties/equipment/components of BHEL/their Client loaned with or without deposit to the contractor in connection with the contract shall remain properties of BHEL/their Client.

2.8.11 The contractor shall use such properties for the purpose of execution of this contract. All such properties/equipment/components shall be deemed to be in good condition when received by the contractor unless he notifies within 48 hours to the contrary. The contractor shall return them in good condition as and when required by BHEL/their Client. In case of non-return, loss, damage, repairs etc, the cost thereof as may be fixed by BHEL Engineer will be recovered from the contractor

2.8.12 Any delay in completion of works/or non-achievement of periodical targets due to the reasons attributable to the contractor, the same may have to be compensated by the contractor either by increasing manpower and resources or by working extra hours and/or by working more than one shift. All these are to be carried out by the contractor at no extra cost.

2.8.13 The contractor shall arrange, coordinate his work in such a manner as to cause no hindrance to other agencies working in the same premises.

2.8.14 All safety rules and codes applied by the Client/BHEL at site shall be observed by the contractor without exception. The contractor shall be responsible for the safety of the equipment/material and works to be performed by him and shall maintain all light, fencing guards, slings etc. or other protection necessary for the purpose. Contractor shall also take such additional precautions as may be indicated from time to time by the Engineer with a view to prevent pilferage, accidents, fire hazards. Due precautions shall be taken against fire hazards and atmospheric conditions. Suitable number of Clerical staff, watch and ward, store keepers to take care of equipment/materials and construction tools and tackles shall be posted at site by the contractor till the completion of work under this contract. The contractor shall arrange for such safety devices as are necessary for such type of work and carry out the requisite site tests of handling equipment, lifting tools, tackles etc. as per prescribed standards and practices. Contractor has to ensure the implementation of Health, Safety and Environment (HSE) requirements as per directions given by BHEL/Customer. The contractor has to assist in HSE audit by BHEL/Customer and submit compliance Report. The contractor has to generate and submit record/reports as per HSE plan/activities as per instruction of BHEL/Customer. All tools, plant and equipment brought to the site shall become the property of BHEL and shall not be removed from the site without the prior written approval from BHEL. When the work is finally completed or the Contractor is determined for reasons other than the defaults of the contract, he shall forthwith remove from the site all tools, plants, equipment etc., (other than those as may have been provided by BHEL) and upon such removal, the same shall revert in, and become the property of the contractor.

2.8.15 The contractor will be directly responsible for payment of wages to his workmen on specified date of respective month declared as per applicable Labour Act. A pay roll sheet giving all the payments given to the workers and duly signed by the contractor's representative should be furnished to BHEL site for record purpose.

2.8.16 In case of any class of work for which there is no such specification as laid down in the contract, such work shall be carried out in accordance with the instructions and requirements of the Engineer.

2.8.17 Also, no idle charges will be admissible in the event of any stoppage caused in the work resulting in contractor's labour and Tools & Plants being rendered idle due to any reason at any time.

2.8.18 The contractor shall take all reasonable care to protect the materials and work till such time the plant/equipment has been taken over by BHEL or their Client whichever is earlier.

2.8.19 The contractor shall not stop the work or abandon the site for whatsoever reason of dispute, excepting force majeure conditions. All such problems/disputes shall be separately discussed and settled without affecting the progress of work. Such stoppage or abandonment shall be treated as breach of contract and dealt with accordingly

2.8.20 The contractor shall keep the area of work clean and shall remove the debris etc. while executing day-to-day work. Upon completion of work, the contractor shall remove from the vicinity of work, all scrap, packing materials, rubbish, unused and other materials and deposit them in places specified by the Engineer. The contractor will also demolish all the hutments, sheds, offices, etc. constructed and used by him and shall clean the debris. In the event of his failure to do so, the same will be arranged to be done by the Engineer and the expenses recovered from the contractor. If the work is executed in Factory premises, no hutment will be allowed.

2.8.21 The contractor shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and timely execution shall be the essence of this contract. The contractor shall be responsible to ensure that the quality, assembly and workmanship conform to the dimensions and clearance given in the drawings and/ or as per the instructions of the Engineer.

2.8.22 The Contractor to note that some of BHEL's T&Ps/MMDs may not be insured. The Contractor will take necessary precautions and due care to protect the same while in his custody from any damage/ loss till the same is handed over back to BHEL. In case the damage / loss is due to carelessness/ negligence on the part of the contractor, the Contractor is liable to get them repair/ replaced immediately and in case of his failure to do so within a reasonable time, BHEL will reserve the right to recover the loss from the contractor.

2.8.23 The contractor shall provide all watchmen necessary, for the protection of the site, the work, the materials, the tools , plant, equipment and anything else lying on the site during the progress of the work. He shall solely be responsible for and shall take all reasonable and proper steps for protecting, securing , lighting and watching all places on or about the work and the site which may be dangerous to any person whom so ever.

2.8.24 SITE DRAINAGE: All water that may accumulate on the site during the process of the work, or in trenches and excavations shall be removed to the entire satisfaction of the Engineer-in-charge and at Contractors expense.

2.8.25 INSPECTION OF THE WORK: BHEL Officers concerned with the Contract shall have power at any time to inspect and examine any part of the work and the contractor shall give such facilities as may be required to given for such inspection and examination.

2.8.26 In case the contractor is required to undertake any work outside the scope of this contract, the rates payable shall be those mutually agreed upon if the item rates are not mentioned in existing contract

i. For any item of wok required to be carried out after the contract has been awarded and which is not covered by Contractors Schedule but is covered by C.P.W.D. schedule of rates the rate payable for such a fresh item will be derived from updated C.P.W.D. schedule of rates by the method of proportion as follows:

ii. *Rate as per estimated updated C.P.W.D DSR and loading tender excess (plus or minus) on pro–rata basis for nearest analogous items. For other items rate as per estimated C.P.W.D DSR and loading tender excess(plus or minus)*

iii. *If rates are not available in C.P.W.D. DSR, deviated item rates will be derived from market rate with 15% profit and overheads.*

*2.9 **PROGRESS MONITORING, MONTHLY REVIEW AND PERFORMANCE EVALUATION***

2.9.1 A detailed plan/programme for completion of the contractual scope of work as per the time schedule given in the contract shall be jointly agreed between BHEL and Contractor, before commencement of work . The above programme shall be supported by month wise deployment of resources viz Manpower, T&P, Consumables, etc. Progress will be reviewed periodically (Daily/Weekly/Monthly) vis a vis this jointly agreed programme. The Contractor shall submit periodical progress reports (Daily/Weekly/Monthly) and other reports/information including manpower, consumables, T&P mobilization etc as desired by BHEL.

2.9.2 Monthly progress review between BHEL and Contractor shall be based on the agreed programme as above, availability of inputs/fronts etc, and constraints if any, as per prescribed formats. Manpower, T&P and consumable reports as per prescribed formats shall be submitted by contractor every month. Release of RA Bills shall be contingent upon certification by BHEL Site Engineer of the availability of the above prescribed formats duly filled in and signed.

2.9.3 The burden of proof that the causes leading to any shortfall is not due to any reasons attributable to the contractor is on the contractor himself. The monthly progress review shall record shortfalls attributable to (i) Contractor, (ii) Force Majeure Conditions, and (iii) BHEL

*2.10 **TIME OF COMPLETION***

2.10.1 Time is essence of the contract. The time schedule shall be as prescribed in the Contract. The time for completion shall be reckoned from the date of commencement of work at Site as certified by BHEL Engineers

2.10.2 The entire work shall be completed by the contractor within the time schedule or within such extended periods of time as may be allowed by BHEL under clause 2.11

*2.11 **EXTENSION OF TIME FOR COMPLETION***

2.11.1 If the completion of work as detailed in the scope of work gets delayed beyond the contract period, the contractor shall request for an extension of the contract and BHEL at its discretion may extend the Contract.

2.11.2 Based on the monthly reviews jointly signed, the works balance at the end of original contract period less the backlog attributable to the contractor shall be quantified, and the number of months of 'Time extension' required for completion of the same shall be jointly worked out. Within this period of 'Time extension', the contractor is bound to complete the portion of backlog attributable to the contractor. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly.

2.11.3 However if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take at the risk and cost of contractor.

2.11.4 A joint programme shall be drawn for the balance amount of work to be completed during the period of 'Time Extension', along with matching resources (with weightages) to be deployed by the contractor as per specified format. Review of the programme and record of shortfall shall be done every month of the 'Time extension' period in the same manner as is done for the regular contract period.

2.11.5 During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program

2.11.6 At the end of total work completion as certified by BHEL Engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) Contractor, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/levied for the portion of time extensions attributable to contractor and recoverable from the dues payable to the contractor.

2.12 ***OVERRUN COMPENSATION (THIS CLAUSE IS NOT APPLICABLE IN BHEL FACTORY & TOWNSHIP PREMISES)***

2.12.1 Over Run Compensation (ORC) is payable by way of rate revisions for periods beyond original, contract period subject to the following terms and conditions.

2.12.2 Rates shall be increased by 10% for the first twelve months of one or more extensions beyond original contract period. For the next twelve months of further extensions if any, rates shall be increased as above by 10% over the previous twelve months, and similarly for each subsequent twelve months extension.

2.12.3 Should there be any 'Time extension' for reasons attributable only to the contractor, then the work shall be executed by the contractor at the rates applicable for the period the work was planned

2.12.4 Payment of ORC shall be regulated as follows:

i) Contractor is entitled to Over Run Compensation (ORC) only for the portion of backlog attributable to BHEL.

ii) 50% of the compensation is allocated for deployment of resources agreed as per the joint programme drawn vide 2.11.4. Payment shall however be based on the actual deployment of resources for the month as certified by BHEL, as per weightages assigned therein

iii) 50% of the compensation, is allocated for achieving of planned progress agreed as per the joint programme drawn vide 2.11.4. Payment shall be on pro rata basis for actual achieved quantities

iv) Total Over Run Compensation shall be limited to 10% of the executed contract value as certified in Final Bill. For this purpose executed contract value excludes PVC, ORC, Supplementary/Additional Items and Extra Works done on Man-day rate basis

2.12.5 Contractor shall not be entitled for any Over Run Compensation (ORC) for the portion of backlog attributable to the contractor. Such works shall be executed at the rates applicable for the period the work was planned

2.13 ***QUANTITY VARIATION***

2.13.1 The quoted rates shall remain firm irrespective of any variations in the individual quantities.

2.14 ***EXTRA WORKS***

2.14.1 All rectifications/modifications, revamping, and reworks required for any reasons not attributable to the contractor, or needed due to any change in deviation from drawings and design of equipment, operation/maintenance requirements, mismatching, or due to damages in transit, storage and erection/commissioning, and other allied works which are not very specifically indicated in the drawings, but are found essential for satisfactory completion of the work, will be considered as extra works.

2.14.2 Extra works arising on account of the contractor's fault, irrespective of time consumed in rectification of the damage/loss, will have to be carried out by the contractor free of cost. Under such circumstances, any material and consumable required for this purpose will also have to be arranged by the contractor at his cost.

2.14.3 All the extra work should be carried out by a separately identifiable gang, without affecting routine activities. Daily log sheets in the pro-forma prescribed by BHEL should be maintained and shall be signed by the contractor's representative and BHEL engineer. No claim for extra work will be considered/entertained in the absence of the said supporting documents i.e. daily log sheets. Signing of log sheets by BHEL engineer does not necessarily mean the acceptance of such works as extra works.

2.14.4 BHEL retains the right to award or not to award any of the major repair/ rework/modification/rectification/fabrication works to the contractor, at their discretion without assigning any reason for the same

2.14.5 After eligibility of extra works is established and finally accepted by BHEL engineer/designer, payment will be released on competent authority's approval at the following rate.

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS: Single composite average labour man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework/ repairs/ rectification/ modification/ fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment , if found due will be as per applicable minimum wage act

2.14.6 The above composite labour man hour rate towards extra works shall remain firm and not subject to any variation during execution of the work. PVC will not be applicable for extra works. Rate revision, Over Run Charges/compensation etc will not be applicable due to extra works.

2.14.7 Extra Works for Civil Packages shall be regulated as follows

i) Rates for Extra Works arising due to (1) non availability of BOQ (Rate Schedule), OR (2) change in Specifications of materials/works (3) rectification/modification/dismantling & re erecting etc due to no fault of Contractor, shall be in the order of the following:

a) Item rates are to be derived from similar nature of items in the BOQ (Rate Schedule) with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities.

b) As per applicable updated CPWD-DSR (or latest edition) with applicable escalation derived, Notification issued by the office of CPWD for 'Cost Index' in that Region where the project is being executed,

c) Item rates are to be worked out on the basis of prevailing market rates mutually agreed between BHEL and Contractor, plus 15% towards Contractor's overheads and profit.

ii) PVC and ORC will not applicable be for (i) above.

2.15 ***SUPPLEMENTARY ITEMS***

2.15.1 For NON Civil Works

Supplementary items are items/works required for completion of entire work but not specified in the scope of work. Subject to certification of such items/works as supplementary items by BHEL Engineer, rates shall be derived on the basis of any one of the following on mutual agreement:

i) Based on percentage breakup/rates indicated for similar/nearby items

ii) In case (i) above does not exist, then BHEL/site may derive the percentage breakup/rates to suit the type of work

2.15.2 For Civil Works

i) Rates for Supplementary Works/Additional Works arising out due to additions/alterations in the original scope of works as per contract subject to certification of BHEL Engineer shall be worked out as under:

a) Item rates which are available in existing BOQ (Rate Schedule) shall be operated with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities

b) Items of works which are not available in existing BOQ shall be operated as an 'Extra Works' and rate shall be derived as per clause no 2.14

ii) Execution of Supplementary Works/Additional Works through the Contractor shall be at the sole discretion of BHEL, and shall be considered as part of executed contract value for the purpose of Quantity Variation as per clause 2.13

iii) BHEL Engineer's decision regarding fixing the rate as above is final and binding on the contractor.

iv) PVC and ORC will not be applicable for (i) above.

2.16 ***STRIKES & LOCKOUT***

2.16.1 The contractor will be fully responsible for all disputes and other issues connected with his labour/employee. In the event of the contractor's labour/employee resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of 15 days, BHEL shall have the right to get the work executed through any other

agencies and the cost so incurred by BHEL along with Overhead charges of 35% shall be deducted from the Contractor's bills along with overhead of 35%

2.16.2 For all purposes whatsoever, the employees of the contractor shall not be deemed to be in the employment of BHEL

2.17 FORCE MAJEURE

The following shall amount to Force Majeure:-

2.17.1 Acts of God, act of any Government, War, Sabotage, Riots, Strike, Civil commotion, Police action, Revolution, Flood, Fire, Cyclones, Earth quake and Epidemic and other similar causes over which the contractor has no control.

2.17.2 If the contractor suffers delay in the due execution of the contractual obligation due to delays caused by force majeure as defined above, the agreed time of completion of the job covered by this contract or the obligations of the contractor shall be extended by a period of time equal to period of delay, provided that on the occurrence of any such contingency, the contractor immediately reports to BHEL in writing the causes of delay and the contractor shall not be eligible for any compensation.

2.18 ***ARBITRATION & RECONCILIATION***

2.18.1 In case amicable settlement is not reached in the event of any dispute or difference arising out of the execution of the Contract or the respective rights and liabilities of the parties or in relation to interpretation of any provision by the Contractor in any manner touching upon the Contract, such dispute or difference shall (except as to any matters, the decision of which is specifically provided for therein) be referred to the sole arbitration of the arbitrator appointed by BHEL/In charge.

The award of the Arbitrator shall be binding upon the parties to the dispute Subject as aforesaid, the provisions of Arbitration and Reconciliation Act ***1996*** *(India) or statutory modifications or reenactments thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause. The venue of the arbitration shall be the place from which the contract is issued or such other place as the Arbitrator at his discretion may determine*

2.18.2 In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable:

In the event of any dispute or difference relating to the interpretation and application of the provisions of the Contract, such dispute or difference shall be referred to by either party to the arbitration of one of the arbitrators in the department of public enterprises. The award of the arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make further reference for setting aside or revision of the award to the Law Secretary, Department of Legal Affairs, Ministry of Law and Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special Secretary or Additional Secretary when so authorized by the Law Secretary, whose decision shall bind the parties hereto finally and conclusively.

2.18.3 The cost of arbitration shall be borne equally by the parties.

2.18.4 Work under the contract shall be continued during the arbitration proceedings

2.19 ***PAYMENTS***

Payments to Contractors are made in any one of the following forms

2.19.1 Running Account Bills (RA Bills)

i) These are for interim payments when the contracts are in progress. The bills for such interim payments are to be prepared by Contractor in prescribed formats (RA Bill forms).

ii) Payments shall be made according to the extent of work done as per measurements taken up to the end of the calendar month and in line with the terms of payments described in the Tender documents along with relevant statutory documents applicable for the work.

iii) Recoveries on account of electricity, water, statutory deductions, etc are made as per terms of contract

iv) Full rates for the work done shall be allowed only if the quantum of work has been done as per the specifications stipulated in the contract. If the work is not executed as per the stipulated specifications, BHEL may ask the contractor to re do the work according to the required specifications, without any extra cost. However, where this is not considered necessary 'OR' where the part work is done due to factors like non-availability of material to be supplied by BHEL 'OR' non availability of fronts 'OR' non availability of drawings, fraction payment against full rate, as is considered reasonable, may be allowed with due regard for the work remaining to be done. BHEL decision in this regard will be final and binding on the contractor.

v) In order to facilitate part payment, BHEL Site Engineer at his discretion may further split the contracted rates/percentages to suit site conditions, cash flow requirements according to the progress of work

2.19.2 Final Bill

Final Bill' is used for final payment on closing of Running Account for works or for single payment after completion of works. 'Final Bill' shall be submitted as per prescribed format after completion of works as per scope and upon material reconciliation, along with the following.

i) 'No Claim Certificate' by contractor

ii) Clearance certificates where ever applicable viz Clearance Certificates from Customer, various Statutory Authorities like Labour department, PF Authorities, Commercial Tax Department, etc

iii) Indemnity bond as per prescribed format BHEL shall settle the final bills after deducting all liabilities of Contractor to BHEL

2.20 ***PERFORMANCE GUARANTEE FOR WORKMANSHIP***

2.20.1 Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of as mentioned in the contract/NIT from the date of commencement of guarantee period as defined in Technical Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works at the Contractor's risk and cost, without prejudice to any other rights and recover the same from the balance security deposit.

2.20.2 BHEL shall release the balance security deposit subject to the following

i) Contractor has submitted 'Final Bill'

ii) Guarantee period as per contract has expired

iii) Contractor has furnished 'No Claim Certificate' in specified format

iv) BHEL Site Engineer/Construction Manager has furnished the 'No Demand Certificate' in specified format

v) Contractor has carried out the works required to be carried out by him during the period of Guarantee and all expenses incurred by BHEL on carrying out such works is included for adjustment from the Guarantee money refundable.

*2.21 **CLOSING OF CONTRACTS***

The Contract shall be considered completed and closed upon completion of all contractual obligations and settlement of Final Bill or completion of Guarantee period whichever is later. Upon closing of Contract, BHEL shall issue a completion certificate as per standard format, based on specific request of Contractor.

*2.22 **REVERSE AUCTION/PRICE BID OPENING:***

- *BHEL reserves the right to go for reverse auction at any point of time before opening of Price Bid.*
- *Bids with non-acceptance of reverse auction will be liable for rejection.*
- *Opening of Price Bid at discretion of BHEL.*
- *BHEL shall be at liberty to cancel the tender at any time, before ordering, without assigning any reason.*

*2.23 **SUSPENSION OF BUSINESS DEALINGS***

BHEL reserves the right to take action against Contractors who either fail to perform or Tenderers/Contractor who indulge in malpractices, by suspending business dealings with them in line with BHEL guidelines issued from time to time.

2.24 OTHER ISSUES

2.24.1 Value of Non judicial Stamp Paper for Bank Guarantees and for Contract Agreement shall be not less than Rs 200/- unless otherwise required under relevant statutes.

2.24.2 In case of any conflict between the General Conditions of Contract and Special Conditions of Contract, provisions contained in the Special Conditions of Contract shall prevail.

2.24.3 Unless otherwise specified in NIT, offers from consortium/JVs shall not be considered.

2.24.4 BHEL may not insist for signing of Contract Agreements in respect of low value and short time period contracts

PART-II (PRICE BID)

Bill of Quantity (BOQ) Cum Rate Schedule

(BOS) of 22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at kayamkulam

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
List of Supply items							
1	Supply of cable ties, couplers, joints, bends etc. for 6 sq.mm solar cable routing from string end to SCB.(For DC cable of 2x66.5 Kms) (1 Set as required)	1	Sets	838,005.31	838,005		Nodal
2	Supply of M/s. Multi contact make MC4 connectors for string connection	1800	Pairs	87.23	157,011		Nodal
3	Supply of M/s. Multi contact make Y Connectors	1700	Pairs	398.76	677,888		Nodal
4	Supply of HDPE DWC pipe for routing of 6sqmm cables through pathways	5	Kms	60,192.45	300,962		Nodal
5	Supply of 2.5sqmm lug and M4 size screw of SS-304 grade for earth cable connection on PV module frames.	190920	Nos	12.04	2,298,389		Nodal
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	8.8	Kms	43,338.56	381,379		Nodal
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	4.4	Kms	86,677.13	381,379		Nodal
8	Supply of SCB earthing cable (25 sq.mm CU) with necessary lugs and hardware	500	M	333.04	166,522		Nodal
9	Supply of SCB support structure (Aluminium) and SS304 hardware suitable for mounting SCBs on HDPE floating pontoons	80	Nos	2,859.14	228,731		Nodal
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter	53	Kms	16,251.96	861,354		Nodal
11	Supply of Aluminum/FRP covered cable trays(300 MM wide) with clamping arrangement for running DC cables from SCBs to Hume pipes and to inverter platform along with all mounting accessories.	15000	M	737.36	11,060,363		Nodal
12	Supply of Aluminum/FRP covered cable trays(600 MM wide) with clamping arrangement for running DC cables from SCBs to Hume pipes and to inverter platform along with all mounting accessories.	1000	M	1,128.61	1,128,608		Nodal
13	Supply of double compression weatherproof metallic cable gland, bi-metallic strip or washer, SS304 hardware for 400 sq.mm cable- PCU DC side	170	Sets	812.60	138,142		Nodal
14	Supply of double compression weatherproof metallic cable gland, aluminium cable lug, bi-metallic strip washer, SS304 hardware for 400 sq.mm cable- PCU AC side and TRF LV side	140	Sets	812.60	113,764		Nodal
15	Supply of PEB rooms for placing all the Electrical equipment (dimensions - 4Mx4Mx3.0M(H))	4	Sets	665,487.73	2,661,951		EDN
16	Supply of UPS systems (3 KVA),with 30 mins backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	5	Sets	505,616.58	2,528,083		EDN
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformers for EERs	4	Sets	150,481.13	601,925		EDN
18	Supply of ACDB inside PEB rooms for electrical equipment	4	Sets	120,384.90	481,540		Nodal
19	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70	Nos	963.08	67,416		Nodal
20	Supply of indoor cable termination kit for 33KV(E),1CX240 sq.mm	70	Nos	6,019.25	421,347		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
21	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	15	Nos	15,048.11	225,722		Nodal
22	Supply of straight through joint kits for 3.3KV(E), 1CX400 sq.mm cable	6	Nos	12,038.49	72,231		Nodal
23	Supply of earthing electrodes for under water application for solar array and ESE LA for solar array	50	Sets	60,192.45	3,009,623		Nodal
23	Supply of earthing electrodes with chemical compound for all electrical equipment i.e. unarmored copper cables, termination hardware, cover with inspection lids for inverter platforms,EEPEBRs.	90	Sets	16,359.41	1,472,346		Nodal
25	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS etc. to RTU panel (All OFC cable supplies shall be in BHEL scope)	4	Sets	263,658.70	1,054,635		Nodal
26	Supply of items for LED based outdoor lighting system covering Inverter platforms	8	Nos	21,729.47	173,836		Nodal
27	Supply of weather monitoring system (WMS)	1	Sets	2,564,242.91	2,564,243		Nodal
28	Supply of safety related items including fire alarm systems for PEB, fire extinguishers, sand buckets, safety gadgets etc	4	Sets	213,623.01	854,492		EDN
29	Supply of ESE type lightning arrester including 5 meter pole, counter, base plate and hardware etc.	18	Sets	63,804.00	1,148,472		Nodal
30	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	0.5	Kms	86,075.20	43,038		Nodal
31	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1	Kms	547,125.29	547,125		Nodal
32	Supply of indoor metering cubicle with metering CT,PT,Surge Arrestor,ABT Meters as per specification	2	nos	674,155.44	1,348,311		Nodal
33	Supply of life jackets as per IS 6685.(IROS approved makes)	40	Nos	1,926.16	77,046		Nodal
34	Supply of small passenger boat for 5 persons. Boat shall be with FRP body construction and 6-8 HP outboard diesel/petrol engine motor (reputed make like Suzuki/Yamaha/equivalent). Boat shall be certified for water worthiness by concerned agency like IROS (Indian register of shipping/MMD/Govt. Department as applicable). Boat shall come equipped with 5 life jackets and shall have Nylon ropes for towing, anchoring, mooring and Air tubes (3 Nos.) for functioning in rescue work. Bidder shall provide for a boat driver till completion of contract period.	1	Nos	1,078,648.70	1,078,649		Nodal
35	Supply of miscellaneous items such as cable tags, cable ties, cable ferrules, cable route markers, hoarding board, sign boards, danger boards, display boards, plant Layout boards, electrical insulation mat, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, etc.	1	Sets	1,935,388.58	1,935,389		Nodal
36	Supply of spare items	1	Sets	790,928.79	790,929		Nodal
Total price for Supply				-	**41,890,846**		**-**
List of Works (I&C activities)				-			

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
1	I&C: excavation of isolated earthen/sand dunes,vegetation,coconut tree stumps etc in the kayal (backwater) bottom.The locations are marked in the layout and the final level required is also indicated.After excavation this earth is to be disposed at the desired location.(Disposal location shall not exceed 500m).Vendor has to mobilize his team and vessel for excavation during anchoring anf mooring work done by BHEL.Mobilization of excavation team to be done within 10 days of BHEL intimation for the arrangements for entry of dredger/excavator,power boat for moving excavator machine,barge for soil disposal into the kayal shall be part of the scope	1000	m3	3,058.67	3,058,668		
2	I&C: Installation of floating pontoons and modules as per the instructions and on-site hands-on training by the OEM of pontoons. Supply of pontoons, modules and hardware for installation is in BHEL scope. Anchoring and mooring of the floating island is also in BHEL scope. As per OEM, approximate labour required shall be 3 modules/hour/person. Total number of modules to be installed is 95460 Nos. All tools, tackles and Infrastructure like boats required for Installation of Floaters shall be in the scope of bidder. Bidder has to prepare required no of launch pads (sloped wooden platforms with support on bund) to install the floating platform in the required time duration. (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	17,506,319.99	17,506,320		EDN
3	I&C: Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	5,681,632.24	5,681,632		Nodal
4	I&C: Interconnection of SPV modules, installation of 80 Nos of SCBs, laying/ termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works.(1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	1,819,096.10	1,819,096		EDN
5	I&C: Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	5,614,466.38	5,614,466		EDN
6	I&C: Laying and termination of 1Cx400sqmm DC power cable from PCU to inverter transformer LV side (1 AU= 22 MWAC Block consisting of approx. 95460 SPV modules)	1	AU	470,660.37	470,660		EDN
7	I&C: Earthing of 95460 nos of modules and 80 nos of SCBs using combination of earthing cables of adequate size and earthing strips. Total number of under water earth electrodes for array earthing shall be atleast 32 nos.SCB-SPD earthing cables shall be connected to array earthing grid. (1 AU= 1 earth pit)	32	AU	132,646.33	4,244,682		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
8	I&C: Installation of 18 Nos of ESE type LA on separate floating platform . LAs on pond shall be placed as per tentative layout. LAs shall be earthed to the bottom of the kayal. Supply of necessary metallic base frame for fitting LA pole to the floats along with stay wires is in scope of bidder. (1 AU=installation of one LA)	18	AU	73,636.92	1,325,465		Nodal
9	I&C: Erection of PCUs, HT panels etc. on the inverter platform including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers on the inverter platform. (1 AU= 22MWAC Block)	1	AU	1,249,684.44	1,249,684		EDN
10	I&C:Erection of 33kV transformer yard - Erection of 5.3MVA -4no.s and 2.7 MVA-1no. inverter transformers, cable trays, drain pipes and stone jelly spreading including stone jelly for drain pit. (1 AU= 22MWAC Block)	1	AU	1,498,497.73	1,498,498		EDN
11	I&C: Erection of 33kV HT power cables from transformer to HT panels to Local pooling stations to metering cubicle to final evacuation point (using trefoil clamps). Also laying of SCADA communication (OFC) cable from each RTU inside EEPEBRs to scada room. Trefoils of HT cables laid from the PV plant shall be terminated on the indoor metering cubicle room and further laid through available trenches and terminated at panels in nearby panel room of customer. Conducting of detailed route survey is in vendor scope.Based on the route study,cables shall be laid suitably (underground in trenches). (1 AU= laying of one trefoil for 1 KM)	4	AU	2,814,529.60	11,258,118		EDN
12	I&C: Erection of metering cubicle with CTs,PTs,surge arrestor,ABT measuring meters as per KSEB approval	2	Sets	218,476.30	436,953		EDN
13	I&C: Erection of PEB rooms for placing all electical equipment's.	4	sets	579,898.52	2,319,594		
14	I&C: Erection of Auxiliary transformers, ACDB, UPS/ battery bank, RTU panels etc. in PEB EER (Electrical Equipment Room) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables. This includes erection of one 3KVA (2*100%redudancy) UPS in SCADA Room of NTPC Control Room (1 AU= 22MWAC Block)	1	AU	402,714.24	402,714		EDN
15	I&C: Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment (WMS),metering point of the power plant at the data logger/ PLC panel / HMI computer control desk at SCADA(1 AU= for 22MWAC Block).	1	AU	353,244.97	353,245		EDN

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount-Rs	% GST	Item billed to EDN/Nodal
16	I&C: Earthing system for Inverter platforms (including EEPEBRs) and 33kV transformer yards including laying of underground earth mat grids, providing electrodes with earth chambers and lids, laying/termination of earthing strips from all electrical equipment to earth mat grid etc. (1 AU= for 22MWAC Block)	1	AU	657,301.55	657,302		Nodal
17	**I&C:** Plant lighting system including outdoor cable laying, cable terminations at poles / lights as well as DB boards of inverter platforms. (1 AU= for 1 LED fixture)	8	AU	10,174.75	81,398		Nodal
18	I&C: Miscellaneous and safety items such as cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, weather monitoring system, items for remote connectivity of SCADA, identification markings using painting etc (1 AU= for 22MWAC Block)	1	AU	1,056,389.09	1,056,389		Nodal
19	I&C: Pre-commissioning inspections/ checks/tests, MRT tests, coordination/liaison with state /central departments/CEIG etc for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning (1 AU= for 22MWAC Block)	1	AU	1,961,828.00	1,961,828		Nodal
20	Deputation of Safety supervisor for duration of I&C (1 AU = 1 Month)	5	AU	35,669.60	178,348		Nodal
21	Provision of emergency vehicle/Ambulance on standby for duration of I&C (1 AU = 1 Month)	5	AU	66,880.50	334,403		Nodal
Total I&C Works					**61,509,463**		
Total (Supply + I & C works)					**103,400,309**		

QUOTE PERCENTAGE (%) ABOVE/BELOW (+/-) (OR) AT PAR TO TOTAL AMOUNT		
QUOTED PERCENTAGE (%) IN WORDS ABOVE/BELOW (OR) AT PAR TO TOTAL AMOUNT		
	GST (As applicable) To be mandatorily indicated in the column above.	
	NOTE: 1.CONTRACTOR SHOULD QUOTE PERCENTAGE (%) ABOVE/BELOW (OR) AT PAR TO TOTAL AMOUNT	
	2. QUOTED PERCENTAGE (%) IS APPLICABLE ON ALL ITEM RATES UNIFORMLY.	



GOOGLE MAP VIEW OF SITE

SITE PHOTOGRAPHS



View of NTPC Power Plant

SITE PHOTOGRAPHS





View from NTPC Road

SITE PHOTOGRAPHS



SITE VIEW FROM ROAD

isolated earthen/sand dunes,vegetation



SITE PHOTOGRAPHS





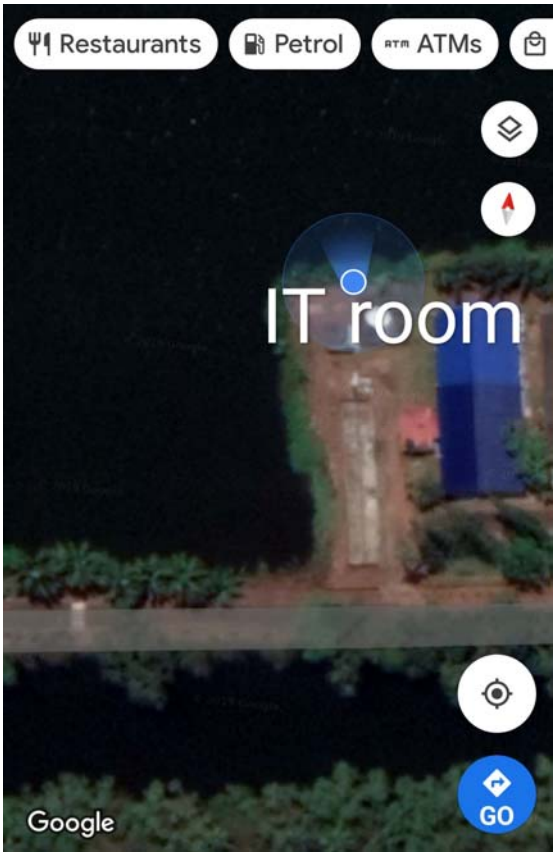
CABLE ROUTE 7 MW

SITE PHOTOGRAPHS



NEARBY LOCATION IP-1- 7 MW

SITE PHOTOGRAPHS



LOCATION IP-2

SITE PHOTOGRAPHS





VIEW FROM IP-2

SITE PHOTOGRAPHS



VIEW FROM IP-2



LOCATION IP-3

SITE PHOTOGRAPHS



LOCATION IP-3

SITE PHOTOGRAPHS



LOCATION IP-3

SITE PHOTOGRAPHS



LOCATION IP-4

SITE PHOTOGRAPHS



LOCATION IP-4

SITE PHOTOGRAPHS



LOCATION IP-4

SITE PHOTOGRAPHS



LOCATION IP-4

SITE PHOTOGRAPHS



CABLE ROUTE 15 MW

Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Electronics Division
Mysore Road, Bangalore - 560 026

Scope of Work Cum Technical Specification FOR

Erection and commissioning works (BOS)

For

22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC

at

Rajiv Gandhi Combined Cycle Power Project

Kayamkulam

in

Kerala

SPECIFICATION No.: PS-439-1334 REV. 00

Date: 30.04.2020

NIT ISSUED BY:
Punam Mishra
Sr. Manager-SC&PV (Engg.)

Seal and sign of Bidder

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Technical specification
for
Supply of Balance of System items, Installation & Commissioning
for
22MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC - Rajiv Gandhi Combined Cycle Power Project at Kayamkulam- Kerala .

Revision details: Rev:00	Prepared	Checked	Approved:	Date:
	R. Saravanabhavan	Vipindas CP	M SREENATH	30.04.2020

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1.0 Introduction

1.1 Overall project outline of 22MW (AC) Floating solar photovoltaic power plant:

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 22MW (AC) Floating solar photovoltaic (SPV) power plant for NTPC at Rajiv Gandhi combined Cycle Power Project at Kayamkulam, Kerala.

The supply of all floatation devices including hardware for forming floating islands shall be in scope of BHEL. However, assembly of floatation devices as per OEM manual shall be in bidder's scope. All necessary on site hands on training for assembly of floatation devices will be given to the bidder's labours by OEM of floatation devices and BHEL. Design, Anchoring and mooring of the floating island is in the scope of BHEL.

After forming floating island, the installation of BHEL supplied solar PV modules on the floating island using BHEL supplied hardware shall be in the scope of bidder. The floating solar array shall be formed as per the BHEL drawings. Solar PV modules employed at the plant, generates DC electricity that in turn shall be inverted to AC in the range 630V. The output voltage from inverter/PCU stepped up to 33KV level. The combined output at 33KV level shall be terminated in the Kayamkulam indoor panel which is approximately 2500 meters away.

Laying of three runs of 33KV(E), 1CX240 sq.mm Phase cables from 15M WAC, 7MWAC Local Pooling station to Indoor metering cubicle and then to final termination at NTPC Control Room close to the metering cubicle. Necessary tree felling if required during routing and laying of HT cables as above also has to be done. Vendor shall coordinate with Contractor of NTPC for 70MW Floating project regarding laying of HT Cable along common route from 15MWAC to NTPC Control Room. Due to space constraints on the route , vendor shall closely work with 70MW project team for cable laying in common trench if possible.

1.2 Scope of this tender specification

Bidder scope includes supply, installation, testing and commissioning of identified activities of the floating solar photovoltaic power plant.

This scope includes activities but not limited to obtaining approval from BHEL / NTPC for the datasheets / drawings / MQP, manufacture / testing / inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery to site, unloading, storage, installation and commissioning of AC and DC side activities of power plant identified under this specification.

Note: The above is only a broad outline of bidder scope for the sake of introduction. The detailed bidder scope is elaborated under various other sections of this specification.

1.3 Enclosures to this tender specification (Tender purpose only)

1	AC single line diagram of overall Solar PV power plant
2	Tentative array layout with SCB locations
3	SPV module drawing
4	Tentative layout of EEPEBRs
5	Cable installation methodology
6	Weather monitoring system specification

7	UPS-Battery specification
8	Fire Fighting & Alarm System specification
9	33KV indoor metering cubicle Specification
10	Earthing system specification
11	ESE Lightning Arrester specification
12	Illumination system specification
13	NTPC approved vendor list
14	Auxiliary Transformer specification
15	LT switchgear specification
16	Floater installation manual
17	Tentative layout of inverter-Transformer-HT switchgear Yard
18	Specification for General Civil works
19	PEB room Specification
20	Safety manual

1.4 Location/ address of power plant:

22MW (AC) Floating Solar Photovoltaic Power Plant,
NTPC Rajiv Gandhi combined Cycle Power Project
Kayamkulam ,Kerala

2.0 Scope of Work

2.1 Bidder scope of supply, Installation and Commissioning:

The table below briefly indicates the scope of work for the bidder, as briefly outlined.

#	Bidder scope of work (as briefly outlined)	Qty
	List of Supply items	
1	Supply of cable ties, couplers, joints, bends etc. for 6 sq.mm solar cable routing from string end to SCB.(For DC cable of 2x73.5 Kms)	1 set (as required basis)
2	Supply of M/s. Multi contact make MC4 connectors for string connection	1800 pairs
3	Supply of M/s. Multi contact make Y Connectors	1700 pairs
4	Supply of HDPE DWC pipe for routing of 6sqmm cables through pathways where SCBs are mounted.	5 Kms
5	Supply of 2.5sqmm lug and M4 size self-tapping screw of SS-304 grade for earth cable connection on PV module frames.	190920 sets
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	8.8 Kms
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	4.4 Kms
8	Supply of SCB earthing cable (25 sq.mm CU) with necessary lugs and hardware	500 M
9	Supply of SCB support structure (Aluminium) and SS304 hardware suitable for	80 Nos

	mounting SCBs on HDPE floating pontoons	
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter connecting 30 modules in a row	53 Kms
11	Supply of FRP/Aluminium ladder type cable tray with cover and supporting arrangement consisting of mounting bar and clamp with SS 304 hardware for clamping with HDPE floaters – 300mm wide	15 Km
12	Supply of FRP/Aluminium ladder type cable tray with cover and supporting arrangement consisting of mounting bar and clamp with SS 304 hardware for clamping with HDPE floaters – 600mm wide	1 Km
13	Supply of double compression weatherproof metallic cable gland, bi-metallic strip or washer, SS304 hardware for 400 sq.mm cable- PCU DC side	170 set
14	Supply of double compression weatherproof metallic cable gland, aluminium cable lug, bi-metallic strip washer, SS304 hardware for 400 sq.mm cable- PCU AC side and TRF LV side	140 set
15	Supply of PEB rooms for placing all the Electrical Equipment's (Internal clearance 4x4) Height=Min 3 mts and Staad calaculation for stability to be provided.	4 sets
16	Supply of UPS systems (3 KVA),with 30 mins backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	5 sets
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformers for EEPEBRs	4 sets
18	Supply of ACDB inside EEPEBRs for electrical equipment	4 Sets
19	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70 Nos
20	Supply of indoor cable termination kit for 33KV(E),1CX240 sq.mm	70 Nos
21	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	15 Nos
22	Supply of straight through joint kits for 3.3KV(E), 1CX400 sq.mm cable	6 Nos
23	Supply of earthing electrodes for under water application for Solar Array and ESE LA for solar array.	50 sets
24	Supply of earthing electrodes with chemical compound for all electrical equipment i.e. termination hardware, cover with inspection lids for inverter platforms, EEPEBRs,	90 sets
25	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS etc. to RTU panel (all OFC cable supplies shall be in BHEL scope)	4 sets
26	Supply of items for LED based outdoor lighting system covering Inverter platforms and transformer yards.	8 Nos
27	Supply of weather monitoring system (WMS)	1 set
28	Supply of safety related items including fire alarm systems for PEB, fire extinguishers, sand buckets, safety gadgets etc	4 set
29	Supply of ESE type lightning arrester including 5 meter pole, counter, base plate and hardware etc.	18 sets
30	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	500m
31	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1 Km

32	Supply of Indoor Metering cubicle with Metering CT,PT, Surge Arrestor, ABT Meters as per specification.	2 Nos
33	Supply of life jackets as per IS 6685.(IROS/ SOLAS approved makes)	40 Nos
34	Supply of small passenger boat for 5 persons. Boat shall be with FRP body construction and 6-8 HP outboard diesel/petrol engine motor (reputed make like Suzuki/Yamaha). Boat shall be certified for water worthiness by concerned agency like IROS (Indian register of shipping/MMD/Govt. Department as applicable). Boat shall come equipped with Nylon ropes for towing, anchoring, mooring and Air tubes (3 Nos.) for functioning in rescue work.	1 No
35	Supply of miscellaneous items such as cable tags, cable ties, cable ferrules, cable route markers, hoarding board, sign boards, danger boards, display boards, plant Layout boards, electrical insulation mat, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, etc.	1 set (as required)
36	Supply of spare items	1 set
	List of Works (I&C activities)	
1	**I&C**: Excavation of isolated earthen/ sand dunes, vegetation, coconut tree stumps etc in the kayal (backwater). The location of earthen/sand dunes/vegetation, coconut tree stumps are marked in the layout and the final level required is also indicated. After excavation this earth/vegetation etc is to be disposed at the desired location. (Disposal location shall not exceed 500m). Vendor has to mobilize his team for excavation during the Anchoring and Mooring work done by BHEL. Mobilization of excavation team to be done within 10 days of BHEL intimation for the same. Arrangements for entry of dredger/excavator, power boat for moving excavator machine, barge for soil disposal into the kayal shall part of scope.	1000CUM
2	**I&C**: Installation of floating pontoons and modules as per the instructions and on-site hands-on training by the OEM of pontoons. Supply of pontoons, modules and hardware for installation is in BHEL scope. Anchoring and mooring of the floating island is also in BHEL scope. As per OEM, approximate labour required shall be 3 modules/hour/person. Total number of modules to be installed is 95460 Nos. All tools, tackles and Infrastructure like boats required for Installation of Floaters shall be in the scope of bidder. Bidder has to prepare required no of launch pads (sloped wooden platforms with support on bund) to install the floating platform in the required time duration. (1 AU= 22MWAC Block consisting of approx. 95460 SPV modules)	1AU
3	**I&C:** Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 22MWAC Block consisting of approx. 95460 SPV modules)	1 AU
4	**I&C**: Interconnection of SPV modules, installation of 80 Nos of SCBs, laying/ termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works. 1 AU= 22MWAC Block consisting of approx. 95460 SPV modules)	1 AU
5	**I&C**: Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays. 1 AU= 22MWAC Block consisting of approx. 95460 SPV modules)	1 AU
6	**I&C**: Laying and termination of 1Cx400sqmm DC power cable on floaters from PCU to inverter transformer LV side 1 AU= 22MWAC Block consisting of approx. 95460 SPV modules)	1 AU

7	**I&C**: Earthing of 95460 nos. modules and 80 nos. of SCBs using combination of earthing cables of adequate size and earthing strips. Total number of underwater earth electrodes for array earthing shall be at least 32 Nos. SCB-SPD earthing cables shall be connected to array earthing grid. (1 AU= 1 earth pit)	32 AU
8	**I&C**: Installation of 18 Nos of ESE type LA on separate floating platform and. LAs on pond shall be placed as per tentative layout. LA shall be earthed to the bottom of the Kayal. Supply of necessary metallic base frame for fitting LA pole to the floats along with stay wires is in scope of bidder. (1 AU=installation of one ESE LA)	18 AU
9	**I&C:** Erection of PCUs, HT panels etc. on the inverter platform including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers on the inverter platform. (1 AU= 22 MWAC Block)	1 AU
10	**I&C:** Erection of 33kV transformer yard - Erection of 5.3MVA – 4 nos and 2.7MVA – 1 no inverter transformers, cable trays, drain pipes and stone jelly spreading, including stone jelly for drain pit . (1 AU= 22MWAC Block)	1AU
11	**I&C:** Erection of 33kV HT power cables from transformer to HT panels to Local pooling stations to metering cubicle to final evacuation point (using trefoil clamps). Also laying of SCADA communication (OFC) cable from Each RTU inside EEPEBRs to metering cubicle to scada room Trefoils of HT cables laid from the PV plant shall be terminated on the indoor metering cubicle room and further laid through available trenches and terminated at Panels in nearby panel room of customer. Conducting of detailed route survey is in Vendor scope. Based on the route study, Cables shall be suitably laid underground in trenches .Some of the reference photos are attached for vendor reference. (1AU = laying of one trefoil for 1 KM)	4 AU
12	**I&C:** Erection of metering cubicle with CTs , PTs, Surge Arrestor ,ABT Measuring Meters as per KSEB approval	2 sets
13	I&C : Erection of PEB rooms for placing all the Electrical Equipment	4 sets
14	**I&C:** Erection of Auxiliary transformers, ACDB, UPS/ battery bank, RTU panels etc. in PEB EER (Electrical Equipment Pre-Fabricated Building Rooms) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables. This includes erection of one 3KVA (2 x100% redundancy) UPS in SCADA room of NTPC Control Room. 1 AU= 22MWAC Block	1 AU
15	**I&C**: Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment , (WMS) , metering point of the power plant at the data logger/ PLC panel / HMI computer control desk at SCADA (1 AU= for 22MWAC Block).	1 AU
16	**I&C:** Earthing system for Inverter platforms (including EEPEBRs) and 33kV transformer yards including laying of underground earth mat grids, providing	1 AU

	electrodes with earth chambers and lids, laying/termination of earthing strips from all electrical equipment to earth mat grid etc. (1 AU= for 22MWAC Block)	
17	**I&C:** Plant lighting system including outdoor cable laying, cable terminations at poles / lights as well as DB boards of inverter platforms. (1 AU= for 1 LED fixture)	8 AU
18	**I&C:** Miscellaneous and safety items such as cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, weather monitoring system, items for remote connectivity of SCADA, identification markings using painting etc (1 AU= for 22MWAC Block)	1 AU
20	**I&C:** Pre-commissioning inspections/ checks/tests, MRT tests, coordination/liaison with state /central departments/CEIG etc for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning (1 AU= for 22MWAC Block)	1 AU
21	Deputation of Safety supervisor for duration of I&C (1 AU = 1 Month)	5 AU
22	Provision of emergency vehicle/Ambulance on standby for duration of I&C (1 AU = 1 Month)	5 AU

3.0 BHEL's scope of supplies (only I & C of components in bidder scope)

For clarity to the bidder, other items and activities within BHEL scope of solar PV plant end of the project are listed below:

1	Supply of solar PV modules	95460 Nos
2	Supply of floating pontoons for modules, SCBs and LAs	As per requirement
3	Supply of 1C x 6 sqmm Solar Cable	~150 Kms
4	Supply of DC cable,3.3 KV,1C x 400sq mm, Al, XLPE, Un armoured as per IS: 7098 (from SCB to PCU and PCU to Transformer)	~55 Kms
5	Supply of 33kV(E) HT cable, 1C x 240 sq.mm, Al, XLPE, armoured as per IS: 7098	~40 Kms
6	Supply of power conditioning units (PCUs) of 2500 kW	9 Sets
7	Supply of String Combining Box (SCB)	81 Nos
8	Supply of inverter transformer 5.3 MVA, 33kV/630-630 V, ONAN	4 Nos
9	Supply of inverter transformer 2.7 MVA, 33kV/630V, ONAN	1 Nos
10	Supply of 33kV HT panels	10 panels
11	Supply of SCADA system including PLC panels, computers, software systems and related peripherals & accessories.	As per requirement

4.0 List of documents to be submitted along with the technical bid:

1. All supporting documents to meet Pre-Qualification Criteria (PQC) as mentioned in the RFQ.
2. Bidder has to enclose the deviation sheet clause wise separately, in case any deviations are

sought by the bidder. Absence of any deviation sheet shall be taken as compliance of BHEL technical specification in total without any deviation.

5.0 Technical specification for supply, installation and commissioning

#	BHEL purchase specification
5.0	**Electrical power / water for construction** a) Power for construction shall be arranged through DG set or by other means by bidder viz. obtaining temporary utility supply on chargeable basis. b) For construction activities if any vendor has to arrange his own water.
5.1	Excavation of isolated earthen/ sand dunes, vegetation, coconut tree stumps etc in the kayal (backwater). The location of earthen/sand dunes/vegetation , coconut tree stumps are marked in the layout and the final level required is also indicated. After excavation this earth/vegetation etc is to be disposed at the desired location. (Disposal location shall not exceed 500m).Vendor has to mobilize his team for excavation during the Anchoring and Mooring work done by BHEL. Mobilization of excavation team to be done within 10 days of BHEL intimation for the same
5.2	**Construction of temporary yards for safe storage of bidder supplied items** a) Bidder shall, at a suitable location at the site, as decided based on discussions with BHEL site engineer, construct temporary yards for safe storage of bidder supplied items. b) Area of all storage yards/sheds shall be selected based on sizes of items. Bidder shall, at the time of starting their activities at site, submit drawings/ sketches/ dimensions etc to obtain approval from BHEL. c) Safety and security of all the items shall be within bidder scope. Accordingly, bidder shall ensure adequate security watch and ward for these items round the clock.
5.3	**Movement of items received at site**: a) Arrangements shall be made by bidder for movement of the stored items from interim storage yards to the exact construction locations within the project site. b) Bidder shall maintain proper documentation / compilation of all the records related to shipping (invoices, LRs, delivery challans, material receipt certificates etc.) and shall take approval from BHEL site engineer for every consignment. The documents shall be suitably preserved for further handing over to BHEL. c) Registers shall be maintained for the yard to keep track of day to day incoming/outgoing items. d) Safety of items at the work spot/s shall be in bidder scope. Accordingly, suitable watch and ward shall be deployed on round-the-clock basis. e) As the most of the proposed plant area is covered with water in three sides , necessary precautions to be taken while transporting.

5.4	**Installation of floating pontoons with module mounting mechanism:** **HDPE floaters and HDPE hardware, Total quantity = 95460+ Nos (BHEL scope of supply)** Bidder shall be imparted necessary training to carry out the work of assembly of floatation platform and surrounding pathway using the HDPE floaters and HDPE hardware and for Mounting of the PV modules on the floaters. The bidder has to arrange work men who shall be trained by the OEM of floater platform to carry out the work and to further ensure and Supervise the proper assembly and quality of the platform and module mounting. The vendor shall arrange the following essential tools/accessories and Safety personnel to enable safety to equipment and work men during the course of work: a) Provide Life jackets for all workers working on water body b) Provide Inflatable / other small boats for work over water and for towing floaters. Boats employed shall have water service fitness certificate issued by IROS/SOLAS/Govt agency c) Provide and lay carpet of Rubber/HDPE/Canvas sheets on land next to water body for enabling assembly of floaters without damage from friction/scratches on concrete/ground and during launching by sliding into water d) Provide temporary nylon ropes for tying floaters to shore before assembly and for towing upto work point and for cordoning safe areas of working e) Provide sheets for holding hardware and cabling accessories for assembly without accidental dropping into water f) One Rescue and Safety motor boat having driver and expert swimmer and provided with additional 3 life jackets and Air tubes and Nylon ropes shall be stationed during working hours for emergency support. g) One qualified Safety supervisor shall be stationed at site throughout the duration of works and activities associated with movement in water. He shall be equipped with binoculars for observation of activities in water and near shore. **For more details, please refer attached installation manual of floater manufacturers (OEM).**
5.5	**Launching platform base Details (sequence work details for floaters assembly)** a) For Assembly of floaters along with PV modules and formation of strings prior to launching in water, sloping platforms with ramp gradient shall be constructed at one or more locations over the bund slope as per location indicated. b) These platforms are normally constructed with wooden planks/particle boards covered with plastic sheet/ tarpaulin sheets to provide smooth gliding surface for movement into water and to avoid damage to floaters. c) Care shall be taken not to damage the bund or its surface, while constructing and securing the platform/s. d) Location for the platform shall be informed to the bider by BHEL in consultation with customer as regards approach and movement

5.6	**Series interconnection of SPV modules to form strings** Type of module and rating: (Min 330 Wp). Total quantity = 95460 Nos. (BHEL scope of supply) Bidder shall interconnect the SPV modules as follows: a) Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm). b) Positive cable of one module shall be connected to the negative cable of next module. The cables have MC4 type of connectors. One polarity cable has male type connector, while the other has female type connector. c) In this manner 30 modules shall be connected in series. Each set of connections is called as a series string.
5.7	**Interconnection of SPV module strings to 1Cx6sq.mm. cable:** a) Vendor shall connect two series strings of 60(30+30) SPV modules to 1Cx6sqmm cable using **Y-connector.** b) Required tools and tackles for crimping of cable etc. shall be arranged by bidder. This shall include crimping tool MC4, open end spanner set MC4, stripping plier MC4, socket wrench insert to tighten, socket wrench insert to secure, inserts for both 1Cx4 and 1Cx6 (of both pliers). **c)** Extra quantity of Y Connector shall be procured for any damages / pilferage during the installation by vendor at site. Such additional quantities will not be paid for. Vendor shall ensure that there shall not be any shortage during execution time. The cable shall be neatly dressed and tied with UV resistant ties so as not to dangle and be in contact with water.
5.8	**Ferruling for 1Cx6sq.mm cable:** a) For 1Cx6 sq.mm DC solar array cable, bidder shall provide UV resistant ferrules printed with **source / destination** identification of cable. Printing details shall be submitted for **BHEL /NTPC** approval during detailed engineering. b) Printing shall be of appropriate size to ensure readability. Supply of ferrule shall be in bidder scope. c) Ferrules shall be provided on both the termination ends: module end and SCB end.
5.9	**Installation of SCBs on floating pontoons**: Supply of string monitoring boxes (SCB), 80 sets, is in BHEL scope. These are 22-in / 1-out type. a) Bidder shall install the SCBs using suitable fixing mechanism of SCB support structure (Aluminium) and SS304 hardware, which shall be suitably mounted on HDPE floating pontoons. Vendor to assemble proto type of the SCB support structure and demonstrate for approval and clearance for bulk supply.

	b) Supply of SCB support structure is under bidder scope. Provision will be provided in the pontoon to mount the SCB structure. However, necessary hardware like nuts, bolts, washers etc. shall be in the bidder scope of supply. **c)** All necessary labour, tools, machinery etc. for erection work shall be in bidder scope.
5.10	**Routing of 1Cx 6sq.mm cable up to SCB:** a) Cable from the farther end of the string shall be routed below the module till other end. From that point both positive and negative cables shall be neatly routed through HDPE pipe using necessary water tight joints **till SCB input side**. **The HDPE pipes for routing cables are only required in pathways where SCBs are mounted.** Row-wise HDPE pipes are not envisaged. After completing the cabling and terminations at both sides, bidder shall seal the HDPE pipes with non-inflammable foam filling or any other reliable method using reputed makes for water sealing.minimum 5 cm water sealant needs to be present at every ends ot HDPE pipe.The HDPE pipes shall be tied neatly to the pontoon lips at regular intervals. b) HDPE DWC pipe together with necessary HDPE couplers/ joints (T-joints, elbows, bends etc.), UV resistant Cable ties, shall be within scope of bidder supply. **Specification:** As per relevant IS; ID (Internal Diameter) shall be selected to accommodate the number of 1Cx6sq.mm cables to be guided. ID shall be minimum 63mm. However, exact ID shall be selected to ensure that only a maximum of 60% of the ID space is occupied by the cables. Make, part number, sizes/ dimensions shall be submitted for **BHEL/NTPC** approval during detailed engineering. c) Cable ties shall be in bidder scope of supply. Width of the cable ties shall be min 4.5 mm. d) Cable ties, nylon polyamide 6.6 UV stabilized black, UL94 flammability rating V2, operating temperature up to 85 deg C, shall be used to arrest any possibility of movement or sagging. **Cable ties shall be of make: 3M**, **Phoenix contact, Weidmuller, Hellermanntyton, Panduit or other reputed equivalent, subject to BHEL/NTPC approval.** Width and Length shall be so appropriate as to ensure that the bunched cables are held firmly to the mounting structure. During detailed engineering, **BHEL/NTPC approval shall be obtained for the selected brand and sizes of cable tie.** e) Spacing between two adjacent cable ties shall be so appropriate as to ensure that there is no loose hanging of cables and no contact with water.
5.11	**Termination of 1Cx6sq.mm. Copper cables on input side of SCBs:** a) 1Cx6sq.mm cables of positive and negative polarities originating from SPV module strings shall be terminated at the input side of SCBs using MC4 connectors. b) Bidder scope includes removal of sleeve of cable, crimping at the cable end and fixed with MC4 connector to SCB. c) MC4 connector for 6sqmm cable termination to SCB shall be in BHEL scope of supply d) Any other hardware, if necessary for fulfilling the connection, such as bolts, nuts, screws, washers etc. shall be in bidder scope of supply. **All hardware shall be of SS304.** e) All necessary tools such as pliers, strippers, MC4 crimping tools etc. shall be within bidder scope.

	f) After cable termination, all the cable entry points shall be sealed from outside using non inflammable foam or any other reputed proven weather resistant water sealing mechanisms to avoid water ingress.
5.12	**Termination of 2 run 1Cx400 DC power cables at SCBs** a) Cables of 2run, 1Cx400 (Al conductor, XLPE insulation, Un-armored) shall be terminated at the output side of SCBs (positive, negative terminals). b) Bidder scope includes removal of sleeve at the cable end, crimping with suitable cable lug of appropriate type/size and connecting the lugged end to the tinned copper bus bar within the SCB. Cables shall enter the SCB through the cable glands that are also supplied by BHEL along with SCBs. c) All necessary tools such as pliers, strippers, crimping tool etc shall be within bidder scope.
5.13	**Laying of 2 runs of 1Cx400sq.mm Al cable upto inverter platform and terminations at PCU** a) 2 Runs per SCB of 1.1kV, 1CX400 sq.mm cable through ladder type cable tray with cover, shall be connected from SCB to PCU through walkway cable floaters. The cable termination at SCB side by using BHEL supplied hardware and cable termination at PCU side with bidder supplied, gland, lugs and hardware is in bidder scope. b) The laying of cable shall be done without overlapping each other and routing neatly through cable trays using cable ties, supporting arrangement consisting of mounting bar and clamp with SS 304 hardware for clamping the tray(300/ 600mm wide) with HDPE floaters .Cable ties and clamps shall be in bidder scope of supply, shall be of 4.5mm minimum thickness, UV resistant and with adequate length of tying. c) All the cables from SCB needs to raised properly with suitable tray to the elevated inverter platform. All the weight of Cables needs to be transferred to trays so that no cable load should act on PCU terminals. d) Bidder shall carry out drilling of holes in cable gland plates of the PCUs for the positive and negative DC inputs of 1Cx400 cable for 9 nos of PCUs. Gas cutting method is strictly not allowed. Bidder shall organize hole-saw cutters of appropriate size for this purpose. All necessary drilling machines / tools etc. shall be made available at site. e) Prior to termination, each cable shall be checked for continuity and meggered. In case any cable found defective, bidder shall implement suitable corrective action such as cable jointing, replacement/re-laying of cable etc. as applicable. f) Bidder shall carry out glanding of the cables following which the glands shall be fitted to the respective holes of gland plates. Bidder shall carry out the cable terminations for positive and negative inputs that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Proper labelling/tagging is to be planned and fixed on cables.idder shall carry out glanding of the cables following which the glands shall be fitted to the respective holes of gland plates. g) Bidder shall carry out the cable terminations for positive and negative inputs that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Proper labelling/tagging is to be planned and fixed on cables.

	h) Bidder shall arrange torque wrench of appropriate range. Torque setting shall be as per the bolt size and property class. For the setting, approval shall be obtained from BHEL site engineer. i) Bidder shall submit details of cable glands/lugs/ties/hardware (Make, part number, size, quantity etc.) Glands shall be of COMET or 3D make. Other than these makes shall not be accepted. j) Cable lugs shall be of Dowell or COMET or 3D make. Other than these makes shall not be accepted. k) All tools/accessories such as crimping tools etc. required to carry out the termination shall be within scope of bidder.
5.14	**Laying and Termination of 1Cx400sq.mm LT AC power cables at PCU and Inverter Transformer** a) LT Cables 6 runs of 1C x 400 sqmm per phase shall be laid between AC side of the PCU and the LT side of the Inverter transformer as per "Cable installation methodology" defined in this specification. b) Bidder scope includes removal of sleeve at the cable end, crimping with suitable cable lug of appropriate type/size and connecting the lugged end to the tinned copper bus bar within the PCU and Transformer. Cables shall enter the PCU and Transformer through the metallic cable glands. c) Cable lug make shall be Dowell, COMET or 3D. Other than these makes shall not be accepted. d) Cable gland metallic type shall be of COMET or 3D make. Other than these makes shall not be accepted. e) Quantity of lug and hardware shall also include contingency requirements arising out of shortage due to various reasons (damage, theft etc.) during installation. f) All necessary tools such as pliers, strippers, crimping tool etc. shall be within bidder scope.
5.15	**Laying and termination of 33KV(E), 1CX240 sq.mm XLPE Al cable from Inverter transformer to HT panel and to local pooling station** a) There will be one no 15MWac, one no 7MWac local pooling station . b) Laying and termination of 3 runs 33KV(E),1CX240 sq.mm XLPE Al armoured cable from HV side of the inverter transformer to HT panels mounted on platforms at each inverter station shall be in vendor scope. c) Laying and termination of 3 runs 33KV (E),1CX240 sq.mm XLPE Al armoured cables from each inverter platform to their corresponding local pooling stations shall be in vendor scope. d) Cable glands, cable lugs, 33kV HT cable termination kits (indoor/ outdoor types as applicable), bolts, nuts, washers etc. shall be in bidder scope of supply. Cable glands make shall be COMET or 3D. Cable lugs make shall be Dowell or COMET or 3D. Other than these makes shall not be accepted. e) HT termination kits (indoor as applicable) shall be Raychem or 3M make/ NTPC approved make. HT termination shall be carried out by certified jointers. Credentials / certification of

	experience from Raychem or 3M for the proposed jointers shall be submitted for BHEL/NTPC approval during detailed engineering.
5.16	**Laying and termination of 33KV(E), 6 (2 nos. of 3 phase lines) runs of 1CX240 sq.mm XLPE Al cable from local pooling station near reservoir to Indoor metering cubicle to evacuation point at existing panels at NTPC Switchgear room** a) Laying and termination of 3run (1 nos. of 3 phase lines) of 33KV(E),1CX240 sq.mm XLPE Al armored cable from 7 MW AC local pooling station to 7MW indoor metering cubicle to final evacuation panel nearly 1.1 Km away through underground cable trench and necessary trays as per standards, shall be in vendor scope. (through proper cable trefoil clamps at regular intervals as per relevant standards) Laying and termination of 3 runs (1 nos. of 3 phase lines) of 33KV(E),1CX240 sq.mm XLPE Al armored cable from 15 MW AC local pooling station to 15MW indoor metering cubicle to final evacuation panel nearly 2.5 Km away through underground cable trench trench and necessary trays above ground if required as per standards, shall be in vendor scope. (through proper cable trefoil clamps at regular intervals as per relevant standards) Conducting of detailed Route survey is in bidder scope. b) Cable glands, 33kV HT cable termination kits (indoor types as applicable), Cable jointing kits, bolts, nuts, washers etc. shall be in bidder scope of supply. Cable glands make shall be COMET or 3D. Cable lugs make shall be Dowell or COMET or 3D. Other than these makes shall not be accepted. c) HT termination kits (indoor as applicable) shall be Raychem or 3M make. HT termination shall be carried out by certified jointers. Credentials / certification of experience from Raychem or 3M for the proposed jointers shall be submitted for BHEL/NTPC approval during detailed engineering. d) All necessary equipment required for termination at evacuation points are in scope of vendor only. i.e. Cable glands, Cable lugs and termination kits, e) Proper HT cable route marker shall be used in regular intervals as approved by BHEL/NTPC. f) Some reference photos are attached for vendor reference.
5.16	**Identification marking of cables using cable tags** a) Cable tags shall be provided on all power cables at both ends just before entering the equipment enclosure. b) Cable tags shall be of rectangular shape. c) Cable tag shall be of 2mm thick aluminum with number punched (embossed) on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. d) Bidder shall submit the technical details of cable tags, ID numbering scheme for BHEL/ NTPC approval during detailed engineering.
5.17	**Installation of electrical panels at platforms constructed for PCUs, Inverter transformer, HT panel and CMCS, other indoor panels at EEPEBRs (Electrical Equipment Pre-fabricated building Rooms) of electrical equipment.** Bidder shall organize necessary resources such as labour, cranes, hydra, forklifts, transportation trucks / trolleys and other accessories for movements and positioning of the panels as below

	(a) PCU: 9 Nos (b) 33kV HT panel: 10 set . (c) SCADA and RTU panel: 1 No scada panel at existing NTPC switchgear indoor room and RTU sub panels in EEPEBRs (PEB buidings- vendor scope) near Inverter platform (d) HMI SCADA control desk with PCs and accessories: 1 set (e) UPS with battery bank (Comprising 2 x100% redundancy) – 5 Sets. (f) ACDB in EEPEBRs– 4 Nos. a) Panels shall be moved to the respective positions and placed over the cable trenches on the inverter platform, in the exact sequence and locations as per drawings approved by BHEL/NTPC. b) PCUs, VCB panels shall be placed on cable trench of Inverter platform, with cable entry openings to match cable trench on bottom side. c) Panels shall be suitably grouted using welding / bolting methods as per relevant standards. BHEL approval shall be obtained for the grouting arrangement. All necessary hardware for the same shall be within bidder scope of supply. Each panel shall be double earthed to the earth mat grid of the room.
5.18	**Design, Supply, Laying and installation of Control / data / instrumentation cables** a) All the cable installation accessories such as cable trays, cable conduits, cable glands, cable lugs, ferrules, cable ties, bolts, nuts, washers etc. shall be in bidder scope of supply. Cable laying and cable terminations shall be in bidder scope. All necessary resources such as labour, tools and accessories required to carry out laying and termination works etc. shall be in bidder scope. b) All the other cables such as (i) control cables from inverter transformer marshalling boxes to relay circuits in VCB panels (transformer trip signals), (ii) control cables from inverter transformer marshalling boxes to SCADA (transformer alarm signals), (iii) control cables from SCADA panels to relay circuits in VCB panels (VCB on/off status, VCB close/open command signals), (iv) instrumentation cables from inverter transformer marshalling boxes to SCADA panels (4-20mA signals, WTI/OTI values) shall be in bidder scope of supply. c) Cable laying and cable terminations shall be in bidder scope. Make shall be as per NTPC approved list of cable vendors. Design calculations for cable selection together with GTP/datasheet particulars shall be submitted for BHEL/ NTPC approval. Number of cores, length requirements shall be appropriately assessed by the bidder. d) Bidder shall lay and terminate the OFC/RS485 cables to SCADA from (a) Local pooling station, (b) Weather monitoring station e) Bidder shall lay and terminate the Ethernet cables to SCADA from (a) PCUs, (b) numerical relays of VCB panels. f) Bidder shall lay and terminate OFC cables from each RTU to SCADA termination point of NTPC at Kayamkulam kulam RGCCPP g) All necessary resources such as labour, tools and accessories required to carry out laying and termination works etc shall be within scope of bidder.

	h) All applicable/ relevant clauses under "**Cable installation methodology**" sections of this specification shall be adopted for all aspects of these cables such as technical specifications (ratings, sizes, calculations etc), cable selection, tests on cables, cable installation, cable accessories etc.
5.19	**Specification of Earthing system: As per attached Annexure**
5.20	**Specification of Firefighting and alarm system : As per attached Annexure**
5.21	**Specification of cable installation methodology: As per attached Annexure**
5.22	**Specification of UPS with battery bank: As per attached Annexure**
5.23	**Specification of Auxiliary Transformer: As per attached Annexure**
5.24	**Specification of ESE type LAs :As per attached Annexure**
5.25	**Specification of 33KV indoor metering cubicle: As per attached Annexure**
5.26	**Specification of illumination system: As per attached Annexure**
5.27	**Specification of PEB rooms: Detailed Specifications are as per attached Annexure. However, specifications of standard bought out PEB rooms of 4Mx4Mx3.0M(H) dimension may also be accepted after design review.**
5.28	**Auxiliary AC/DC power supply system DB of Nearest PCU** distributes the AC power to various utility applications in main control room. (Viz. SCADA, UPS required for SCADA, other utilities required in Main control room such as main control room lights, ceiling fans, exhaust fans, plant lighting, other electric appliances). a. **30 KVA** type Auxiliary Transformer **(Dry type)** for tapping power from LV side of PCU (other four platforms) and for connecting to ACDB (providing LT supply of 3 phase, 415 V). Auxiliary transformer of approved make to be supplied and erected by the bidder at each b. ACDB of each PCU shall be connected all required power consumptions available in the local inverter platforms (Viz. HT panels, UPS required for HT panels, other utilities required in the local Inverter platform). c. Connections of the same with all necessary protection system shall be vendor scope. Vendor shall submit detailed SLD diagram of Aux AC/DC system with ELR/CBCT, MCCB, MCB types (TPN, DP, SP)/ Amp/kA ratings for incoming/ outgoing feeders for various electrical loads/ utilities for BHEL/NTPC approval during detailed engineering. Following DB boards for application in main control room and EERs (RCC buildings) shall be in bidder scope of supply, installation and commissioning: 1. UPS DB for 230V AC UPS supply to SCADA, weather monitoring system, fire alarm system, emergency loads, CR DB (room utilities) - 1 Set 2. Above DB boards shall also provide for any other feeders, if necessary, to meet functional requirements. In addition, at least two spare feeders shall be provided in each of the above DB boards. Further, any extra DB boards to meet functional requirements of Aux AC/DC system shall be provided by the bidder. 3. Above DBs shall be of reputed make such as Legrand, Siemens, Schneider or any other

	reputed make as approved by BHEL/NTPC. 4. DB boards shall be provided with incoming/ outgoing MCB as applicable (based on rating requirements) with spare feeders as shall be approved by BHEL/NTPC. 5. Installation of all the above items including all necessary cables, cable terminations/ installation shall be in bidder scope. 6. Constructional features of the connections shall be as per specification **"LT switchgear**". 7. LT switchgear component of reputed make such as L&T, Siemens, ABB, Schneider or any other NTPC approved makes are only accepted. 8. MFM meter with RS485 communication feature to facilitate SCADA connection shall be provided in LT SWITCHGEAR.
5.29	**I&C of electrical connections to EEPEBRs** Bidder shall provide all necessary electrical connections and laying of LT power cable in EEPEBRs,.
5.30	**Supply and installation of Weather monitoring system** **As per attached Annexure "Weather monitoring system"**
5.31	**Installation and commissioning of SCADA integration systems** (1) SCADA system, supply of which shall be in BHEL scope, comprises of data station panels and PC based control desks with software to collect, store, process and report the data parameters of power plant and also to control the operations of the power plant by integrating the various equipment at the segments as follows: (a) SCADA panels placed on the inverter platforms. (b) Power conditioning units (10 Nos): DC input / AC output parameters of inverters, grid data, fault status and events logged, etc. (c) Inverter transformers (5 Nos): Alarm/Trip signals, WTI/OTI temperature values. (d) 33kV VCB breaker panels (as per SLD): status of VCB breakers, status of protection relays of transformers, oil / winding temperatures, AC parameters. (e) Fire alarm system at main control room: status signals (f) Weather monitoring equipment **(2) BHEL scope of SCADA:** (a) Data station panels with necessary data loggers / PLCs and other accessories such as power supply etc to integrate the data signals. (b) Desktop PCs (HMI control desks) provided with necessary software packages and remote monitoring features. (c) Supply of SCADA related communication/ data / LAN cables as brought out in other clauses of this specification. **(3) Bidder scope of supply and installation of SCADA system:** (a) Bidder shall install the BHEL supplied SCADA system in the SCADA room in NTPC's existing switchgear room. Cable laying/ terminations of all SCADA cables at respective panels / equipments shall be in bidder scope of supply. OFC cables need to be laid from each Inverter platform to respective local pooling station then to metering point and to final evacuation point.

5.32	**Earthing of solar PV modules and SCBs** The solar PV modules and SCBs installed by the bidder shall be provided with appropriate earthing for protection against faults as guided by IEC 60364. Bidder shall use min 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for connecting 30 modules in a row. Similar 3182 Nos of rows shall be directly connected to earthing strip from both sides of row. Same earth strip shall be used for SCB earthing also. Suitable size of cable (2 loops) shall be used for SCB earthing connection to strip. The size of earth strip shall be minimum 25 x 3 mm GS flat. **Bidder shall submit for approval detailed earthing plan with earthing cable sizing and break proof methodology for linking solar PV modules and SCBs earthing**. Supply and laying of earth strip is under bidder scope. **Installation of earthing electrodes on resevoir bed and interconnection to earthing grid** Bidder shall make arrangements to carry out under water drilling on the reservoir bottom to insert the required number of electrodes into ground. Drilling mechanism mounted in boat or by under water equipment shall be used to place earth electrodes at locations marked by BHEL and to connect the earthing conductors from any floating platform to the electrode terminal securely. Required SS 304 hardware, Cable clamp/lug for fastening the conductor with terminal shall be supplied by bidder after finalizing method for permanent connection. The approx. reservoir depth is 2-5 mts.
5.34	**Identification marking of electrical items using painting** Following items shall be identified by way of artistic painting in black letters with yellow background. For danger symbol/text, white letters in red background. Identification number/ text to be painted shall be submitted for BHEL/NTPC approval during detailed engineering for the following. (1) String Combiner boxes: 80 Nos (2) Size/ source/ destination of DC cable 1Cx400 with arrow mark (power flow direction) to be painted on SCBs and PCUs (3) PCUs front side: PCU ID number (1 to 9) with rating 2500kW, AC chamber/ DC chamber, Danger text/symbol (4) PCUs DC chamber back side: SCB ID numbers, cable size (1Cx400 +,-) with upward arrow mark, danger text/symbol (5) PCUs AC chamber back side: Inv Trnfmr ID, cable size (6Rx1Cx400 / ph) with downward arrow mark, danger text/symbol (6) Same way as above, the corresponding panel ID with rating, cable destination with arrow mark in power flow direction, danger text/symbol shall be painted for all VCB panels, Inverter transformers (HV and LV sides). (7) For UPS/ SCADA/ ABT metering Cubicle, all DB boards/ fire alarm panels, ID number shall be painted. Cable size/ destination/ arrow marks not required to be painted as cable tags shall be adequate. (8) For earth chambers of main control room ID number shall be painted. (9) All switchboards shall be painted with ID number.

5.35 Cable markers and cables tags

(1) Cable markers and joint markers for underground cables shall be provided along the route of the cables as per section "**Cable installation methodology**" of this specification.

(2) Cable tags shall be provided at either of the cable (at the entry point to the panel / equipment to which it is connected / terminated) shall be provided as per section "**Cable installation methodology**" of this specification.

(3) Bidder shall submit the respective schemes of marking and tagging for BHEL/NTPC approval during detailed engineering.

5.36 Display boards and sign boards

Sl. No	Description	Qty for Control room
1	Board displaying instruction chart for restoration from Electric Shock	5 No
2	Board displaying instruction chart for artificial respiration	5 No
3	Board displaying dos and don'ts.	5 No
4	Board displaying fire extinguishers details and operations	5 No
5	"No smoking" board	5 Nos
6	Danger boards: 33000V with danger symbol in Hindi, Telugu and English	As required
7	Identification boards, of suitable sizes, within and outside Electrical Equipment room, Transformer yard, HT Switchgear Platform point etc. BHEL will provide list during detailed engineering.	As required

Note: In addition to the above, requirement of hoarding board as well as direction board for the overall power plant shall be fabricated in consultation with BHEL/NTPC and installed at a suitable location near the main entrance gate of the plant.

5.37 Electrical insulation mat

(1) Bidder shall supply electrical insulating mats as follows:

(a) Reputed make as shall be approved by BHEL/ NTPC

(b) As per IS: 15652:2006

(c) Class B

(d) Thickness 2.5 mm minimum

(e) Size = 2m x 1m minimum, exact size shall be as approved by BHEL/NTPC during detailed engineering.

(f) Colour: to be approved by BHEL/NTPC

(g) Max use voltage = 33 kV

(h) Marking of IS standard on the mat

(2) Test certificate shall be provided by bidder

(3) Bidder shall lay the mats in front of all the indoor electrical panels viz. PCUs, VCB panels, SCADA panels, UPS panels etc.

5.38	**Supply and Installation Miscellaneous Items for NTPC Control Room** Furniture for SCADA room as below: • Control desk for OWS and EWS – 1 No • Chair, industry standard, revolving type, with wheels, arm rest, provisions for adjustment of height (hydraulic/ gas lift): 4 Nos • Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. • One Printer Table made of Laminated Wood or Heavy Duty MDF shall be provided for printer. • All the furniture shall be of reputed make (Godrej or Equivalent).
5.39	**Tool kits and instruments:** The bidder shall keep ready stock of tools, tackles and essential spares that will be needed for the day-to-day maintenance of the solar PV system. This shall include but not be limited to the following: • Screw driver and / or Allen key suitable for the connectors, power distribution blocks, Circuit breaker terminals and surge arrestor terminals. • Spanners / box spanners suitable for the removal of solar PV modules from the solar PV module support structure. • Digital multimeter- 2 Nos • AC/DC clamp meter – 2 Nos • Meggering kit (5 KV) – 1 No. • Cable crimping tool – 1 no. 2.5/4/6/10 sq.mm and 1 no. 240-400 sq.mm (hydraulic type) • Crimping tool for MC4 connectors-2 no.s • MC4 joint disconnection tool – 10 no.s • Rechargeable LED type water proof Flash lights – 5 nos. • Discharge rods for 33KV – 1 no. • 33 KV safety gloves – 5 no.s • Vacuum cleaner cum blower – 1 no. Note: Make / model number etc shall be approved by BHEL/NTPC prior to procurement.
5.40	**PRE-COMMISSIONING AND COMMISSIONING FACILITIES** a) The Vendor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. b) During commissioning the Vendor shall carry out system checking and reliability trials on various parts of the facilities. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and

	included in the Vendor's quality assurance plan as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the vendor. c) The pre-commissioning and commissioning activities of the equipment/systems furnished and installed by the vendor shall be the responsibility of the Vendor. The Vendor shall provide, in addition, temporary instrumentation and other measuring devices, test instruments, calibrating devices etc. and labor required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Vendor's workmen required for the above test shall always be present at site during such operations. **All erection & commissioning checks shall be as per manufacturer's manual on mutually agreed terms** a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Vendor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Vendor's quality assurance plan as well as those included elsewhere in the Technical Specifications. b) The Vendor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with subsystems and supporting equipment as a complete plant. c) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. d) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over for commissioning (start-up), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SCL (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] to be furnished by the manufacturer/supplier. e) The Vendor shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.
5.41	**Spares required to be supplied along with main consignment:** **Spares on DC side** • Indicating lamp set of all types: 1% of total population of respective items • Surge protection devices/ MOV: 1% of total population of respective items • Lighting LED lamps: 5% each type. • Indicating lamp set of all types: 1% of total population of respective items • Straight-through jointing kit for 3.3 kV 1Cx400 cable (Al, XLPE, un-armoured, PVC): 4 kits for DC side.

5.42	**Spares required to be supplied along with main consignment:** **Spares on AC side** 1) 33 KV indoor Current transformer (if applicable) 2) 33 KV indoor voltage transformer (if applicable)33 KV indoor surge arrestor (if applicable) Auxiliary Transformer (Highest size) 3) 33kV(E) termination kit for 1Cx240 cable: 3 Nos 4) 33kV(E) straight through jointing kit for 1Cx240 cable: 3 Nos 5) Fuses of all types: 10% of total population of respective items 6) MCCB, MCB of all types: 10% of total population of respective items 7) Indicating lamp set of all types: 10% of total population of respective items 8) Surge protection devices/ MOV: 10% of total population of respective items 9) Plant lighting LED lamps: 5% each type. Notes: (a) In case quantity arrived based on percentage is a decimal figure, it shall be rounded off to next higher integer. (b) Bidders shall supply the above mentioned item as applicable in their scope.

6.0 General conditions applicable during supply, installation and commissioning phase

6.1	Bidder shall arrange sufficient water safety equipments for floater installation like, safety vests, nylone ropes, buoys, inflatable rafts etc. Temporary power supply for I&C work shall be taken through LT Panel boards having ELCBs, fuses and duly earthed.
6.2	Bidder to source items as per NTPC approved vendor list as applicable.
6.3	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys etc necessary for movement and installation of materials / panels / equipment etc shall be organized by the bidder.
6.4	All necessary tools and tackles such as crimping tool (**including heavy duty tools for crimping copper/ aluminium cables up to 400 sq-mm**), screw driver set, power screw drivers, cutting pliers, nose pliers, spanner sets, adjustable spanners, hole-saw cutter set, bending tools, torque wrenches, hack saw blades, pipe wrenches, flat / round files, HV termination tools, drilling machines, welding machines, concrete mixers, steel bar bending tools / templates/ shuttering materials for RCC works, spade, shovel, hammer etc shall be organized by the bidder.
6.5	All necessary measuring instruments such as digital multimeters, measuring tapes, vernier calipers, electrical testers, digital meggers (1kV, 2.5kV, 5kV), earth resistance meters, clamp meters, transformer oil BDV kit, relay testing kit (secondary injection), primary injection kit, infrared thermal imaging handheld temperature meter etc. All these instruments shall possess valid calibration certificate issued from approved NABL laboratory.
6.6	Bidder shall make their own arrangements for necessary food, drinking water and accommodation for their labour and employees posted at the site. Similarly, food and drinking water required at the site, during the construction operations, shall also be in scope of bidder.
6.7	Bidder shall organize all necessary steps to meet statutory requirements such as labour license, PF, ESI etc and also ensure compliance with relevant acts such as minimum wages act, income tax act, employee insurance act etc for their labour deployed at site.

6.8	Bidder shall maintain updated labour register, with name, age, qualification, salary, attendance details etc. at the site.
6.9	Bidder shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
6.10	Bidder shall adhere to all necessary safety norms such as use of helmet, goggles, hand gloves, gumboots, aprons etc. It is the ultimate responsibility of the bidder in all respect to prevent accidents at the site and safeguard their labour from accidents.
6.11	Bidder shall, at the completion of every work, clear off the debris, which resulted out of the work. In case of excavation work such as cable trench etc, bidder shall finish the land neatly with necessary leveling, rolling etc.
6.12	Bidder shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, bidder shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
6.13	Any damages on the building, structures etc. attributable to the acts of labour / employees of bidder shall be rectified and made good by the bidder at their own cost.
6.14	No child labour shall be employed for execution of the present contract.
6.15	Any miscellaneous materials, which are found essential for technical completion of the contract but not mentioned explicitly in this specification, shall be deemed to be included in the specification. Accordingly, such materials shall be included by the bidder as part of the offer.
6.16	Special instruction for earthing: In compliance with Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode. Accordingly, all cases such as cable support structures, cable ladders, cable trays (control room) etc. shall be earthed.
6.17	BHEL/NTPC shall witness routine/ acceptance/ type tests performed at manufacturer works for the items supplied by bidder. Bidder shall accordingly provide inspection call to BHEL with submission of quality assurance plan in advance. For the items bought out from dealers, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/NTPC for procurement of the item from dealers.
6.18	Field Quality Plan / Quality control system (if applicable) Bidder shall set up a field quality control laboratory with full set up to facilitate testing of all construction materials in accordance with FQP (Field quality control plan) as approved by BHEL/NTPC. Bidder shall deploy a well experienced quality control engineer to monitor all QC activities at site as per approved FQP. Specifically, with reference to civil works, bidder shall submit all concrete mix designs and bituminous mix designs for BHEL/NTPC approval before starting of the work. All the third party testing should be conducted in NABL approved laboratories only. Bidder shall submit the FQP for the civil construction works before starting of the works for approval of BHEL/NTPC.
6.19	Any deviations shall be discussed with BHEL/NTPC site engineers and implementation shall be taken up only after approval from BHEL /NTPC.
6.20	Bidder shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.
6.21	Bidder shall, as and when required by BHEL/NTPC, participate in the review meetings conducted by BHEL/NTPC at project site, BHEL-EDN (Bangalore), BHEL-Corporate office (New Delhi), NTPC office (Kolkata) etc.
6.22	**General Guidelines** a) Any civil or electrical work which is not mentioned or included in this tender document but necessary for functional requirements of the plant shall be carried out by bidder.

	b) Bidder shall prepare all designs / drawings based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard. c) Bidder shall provide type test reports and datasheet/ GTP for all equipments covered under bidder scope of supply. d) BHEL reserves right to modify the design at any stage to meet local site conditions / project requirements. e) All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules formed thereunder and as amended from time to time.

6.0 Documents to be submitted for BHEL/NTPC approval during detailed engineering

6.1	BHEL / NTPC approval shall be obtained for the following technical documents, which shall be submitted to BHEL in phased manner based on priority sequence of activities during detailed engineering (after receipt of purchase order from BHEL).
6.2	Name of bidder/ make, model number/ part number, specification/ sizes/ dimensions/ drawings/ datasheets shall be submitted for approval to BHEL / NTPC for the items which cases bidders name is not mentioned.
6.3	Design calculations/ general arrangement drawings/ single line diagrams/ GTP particulars/ datasheets/ schemes/ layouts/ bill of materials etc., as applicable, shall be submitted for the following: (1) GI/Aluminium cable trays for internal cable trench, cable ties, HDPE DWC conduits, 33kV termination kits, 33kV straight through jointing kits, cable glands, cable lugs, (2) Earth chambers of solar array / main control rooms: GA, cross section, BoM with GTP/ datasheets etc. (3) Lighting system: lux calculations, lighting layouts, GA drawings of these, SLD, BoM with GTP/ datasheets etc. (4) Fire extinguisher datasheets (5) Weather Monitoring system BoM with GTP/ datasheets etc. (6) LT straight through jointing kits, 33kV termination kits, 33kV straight through jointing kits. (7) LT Switchgear, UPS with battery bank etc. (8) Fire detection/ alarm system: Layouts in main control room, overall layout with zones/ sensor/ hooter/ control panel locations, BoM with GTP/ datasheets etc. (9) Any other designs/ schemes/ layouts etc as applicable as per BHEL / NTPC requirements that will be discussed during detailed engineering.
6.4	Manufacturing Quality Plans for all the bidder supplied items
6.5	Field quality plan for the field work: civil works, electrical works
6.6	Detailed activity-time chart for project implementation
6.7	Detailed manpower deployment schedule
6.8	Operation and maintenance manuals of bidder supplied items.

DRAWING NO. 5742-004-PVE-P-101

LEGEND DETAILS

SL. NO.	SYMBOL	DESCRIPTION
1		INVERTER DUTY TRANSFORMER- 2 WINDING / 2 WINDING
2		1000 A/33A 12.5KA/1SEC
3		SURGE DIVERTER, 33KV/30kA
4	86	MASTER TRIP RELAY
5	95 / 96	TRIP CIRCUIT SUPERVISION RELAY
6	30	ANTI PUMPING RELAY
7	63	BUCHHOLZ RELAY
8	71	MAGNETIC OIL LEVEL GAUGE
9		VCB ON
10		VCB OFF
11		SPRING CHARGE
12		AUTO TRIP
13		TRIP CIRCUIT HEALTHY
14		SERVICE POSITION
15		TEST POSITION
16		DC FAILURE
17	50	TEST OVER CURRENT RELAY
18	51	START OVER CURRENT RELAY
19	50N	NEUTRAL INSTANTANEOUS OVER CURRENT RELAY
20	51N	START EARTH FAULT RELAY
21	MFM	MULTI FUNCTION METER
22		CURRENT TRANSFORMER
23		MOLDED CASE CIRCUIT BREAKER (MCCB)
24		MINIATURE CIRCUIT BREAKER (MCB)
25		POTENTIAL TRANSFORMER
26		FUSE
27		AIR CIRCUIT BREAKER (ACB)
28	TEM	TARIFF ENERGY METER
29	DCFI	DC FAILURE INDICATION
30	WTI	WINDING TEMP INDICATOR AND OIL TEMP INDICATOR
31	74	PRESSURE RELIEF DEVICE

15MW(AC) POWER THROUGH EXISTING PANEL

PT INPUT

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

INDOOR METERING PANEL AT NTPC's CMCS ROOM

360/1
CL-0.2S,5VA

MAIN CHECK METER

33kV / 110V
Core: CL-0.2,5VA

PT

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

15MW LOCAL POOLING STATION

33kV VCB PANEL

SURGE DIVERTER — 33kV/10kA

CT
CORE-1
360/1A
CL-5P20,5VA

CORE-2
360/1A
CL-0.5,5VA

MFM

Line PT
33kV / 110V
Core-1 CL-0.5,30VA

VCB
33KV,630A
12.5kA/1SEC

33kV, 360A, 12.5kA for 1 sec (Min) Al bus bar

33kV(E), 1Cx240Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
5.3MVA,ONAN, Dyn11yn11
33kV/630V-630V, %Z=7

3.3kV(E),6Rx1Cx400sqmm/phase
XLPE Armored Al Cable

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500V

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
5.3MVA,ONAN, Dyn11yn11
33kV/630V-630V, %Z=7

3.3kV(E),6Rx1Cx400sqmm/phase
XLPE Armored Al Cable

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500V

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
5.3MVA,ONAN, Dyn11yn11
33kV/630V-630V, %Z=7

3.3kV(E),6Rx1Cx400sqmm/phase
XLPE Armored Al Cable

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
5.3MVA,ONAN, Dyn11yn11
33kV/630V-630V, %Z=7

3.3kV(E),6Rx1Cx400sqmm/phase
XLPE Armored Al Cable

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

7 MW(AC) POWER THROUGH EXISTING PANEL

PT INPUT

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

INDOOR METERING PANEL AT NTPC's CMCS ROOM

180/1
CL-0.2S,5VA

MAIN CHECK METER

33kV / 110V
Core: CL-0.2,5VA

PT

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

7MW LOCAL POOLING STATION

33kV VCB PANEL

SURGE DIVERTER — 33kV/10kA

CT
CORE-1
180/1A
CL-5P20,5VA

CORE-2
180/1A
CL-0.5,5VA

MFM

Line PT
33kV / 110V
Core-1 CL-0.5,5VA

VCB
33KV,630A
12.5kA/1SEC

33kV, 180A, 12.5kA for 1 sec (Min) Al bus bar

33kV(E), 1Cx240Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
2.7MVA,ONAN, Dyn11
33kV/630V, %Z=6.25

3.3kV(E), 6RX1Cx400 Sqmm/Phase
XLPE ARMOURED AL. CABLE

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

33kV(E), 1Cx240 Sqmm/Phase
XLPE ARMOURED AL. CABLE

TRANSFORMER
5.3MVA,ONAN, Dyn11yn11
33kV/630V-630V, %Z=7

3.3kV(E),6Rx1Cx400sqmm/phase
XLPE Armored Al Cable

PCU

TP,EDO ACB
5000A, 50kA

INVERTER
2500kW,1500V

3.3 kV(E), 2Rx1Cx400 Sqmm/SCB
XLPE Armored Al Cable

PV SUB ARRAY
3.5 MWp DC

NOTE:

1. Outdoor PCU, INV Transformer, outdoor HT panel, EEPEB room shall be located on raised platforms along the periphery of the reservoir at 4 pre-determined locations.
2. Aux power requirement for each platform is taken from aux transformer placed inside EEPEB room.
3. CMCS building is not a part of this contract. NTPC shall provide space for metering panel with CT&PT in switchgear room and space for placing SCADA panel and UPS at SCADA room. Aux power for UPS will be taken from NTPC's CMCS room.

REV.	DATE	ALTERED / CHECKED / APPROVED
01	21.05.20	1) HT panel detailes modified.

	NAME	SIGN	DATE
DRAWN	KRI		11.12.19
CHECKED	VCP		11.12.19
APPROVED	MS		11.12.19

DEPT. SCS/PV | CODE 439

PROJECT : 22MW (AC) FLOATING SOLAR POWER PLANT
CUSTOMER : NTPC–KAYAMKULAM

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

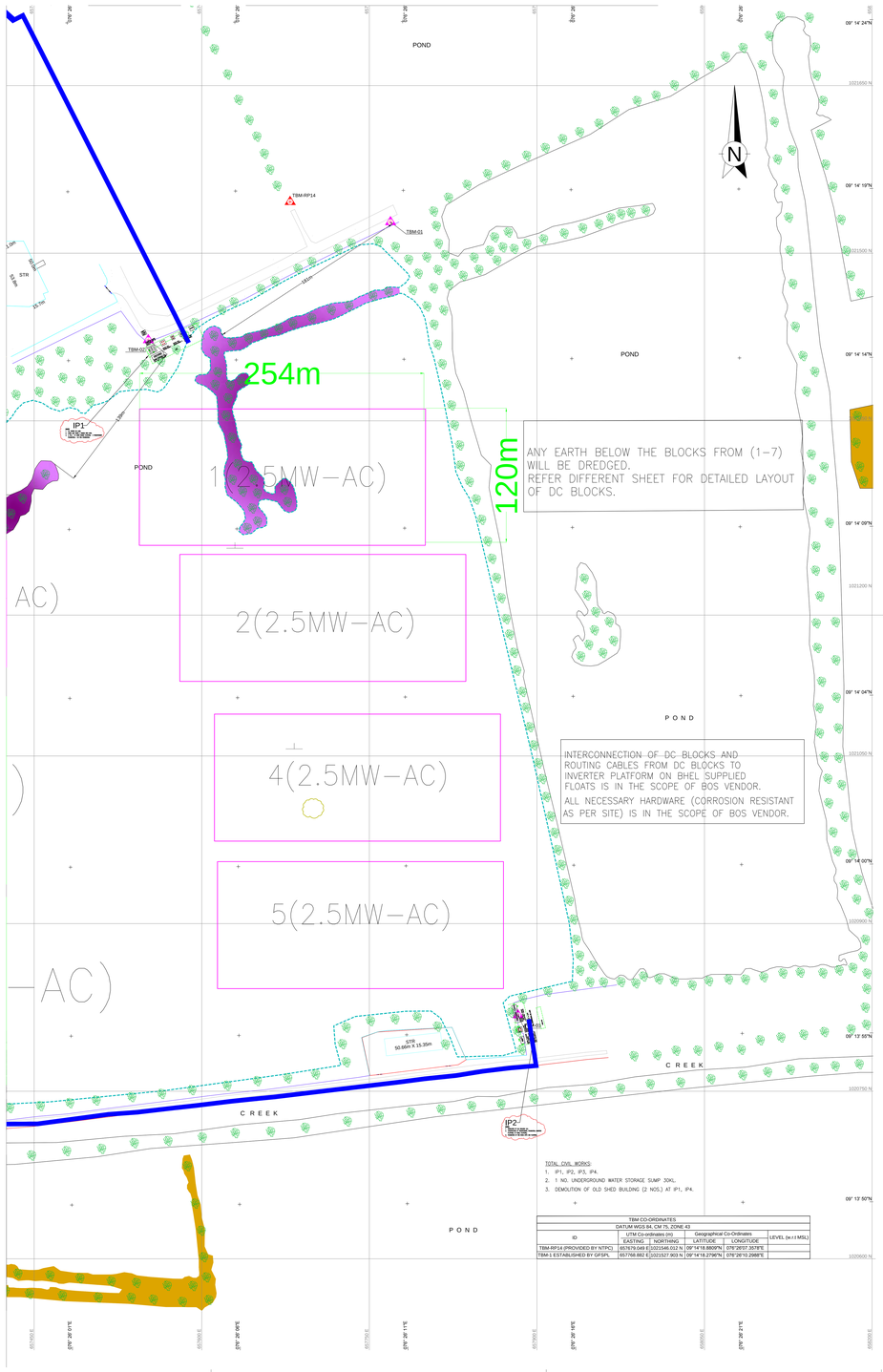
TITLE: SINGLE LINE DIAGRAM–AC

No. OF SHEETS 01 | SHEET No. 01 | REV 01

MFG DRAWN | DWG. REF. NO. 5742-004-PVE-P-101

A0 SIZE

REV. DRG.NO. | SIGN & DATE | INVENTORY NO.



TOTAL CIVIL WORKS:
1. IP1, IP2, IP3, IP4.
2. 1 NO. UNDERGROUND WATER STORAGE SUMP 30KL.
3. DEMOLITION OF OLD SHED BUILDING (2 NOS.) AT IP1, IP4.

TBM CO-ORDINATES

DATUM WGS 84, CM 75, ZONE 43

ID	UTM Co-ordinates (m)		Geographical Co-Ordinates		LEVEL (w.r.t MSL)
	EASTING	NORTHING	LATITUDE	LONGITUDE	
TBM-RP14 (PROVIDED BY NTPC)	657679.048 E	1021546.012 N	09°14'16.8609"N	076°26'07.3578"E	
TBM-1 ESTABLISHED BY GFSPL	657768.882 E	1021527.903 N	09°14'16.2796"N	076°26'10.2988"E	

GENERAL :-
- UTM GRID INTERSECTION (WGS84 DATUM)
- GEOGRAPHICAL GRID INTERSECTION (WGS84 DATUM)
- BANK LINE
- FENCING
- LAND AREA
- LAND FORM INSIDE THE WATER BODY
- TBM-RP14 PROVIDED BY NTPC
- TBM ESTABLISHED BY GFSPL
- STR PERMANENT STRUCTURE
- TREES AND BUSHES
- 1.5 MINIMUM WATER DEPTH
- 5.0 MAXIMUM WATER DEPTH

BATHYMETRY :-
- 3.4 WATER DEPTH IN METRES & DECIMETRES
- BATHYMETRY CONTOURS SHOWING AS PER WATER DEPTHS
- 2.25 TOPOGRAPHIC SURVEY W.R.T ABOVE MEAN SEA LEVEL (MSL)

NOTES:

1) BATHYMETRY SURVEY WAS CARRIED OUT FROM BOAT MFB-SWAMI AYYAPPA BETWEEN 27th to 29th JANUARY 2020.
2) TOPOGRAPHIC SURVEY WAS CARRIED OUT FROM SOUTH NTS3429N6 TOTAL STATION BETWEEN 26th TO 28th JANUARY 2020.
3) POSITION FIXING WAS CONTROLLED FROM HEMISPHERE DGPS POSITIONING SYSTEM.
4) ODOM HYDROTRAC SINGLE BEAM ECHOSOUNDER WAS DEPLOYED FOR RECORDING WATER DEPTH.
5) THE VALUE OF TEMPORARY BENCH MARK AT NTPC KAYAMKULAM POWER PLANT IS 5.259 (RP-1)ABOVE MEAN SEA LEVEL.
6) SURVEY AREA CO-ORDINATES WERE PROVIDED BY THE CLIENT.

GEODETIC PARAMETERS

HORIZONTAL CO-ORDINATE SYSTEM	:	WGS84
GEODETIC DATUM	:	WGS84
ELLIPSOID	:	WGS84
Semi major axis	:	6378137.000 m
Semi minor axis	:	6356752.314 m
Inverse flattening	:	298.257223K
PROJECTION	:	Universal Transverse Mercator
Central Meridian (CM)	:	75° E (Zone 43)
Latitude of Origin	:	0°
False Easting	:	500000 m
False Northing	:	0 m
Scale factor at CM	:	0.99960

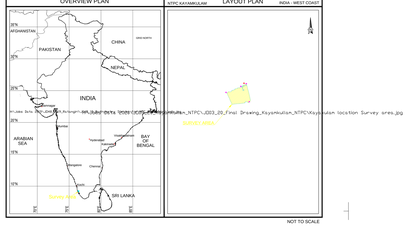
REFERENCE DRAWINGS

Rev. No.	Date:	Drawing No.	Description:

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LOCATION MAP

OVERVIEW PLAN | LAYOUT PLAN — NTPC KAYAMKULAM — INDIA - WEST COAST



NOT TO SCALE

CLIENT

M/s. Bharat Heavy Electricals Limited,
Electronics Division,
Mysore Road,
Bangalore - 560026.

SURVEY CONTRACTOR

GEO FOUNDATIONS & STRUCTURES PVT LTD
NO.89, 1ST MAIN ROAD, GANDHI NAGAR, ADYAR
CHENNAI, TAMIL NADU-600020
Ph: 044-24451972, 24430399, 044-24540930

PROJECT

BATHYMETRIC SURVEY FOR THE PROPOSED PROJECT SITE OF FLOATING SOLAR POWER PLANT OF 22 MW AT RGCCPP, NTPC KAYAMKULAM, KERALA.

BATHYMETRY & TOPOGRAPHIC SURVEY CHART
BATHYMETRY GRID (20m X 20m)

SCALE

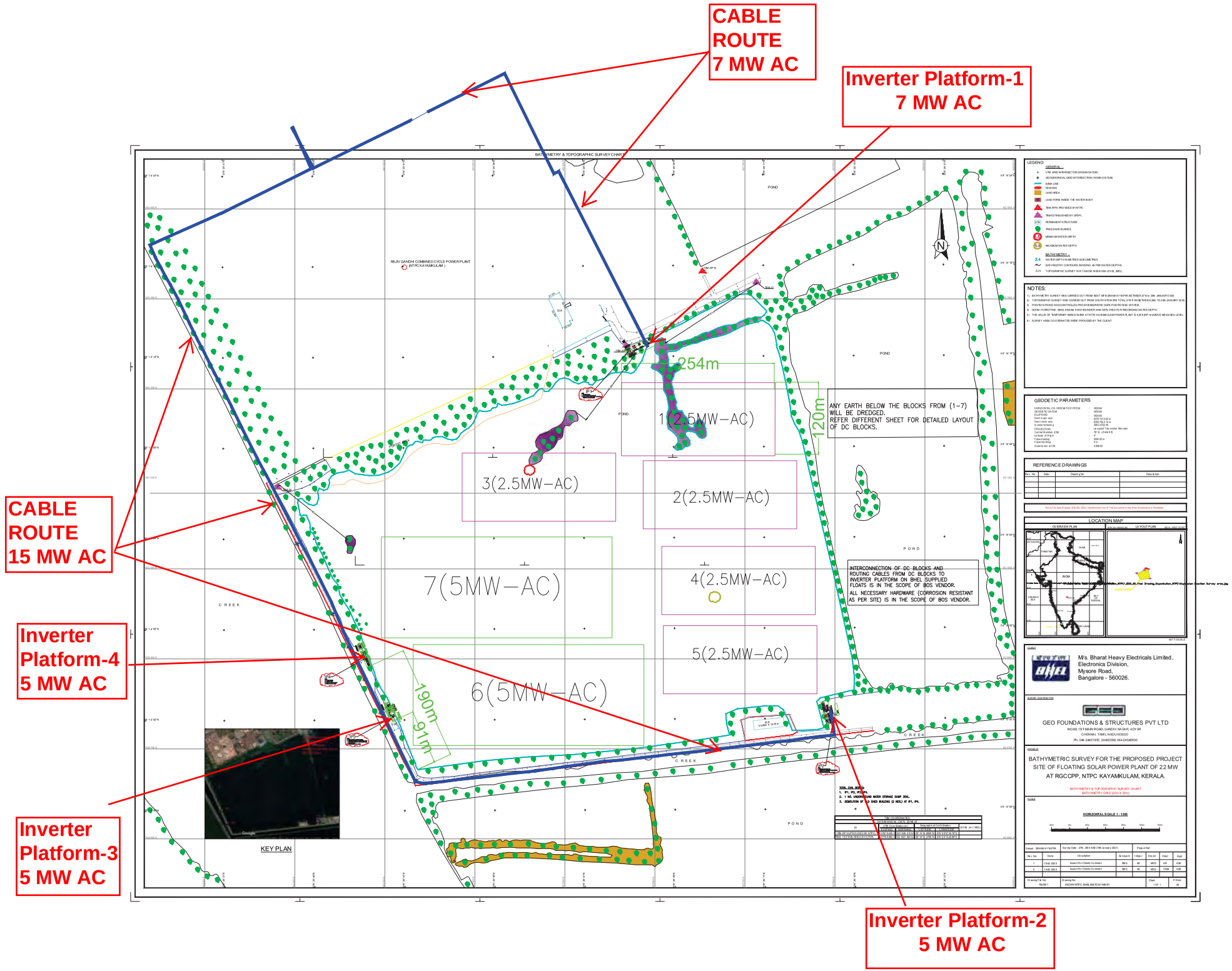
HORIZONTAL SCALE 1 : 1500

30m 0m 30m 60m 90m 120m 150m

Vessel : SWAMI AYYAPPA | Survey Date : 27th, 28th AND 29th January 2020 | Project Ref :

Rev. No:	Date:	Description:	Surveyed:	Interpr.	Drawn:	Chkd:	Appr:
1	19-02-2020	Issued For Clients Comment	SMS	AS	MSS	AR	ASK
0	14-02-2020	Issued For Clients Comment	SMS	AS	MSS	VNM	ASK

Drawing File No:	Drawing No:	Chart:	P.Size:
154/01	SI/CHN/NTPC-BHEL/B&T/20/154/01	1 OF 1	A0

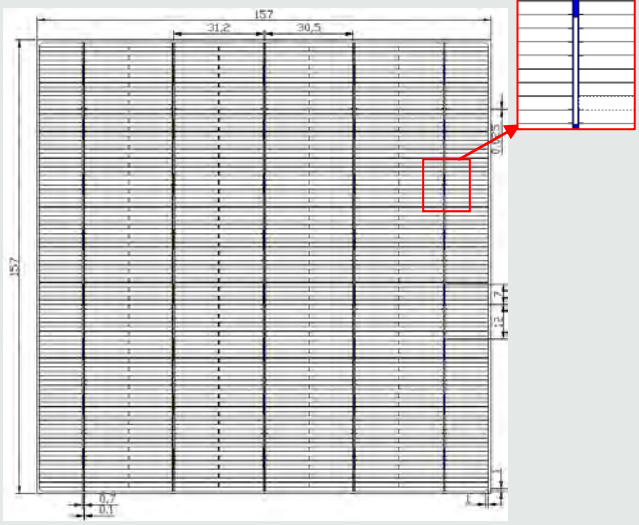

CABLE ROUTE 7 MW AC
Inverter Platform-1 7 MW AC
CABLE ROUTE 15 MW AC
Inverter Platform-4 5 MW AC
Inverter Platform-3 5 MW AC
Inverter Platform-2 5 MW AC
BATHYMETRY & TOPOGRAPHIC SURVEY CHART
RAJIV GANDHI COMBINED CYCLE POWER PLANT (NTPC KAYAMKULAM)
POND
CREEK
254m
120m
190m
91m
1(2.5MW–AC)
2(2.5MW–AC)
3(2.5MW–AC)
4(2.5MW–AC)
5(2.5MW–AC)
6(5MW–AC)
7(5MW–AC)
ANY EARTH BELOW THE BLOCKS FROM (1–7) WILL BE DREDGED. REFER DIFFERENT SHEET FOR DETAILED LAYOUT OF DC BLOCKS.
INTERCONNECTION OF DC BLOCKS AND ROUTING CABLES FROM DC BLOCKS TO INVERTER PLATFORM ON BHEL SUPPLIED FLOATS IS IN THE SCOPE OF BOS VENDOR. ALL NECESSARY HARDWARE (CORROSION RESISTANT AS PER SITE) IS IN THE SCOPE OF BOS VENDOR.
KEY PLAN
LEGEND
NOTES:
GEODETIC PARAMETERS
REFERENCE DRAWINGS
LOCATION MAP
M/s. Bharat Heavy Electricals Limited, Electronics Division, Mysore Road, Bangalore - 560026.
GEO FOUNDATIONS & STRUCTURES PVT LTD
BATHYMETRIC SURVEY FOR THE PROPOSED PROJECT SITE OF FLOATING SOLAR POWER PLANT OF 2.2 MW AT RGCCPP, NTPC KAYAMKULAM, KERALA.
HORIZONTAL SCALE 1 : 1500

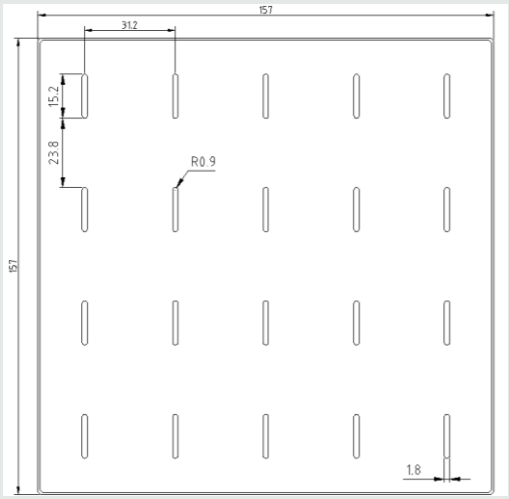
Poly-crystalline cells ——EN157P220.5-5BB

Physical Characteristics

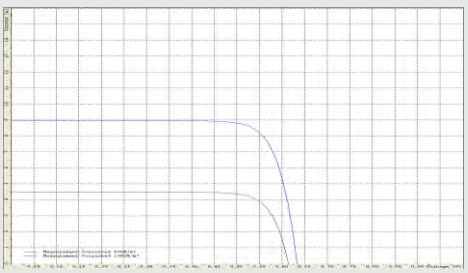
Dimensions	157mm×157mm±0.25mm
Diagonal	220.5mm±1mm
Thickness(Si)	180μm±20μm; 200μm±20μm
Front surface	Blue silicon nitride antireflective coatings
	5*0.7mm-width silver contact on silicon nitride
Back surface	Full-surface aluminium back-surface field
	1.8mm silver discontinuous soldering pads

Basic Dimensions





I-V Characteristic Curve



Features and Quality Control

- Each of Econess's solar cells features silicon nitride antireflection coatings which are deposited using plasma-enhanced chemical vapor deposition process
- Cells have state-of-the-art silver front contacts, silver back contact strips, and full-coverage aluminium back contacts with back surface field
- Metal pastes are screen printed in a fully automated process
- 100% checked for visual appearance, unqualified degraded after measuring electrical performance
- Classified the grades by cell efficiency, Series/parallel resistor and reverse current
- Frequent reliability monitoring

Our Commitment to Quality

- Econess is ISO 9001 and ISO 14000 certified
- Color uniformity among cells and within cells
- Excellent resistance to PID attenuation performance
- Long-term stability & reliability
- Small light-induced degradation

Electrical Characteristics

（Test conditions: AM1.5, 1000±50W/m², 25±2℃ Area：243.34cm²）

No.	Efficiency range	Nominal efficiency	Nominal power
1	>19.30%	19.30%	4.696W
2	19.20%-19.30%	19.20%	4.672W
3	19.10%-19.20%	19.10%	4.648W
4	19.00%-19.10%	19.00%	4.623W
5	18.90%-19.00%	18.90%	4.599W
6	18.80%-18.90%	18.80%	4.575W
7	18.70%-18.80%	18.70%	4.551W
8	18.60%-18.70%	18.60%	4.526W
9	18.50%-18.60%	18.50%	4.502W
10	18.40%-18.50%	18.40%	4.478W
11	18.30%-18.40%	18.30%	4.453W
12	18.20%-18.30%	18.20%	4.429W

江苏东鋆光伏科技有限公司
Jiangsu Econess-energy Co., LTD

TECHNICAL DATA SHEET FOR PHOTOVOLTAIC MODULES

Project	22 MW NTPC, Kayamkulam Floating Solar Power Project
Product	Solar PV Module – 330 Wp
PV Module Manufacturer	Econess Energy Co., Ltd, China
Quantity	Total Quantity : 31.515 MW 330 Wp – 31.515 MW
Customer	NTPC, India
BHEL Purchase Order No.	

BHEL Approval with Seal and Sign

ಮುಹಮ್ಮದ್ ಶಕೀರ್ ಎಂ.ಕೆ., ಹಿರಿಯ ಎಂಜಿನಿಯರ್/ಎಸ್.ಸಿ.ಸಿ ಪಿ.ವಿ.-ಎಂ.ಎಂ.
मुहम्मद शकीर एम.के., वरि.इंजीनियर/एससी एवं पीवी-एम.एम.
MUHAMMED SHAKIR M.K., SR.ENGINEER SCSS PVM
BHEL-EDN, MYSORE ROAD, BANGALORE-560 026.

REVISION NUMBER: 00	**DATE** 01.05.2020
PREPARED 2020.5.7	**APPROVED WITH SEAL** 2020.5.7

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1. PHYSICAL CHARACTERISTICS:

PV MODULE TYPE NO.	EN156P-72-330
CONFIGURATION	Single glass laminated type with 72 nos. of 157 mm multi-crystalline silicon solar cells (12*6) in series configuration
OVERALL MODULE SIZE	1960* 992 * 35 mm
WEIGHT	21.5 Kg. (Typ.)
SOLAR CELLS	'A' grade solar cells
BILL OF MATERIAL (BOM)	As per IEC 61215 certified materials
FRAME MATERIAL	Anodized Aluminium
JUNCTION BOX (JB)	IP68 Grade
CABLES CONNECTED TO JB	1.2 Metre length, 4 Sq. mm size
CONNECTORS	MC4 Compatible connectors
BYPASS DIODES	3 nos. per junction box
RATING STICKER	Each PV module will be provided with a rating sticker on backside.
PID FREE MODULE	PV Module is PID free.
PV MODULE SYSTEM VOLTAGE	1500 V
PV MODULE REGISTERED WITH BIS	The offered PV module is BIS registered. (BIS No. R-41115355, Date: 08.02.2019, Valid upto: 13.01.2021)
RFID Tag	RFID Tag fixed outside the laminate on the backsheet and shall contain the following information. a. Name of module manufacturer with country of origin b. Month & year of manufacture of modules c. Name of cell manufacturer with country of origin d. Month & year of manufacture of cells e. I-V curve at standard test condition f. Pmax, V_{mp}, I_{mp}, V_{oc}, I_{sc},Temperature coefficient of Power, Fill factor g. Module model number h. Unique Module serial number i. Date of obtaining IEC qualification certificates j. Name of test lab issuing IEC certificates
Packing Box identification	Each carton box will have one wattage PV module and shall be identified with wattage (eg. 330 Wp) on the carton.

2. TYPICAL ELECTRICAL CHARACTERISTICS OF PV MODULES :

TYPICAL ELECTRICAL CHARACTERISTICS	330 Watts
OPEN CIRCUIT VOLTAGE (Voc)	45.9 V
SHORT CIRCUIT CURRENT (Isc)	9.29 A
VOLTAGE AT PEAK POWER POINT (Vmp)	37.73 V
CURRENT AT PEAK POWER POINT (Imp)	8.75 A
MODULE POWER RATING (Pmax)	330 Wp
MODULE EFFICIENCY (%)	16.97%
FILL FACTOR	≥ 0.75

Note : No negative tolerance on module power rating (P_{max}).

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3. OPERATING CONDITIONS:

TEMPERATURE RANGE	: - 40 deg C to +85 deg C
RELATIVE HUMIDITY	: 85 %
WIND SPEED (GUST)	: 150 km/hr

4. TEMPERATURE CO-EFFICIENTS (% / deg C):

CURRENT	: +0.0499
VOLTAGE	: - 0.3062
POWER	: - 0.4146

5. WARRANTY:

5.1. Product Warranty:The modules are warranted for 10 years for failures due to material defects and workmanship.

5.2. Performance Warranty: 90% of the peak power capacity at the end of 10 years and 80 % at the end of 25 years. Degradation of PV module for first year shall be limited to 2.5% and shall not be more than 1 % in any subsequent year.

6. PACKING

The modules shall be packed in carton boxes. Module power rating (330 Wp) shall be displayed with a sticker on both the longer sides of the carton box.

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7. IEC Certifications

PV Module Model No. : EN156P-72-330

Sl. No.	IEC Certificate	Certificate Issued by	Validity of Certifciate upto date
1.	IEC 61215-1:2016 (Design Qualification and Type Approval-Part 1) IEC 61215-1-1:2016 (Design Qualification and Type Approval-Part 1-1) IEC 61215-2:2016 (Design Qualification and Type Approval-Part 2)	TUV NORD	2023-11-06
2.	IEC 61730-1:2016 (Safety Qualification – Part 1) IEC 61730-2:2016 (Safety Qualification – Part 2)	TUV NORD	2023-11-06
3.	IEC 61701:2011 (Salt Mist Corrosion testing)	SGS	2024-04-22
4.	IEC 62716:2013 (Ammonia Corrosion testing)	TUV NORD	2024-12-12
5.	IEC 62804-1:2015- (Test methods for the detection of PID - Part 1)	SGS	2024-04-22

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8. Bill of Materials (as per IEC Type tested CDF)

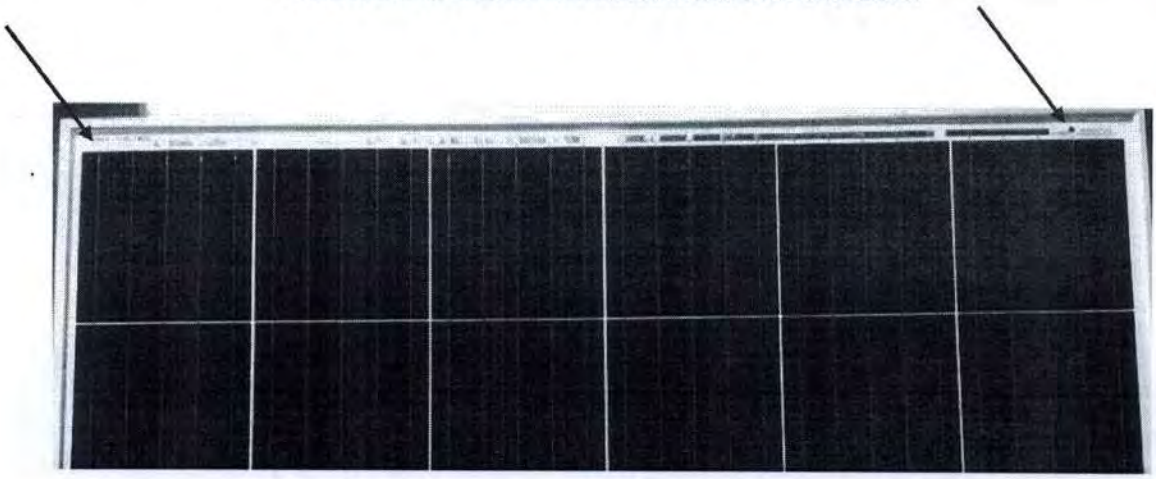
Sl. No.	Item Description	Brief Spec.	Source or Make
1.	Solar Cells	Type : Multi-crystalline solar cells Size of Cells :157 mm*157 mm Cell Wattage : ⩾4.644W Cell efficiency :≥18.9 No. of busbars : 5 **Solar cell product catalogue enclosed**	Econess Energy Co.,Ltd.
2.	Glass	Size :1954*986*3.2mm Light Transmission : ≥93.5%	Xinyi PV Products (Anhui) Holdings Ltd.
3.	EVA	Type : Fast Cure Thickness :0.45mm Gel content : 75%-95% UV Resistant : Yes	Hangzhou First Applied Material Co.,Ltd.
4.	Back Sheet	No. of layers:3 Thickness : 0.313mm Water vapour transmission rate : <2.0 $g.m^2$ /day	Cybrid Technologies inc.
5.	Al. Frame	Corrosion resistant, anodized Aluminum. Anodizing thickness : AA15	Jiangyin East-China Aluminum Technology Co.,Ltd
6.	Junction box	Grade : IP67 grade No. of bypass diodes : 3 nos. UV resistant & weather-proof : Yes	Zhejiang Renhe Photovoltaics Technology o.,Ld.
7.	Cables	Two nos. of 4 sq mm UV resistant cables Cable length : 1.2 Metre	Zhejiang Renhe Photovoltaics Technology o.,Ld.
8.	Connectors	MC4 compatible Plug in connectors (Male and Female)	Zhejiang Renhe Photovoltaics Technology o.,Ld.
9.	Adhesive for framing and junction-box fixing	Colour : white	Tonson Adhesive Inc.
10.	Adhesive for Junction-box potting	Colour : white	Tonson Adhesive Inc.
11.	Solder Busbars	Size :6*0.35mm Coating : Sn60pb40	Suzhou Yourbest New Materials o.,Ltd.
12.	Solder Tabs	Size :0.27*0.9mm Coating : Sn60pb40	Suzhou Yourbest New Materials o.,Ltd.
13.	Liquid Flux	Model no. : PV105A	Vital New Material Co.,Ltd

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Module Sl. No. Sticker laminated inside the PV module.







Note: No negative tolerance on module power rating, will be offered against the project

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RFID Tag fixed on the back sheet. Indicative picture below



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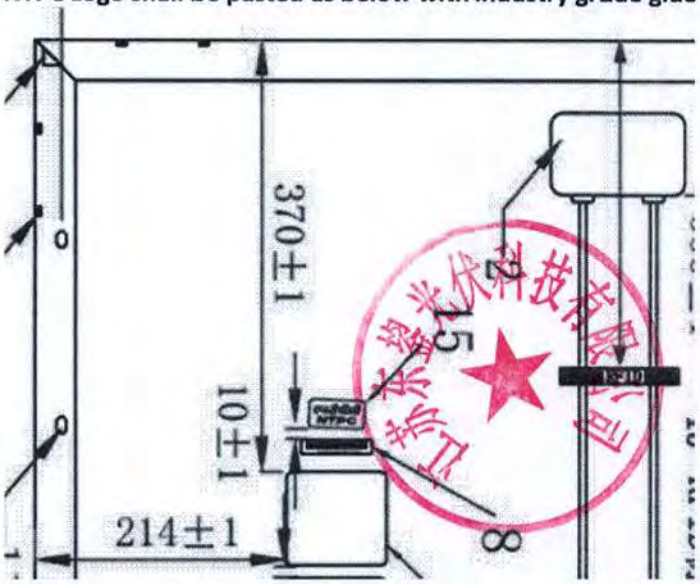
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Typical Picture of Rating Sticker or Name Palte for 330 Wp PV Module



NTPC Logo shall be pasted as below with industry grade glue

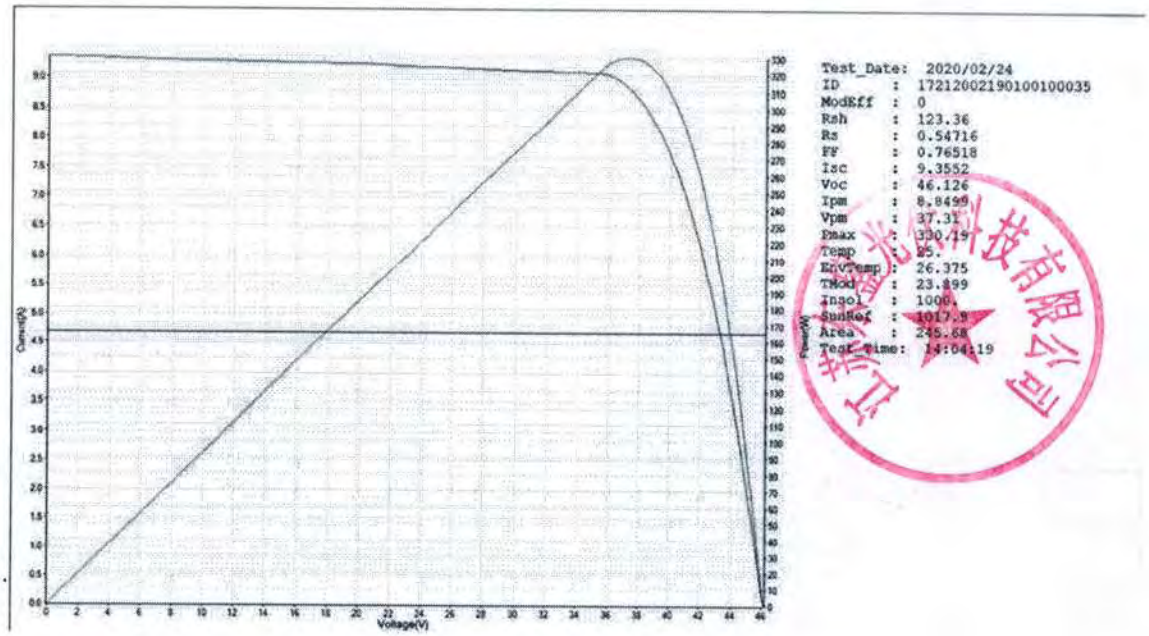


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Typical I-V Curve for 330 Wp PV Module

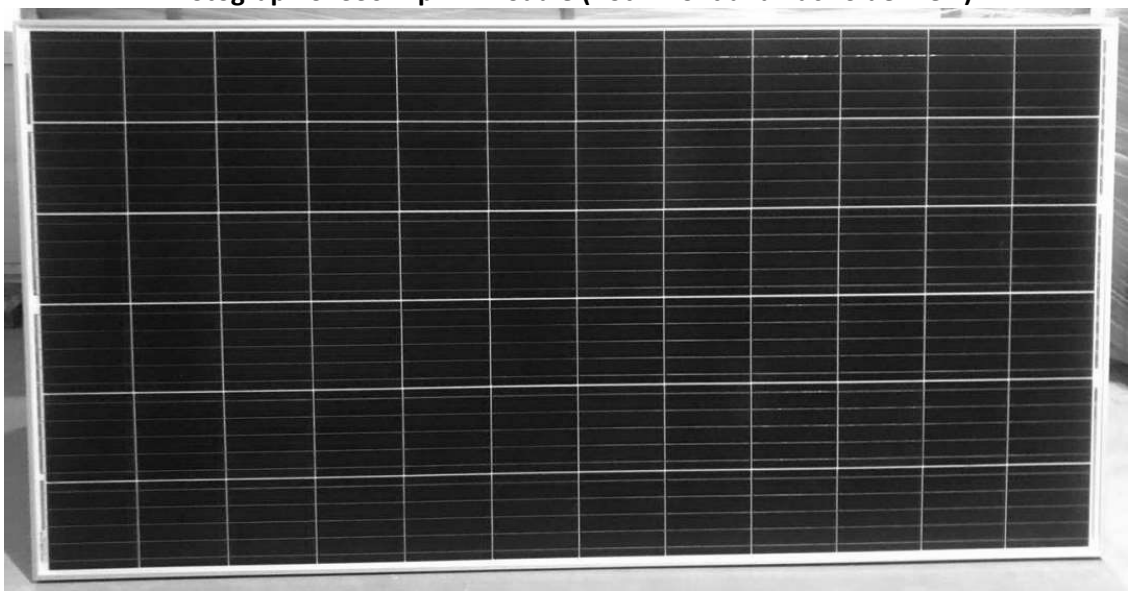


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Photograph of 330 Wp PV Module (Both Front and Back Side View)



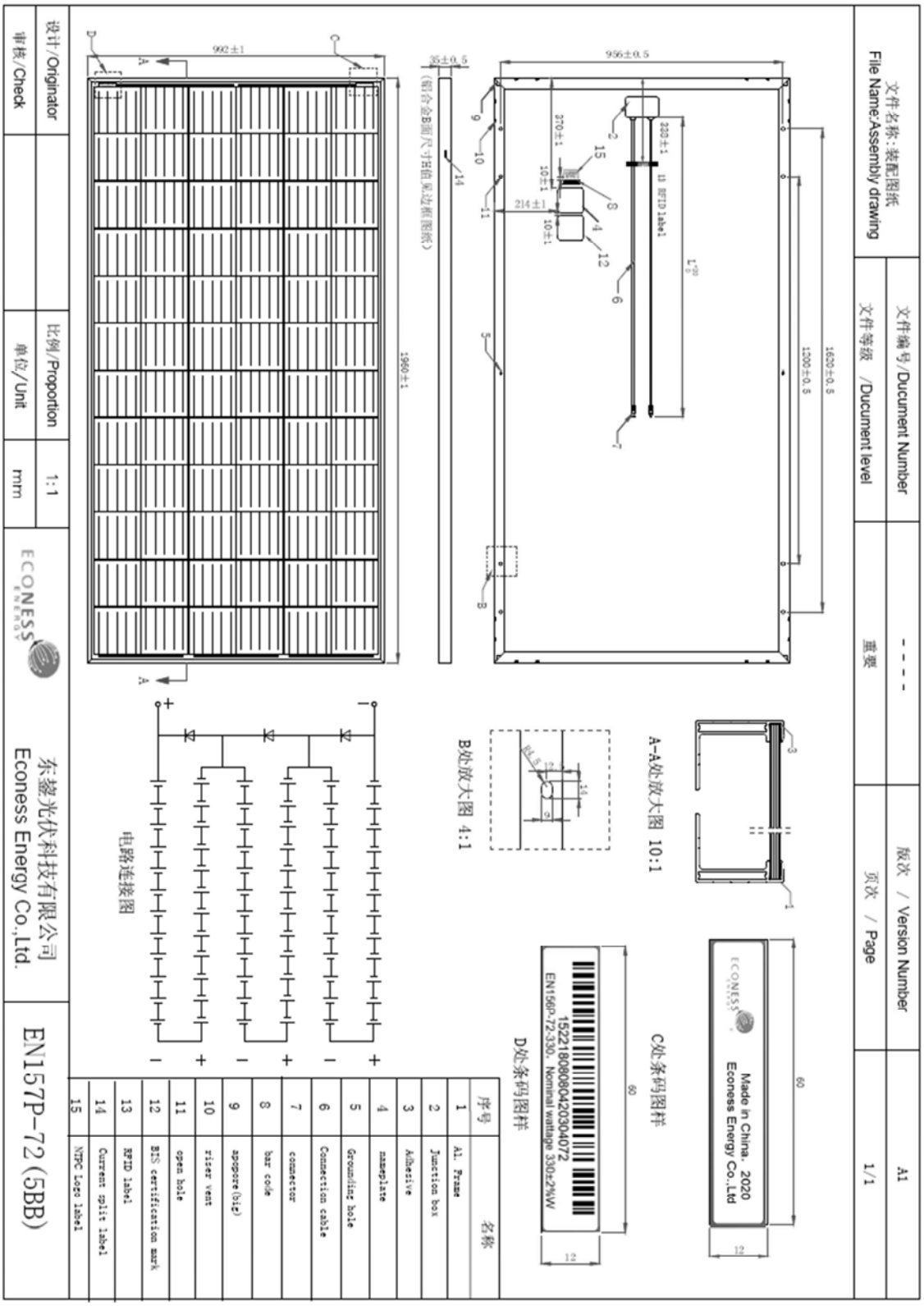


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PV Module Overall assembly Drawing



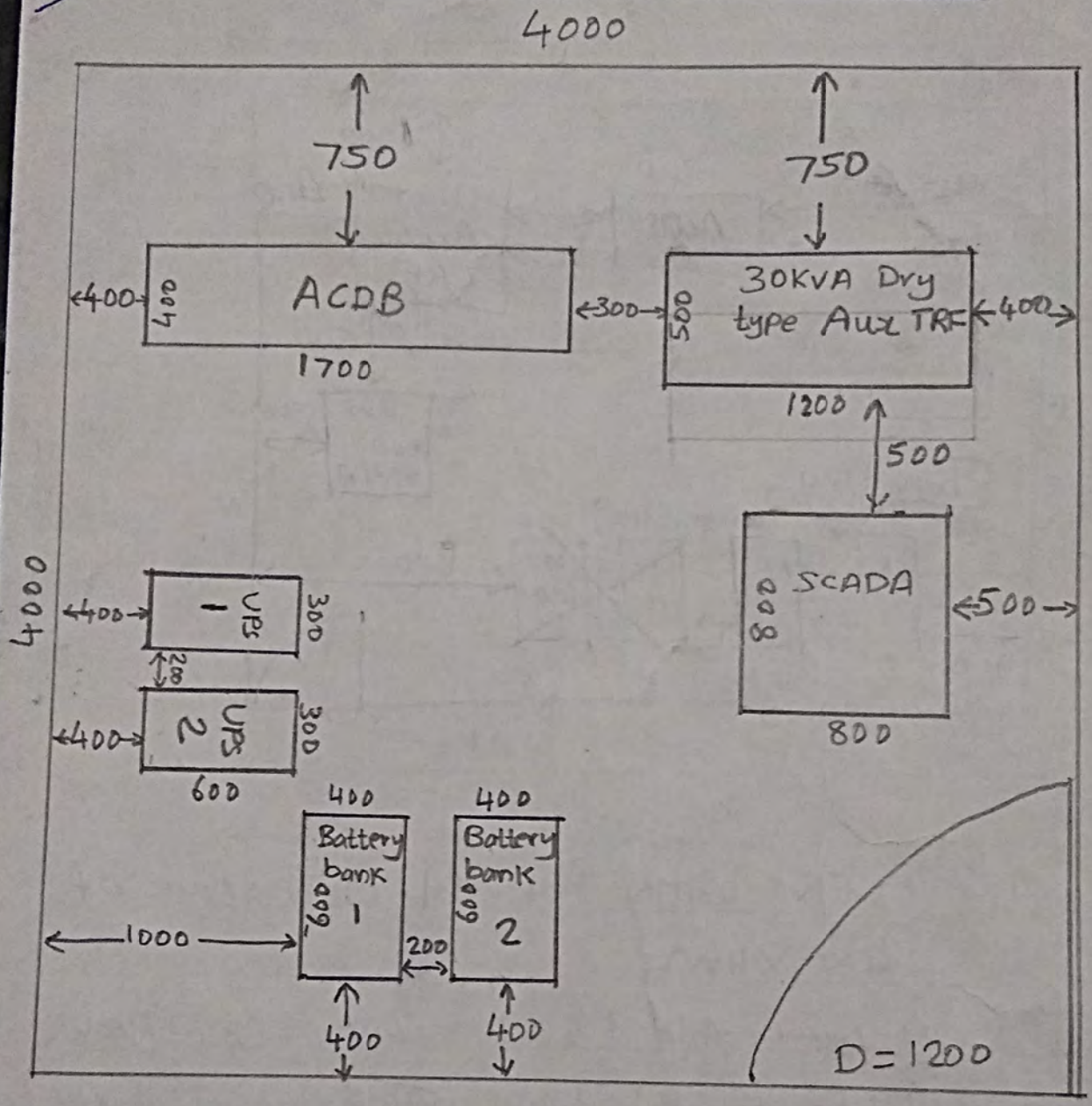
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07-04-20

Electrical Equipment Room



Notes: 1). Dimesions of equipments are typical. May vary slightly during detailed engineering of equipment.

2). No cable trenches are envisaged. Cables will be routed through trays whereever required.

3). EER internal clear area, 4000X4000mm.

C-6 CABLE INSTALLATION METHODOLOGY

1.0 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubulars and other wrought steel fIttings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:2309	Code of Practice for the protection of building and allied structures against lightning.
IS:2629	Recommended practice for hot dip galvanising of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing

IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.

Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

2.0 DESIGN AND CONSTRUCTIONAL FEATURE

Inter Plant Cabling

Interplant cabling for main routes shall be laid in Cable trenches/cable trays/buried/duct banks. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. All buried cables shall be armoured

Cable Sizing Conditions

All cables shall be suitably derated as per the laying conditions for carrying the required load current and fault current. For derating, the ambient temperature for directly buried cables shall be taken as 40° C and 50° C for cables laid in air.
All XLPE cables shall be rated at 90° C conductor temperature for AC Voltage drop calculation and 80° C for DC Voltage calculation .

Trenches

PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

General

The cable slits to be used for motor/equipment power/control supply shall be sand filled & covered with PCC after cabling.

Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.

Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:

- Meet all safety requirements
- Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc

3.0 EQUIPMENT DESCRIPTION

Cable trays, Fittings & Accessories

Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.

Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.

Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.

Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm

Support System for Cable Trays

Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".

Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder:

a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.

b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fitings and accessories shall be prefabricated factory galvanised.

c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvansied surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied

d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drill ing and other machining operation.

e. Support system shall be able to withstand

- weight of the cable trays
- weight of the cables (75 Kg/Metre run of each cable tray)
- Concentrated load of 75 Kg between every support span.
- Factor of safety of minimum 1.5 shall be considered.

PIPES, FITTINGS & ACCESSORIES

Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

GI Pipes shall be of medium duty as per IS:1239

Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

Hume pipes shall be NP3 type as per IS 458

.

Junction Boxes

Junction Boxes with IP:55 degree of protection, shall comprise of a case with hinged door constructed from cold rolled sheet steel of thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

Terminal blocks shall be 1100V grade, 10Amps rated, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq mm each. All internal wiring shall be of minimum 1.5 sq. mm cu. Conductor PVC wire.

Terminations & Straight Through Joints

Termination and jointing kits for 33kV, 11kV, 6.6 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 33kV, 11kV and 6.6 kV grade joints and terminations shall be type tested as per IS:13573. 3.3kV grade joints and terminations shall be type tested as per VDE0278. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solderless crimping type cable lugs & ferrule as per DIN standard.

Straight through joint and termination shall be capable of withstanding the fault level for the system.

1.1 KV grade Straight Through Joint shall be of proven design.

Cable glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to relevant standard

Trefoil clamps

Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the peak value of maximum system short circuit current.

Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment

Receptacles

Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category,

suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.

Galvanising

Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 & IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.

The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS:1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified

Welding

The welding shall be carried out in accordance with IS:9595. All welding procedures and welders qualification shall also be followed strictly in line with IS:9595

4.0 INSTALLATION

Cable tray and Support System Installation

Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.

Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm in general. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm in general. Fixing of cable

trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the approved guidelines/ drawings. Vendor shall design the support system along with tray, spacing etc in line with relevant standard.

The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.

The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners subject to QA approval.

All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/stenciled with identification numbers at every floor.

In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.

Conduits/Pipes/Ducts Installation

The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/ roof/ wall/ cable tunnel/ cable trenches made for conduit installation shall be sealed and made water proof by the Contractor **either with any proven fire sealing system rated for one hour or** Modular multi-diameter cable sealing system consisting of frames, blocks, Compression wedge and its accessories. **The Cable sealing system should have been tested for fire insulation for min. 1 hr as per BS 476 and shall also provide water sealing. System shall be anti- rodent and anti- termite.**

GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material

Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	**Spacing**
Upto 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm and above	3.0 M

For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

Junction Boxes Installation

Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

Cable Installation

Cable installation shall be carried out as per IS:1255 and other applicable standards.

For Cable unloading, pulling etc following guidelines shall be followed in general :

- Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

- While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager.

Cables shall be laid on cable trays strictly in line with cable schedule

Power and control cables shall be laid on separate tiers in line with approved guidelines/drawings. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two meter. All multi core cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self-locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multi core power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multi core power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.

Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.

Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.

No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted. Vendor shall identify and accordingly procure the cable drum length.

In each cable run some extra length shall be kept at suitable point to enable one LT/two HT straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

Wherever few cables are branching out from main trunk route troughs shall be used.

Wind loading shall be considered for designing support as well Cable trays wherever required.

Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.

The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

Separation

At least 300mm clearance shall be provided between :

- HT power & LT power cables,

- LT power & LT control/instrumentation cables,

Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

Directly Buried Cables

- Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS:1255.

- RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties with cable number heat stamped on the cable tags

While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

Cable Terminations & Connections

The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.

Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self-locking type nylon cable ties with de interlocking facility to keep them in position.

All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections

E-1 WEATHER MONITORING STATION

As a part of weather monitoring station, Bidder shall provide following measuring instruments with all necessary software & hardware required to integrate with SCADA so as to enable availability of data from meteorological instrument in SCADA. Each instrument shall be supplied with necessary cables, transmitters and accessories (Trackers, Mounting and base stand etc.) provided by OEM of the sensors only.

Aux. power required by instruments and data logger (If supplied) shall be from UPS only. Data logger shall have provision to receive redundant power supply.

All the instruments to be supplied shall have valid calibration certificate.

1.0 SOLAR RADIATION SENSORS

Contractor shall provide Solar Radiation Sensors as per specification given in following section. Contractor has the option to provide these sensors on separate base or on a single base (radiation monitoring station) with tracker, shadow ring and transmitter etc provided by the OEM. Calibration certificate with calibration traceability to World Radiation Reference (WRR) or World Radiation Centre (WRC) shall be furnished along with solar radiation sensors. Bidder shall provide Instrument manual in hard and soft form.

1.1 Pyranometer

Bidder shall provide minimum **02 (Two) numbers** of Secondary Standard Pyranometers as per ISO 9060 **for measuring incident solar radiation as for following**

- **Global Horizontal Irradiance (GHI)- 1 Nos.**
- **Global Inclined Irradiance (GII)-1 Nos**

Sl.No	Details	Values
1.	Principle	Thermopile
2.	Spectral Response.	310 to 2800 nm
3.	Sensitivity	Min 7 micro-volt/w/m^2
4.	Time response (95%):	Max 15 s
5.	Non linearity:	±0.5%
6.	Temperature Response:	±2%
7.	Tilt error:	< ±0.5%.
8.	Zero offset thermal radiation:	±7 w/m^2

9.	Zero offset temperature change	±2 w/m^2
10.	Operating temperature range:	0 deg to +80 deg.
11.	Uncertainty (95% confidence Level):	Hourly- Max-3%, Daily-Max-2%
12.	Non stability:	Max ±0.8%
13.	Response Time(95% of final value)	<5 sec

Bidder shall provide 1 nos (one) Battery powered portable logger for pyranometer supplied by the OEM of the offered Pyranometer.

Both the pyranometers have to be mounted on floating unit at shade free location. The GII pyranometer has to be mounted at similar angular tilt either through module projection or standalone installation.

2.0 TEMPERATURE SENSORS

2.1 Ambient Air Temperature Sensor (Qty -1 no.)

Sl.No	Details	Values
1.	Principle	RTD (Platinum) Resistance proportional to temperature
2.	Range	0-50 ºC
3.	Accuracy	± 0.2 ºC
4.	Operating Temperature	0 to 50 ºC
5.	Radiation Shield	Non-aspirated Radiation Shield

2.2 Indoor Air Temperature Sensor (Qty – 1 no. at each Inverter room)

Sl.No	Details	Values
1.	Principle	RTD (Platinum) Resistance proportional to temperature
2.	Range	0-70 ºC
3.	Accuracy	± 0.2 ºC
4.	Operating Temperature and calibration	0 to 70 ºC

2.3 Module Temperature Sensor (Qty – 1 no. per 5 MW)

Sl.No	Details	Values
1.	Principle	RTD (Platinum) Resistance proportional to temperature
2.	Range	0-100 ºC

3.	Accuracy	± 0.2 ° C
4.	Operating Temperature	0 to 100 ° C

Module temperature sensor shall be fixed on the back of module surface with adhesive or tape without using any mechanical fastener.

3.0 CALIBRATION

All the instruments to be supplied shall have valid and traceable calibration certificate. Each Pyranometer shall be recalibrated at an interval not more than two years and all other instruments shall be recalibrated at an interval not more than four years.

4.0 DATA LOGGER

Weather Monitoring system shall be provided with standalone Data logger suitable for outdoor application with IP65 Protection and industrial grade hardware suitable for operating temperature up to 55 Deg. C. Data logger shall be calibrated and proven in field for at least one year in outdoor environment. Data logger shall have following minimum features:

Processor	32 bits
Time synchronization	With Built in GPS Clock or with Solar SCADA GPC Clock
Wireless communication	GSM/GPRS Modem
Data storage	SD card, Min 2GB for storage of raw and processed data locally at resolution of 1 Second for retrieval whenever required. Data to be stored shall be in unencrypted CSV or equivalent format.
Display	LCD display for easy maintenance and debugging for site engineer
Scan resolution	1 Sec
Analog to Digital Converter (ADC)	16 Bit, Sampling -10 Hz (Min)
I/P Channel	As required with 20 % spare of each type of channel

It shall have facility for arithmetic processing (Time Integration, Simple Average, and Moving Average etc.) of incoming raw data. Data logger shall be interfaced with Solar SCADA on modbus preferably on TCP-IP. Vendor shall submit Factory Acceptance Test (FAT) report and procedure before dispatch of material to site.

Data logger shall be provided with key-locked door access and all the cables (Power and Signal) to the data logger shall be protected with heavy duty HDPE pipes.

Project file (software, settings and sample reports) shall be handed over to site on permanent storage media (CD/DVD) in two copies after data integrity is verified by site and weather monitoring is commissioned.

1.0 Introduction

This technical specification provides BHEL requirements for supply of UPS with Ni-Cd battery bank for the solar photovoltaic project.

2.0 Scope of supply

Sl. No	Item Description	Qty
1	UPS System - 3KVA, along with Ni-Cd Battery bank	5 set

Note: NTPC approved vendors only are acceptable.

3.0 Technical specifications

The UPS system shall meet the following minimum specifications.

1.0	**Type**	1. UPS System - 3KVA along with Ni-Cd Battery bank shall be required for other four PCUs (placed on inverter platforms).Total auxiliary requirement of PCUs, HT panels and others are included.
2.0	**Configuration**	UPS system shall have **2x100% configuration**, at a time one incomer shall be in service. On failure of any UPS, its load shall automatically get transferred to the other healthy UPS. Suitable auto changeover logic shall be provided. The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg C. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The overall efficiency of UPS shall be at least 80% on full load. The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.
3.0	**Charger**	The chargers shall be self-regulating, solid state silicon controlled, full wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load. Furthermore, the charger should be able to re-charge the fully discharged battery within 8 hours. The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. The charger shall be design for input supply voltage variation of ± 10% and frequency variation of ± 5%. Battery Chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. All Battery Chargers shall be provided with facility for both automatic and

		manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature which may arise during changeover from Auto to Manual mode or vice-versa under normal operating condition. Soft start feature shall be provided to build up the voltage to the set value slowly. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode. When on automatic control mode during Trickle charging, the Charger output voltage shall remain within +/-1% of the set value for AC input voltage variation of +/-10%, frequency variation of +3/-5%, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from zero to full load. Uniform and step-less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire Trickle charging output range specified & shall be capable of matching the float voltage correction recommendations (w.r.t. temperature) as suggested by the respective battery manufacturer. Step-less adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Trickle charging mode. During Boost charging, the Battery Chargers shall operate on constant current mode (When automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be Vernier type. Energizing the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilize, to within the specified limits as mentioned elsewhere, shall be less than fifteen seconds. Momentary output voltage of the Charger, without the Battery connected shall be within 94% to 106% of the voltage setting during sudden load Change from 100% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change.

		Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery. The DC System shall be ungrounded and float with respect to the ground potential when healthy. An earth fault relay shall be provided by the bidder in the DC distribution board for remote annunciation. Digital Outputs shall be configured for connection to the SCADA for realtime charger status updation. Outputs like charger output current, output voltage, float/boost mode, etc may be configured to provide the update to SCADA. The Battery Chargers as well as their automatic regulators shall be of static type. The Chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Nickel-Cadmium Batteries while supplying the D.C. loads. The Batteries shall be Trickle charged at 1.4 to 1.42 Volts per cell. All chargers shall be capable of Boost Charging the associated D.C. Battery at 1.54 to 1.7 Volts per cell at the desired rate. All Battery Chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. A thermal overload relay incorporating a distinct single phasing protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor. The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. Digital or analog indicating instruments shall indicate DC current, DC voltage & AC voltage. The Chargers shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel shall not be less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The Charger shall be tropicalized and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. Treatment as per IS: 6005. Two coats of lead oxide primer followed by powder painting with final shade of RAL9002 for complete panel except end

		covers & RAL 5012 for end covers. All acceptance and routine tests as per the manufacture recommendations and relevant standards shall be carried out. The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application. The Contractor shall also carry out the site tests on battery charger systems required to be conducted as a standard practice of the UPS manufacture or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer. For UPS capacity 5 kVA or more, in addition to indications/display on UPS panel, important alarms along with important analog signal shall also be provided for use in SCADA. For UPS capacity less than 5 kVA bidder shall provide status, common alarm and trip DI (soft or hard) signal to SCADA
4.0	**Battery**	**BATTERY: NICKEL-CADMIUM BATTERY** Ni-Cd vented type, pocket plate high discharge battery of adequate capacity to meet the requirement of UPS, generally conforming to IS-10918. **BATTERY PARAMETERS** a) Battery Voltage : To be decide during Detail Engineering b) No. of Cells : To be decide during Detail Engineering c) Battery type : Nickel-Cadmium d) Nominal discharge voltage per Cell: 1.2 V e) Float voltage : 1.42V/Cell Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters. **CODES AND STANDARDS** All standards, specifications and codes of practice referred to herein, shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes: IEC 60623/ IS 10918 : Specification for vented type Nickel Cadmium Batteries. IS 106 : Quality tolerances for water for storage batteries IEC 60993 : Electrolyte for vented Nickel-Cadmium cells Indian electricity rules Indian electricity acts Equipment complying with other internationally accepted standards such as IEC., BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient

		features for comparison. DC Batteries shall be stationary Nickel Cadmium Pocket plate type conforming to IS:10918. The batteries shall be high/medium discharge performance type suitable for the backup time as specified. For the purpose of design an ambient temperature of 50 deg.C and relative humidity of 85% shall be considered. DC batteries shall be suitable for standby duty. The batteries shall normally be permanently connected to the load in parallel with a charge and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 1.54 to 1.7 volts per cell maximum and float charged at about 1.42 V/cell. **Sizing** a) Environmental temperature 0 to 50 degC. b) Power factor of load - 0.8 c) Adequate I2 t capability to clear fault in the maximum rated branch circuit. d) UPS shall be capable to operate without DC battery in circuit and under all conditions of load. e) In case of failure of a charger / input power, other charger whose input supply is healthy shall be capable to charge the battery and as well supply input power to inverter. No discharge of battery is allowed. f) Inrush current **Construction Features**: **a) Containers** Containers shall be made of polypropylene plastic material. Containers shall be robust, heat resistance, leak proof, non-absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of translucent containers. **b) Vent Plugs** Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent alkali from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition, the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte samples. **c) Plates** The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS:10918. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative terminal posts shall be clearly marked.

		d) Sediment Space Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells. **e) Electrolyte** The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC 60993. The cells can be shipped either in charged condition or in dry condition. Necessary electrolyte for make-up shall be supplied separately. **f) Connectors and Fasteners** Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. The thickness of Nickel coating of connectors should be not less than 0.02 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. **g) Battery racks** Mild steel racks for all the batteries shall be provided. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/High impact plastic insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries racks and supports for cable termination shall be coated with three (3) coats of anti-alkali paint of approved shade. Name plates, resistant to alkali, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. **h) Test** The Contractor shall submit for Owner's approval the reports of all the type tests carried out as per latest IS-1146(for all applicable tests for containers) / IS-10918 (for NI-CD batteries). The complete type test reports shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier. Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of battery.
5.0	**Inverter**	The UPS inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, etc. The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The bidder shall provide status, common alarm and trip DI (soft or hard) signal to SCADA.
6.0	**Efficiency**	a) 100% Full load- 80%
7.0	**Synchronization limit**	Between inverter & standby AC source shall be within 47 Hz to 53 Hz field adjustable. Inverter shall remain synchronized with the AC mains.
8.0	**Inverter protection**	Overload, short circuit and 100% loss of load.
9.0	**Load sharing**	At a time one incomer from UPS shall be in service. On failure of any UPS, its load shall automatically get transferred to the other healthy UPS

		without any degradation of the UPS power quality. Suitable auto changeover logic shall be provided. Power shall be transferred to the standby AC power without a break in synchronization if within limit in case of failure of both inverters. Asynchronous transfer to standby AC source in case inverters are being out of synchronism limit with AC mains.
10.0	**Static switch**	To transfer UPS loads automatically without any break from faulty inverter to standby AC source. Manual bypass switch shall be employed for isolating the UPS during maintenance.
11.0	**Enclosure**	Individual enclosure shall be ventilated switchboard type fabricated from not less than 1.6-mm thick sheet steel. Enclosures shall be furnished with concealed hinges. Front and rear doors shall be designed to permit easy access to all components for maintenance or replacement. The enclosures shall be reinforced with formed steel members as required to form a rigid self-supporting structure. Doors shall have three point latches. Adequate ventilating louvers and enclosure top panels shall be included. All vent openings shall be covered with corrosion resistant fine screen coverings. The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application. The temperature rise inside all the cabinets/enclosures shall not exceed 10 deg.C above ambient temperature.
12.0	**Spare feeders**	25%
13.0	**Accessories**	Power distribution board, Voltage & current meters, power factor meter, KVA, frequency, panel alarms, switches etc. One set of tool shall be provided for maintenance and testing purposes.

4.0 APPROVAL

The Detailed Design Report submitted by the contractor to NTPC must contain but not limited to the following details of the data acquisition and monitoring system:

- Detailed scheme
- Details of panels, metering system
- Necessary drawings for the scheme etc.

Drawings and scheme shall be submitted by the bidder for approval of BHEL/NTPC.

E-2 FIRE FIGHTING AND ALARM SYSTEM

The SPV plant shall be equipped with suitable fire protection & fire fighting systems for protection of entire equipment switchyard & control room as per CEIG requirements.

1.0 Bidder shall comply with recommendation of Tariff Advisory Committee to incurring minimal premium for insurance. The installation shall meet all applicable statutory requirements, safety regulations in terms of fire protection.

2.0 The fire fighting system for the proposed power plant for fire protection shall be consisting of:

a) Sand buckets
b) Portable fire extinguishers
c) Microprocessor based fire alarm panel.

2.1 Portable Fire Extinguishers and Sand Buckets

Bidder to provide following numbers of type tested portable fire extinguishers as per relevant code in the rooms mentioned below.

Rooms	DCP Type (ABC type) (10 Kg. Capacity)	CO_2 Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water $C0_2$ 9 Litre	Sand Buckets
Control Room	2	2	1	1	1
Each Inverter Room	1	1			
ACDB Room(If applicable)	1	1			
Each Transformer Yard	1	1	1		1

2.2 Microprocessor based fire alarm panel

Bidder to provide intelligent microprocessor based main fire alarm panel of modular construction complete with central processing unit, input and output modules, power supply module, supervision control and isolator modules with 10% spare provisions in each loop. Fire detection alarm system shall include) but not limited to the following items

a. Fire Alarm control Panel
b. Multi Sensor smoke detector
c. Heat Detectors
d. Hooter cum strobe
e. Manual call Point
f. Hooter
g. Fault isolation modules
h. Control Modules
i. Cables from Sensors to Fire panels.
j. Digital output from the fire detection system shall be integrated with SCADA
k. Network Control Module
l. Interfacing of Fire Alarm System with SCADA for display and storage of status and alarm in SCADA

Multi sensor type smoke detectors and heat detectors shall be provided for below false ceiling areas of control room and ACDB and/or inverter rooms. One (01) sensor shall be provided for each 20 sq. Meter of area. All the cable trench inside the control room and inverter room shall be provided with Multi Sensor smoke detector.

Fault Isolation module shall be provided in every room and for every 15 sensors at location proposed by Bidder to be approved by employer during detail engineering.

2.3 Fire Alarm Control Panel Indication

i. Alarm conditions shall be immediately displayed on the control panel and in SCADA. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged the LED shall remain lit. A subsequent alarm received from another zone after acknowledgement shall illuminate the alarm LED and the panel display shall show the new alarm information.
ii. During an alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged.
iii. If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated.
iv. All alarm signals shall be automatically “locked in” at the control panel until the operated device is returned to its normal condition and the control panel is manually reset

There shall be weather proof Hooter cum strobe outside and strobe inside each Inverter room and control room for indication fire alarm for respective zone/area at suitable location that is visible from all direction. All the

hardware, relay and accessories required for completeness of fire alarm system is in Bidder scope. Fire alarm system shall have its own battery and charger and it shall be provided power from UPS DB. Each Inverter room and control room shall be also be provided with manual call point, Alarm acknowledge and reset facility for alarm for respective zone only.

Bidder shall submit document to employer for approval that will include fire alarm system configuration, layout, BoM, Datasheet and necessary test report.

Bidder shall consider 30 % design and aging margin for selection of nos. of sensors in each loop and length of each loop. Bidder shall submit the certificate from OEM indicating maximum nos. of sensors in single loop and maximum length of single loop allowed with offered panel and type of cable to be used. Each Fire Alarm Control panel shall have provision for minimum 10 (Ten) % rounded to next higher integer but not less than 2 (two) nos. spare loops for future use of employer.

Bidder shall submit Site Acceptance Test (SAT) for approval by employer. Complete fire alarm system shall be checked at site for verification of faithful performance and completeness of the system. Bidder shall carry out necessary modification and supply hardware/accessories if required.

TECHNICAL SPECIFICATION FOR 33KV INDOOR METERING CUBICLE

There will be 15MW, 7MW indoor metering panel each one number.

The 15MW Indoor metering panel shall have

1. Measuring CT with CL-0.2S, 5VA , 360/1A as per SLD.
2. Measuring PT with CL-0.2, 5VA , 33/√3 kV / 110/ √3 kV as per SLD.
3. ABT meters as per SLD and as per state electricity board approved make.

The 7MW Indoor metering panel shall have

1. Measuring CT with CL-0.2S,5VA , 180/1A as per SLD.
2. Measuring PT with CL-0.2,5VA , 33/√3 kV / 110/ √3 kV as per SLD.
3. ABT meters as per SLD and as per state electricity board approved make.

Note: Maximum foot print of both the panels shall not exceed 1100mm X 1100mm.

All standards, specification and codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of Techno commercial bid. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

Sl No	IS Code	Name Of Equipment
a)	IS: 722	AC electricity meters.
b)	IS: 996	Single phase small AC and universal electrical motors.
c)	IS: 1248	Direct Acting indicating analogue electrical measuring instruments and Accessories.
d)	IS/IEC: 60947	Degree of protection provided by enclosures for low voltage and control gear.
e)	IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts.
f)	IS: 2705	Current transformers.
g)	IS: 3156	Voltage Transformers
h)	IS: 6005	Code of practice for phosphating of iron and steel.
i)	IS: 5082	Specification for wrought aluminium and aluminium alloy bars, rods, tubes and selections for electrical purposes.
j)	IEC: 61850	Communication Standard for Numerical relays
k)	IEC: 61131-3	Automation Standard for Numerical relays
l)	IS: 9046	AC contactors for voltages above 1000 volts and upto and including 11000 Volts.
m)	IS: 13703	Low voltage fuses
n)	IS: 9385	HV fuses
o)	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV
p)	IS: 9921	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V

q)	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
r)	IS: 13118	Specification for high voltage AC circuit breakers.
s)	IEC: 60099-4	Metal oxide surge arrestor without gap for AC systems
t)	IS/IEC: 62271100	High voltage alternating current circuit breakers.
u)	IS/IEC: 62271200	High voltage metal enclosed and control gear.
v)	IEC: 60947-7-1	Terminal blocks for copper conductors
w)	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

TECHNICAL PARAMETERS		
A. SYSTEM PARAMETERS		
a)	Nominal System voltage	33kV
b)	Highest System voltage	36kV
c)	Rated Frequency	50Hz
d)	Number of phases/ poles	Three
e)	System neutral earthing	Solidly Earthed
f)	One minute power frequency withstand voltage	
	- for Type tests	70kV
	- for Routine tests	70kV
g)	1.2/50 microsecond Impulse withstand voltage	170kV (peak)
h)	Minimum system fault level	As per SLD
i)	Short time rating for bus bars, circuit breakers, current transformers and assembly.	As per SLD for one (1) sec.
c	Dynamic withstand rating	2.5 times of system fault current
k)	- Space heaters	240 V AC single phase with neutral solidly earthed
l)	Maximum ambient air temperature	50 deg. C
m)	Internal Arc testing	As Specified in chapter-A2
B. BUS BARS		
a)	Continuous current rating at 500C ambient:	As Per Requirement
b)	Temper Rise allowed above ambient	0 0 40 C for plain joints 55 C for Silver plated joints
c)	Rated Frequency	50Hz
d)	Number of phases/ poles	Three

C. METERING. PANEL CONSTRUCTIONAL REQUIREMENTS		
a)	Colour finish	
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers)
b)	Cable entry	
	Power Cables	Bottom
	Control Cables	Bottom
c)	Earthing conductor	Galvanized steel strip
d)	Service Continuity of metering (LSC2B-PM)	as per IS/IEC 62271200

E. CURRENT TRANSFORMER		
	Accuracy	Two, Tariff CTs shall be with 0.2s accuracy class./ as per tender SLD

F. VOLTAGE TRANSFORMERS		
a)	Accuracy	For tariff metering VT - 0.2

BUSBARS AND INSULATORS

All Busbar and jumper connections shall be of high conductivity aluminium alloy. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

Busbar cross-section shall be uniform throughout the length. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage.

Contact surfaces at all joints shall be silver plated or properly cleaned and non-oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall have high corrosion resistance.

Bimetallic connectors or any other technically proven method shall be used for aluminum to copper connections.

Busbar insulators shall be of arc and track resistant, high strength, nonhygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100pico coulomb at rated voltage x 1.1 / 3. Use of insulators and barriers of in-flammable material such as Hylam shall not be accepted.

Successful Bidder shall furnish calculation establishing adequacy of busbar sizes for the specified continuous and short time current ratings.

All busbars shall be color coded.

The temperature of the busbar and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian Standards, duly considering the specified ambient temperature (50 deg. C). The temperature rise of the horizontal and vertical busbars when carrying the rated current shall in no case exceed 55 deg. C for silver plated joints and 40 deg. C for all other type of joints. The temperature rise at the

terminals intended for external cable termination shall not exceed 40 deg. C. Further the parts handled by the operator shall not exceed a rise of 5 deg. C .The temperature rise of the accessible parts / external enclosure expected to be touched in normal operation shall not exceed 20 deg.C.

EARTHING AND EARTHING DEVICES

A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.

Suitable arrangement shall be provided at each end of the earth bus for bolting to Employer's earthing conductors. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.

All non-current carrying metal work of the panel shall be effectively bonded to the earth bus. Electrical continuity of the whole enclosure frame work and the truck shall be maintained even after painting.

The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.

All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.

VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.

Separate earthing trucks shall be provided by the Contractor for maintenance work. These trucks shall be suitable for earthing the busbars as well as outgoing / incoming cables or busducts. The trucks shall have a interlock to prevent earthing of any live connection.

As an alternative to separate earthing trucks the Bidder may also offer built-in earthing facilities for the busbars and outgoing / incoming connections, in case such facilities are available in their standard proven design. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the panel. These switches shall have facility for padlocking in the earthed condition.

PAINTING

All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

SURGE ARRESTOR

The surge arrestors shall be provided as per tender SLD/ as per system requirement and shall be of metal oxide, gapless type generally in accordance with IEC 60099-4 and suitable for indoor duty. These shall be mounted within the switchgear panel between line and earth, preferably in the cable compartment. Surge arrestor selected shall be suitable for un-earthed system and rating shall be in such a way that the value of steep fronted switching over voltage generated at the switchgear terminals shall be limited to the requirements of switchgear.

INSTRUMENT TRANSFORMERS

All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.

All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

The parameters of instrument transformers specified in this specification are tentative and shall be finalized by the Employer in due course duly

Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.

All voltage transformers shall have suitable current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in isolated position. The secondary fuses shall be mounted on the fixed portion and the fuse replacement shall be possible without drawing out the VT truck from service position.

All voltage transformers shall be designed and manufactured for 0.8 Tesla operating point on B-H curve. VT shall be fully insulated type (i.e. double pole construction and neutral side fully insulated to rated BIL). VT shall be manufactured without any joint in secondary winding.

SPACE HEATER

Each panel shall be equipped with thermostatically controlled space heater(s), suitably located in breaker and cable compartments to prevent condensation within the enclosure. The space heater shall be connected to 240V single phase AC auxiliary supply available in the switchgear, through switches and fuses provided separately for each panel.

A 240V single phase 50 Hz AC plug point shall be provided in the interior of each panel with ON-OFF switch for connection of hand lamp.

POWER CABLE TERMINATION

Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armored / unarmored, PVC jacketed, single core / three core, unearthed / earthed grade power cable(s).

A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Interphase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and

the electrical clearances available shall be submitted for Employer's approval during detail engineering.

Cable termination compartment shall have provision for termination of power cables of sizes as indicated during detailed engineering with removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material. Cable entry shall be from bottom. Any change will be intimated later .

Metering panel with padlock arrangement needs to be as per KSEB approval.

The panel GA and Technical GTP needs to be approved by BHEL/NTPC before manufacturing.

C-13 METERING SYSTEM

1.0 Energy meter (0.2s accuracy class suitable for ABT requirement with metering panel as required conforming to STU/PGCIL requirement shall be as per Cl. 2.0 of Chapter-A2.

2.0 For measurement of Auxiliary power consumption, MFM in ACDB incomer shall be provided by the bidder.

3.0 Meter shall be suitable for interfacing for synchronizing the built-in clock of the meter by GPS time synchronization equipment. Bidder shall synchronize the meter using GPS time synchronization equipment. All the hardware required for synchronization shall be in scope of bidder.

4.0 The ABT meters supplied under this contract shall also meet the requirement of respective RLDC/State power Utilities.

5.0 This metering system shall have following features:

i. Meters shall be microprocessor-based MWH meters having an accuracy class of 0.2S or better. MVARH meters shall have accuracy class of 0.5 or better.

ii. These meters shall have provision for downloading of data through an optical port and /or through RS 232/485 port.

iii. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meters.

6.0 **Technical Requirements of Energy Meters for ABT Requirement**

Contractor shall supply energy meters along with metering station, 4 Nos. machine Clients, 20 nos web client license. MRI or lap top (as applicable) as per the technical specification given below:

a) Shall be microprocessor-based conforming to IEC 62052-11, IEC 62053-22, IS 14697

b) Shall carry out measurement of active energy (both import and export) and reactive energy (both import and export) by 3-phase, 4 wire principle suitable for balanced/ unbalanced 3 phase load.

c) Shall have an accuracy of energy measurement of at least Class 0.2S for active energy and at least Class 0.5 for reactive energy.

d) The active and reactive energy shall be directly computed in CT & VT primary ratings.

e) The reactive energy shall be recorded for each metering interval in four different registers as MVARh (lag) when active export, MVARh (Lag) when active import, MVARh (lead) when active export, MVARh (Lead) when active import.

f) Two separate registers shall be provided to record MVARH when system voltage is >103% and when system voltage is < 97%.

g) Shall compute the net MWh and MVARh during each successive 15-minute block metering interval along with a plus/minus sign, instantaneous MWh, instantaneous MVARh, average frequency of each 15 minutes, net active energy at midnight, , net reactive energy for voltage low and high conditions at each midnight.

h) Each energy meter shall have a display unit. It shall display the net MWh and MVARh with a plus/minus sign and average frequency during the previous metering interval; peak MWh demand since the last demand reset; accumulated total (instantaneous) MWh and MVARh with a plus/minus sign, date and time; and instantaneous current and voltage on each phases.

i) All the registers shall be stored in a non-volatile memory. Meter registers for each metering interval, as well as accumulated totals, shall be downloadable. All the net active/reactive energy values displayed or stored shall be with a plus /minus sign for export/import.

j) At least the following data shall be stored before being over-written for the following parameters.

	Parameters	Details	Min No of days
1.	Net MWH	15 min block	40days in meter
2.	Aver Freq	15 min block	40days in meter
3.	Net MVARH for V > 103%	15min block	40days in meter
4.	Net MVARH for V < 97%	15min block	40days in meter
5.	Cumulative Net MWH at every midnight		10 days in meter/ 40 days in PC
6.	Cumulative Net MVARH for V> 103% at every midnight		10 days in Meter/ 40 days in PC

7.	Cumulative Net MVARH for V < 97% At every midnight		10 days in Meter/ 40 days in PC
8.	Date and time blocks of VT failure on any phase.		

k) Shall have a built in clock and calendar with an accuracy of less than 15 seconds per month drift without assistance of external time synchronizing pulse.

l) Date/time shall be displayed on demand. The clock shall be synchronized by GPS time synchronization equipment being supplied by the contractor.

m) The voltage monitoring of shall be inbuilt feature provided to signal failures to the Substation Automation System, The meter shall be suitable to operate with power drawn from the VT supplies. The burden of the meters shall be less than 2 VA.

n) The power supply to the meter shall be healthy even with a single-phase VT supply. An automatic backup, in the event of non-availability of voltage in all the phases, shall be provided by a built in long life battery and shall not need replacement for at least 10 years with a continuous VT interruption of at least 2 years. Even under absence of VT input, energy meter display shall be available and it shall be possible to download data from the energy meter. Incase data downloading is not possible in absence of VT supply, meter with provision of 220V DC auxiliary power shall be provided. Date and time of VT interruption and restoration shall be automatically stored in a non-volatile memory.

o) Shall have an optical port on the front of the meter for data collection from either a hand held meter reading instrument (MRI) having a display for energy readings or from a notebook computer with suitable software . The contractor shall supply the MRI and/or notebook complete with all optical interface unit required.

p) The meter shall have means to test MWh and MVARh accuracy and calibration at site in-situ and test terminal blocks shall be provided for the same.

q) Each meter shall have a unique identification code provided by the Owner and shall be permanently marked on the front of the meter and stored in the non-volatile memory of the meter.

7.0 **Type Test requirement for Energy Meter**

All Type Test Reports shall be provided as per IEC 62052-11, IEC 62053-22, IS 14697.

ANNEXURE -A

KAYAL WATER TEST READINGS (North of South Bund- 22MW floating Solar plan)											
	pH	Conductivity	Turbidity	CaH	Total hardness	Total Alkali	Chlorides(Cl^-)	Sulphates(So_4^{2-})	Silica(Sio_2)	Fe	Organic Matter
SAMPLE 1	7.66	7.94	2.94	130	790	22	2573.75	38.602	0.8723	0.2016	1.2
SAMPLE 2	7.67	7.85	3.79	140	770	26	2556	34.045	0.8659	0.1837	1
SAMPLE 3	7.64	7.49	4.48	120	750	28	2564.87	36.488	1.3119	0.1318	1.1

sample 1 - From east side
sample 2- From south side
Sample 3- From west side

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PURCHASE SPECIFICATION FOR

SUPPLY OF

ESE LIGHTNING ARRESTOR SYSTEM

01	21-05-2020	VIPINDAS CP	SREENATH M
Revision	**Date**	**Prepared**	**Checked & Approved**

1.0 Introduction

This technical specification provides BHEL requirements for supply of ESE Lightning protection system for the Floating type solar photovoltaic project.

2.0 Scope of supply

Sl. No	Item Description	Qty
A	**Supply of Lightning arrestor protection system** (comprising of following components) • Supply of ESE lightning arrestor terminal as per clause A 1.0 • Supply of 5m LA mounting pole & accessories for array as per clause A 2.0 • Supply of Down Conductor as per clause A 3.0 • Supply of Lightning Event Counter as per clause A 4.0 • Supply of earthing set for LA as per clause A 5.0 • Installation of ESE lightning arrestor as per clause A 6.0	18 sets

3.0 Documents to be submitted along with offer

- BHEL specification duly signed and sealed by vendor on each page
- Product catalogue of ESE-LA
- Type test certificates for ESE-LA terminal with test reports complying to NF C 17 102(2011)
- General arrangement and detailed drawings with bill of materials of the overall LA arrangement
- Lightning arrestor protection coverage area calculations
- Installation manual for ESE-LA

A) Supply and Installation of Lightning arrestor protection system

The vendor shall supply lightning protection system to protect the **floating** solar array, floating inverter platform and control room using ESE-type Lightning arrestors complying to NF C 17 102 (2011) standard. Vendor shall provide the lightning radius coverage with supporting calculations.

The complete lightning protection system will comprise the following key components:

1. ESE type Lightning Air Terminal
2. Mounting support and mounting accessories
3. Down conductor
4. Lightning Event Counter
5. Dedicated earthing system

1.0 ESE type Lightning Air Terminal

1. The lightning air terminal shall be an Early Streamer Emission type terminal which will respond dynamically upon downward leader activity in the near area.
2. The external shape of the advanced lightning rod shall be such that it will limit the development of sharp point corona discharge under static thunderstorm conditions and enhance leader initiation.
3. The lightning air terminal shall have no moving parts and will have no dependence on an external power supply or batteries.
4. All components of the advanced lightning terminal shall be non-corroding.

5. The lightning air terminal should have been tested and certified in accordance with NF C 17-102:2011.
6. The radius of coverage of LA shall be as per protection Level 4 (minimum 107m protection radius).
7. Triggering gap shall be selected so that streamers are not launched until the electric field conditions are at an optimum magnitude for conversion to a stable, propagating upward leader.

2.0 LA mounting pole for Lightning Air Terminal

1. The mounting pole shall be used to support the lightning air terminal. It shall be steel material.
2. Lightning protection system shall protect the solar array modules which are floating on the water body. The lightning pole height shall be minimum 5 m from floater surface level for PV array and inverter platform, and minimum 5 m for control room.
3. The mounting pole shall be supported with minimum 3 set of Guy wires with suitable guy ring, clamps and hardware. The guy wire kit shall be supplied by vendor.
4. Mounting pole shall have appropriate base plate for mounting on floating platform/RCC control room.
5. Suitable provision for running the down conductors through the centre of the pole shall be provided.

3.0 Down Conductor

1. Each lightning air terminal shall be connected to earth (under water) using down conductor.
2. The down conductors shall have a minimum size of 50 mm^2 each and shall be insulated round stranded copper conductor cable of reputed make. The down conductors shall be fixed securely every one meter along the length of mast wherever exposed.
3. Below water down conductor can be bare conductor also.
4. The down conductors shall allow for direct connection to the lightning rod and to the earth electrode through the use of compression lug. The ESE lightning terminal shall have provision for the lug connection. Suitable lugs and hardware shall be supplied along with the down conductor.

4.0 Lightning Event Counter

1. Each ESE type lightning arrester shall be provided with individual lightning event counter to record lightning events arrested by particular ESE LA.
2. Lightning counters shall have IP65 or better rating enclosure and shall have provision for fixing of lightning mast pole using clamp, bolts and nuts.
3. Lightning counter shall have suitable lightning current withstand capacity according to the ESE LA rating. Test links shall be supplied along with each Lightning event counter to enable testing of LA and counter.

5.0 Earthing set for ESE LA

The earthing system shall incorporate minimum two dedicated chemical earth electrode for each ESE LA. The electrode shall be deep driven solid copper, copper bonded steel rod. Earth resistance enhancing compound shall be used in order to reduce the resistivity levels of the earthing system. All components of the earthing system shall be electrically connected to the central injection rod which is securely connected to the lower end of the high voltage shielded cable. The earthing system shall be installed so that the enhanced earth resistance reading does not exceed 5 Ohms.

6.0 Installation of ESE LA

Vendor shall fabricate suitable base plate for fixing the LA on HDPE floating platform or construct the suitable RCC foundations for installing on ground on case to case basis and install the LA mast along with guy wires, down conductor, lightning event counters and test link. The earth pit installation and interconnection with associated LA is also in vendor scope.

B) Documents to be submitted within 7 days after receipt of purchase order

1. General arrangement and detailed drawings with bill of materials of the overall lightning arrestor arrangement
2. Lightning arrestor protection coverage area calculations
3. Mounting details of base plate arrangement.
4. Installation manual for LA-ESE and earthing

C) Documents to be submitted along with consignment

1. ESE LA installation manual with GA drawings
2. Manufacturer test report for each LA

C-10 PLANT ILLUMINATION SYSTEM

This chapter covers supply and installation of suitable illumination system along the peripheral roads and along the approach roads to inverter room and main control room, control room, inverter room(s), switchyard and other facilities inside the plant.

1.0 DESIGN PHILOSOPHY

A comprehensive illumination system shall be provided in the entire project. Each building shall be provided with adequate light fittings,6A/16A socket, fans, etc. Exhaust fans shall also be provided in toilets, battery room, etc

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.

2.0 LIGHTING SYSTEM DESCRIPTION for CMCS and inverter room

Normal AC Lighting System: AC lighting system 415V, 3Phase, 4wire, will be fed from lighting panels Control Board (LPs) which in turn will be fed from the lighting distribution boards (LDBs) of AC Switch board MCC.
Emergency AC Lightning System: The emergency lighting system consisting of 20% of the lights shall be fed from UPS DB or DCDB as per scheme adopted by the EPC bidder. Load of the same has to be considered for UPS/ Battery and charger sizing. Bidder shall provide indoor and outdoor emergency lighting at each inverter room, CMCS, security room and main gate.

3.0 Lighting Fixture, Lamps & Accessories

a. All lighting fixtures and accessories shall be designed for continuous operation for its life under atmospheric conditions existing at site.
b. AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of +/-10%, frequency variation of +/- 5% and combined voltage and frequency variation (absolute sum) of 10% DC lighting fixtures and accessories shall be suitable for operation on 220 V, with variation between 190 V & 240 V.
c. All lighting fixtures shall be complete with lamp(s), lamp holder(s), LED chip assembly, terminal blocks, clamps, locking arrangements, fixing brackets etc. Driver circuit/Control gears shall be provided as applicable / specified. The fixtures shall be fully wired upto terminal block. The internal wiring of the fixtures shall be done with suitable low smoke halogen free thermo-plastic or silicon rubber insulated or fire

retardant PTFE copper conductor wires of suitable size and type. Further fuse protection of suitable rating in input side shall also be provided specifically for LED luminaires. However, the normal cross section of conductor shall be not less than 0.5 Sq. mm and minimum thickness of insulation shall be 0.6 mm. The wiring shall be capable of withstanding the maximum temperature to which it will be subjected under specified service conditions without deterioration and affecting the safety of the luminaire when installed and connected to the supply. All fixing /locking screws, washers, nuts, brackets, studs etc, shall be zinc plated and passivated.

d. All lighting fixtures shall be provided with an external, brass/GI earthing terminal suitable for connecting 14 SWG, GI earthing wire. All metal or metal enclosed parts of the housing and accessories shall be bonded and connected to the earthing terminal as so to ensure satisfactory earthing continuity through out the fixture
e. The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection
f. The reflectors shall be manufactured from CRCA sheet steel or aluminium as specified. The aluminium reflectors shall be made of high purity aluminium sheet, polished electrochemically brightened and anodized or proven alternate arrangement of anodizing
g. Starters shall have bi-metal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without use of any tool. Starter shall have brass contacts and radio interference suppressing capacitor.
h. LED luminaires body shall such designed that heat sink/heat dissipating housing shall be mounted outside the overall luminaires fixture housing, and shall be suitably clearing the driver circuit. Further for outdoor type LED luminaires, the exposed heat sink shall be suitably designed to avoid dust/foreign particles accumulation on the same.
i. LED luminaires housing/body shall be pressure die cast aluminium or extruded Aluminium or CRCA as specified alongwith finished powder coating. Care shall be taken in the design that there is no water stagnation anywhere.

4.0 LED LUMINAIRES:

4.1 CODES AND STANDARDS

All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of techno-commercial bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the

former shall prevail. All work shall be carried out as per the following standards & codes.

16101:2012	General Lighting. LEDs and LED modules Terms and definitions
16102(Part 1):2012	Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.
16102(Part 2):2012	Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.
16103(Part I):2012	LED modules for General lighting Safety Requirements.
15885(Part 2/Sec. 13) :2012	Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules
16104:2012	d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.
16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.
16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products
16107:2012	Luminarie Performance
16108:2012	Photobiological safety of Lamps and Lamp Systems
IS 513	Cold rolled low carbon steel sheets and strips
IS 12063	Classification of degree of protection provided by enclosures.

IS 14700 (Part 3/Sec. 2)	Electro magnetic compatibility (EMC) – Limits for Harmonic emission – THD < 15% (equipment, input current < 16 Amps. per phase.
IS 9000 (Part 6)	Environment testing: Test Z – AD: composite temperature/humidity cyclic test.
IS 15885 (Part 2/Sec. 13) IS 16004 – 1 and 2)	Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules.
IS 4905	Method for random sampling
IEC 60598	Ingress protection, luminaire performance and safety
IEC 61000-3-2	Total Harmonic Distortion
IEC 61000-4-5	Surge Protection
IES-LM 80 along with TM 21/ IS 16105	Lumen Depreciation and Rated life of LED chip
IES-LM 79 / IS 16106	Luminaire optics and color parameter and electrical parameter

4.2 LED LIGHTING SYSTEM

LED Luminaires shall be used for the lighting of all the indoor & outdoor areas. However for DC lighting & hazardous areas conventional type luminaires shall be used. In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.

The individual lamp wattage for LED shall be upto 3 watt for outdoor type luminaires. However for indoor type luminaires fractional wattage LEDs are also acceptable. The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall not be less than 80 Lm/W. Heat sink/heat dissipation arrangement shall be provided in the luminaires. The LED used in the luminaires shall have colour rendering index (CRI) of Min 70 and 80 for outdoor and indoor luminaires respectively.

Colour designation of LED shall be “cool day light” (min 5700K) type for indoor type LED luminaires. Further for outdoor type luminaires, the colour designation shall be 5000K, except for well glass type LED luminaires, where the colour designation shall be 4000K. The LED luminaires shall

have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.
The beam angle for LED chip for indoor type luminaires shall be 120 degrees. However for highbay & flood light type outdoor luminaires the LED chip with suitable beam angle shall be used to deliver better lumen-output. The maximum junction temperature of bare LED without heat sink shall be limited to 85 deg C, further the lumen maintenance at this temperature shall be min 90%. The THD of tube light based LED Luminaires shall be less than 20%. For other type of luminaries, it shall be minimum 10%.

Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9. The marking on luminaire & safety requirements of luminaire shall be as per IS standards. Suitable heat sink/ heat dissipation arrangement, with proper thermal management shall be designed for the luminaires.

Driver Circuit: LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED manufacturer.
LED Drivers may have following control & protections:-

- Suitable precision current control of LED.
- Open Circuit Protection
- Short Circuit Protection
- Over Temperature Protection
- Overload Protection
- Surge Protection

Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have IP55 degree of protection.
Wires of different phase shall normally run in separate conduit.
Power supply shall be fed from 415 / 240 V normal AC supply through suitable number of conveniently located lighting distribution boards (LDB) and at least one 6/16A, 240V AC universal socket outlet with switch shall be provided in offices, cabins, etc.
Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for welding purposes at one location.
Incandescent lamps may be used only with DC Lighting.
Electrification of all building shall be carried out as per IS 732-1989, IS 4648-1968 and other relevant standards.

Indoor Lighting fixtures shall generally be controlled from switch boxes of each area not directly from lighting panel. Each switch shall control a maximum of three fixtures.

All luminaries and their accessories and components shall be of type readily replaceable by available Indian makes.

Following test reports to be submitted for LED chip/LED luminaires:

a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.

b) LM 80/IS: 16105 report.

c) LM 79/IS: 16106 report

5.0 JUNCTION BOXES, CONDUITS, FITTING & ACCESSORIES

Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type.
Junction boxes for street lighting poles and lighting mast if applicable , shall be deep drawn or fabricated type made of min. 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55.
All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox & plate.
Conduits, Pipes and Accessories:
Heavy duty PVC conduits conforming to IS: 9537 Part-III along with various accessories shall be used for indoor wiring in the buildings. These conduits shall be concealed in the wall/floor/roof. However, in PEB's, conduits can be fixed on surface.
Pull out boxes shall be provided at suitable interval in a conduit run .Boxes shall be suitable for mounting on Walls, Columns, etc. Pull-out boxes shall have cover with screw. Pull out boxes used outdoor shall be weather proof type suitable for IP: 55 degree of protection and those used indoor shall be suitable for IP: 52 degree of protection.

6.0 LIGHTING WIRES

Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R,Y,B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper

7.0 LIGHTING POLES

The Street Light system and peripheral lighting shall be designed generally in line with design guidelines. Height of the poles should be chosen so as not to affect working of Solar panels. The poles shall be hot-dip galvanized as per relevant IS2629/ IS2633/ IS4759. The average coating thickness of galvanizing shall be min. 70 micron. The System shall be capable of withstanding the appropriate wind load etc as per IS 875

considering prevailing soil/ site condition considering all accessories mounting on pole.
The street light poles shall have loop in loop out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB. The required illumination level shall be as per Cl. 9.0 taking consideration of existing lighting infrasture.

Hot dipped Galvanized with 80 mm thickness hexagonal/Octagonal lighting pole with inbuilt JB shall also be acceptable
Bidder to provide 20A industrial socket at each 100 meter distance interval at the street light pole.

8.0 EARTHING

Lighting panels, etc. shall be earthed by two separate and distinct connections with earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single phase receptacles etc. shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run along with each conduit run. Cable armours shall be connected to earthing system at both the ends.
Alternately Vendor may offer technically superior and proven product subject to approval of employer.

9.0 AVERAGE ILLUMINATION LEVEL

Location	Average Illumination Level (Lux)	Type of Fixture
Control Room	300	LED Luminaries
Store Room	200	LED Luminaries
Switchgear Room, HT Room	150	LED Luminaries
Inverter Room	150	LED Luminaries
Street lighting-Roads	10	LED Luminaries
Yard/ Substation	20(general) 50(on strategic equipment)	LED Luminaries

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1.	SPV module	I	Q-001	BHEL	Bangalore	A	
				Warree	Surat	A	
				Emmvee	Bangalore	A	
				Vikram Solar	Parganas	A	
				Lanco Solar	Chattisgarh	A	
				Tata Power Solar	Bangalore	A	
				Alpex	Solan	A	
				Synergy	Durgapur	A	
				Photonix	Satara	A	
				HHV Solar	Bangalore	A	
2.	Power Conditioning Unit (PCU)	I	Q-002	Schneider	Bangalore	A	Conditions apply
				ABB	Bangalore	A	Conditions apply
				Bongfiglioli	Germany	A	Conditions apply
				Fecon	Germany	A	Conditions apply
				AEG	Bangalore	A	Conditions apply
				Hitachi-Hirel	Gandhinagar	A	Conditions apply
				Hitachi-Hirel	Sananad	A	Conditions apply
				Vacon	Bangalore	A	Conditions apply
3.	String Monitoring Box (SMB)	II	Q-003	Trinity Touch	Palwal	A	Conditions apply
				Hensel	Sriperumbudur	A	Conditions apply
				AEG	Bangalore	A	Conditions apply

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				Statcon	Pilkhuwa	A	Conditions apply
				Weidmuller	Spain	A	Conditions apply
4.	Weather station panel (comprising of Pyranometer, anemometer & thermometer etc.)	III		Any make-model with VDE/ CE/UL/ CSA marking or BIS approved with CML no. (Refer Note-6)			
5.	DC Cable Connector	III		Any make-model which is Type Tested as per EN 50521 or having marking of VDE/ CE/UL/ CSA/ "BIS with CML no." (Refer Note-1)			
6.	Floor mounted Draw out type indoor LT Switchgear Panel (MCC etc.) Refer Note-5	I	Q-004	L&T	Mumbai / Coimbatore/Ahmednagar	A	BOIs preferably with VDE/CE/UL/CSA marked or BIS approved with valid CML no.
				GE	Bangalore	A	
				C&S Electric	Noida / Hardwar	A	
				Schneider	Nasik	A	ACB from Schneider, France
				Unilec	Gurgaon	A	
				Siemens	Kalwa	A	Conditions apply
				Tricolite	Sahibabad/ Manesar	A	Conditions apply
				Nitya Electrocontrols	Noida	A	
7.	LV Air Circuit	*		C&S Electric	Noida	A	*(part of Swgr MQP)

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
	Breaker						
				L&T	Mumbai	A	
				GE	Bangalore	A	
				Siemens	Germany	A	
				Schneider	France	A	
8.	Floor mounted Fixed type indoor LT Switchgear Panel (ACDB / DCDB / MLDB etc.) Refer Note-5	I	Q-005	Switching Circuits	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Hindustan Control & equipment Ltd	kolkata	A	With fabrication & painting at unit II & MP Electrical Narendrapur
				Maktel	Vadodara	A	Prior Type Testing
				Jakson	Greater Noida	A	
				Vidyut Control	Gaziabad	A	
				Adlec Power	Rohad (Jhajjar)	A	
				Pyrotech	Udaipur	A	
				Conquerent Control System	Manesar	A	Condition apply ,upto 1250A
				Control & Schematics	Hyderabad	A	
				Positronics	Vadodara	A	
				Anand Power Ltd.	Noida	A	
				Additionally all vendors identified for Floor mounted Draw out type indoor LT			

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Switchgear Panel			
9.	Wall mounted fixed type indoor / outdoor LT Switchgear non compartmentalized Panel (Lighting panels / AC / DC Fuse boards etc.) Refer Note-5	I	Q-006	Control Devices	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.
				Jasper	Noida	A	
				Havells	Faridabad	A	
				Novateur Electrical & distribution systems	Murthal	A	
				Avaid Technovator	Manesar	A	
				Additionally all vendors identified for Floor mounted Draw out type indoor LT Switchgear Panel			
				Additionally all vendors identified for Floor mounted fixed type indoor LT Switchgear Panel			
10.	Lighting & Welding Transformer	II	Q-007	Southern Electric	Chennai	A	

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				Indcoil	Thane	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				Precise	Mumbai	A	
				Logicstat	Delhi	A	
				Gujarat Plug in	Vadodara	A	
				AE	Thane	A	
				Power Pack Enterprises	Mumbai	A	
				Amex Impex,	Ahmedabad	A	
11.	LT CT/PT/CBCT/ Control Transformer	III		Kappa	Bangalore	A	
				Southern Electric	Chennai	A	
				Precise	Mumbai	A	
				G&M	Baroda	A	CBCT Only
				Silkaans	Mumbai	A	
				Ind Coil	Mumbai	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				AE	Mumbai	A	
				Logicstat	Delhi	A	For control transformer only
				C&S Electric	Noida	A	For CT only
				Newtek	Aurangabad	A	For CT/PT/Control transformer
12.	1.1Kv LT Power Cable	Refer	Q-008	Universal Cable Ltd.	Satna	A	

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	(From SMB to PCU)	Note-2					
				NICCO	Shamnagar , Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				Incab	Pune	A	
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	A) Unarmoured cable all sizes. B) Armoured cable up to 3.5 x 240 sq. Mm with GI strip armour and 1CX70 sq mm with Al strip armour
				Paramount Cable	Khushkhera	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Sri ram Cables	Bhiwadi	A	
				Ravin Cables	Pune	A	
				Thermocables	Hyderabad	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Gupta Power Cables	Khurda	A	
				Finolex	Pune	A	
				Scot Innovation wires and cables	Baddi	A	
				Anhui Hualing	China	A	

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				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	
				Apar Industries	Umbergaon	A	
				Special Cables	Rudrapur	A	
				ABB Kabel	Germany	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanpur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	
				Dynamic Cables	Jaipur	A	Conditional Approval
13.	1.1 KV Control Cable	Refer Note-2	Q-009	Universal Cable Ltd.	Satna	A	
				NICCO	Shamnagar, Kolkata	A	
				Torrent Cable Ltd	Nadiad	A	
				Incab	Pune	A	
				Polycab WiresPvt. Ltd	Daman	A	
				Hindustan Vidyut Products Ltd	Faridabad	A	
				KEI Industries	Bhiwadi	A	
				Delton Cable Ltd	Faridabad	A	
				Paramount Cable	Khushkher	A	

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					a		
				Gemscabs Industries	Bhiwadi	A	
				Cords Cables	Bhiwadi	A	
				SPM Cables	Hyderabad	A	
				Elkay Telelink	Faridabad	A	
				Havells India Ltd.	Alwar	A	
				R.R. Kabel	Silvasa	A	
				Ravin Cables	Pune	A	
				Gupta Power cable	Khurda	A	
				Thermocables	Hyderabad	A	
				Finolex	Pune	A	
				Sbee Cables	Bangalore	A	
				Suyog Cables	Vadodara	A	
				Scot Innovation wires and Cables	Baddi	A	
				Anhui Hauling	China	A	
				LS Cable	Korea	A	
				Radiant Cables	Hyderabad	A	
				Tirupati Plastomatics	Jaipur	A	
				Apar Industries	Umbergaon	A	
				Special Cables	Rudrapur	A	
				Advance cable	Bengaluru	A	
				Step Industries	Shahjahanpur	A	
				Taihan Electric Wire	Korea	A	
				Tbea Shandong	China	A	
				CMI	Baddi	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Goyoline Fibres(I) Ltd	Daman	A	
14.	HT Cable Upto 11KV	Refer Note 2	Q-010	Universal Cable Ltd.	Satna	A	
				NICCO	Shamnagar , Kolkata	A	
				Torrent Cable Ltd	Nadaid	A	
				Incab	Pune	A	
				Polycab Wires Pvt. Ltd	Daman	A	
				KEI Industries	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Sri ram Cables	Bhiwadi	A	
				Krishna Electrical Industries Ltd	Gwalior	A	
				Apar Industries	Valsad	A	
				Finolex	Pune	A	
				KEC International	Vadodara	A	
				Tirupati Plastomatics	Jaipur	A	
				Gupta Power	Kashipur	A	
				Paramount	Khuskhera	A	
				Gemscab	Bhiwadi	A	
				Sterlite	Haridwar	A	
15.	HT Cable upto 33KV	Refer Note 2	Q-011	Universal Cable Ltd.	Satna	A	
				Torrent Cable Ltd	Nadiad	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Polycab Wires Pvt. Ltd	Daman	A	
				KEI Industries	Bhiwadi	A	
				Havells India Ltd.	Alwar	A	
				Apar Industries	Valsad	A	
				Finolex	Pune	A	
				KEC International	Vadodara	A	
				Gupta Power	Kashipur	A	
				Paramount	Khuskhera	A	
				Gemscab	Bhiwadi	A	
				Sterlite	Haridwar	A	
				Gupta Power	Kashipur	A	
16.	DC Cable (Interconnecting SPV Modules, SPV Module to SMB) As per NTPC specification	I	Q-012	Siechem	Pondicherry	A	Upto 35 sq.mm.
				Apar	Khatalwada	A	Conditions apply
17.	Battery (Ni-Cd)	II	Q-013	M/S HBL-Power System	Hyderabad	A	Up to 990 Ah with conditions
				M/S Amcosaft	Bangalore	A	8Ah to 990Ah- KPH type 10Ah to 1365 Ah- KPM type 11Ah to 1550Ah – KPL type
18.	Battery Plante /Tubular	II	Q-014	M/s Exide	Kolkata	A	
				Hoppeke	Brilon,Ger	A	

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					many		
19.	Battery charger	II	Q-015	M/s Amararaja	Tirupati	A	
				M/s HBL- Power System	Hyderabad	A	
				M/s Chhabi electrical	Jalgaon	A	
				M/s. Chloride Power	Kolkatta	A	
				M/s Statcon	Hapur	A	Up to 220, V 850 A
				M/s Dubas	Bangalore	A	Up to 220 V, 250 A
				M/s Saft Nife Power Systems	Singapore	A	
				M/s Masstek	Jalgaon	A	
20.	Earthing & Lightning Protection Material like GI Strip/GI Wire etc	III		Main contractor Approved Sources box subject to galvanization at NTPC approved sources as per Note-4			
21.	HT Cable Termination Kits & Straight Through Jointing Kit (Heat shrinkable type)	III		M/s 3M Electro & Communication	Pune	A	Upto 33KV
				Raychem	Halol	A	Upto 33KV
				Hari Consolidated	Delhi	A	Upto 11KV(conditions apply)
22.	Lighting fixtures with accessories including lamp (Filament type)	II	Q-016	M/s Crompton	Mumbai	A	
				M/s Bajaj Electricals	Mumbai	A	

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				M/s Philips	Noida	A	
				M/s Wipro	Mumbai	A	
				M/s Surya Roshni	Noida	**A**	Conditions apply
23.	Lighting fixtures with accessories including lamp (LED type)	II	Q-017	M/ s Wipro	Pune	A	Conditions apply
				M/s Surya Roshni	Noida	A	Conditions apply
				M/s Bajaj	Mumbai	A	Conditions apply
				M/s Goldwyn	Noida	A	Conditions apply
24.	MCB Boxes/Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III		Main Contractor approved sources with galvanization from NTPC approved sources			BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no, Refer Note-6
25.	Industrial /welding receptacles & boxes	III		Schneider	Nasik	A	
				M/s BCH	Faridabad	A	
				M/s Ajmera	Mumbai	A	
				M/s. Sakthi & Crown	Chennai	A	
				Any other make having CE / UL / CSA mark or BIS approval with valid CML number.			
26.	PVC conduit/hume pipe/lighting wire/GI	III		BIS licensee with valid CML number / ISI marked with valid CML number			

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	pipes/HDPE pipe/Structural Steel/ GI steel rigid conduit/ epoxy conduit						
27.	MV Switchgear Panel (Refer Note-5)	I	Q-018	BHEL	Bhopal	A	Upto 33KV
				Megawin	Salem	A	Upto 33KV
				L&T	Ahmednagar	A	Upto 33KV
				Siemens	Mumbai	A	Upto 33KV
				Jyoti	Vadodara	A	Upto 33KV
				ABB	Nasik	A	Upto 33KV
				Schneider	Kolkata	A	Upto 11KV -Salt lake works -VG series Interrupter made at Salt Lake Works
28.	MV Vacuum Type Circuit Breaker	(part of Swgr MQP)		Siemens	Mumbai	A	Upto 33kv
				BHEL	Bhopal	A	Upto 33kv
				L&T	Ahmednagar	A	Upto 33kv
				ABB	Nasik	A	Upto 33kv
				ABB	Italy	A	Upto 33Kv
				Megawin	Salem	A	Upto 33kv
				Jyoti	Vadodara	A	Upto 33kv

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Schneider	Kolkata	A	Upto 11kv
29.	IEC 61850 compliant Numerical Protection Relays	(Part of Swgr MQP)		SEL	Pullman, USA	A	
				ALSTOM T&D	Stafford, UK	A	P14X, P34X, P44X, P64X, P74X models only.
				ALSTOM T&D	Chennai	A	P14X, P24X, P34X, P44X, P64X, P74X models only.
				ABB	Finland	A	
				ABB	Baroda	A	For 6XX Series
				GE Multilin	Zamudio, Vizcaya, Spain/ Markham, Ontario, Canada	A	F-650 only
				Schneider	Stone, UK	A	PX30, PX40, VAMP 5X and VAMP 2XX models only.
				Siemens	Germany	A	7SX Series only
				Siemens	Goa	A	7SR2X , 7SJ66X series only
30.	Single Rod Air Terminal Type Solar Array Lightning	III		Main Contractor approved sources: subject to manufacturer / supplier having valid Type Test Report as per IS 2309 or equivalent Standard			

INDICATIVE

एनटीपीसी NTPC	PROJECT : DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP KAYAMKULAM KERALA PACKAGE : SOLAR CONT. NO. :				INDICATIVE VENDOR LIST		DOC NO. : REVISION NO. 00 PAGE : 15
Sl. No.	**ITEM**	**QP / INS CAT.**	**QP No. -**	**ACCEPTABLE SUPPLIER AS PER DATABASE**	**PLACE**	**SC APPL STATUS**	**REMARKS**
	Arrestor						
31.	ESE Type Solar Array Lightning Arrestor	III		Main Contractor approved sources: subject to manufacturer / supplier having valid Type Test Report as per latest version of NF C 17-102 & country of origin documents			
32.	Lighting Poles	III		BIS Licensee as per IS 2713			
33.	Cable Lug	III		M/s Dowell	Mumbai	A	
				M/s Billets Elektro Werke Ltd. (3 D)	Umbergaon	A	
				M/s Chetna	Nasik	A	
				Additional Vendors with Make-Model having mark of VDE/ UL /CSA / BIS with CML no. Refer Note-1			
34.	Cable Gland	III		Any Make-Model having mark of VDE/ UL /CSA / BIS with CML no. Refer Note-1			
35.	GI Cable Tray, fitting, accessories including bends	Refer Note-3	Q-019	Inar Profiles Ltd	Enkapalli (Vishakhapatnam)	A	
				Vatco	Mumbai	A	Galvanization at Sigma Mumbai
				Indiana cable trays	Mumbai	A	Galvanization at Karamtara galvanizer- Mumbai
				Industrial Perforation	Kolkata	A	Galvanized and offered for inspection at M/s Industrial Perforation Pvt Ltd, Ganganagar , Kolkata, WB
				Ratan Projects	Howrah	A	Galvanization at DMP Projects- Howrah

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एनटीपीसी NTPC	PROJECT : DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP KAYAMKULAM KERALA PACKAGE : SOLAR CONT. NO. :				INDICATIVE VENDOR LIST		DOC NO. : REVISION NO. 00 PAGE : 16
Sl. No.	**ITEM**	**QP / INS CAT.**	**QP No. -**	**ACCEPTABLE SUPPLIER AS PER DATABASE**	**PLACE**	**SC APPL STATUS**	**REMARKS**
				India Electric Syndicate	Kolkata	A	Galvanization at BMW Industries/B.P Projects- Howrah
				Steelite engg.	Mumbai	A	
				Premier Power Products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Indiana Gratings	Pune	A	
				M.J. Engineering	Okhla/ Bhiwadi	A	
				T.R.G	Chennai	A	Galvanization at TM Radhakrishna Chetty & Co-Chennai
				Amtech	Pune	A	Galvanization at B.G. Shirke - Pune
				Kannade Anand Udyog	Mumbai	A	Fabrication at their units: Plot No. 42, Morivali, MIDC Thane & Plot No.: D-35 Anand Nagar MIDC, Addl. Ambernath , Dist.Thane Galvanization and offer the galvanized cable trays for inspection at D-34 Anand Nagar MIDC, Addl. Ambernath, Dist.Thane.
				Rukmani	Raipur	A	Ladder type cable trays only
				Passive Infra	Hasangarh (Rohtak)	A	
				Unitech Fabricators & Engineers	Howrah/ Hoogly (Kolkata)	A	
				Patny System	Hyderabad	A	
				Rabi Engg	Kolkata	A	Galvanizing from NTPC approved sources
				MKSD Industries	Taloja	A	Galvanising at Encorp Power trans PVT Ltd, Palghar
				Reliable Sponge	Kalunga	A	
				Rukmani	Hoogly	A	Galvanization at Rukmani Fab & Gal- Howrah
				Eros Metal Works	Nagpur	A	Conditions apply

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Indmark Formtech	Pune	A	Conditions Apply
36.	Cable Tray Flexible Tray Support System	Refer Note-3	Q-020	Vatco	Mumbai	A	Galvanising at Sigma Mumbai
				Inar profiles	Enkapalli	A	
				Industrial perforations	Kolkata	A	
				Premier power products	Howrah	A	Galvanising at Neha Galvaniser- Howrah
				Steelite engg.	Mumbai	A	
				Indiana gratings	Pune	A	Galvanising at Poona Galvaniser- Pune
				Amtech	Pune	A	Galvanising at B.G. Shirke- Pune
				Ratan Projects	Howrah	A	Galvanization at NTPC approved sources
				MKSD Industries	Taloja	A	Galvanising at Encorp Power trans PVT Ltd, Palghar
				Indmark Formtech	Pune	A	Conditions apply
37.	Piping – ERW (IS 1239)	III		Main Contractor approved sources; with valid BIS license			
38.	INSTRUMENTATION CABLE	REFER NOTE-2	Q-021	DELTON CABLES LTD	FARIDABAD	A	PVC, FRLS TYPE
				PARAMOUNT COMMUNICATION LTD	KHUSHKHERA	A	PVC, FRLS TYPE
				CORDS CABLE INDUSTRIES LTD	BHIWADI/ KAHARANI	A	PVC, FRLS TYPE
				KEI INDUSTRIES LTD	BHIWADI	A	PVC, FRLS TYPE
				POLYCAB WIRES PVT. LTD	DAMAN	A	PVC, FRLS TYPE
				THERMOCABLES	HYDERABAD	A	PVC, FRLS TYPE

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				ELKAY TELELINKS	FARIDABAD	A	PVC, FRLS TYPE
				GUPTA POWER	KHURDHA	A	PVC, FRLS TYPE
				CMI	Faridabad	A	PVC, FRLS TYPE
				Universal Cables	Satna	A	PVC, FRLS TYPE
39.	FIRE ALARM PANEL (-MICROPROCESSOR BASED) & MANNUAL CALL POINTS	II	Q-022	NOTIFIER	USA	A	
				TYCO	USA	A	SIMPLEX BRAND
				AUTRONICA	NORWAY	A	
				SCHRACK	AUSTRIA	A	
				EDWARDS	USA	A	
				Shield Fire Safety	UK	A	
40.	ADDRESSABLE DETECTORS (MULTI SENSOR), INTERFACE UNITS ,HOOTER CUM STROBE & HOOTER	II	Q-023	NOTIFIER	USA/GURGAON	A	
				TYCO	USA	A	SIMPLEX BRAND
				AUTRONICA	NORWAY	A	
				SCHRACK	AUSTRIA	A	
				EDWARDS	USA	A	

INDICATIVE

Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Shield Fire Safety	UK	A	
41.	FIBRE OPTIC CABLES	III		BIRLA ERICSSON OPTICAL	REWA	A	
				AKSH FIBER	BHIWADI	A	
				FINOLEX	PUNE/GOA	A	
				R&M	SWITZERLAND	A	
				HFCL	GOA	A	
				Molex	UK	A	
				Corning	USA	A	
42.	PLC BASED SCADA SYSTEM	I	Q-024	SIEMENS	NASIK	A	
				SCHNEIDER ELECTRIC	BANGALORE	A	
				ROCKWELL AUTOMATION	SAHIBABAD	A	
				ABB	BANGALORE	A	
				GE INTELLIGENT PLATFORM	BANGALORE	A	
43.	ENCLOSURE FOR PANELS	*		PYROTECH	UDAIPUR	A	*Part of PLC Based SCADA System
				PENTAIR (HOFFMAN)	BANGALORE	A	*Part of PLC Based SCADA System
				RITTAL	BANGALORE	A	*Part of PLC Based SCADA System
				MPP	Bangalore	A	*Part of PLC Based SCADA System
44.	UPS SYSTEM with	I	Q-025	FUJI ELECTRIC	JAPAN	A	

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एनटीपीसी NTPC	PROJECT : DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP KAYAMKULAM KERALA PACKAGE : SOLAR CONT. NO. :				INDICATIVE VENDOR LIST		DOC NO. : REVISION NO. 00 PAGE : 20
Sl. No.	**ITEM**	**QP / INS CAT.**	**QP No. -**	**ACCEPTABLE SUPPLIER AS PER DATABASE**	**PLACE**	**SC APPL STATUS**	**REMARKS**
	ACDB						
				Vertiv Energy (Emerson)	AMBERNATH	A	APPROVED UP TO 160 KVA, 1Φ
				HITACHI HIREL	GANDHINAGAR	A	APPROVED UP TO 160 KVA, 1Φ
				Vertiv Energy (DB Power)	PUNE	A	APPROVED UP TO 125 KVA, 1Φ
				KELTRON	TRIVENDRUM	A	APPROVED UP TO 150 KVA, 1Φ
				GUTOR	SWITZERLAND	A	
				AEG(Saft)	Germany	A	
45.	CCTV COMPONENTS IP Based (Refer Note-7)	II	Q-026	BOSCH	BANGALORE	A	1.All active main CCTV components like Camera, Server / Storage, Joystick, Video management software will be of Bosch make and to be procured from ***M/s. Bosch Ltd., Bangalore*** [Work address: ***Hosur Road, Adugodi, Bangalore – 560 030***]. 2.Other items like workstation, keyboard, monitors, network switches, media converters, interconnecting cables will be supplied as per LOA agreed source.
				Axis	Sweden	A	1-CCTV components will be of Axis communication AB,Sweden make & Video Management Software will be of Milestone Brand. 2.To make the system complete, other indigenous items like server/OWS/PC, Network Switch, Cables etc are to be procured from NTPC approved sources which will be tied up during the finalization MQP 3. Toshniwal Industries Pvt lts (works address: industrial Estate, Makhupura, Ajmer-305002, Rajasthan, India) will do the complete integration of CCTV System and installation at site which is noted by NTPC.
				Honeywell	Gurgoan	A	CCTV active component including explosion proof camera along with VMS will be honeywell china make

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46.	Fire Extinguisher	III		BIS approved sources with valid BIS License.			
47.	Circuit Breaker upto 220 Kv (SF6 & outdoor type)	I	Q-027	Siemens	Aurangabad	A	
				ABB	Vadodara	A	
				CGL	Nasik	A	
				BHEL	Hyderabad	A	
				GE	Kanchipuram	A	
48.	Isolator upto 220 kv (outdoor type)	I	Q-028	GR Power	Hyderabad	A	
				Hivelm	Chennai	A	
				S&S	Pondicherry	A	
				Switchgear & Structurals	Hyderabad	A	
				Siemens Ltd	Hyderabad	A	
49.	PT (Outdoor Type, upto 33Kv)	I	Q-029	Mehru	Bhiwadi	A	
				ABB	Vadodara	A	
				GE	Hosur	A	
				CGL	Nasik	A	
50.	CT (Outdoor Type, upto 220 Kv Oil Filled	I	Q-030	Mehru	Bhiwadi	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
	type)						
				GE	Hosur	A	
				ABB	Vadodara	A	
				CGL	Nasik	A	
				BHEL	Jhansi/Bhopal	A	
				Vishal Transformer	Meerut	A	UP TO 33 KV CT ONLY
				Heptacare	Meerut	A	UP TO 33 KV CT ONLY
51.	CVT (Outdoor Type, upto 220 Kv	I	Q-031	GE	Hosur	A	
				ABB	Vadodara	A	
				CGL	Nasik	A	
				BHEL	Jhansi/Bhopal	A	
52.	LA (Outdoor Type, upto 220 Kv)	I	Q-032	Oblum	Hyderabad	A	
				Lamco	Hyderabad	A	
				Elektrolite	Jaipur	A	UP TO 33 KV ONLY.
				CGL	Nasik	A	
53.	AB Tariff energy meter	II	Q-033	SEMS	Udaipur/Solan	A	Inspection with representative from Local Electricity Board.
				Elster	Mumbai	A	
				L&T	Mysore	A	With CMS software.
54.	Conductor	III		Smita	Ghaziabad	A	
				Gupta Power Infra	Bhubaneswar	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Saravathy	Bangalore	A	
				Galaxy	Sangli	A	
				Hindustan Vidyut products	Faridabad	A	
				Apar Industries	Vadodara / Silvassa	A	
				Hira Cables	Hirakud	A	
				JSK	Silvasa	A	
				Cabcon	Kolkatta	A	
55.	Disc Insulator/Long Rod Insulator	III		Aditya Birla	Rishra	A	For Disc Insulator only
				Aditya Birla	Halol	A	For Long Rod Insulator only
				IEC	Bhopal	A	For Disc Insulator only
				WSI	Chennai	A	For Disc Insulator only
				BHEL	Bangalore	A	
				Imperial Ceramics	Bikaner	A	For Disc Insulator only, Upto 90KN
				Modern Insulator	Abu Road	A	For Disc Insulator only
				Goldstone	Hyderabad	A	For Long Rod Insulator only
56.	Bus Post Insulator	III		Aditya Birla	Halol	A	
				IEC	Bhopal	A	
				WSI	Chennai	A	
				MODERN Insulator	Abu Road	A	
				SARAVANA Global Energy	Cuddalore	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
57.	Clamps & connectors	III		KLEMMEN ENGG	CHENNAI	A	
				MILIND	MUMBAI	A	
				EMI	MUMBAI	A	
				NOOTAN ENGG	MUMBAI	A	
				TAG CORPORATION	CHENNAI	A	
				ITPL	MUMBAI	A	
				RASHTRAUDYOG	KOLKATA	A	
				PEE VEE ENGG	BANGALORE	A	
				MEGHA Engg	CHENNAI	A	
				EXALT	Mumbai	A	
58.	Insulator hardware, conductor accessories & earthwire accessories	III		RASHTRA UDYOG	KOLKATA	A	
				IAC	KOLKATA	A	
				ITPL	MUMBAI	A	
				EMI	MUMBAI	A	
				EMTT	Kolkatta	A	
59.	Aluminium tube	III		HINDALCO	RENUKUT	A	
				INDALCO	ALUPURAM	A	
				CENTURY EXTRUSIONS	KOLKATA	A	
				JINDAL ALUMINUM TUBE	BANGALORE	A	
				ALOM EXTRUSIONS	KOLKATA	A	
				BALCO	KORBA	A	

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				SUDAL	NASIK	A	
				Banco	Vadodara	A	
60.	Switchyard Control & Relay Panel / SAS	I	Q-034	GE (Alstom)	Chennai	A	
				Siemens	Kalwa/Goa	A	
				ABB	Peenya	A	
				Schneider	Noida	A	
				BHEL	Bhopal	A	Approved for C&R Panel only
61.	Numerical Relays for Switchyard	(part of C&R MQP)		GE	UK/Chennai	A A	
				Siemens	Germany	A	
				ABB	Sweden/ Bangalore	A	
				Schneider	UK	A	
62.	Transformer (Oil filled type) Refer Note-8	I	Q-035	BHEL	Bhopal	A	up to 400 kV Class
				GE (T&D)	Naini	A	up to 400 kV Class
				Toshiba	Hyderabad	A	up to 400 kV Class
				TELK	Agnamaly, Kerala	A	up to 400 kV Class
				ABB	Vadodara	A	up to 765 kV Class

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				CG Power & Industrial Solutions Ltd.	Kanjur Marg	A	up to 400 kV Class
				EMCO	Thane	A	up to 400 kV Class
				BHEL	Jhansi	A	up to 220 kV Class
				Schneider	Vadodara	A	up to 50 MVA, 132 kV Class
				T&R	Ahmedabad	A	up to 90 MVA, 132 kV Class
				Kanohar	Merrut	A	up to 16 MVA, 33 kV Class
				EMCO	Jalgaon	A	up to 16 MVA, 33 kV Class
				Kirloskar	Mysore	A	up to 16 MVA, 33 kV Class
				Andrew Yule	Chennai	A	up to 10 MVA, 33 kV Class
				Tesla (unit-2)	Bhopal,(23A, Sector-B, Industrial Area, Govindpura, Bhopal	A	up to 5.0 MVA, 33 kV Class,
				Indotech Transformers	Chennai	A	up to 16 MVA, 11 kV Class
				PETE Hammond	Hyderabad	A	up to 10 MVA, 33 kV Class
				CG Power & Industrial Solutions Ltd.	Malanpur	A	up to 7.5 MVA, 33 kV Class
				ECE	Sonepat	A	up to 4.0 MVA, 11 kV Class
				Voltamp	Savli	A	up to 3.5 MVA, 33 kV Class
				Kirloskar	Pune	A	up to 2.0 MVA, 33 kV Class
				RAYCHEM RPG	Pune	A	Up to 5 MVA, 33 kV Class
				Esennar	Medak	A	Up to 16 MVA, 66 kV Class
				Technical Associate Ltd	Sitarganj	A	up to 16 MVA, 33 kV Class, Conditions Apply
				Prime Meiden Ltd	Nellur	A	up to 63 MVA, 132 kV Class
				KRYFS Power Components Ltd	Silvassa	A	Up to 2.5 MVA, 33 kV Class

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Sl. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
				Sudhir Transformers	Bangalore	A	Upto 12.5 MVA, 33KV Class
				Sudhir Power Ltd	Silvassa	A	Upto 12.5 MVA, 33KV Class
63.	Dry Type	I	Q-036	ABB	Savli	A	up to 8 MVA, 24 kV Class
	Transformer			Raychem	Pune	A	Up to 3.5 MVA, 33 kV Class
	(refer note-8)			Toshiba	Hyderabad	A	Up to 2.0 MVA, 33 kV Class
				BHEL	Jhansi	A	Up to 6.3 MVA, 33 kV Class
				Kirloskar	Pune	A	Up to 4.0 MVA, 33 kV Class
				Voltamp	Savli	A	Up to 3.25 MVA, 33 kV Class
				PETE Hammond	Hyderabad	A	Up to 95 KVA, 33 kV Class
				Sudhir Power Ltd	Silvassa	A	Upto 12.5 MVA, 33KV Class
64.	132KV Cables	I	Q-037	Iljin Electric	South Korea	A	
				KEI Industries	Bhiwadi	A	
				Phelps Dodge	Bangkok	A	
				Universal Cable Ltd.	Satna	A	
65.	Battery Health Monitoring System (220V/110V)	II	Q-038	M/s. Chloride Power	Kolkatta	A	
				M/s Dubas	Bangalore	A	
				M/s HBL- Power System	Hyderabad	A	

Under Sub Supplier approval status as per NTPC column:
A: mean that manufacturer proposed main contractor for this items is acceptable to NTPC.
CA: mean that manufacturer proposed by main contractor is acceptable to NTPC with certain conditions

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DR-mean that manufacturer proposed by main contractor for the items will be assessed by NTPC. Main contractor is obliged to procure the item from "DR" category manufacturer only after written approval from NTPC

Under QP / INSPN CATEGORY column:

CAT-I : For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection & witness by NTPC

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on basis of verification of documents as per approved QP

CAT-III : For these items Main supplier approves the Quality Plans. The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.

General Notes:

1) Vendors acceptance is subject to sub-QR clearance as applicable. Sub-QR/Proveness criteria as per the scope/technical specification shall also be applicable for consideration as approved manufacturer/vendor

2) Vendor list & inspection category of the mandatory spares shall be as mentioned above.
3) For item not appearing in the above list, Main Contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
4) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

Note-1- "TYPE TEST REPORT AS PER EN 50521" OR "VDE / CE / UL / CSA MARKING CERTIFICATION PREFERABLY FROM THIRD PARTY AGENCY" OR "BIS APPROVAL LETTER" SHALL BE SUBMITTED FOR NTPC's VERIFICATION /INFORMATION.

Note-2-

Category of inspection for Instrumentation cable/LT Cable(Power & controls) :

TOTAL CONTRACT QUANTITY PER SIZE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 1KM PER SIZE/TYPE	CAT-III AND SUBMISSION OF TC AND CERTIFICATE OF CONFORMANCE BY MAIN CONTRACTOR
TOTAL QUANTITY UPTO 2.5 KM PER SIZE/TYPE	CAT-II
TOTAL QUANTITY MORE THAN 2.5 KM PER SIZE/TYPE	CAT-I

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Category of inspection for HT cables

TOTAL CONTRACT QUANTITY PER SIZE/TYPE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 500 M	CAT-III
GREATER THAN 500 M	CAT-I

Note-3-

FOR CABLE TRAYS THE CATEGORY OF INSPECTION SHALL BE AS FOLLOWS

TOTAL CONTRACT QUANTITY PER SIZE /TYPE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 1KM	CAT-III AND SUBMISSION OF TC AND CERTIFICATE OF CONFORMANCE BY MAIN CONTRACTOR
GREATER THAN 1 KM AND LESS THAN EQUAL TO 5 KM	CAT-II
GREATER THAN 5 KM	CAT-I

FOR CABLE TRAYS SUPPORT SYSTEM:

THE CATEGORY OF INSPECTION SHALL BE AS FOLLOWS

TOTAL CONTRACT QUANTITY PER TYPE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 1KM OF SUPPORT CHANNEL	CAT-III AND SUBMISSION OF TC AND CERTIFICATE OF CONFORMANCE BY MAIN CONTRACTOR
GREATER THAN TO 1KM AND LESS THAN 5 KMS OF SUPPORT CHANNEL	CAT-II
GREATER THAN TO 5KM OF SUPPORT CHANNEL	CAT-I

INDICATIVE

TOTAL CONTRACT QUANTITY PER SIZE / TYPE	CATEGORY OF INSPECTION
LESS THAN EQUAL TO 500 NOS. OF CANTILEVER ARMS	CAT-III AND SUBMISSION OF TC AND CERTIFICATE OF CONFORMANCE BY MAIN CONTRACTOR
GREATER THAN TO 500 NOS. AND LESS THAN 2500 NOS CANTILEVER ARMS	CAT-II
GREATER THAN TO 2500 NOS. CANTILEVER ARMS	CAT-I

Note-4- Indicative List of acceptable galvanizing sources:

1. M/s M J Engg,Delhi 2. M/s Indmark , Pune 3. M/s A.V. Engg, Kolkata 4. M/s Inar Profiles, Vishakapatnam 5. M/s Anand Udyog, Mumbai 6. M/s Techno Engg,Chandigarh 7. M/S Steelite Engg, Mumbai	8. M/s National Galvanizer, Kolkata 9. M/s Unistar Galvanizer, Kolkata 10. M/s B.P. Project. Kolkata 11. M/s Bajaj Pune 12. M/s Electrocare Industries, Mumbai 13. M/s B.G. Shirke, Pune 14. M/s Gurpreet Galvanizer, Hyderabad	15. M/s Sigma, Mumbai 16. M/s Radhakrishnan Shetty, Chennai 17. Karamtara Mumbai 18.Poona Galvanizers Pune 19. Neha Galvanizer- Kolkata 20. Unitech Fabricators & Galvanizers- Hoogly 21. Patny Systems- Mehdak	22. Indian Gratings, Pune 23. Encorp Power trans PVT Ltd, Palghar 24. Reliable Sponge, Kalunga 25- Rukmani Fab & Gal- Howrah

Note-5:

a. Raw material & Bought Out components for main equipment will be finalized with vendor identified by Main Contractor.

Note-6: "VDE / CE / UL / CSA MARKING CERTIFICATION PREFERABLY FROM THIRD PARTY AGENCY" OR "BIS APPROVAL LETTER" SHALL BE SUBMITTED FOR NTPC's VERIFICATION /INFORMATION.

INDICATIVE

Note-7: CCTV Components consists of Camera with motorized zoom lens, Enclosure, Pan Tilt arrangement, Matrix Switcher, Key Board with LCD, Digital Video Recorder, Monitor, Receiver Driver Unit, Code Distribution unit, Amplifier etc. shall be supplied from the principal manufacturer of CCTV and shall be identical make. Other than this item can be supplied from Indigenous local source approved by NTPC or Principal Manufacturer's approved source.

Note-8:

8.1 Raw material & bought out components for main equipment will be finalized with vendor identified by Main Contractor.

8.2 For Auxiliary Transformers (Oil Filled & Dry Type- below 1.0 MVA, 11 KV Class):

a. Main Contractor's approved sub-vendors will also be acceptable subject to sub-vendor shall have minimum two years of supply experience for similar rating & type of transformers.

b. NTPC will review the Routine Test Inspection Report, witnessed by Main Contractor as per IS 2026/IS 1180 for Oil Filled Transformer and as per IS 11171 for Dry type Transformer

INDICATIVE

	PROJECT: DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP,KAYAMKULAM KERALA	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS					
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
1.	**CEMENT**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
2.	**CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS WATER PROOFING COMPOUNDS GROUTS**	**III**	-	SIKA INDIA LTD	-	A	
				CICO TECHONOLOGIES LTD	-	A	
				FOSROC CHEMICALS (I) PVT LTD	-	A	
				BASF	-	A	
3.	**PAINT AND PAINTING SYSTEM**	**III**	-	BERGER	-	A	
				SHALIMAR PAINTS	-	A	
				JENSON AND NICHOLSON	-	A	
				KANSAI NEROLAC	-	A	
				AKZO NOBEL	-	A	
				ASIAN PAINTS	-	A	
4.	**GI PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
5.	**BITUMEN ASPHALT**	**III**	-	ALL GOVERNMENT REFIINARIES	-		
6.	**PLASTIC/ PVC PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
7.	**BITUMEN IMPREGNATED FIBER BOARD JOINT FILLER , BITUMEN SEALING COMPOUND**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
8.	**CERAMIC / VITRIFIED TILES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	

INDICATIVE LIST

	PROJECT: DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP,KAYAMKULAM KERALA	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS					
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
9.	**PARTICLE BOARDS, PLYWOOD, MDF**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
10.	**HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING**	**III**	-	STP	-	A	
				IWL INDIA LTD	-	A	
				LLOYDS	-	A	
				CICO TECHONOLOGIES LTD	-	A	
				FOSROC CHEMICALS (I) PVT LTD	-	A	
11.	**POLYTHENE WATER STORAGE TANKS**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
12.	**MINERAL WOOL FOR THERMAL INSULATION**	**III**		ROCKWOOL INDIA LTD.	HYDERABAD	A	
				PUNJSTAR INSULATION FIBRE COMPANY	BHILAI	A	
				LAPINUS	MALANPUR (MP)	A	
				MINWOOL	RAJANANDGAON	A	
				LLOYD INSULATION	BHILAI	A	
				GOENKA ROCKWOOL (I) PVT LTD	RAIPUR	A	
				SHREERAM EQUITECH PVT LTD	DURG	A	
				U.P. TWIGA	BULENDSHAHAR	A	
13.	**CI PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE			
14.	**FLOATING SYSTEM**	**III**		MAIN CONTRACTOR'S APPROVED SOURCES			

INDICATIVE LIST

	PROJECT: DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP,KAYAMKULAM KERALA	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS					
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
15.	**GALAVANISED STEEL STRUCTURES FOR TRANSMISION LINE**	**I**		L&T	PITAMPUR	A	
				NAMPA STEEL	HOWRAH	A	
				UNITECH POWER TRANSMISSION LTD.	NAGPUR	A	
				L&T	PONDICHERRY	A	
				ASSOCIATED POWER STRUCTURES	VADODARA	A	
				GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
				R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
				ADVANCE STEEL TUBE	SAHIBABAD	A	
				RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
16.	**GALVANISED STEEL STRUCTURE (LATTICE & PIPE)**	**I**		GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
				RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
				L&T	PONDICHERY	A	
				L&T	PITAMPUR	A	
				R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
				VIJAY TRANSMIISION P. LTD	RAIPUR	A	
				UNIQUE STRUCTURES & TOWERS LTD.	RAIPUR	A	
				VATCO ELEC-POWER PVT. LTD.	NAVIMUMBAI	A*	*Galvanising at M/s Sigma Galvaniser, Navi Mumbai
				R.S. INFRAPROJECTS PVT. LTD	GHAZIABAD	A	
				ADVANCE STEEL TUBE ,	SAHIBABAD	A	
				SANGAM STRUCTURES LTD.	ALLAHABAD	A	

INDICATIVE LIST

	PROJECT: DEVELOPMENT OF 22 MW FLOATING SOLAR PV PROJECT AT RGCCPP,KAYAMKULAM KERALA	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS					
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				NEW MODERN TECHNOMECH	MAYURBHANJ (OR)	A	
				UNITECH POWER TRANSMISSION LTD.	NAGPUR	A	
				ASSOCIATED POWER STRUCTURES	VADODARA	A	
				RELIABLE SPONGE PVT LTD,	KALUNGA, ODISHA	A	
17	**FOUNDATION BOLT**	**III**		MAIN CONTRACTOR'S APPROVED SOURCES			

LEGENDS:
1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any.
DR – For these items "Details required" for NTPC review. To be identified with letter "DR" in the list.

2. QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved quality plan.
CAT-III : For these items Main Supplier approves the Quality Plans.
UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE 1: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of MTC / certificate of conformance in line with Indicative FQP / Technical Specifications.
NOTE 2: Clearance from NTPC Engineering required wherever the Proveness / Sub-QR criteria mentioned against that particular BOIs or Sub-Suppliers in the Technical specifications.

INDICATIVE LIST

Specification of auxiliary transformer 30 KVA 630V/415V, Dyn11

1.0 Technical parameters and specifications:

#	Technical parameter	Specification
1	Transformer type	Dry type
2	IP class	The transformers shall be housed in a metal protective housing, having a degree of protection of IP-23 or higher. The enclosure shall be provided with suitable hardware (as required).
3	Type of cooling	AN
4	Governing Standard	IS:2026, IS:11171 or equivalent to any other international standard, Indian Electricity Act 2003, BEE Guideline & CEA notifications
5	Rating in KVA	30 KVA as mentioned in specification a. power requirement, **30 KVA** type Auxiliary Transformer **(Dry type)** for tapping power from LV side of nearest PCU for connecting to ACDB (providing LT supply of 3 phase, 415 V).
6	No. of phases	3
7	Frequency	50 Hz, +/- 3%
8	HV winding	630kV, 3-Ph, with **Delta** connection
9	LV windings	433V, 3-Ph, with **Star** connection
10	Winding material	Electrolytic grade copper for both HV and LV windings
11	Winding Insulation	Class F or better
12	Neutral on LV side	Neutral terminal shall be brought out separately to facilitate earthing connections.
13	Vector Group	Dyn11
14	Short circuit withstand time (thermal)	2 sec.
15	% Impedance	As per IS: 1180
16	Termination HV/LV/Orientation	Air insulated cable box with disconnecting chamber, for both HV and LV sides. Cable box / Cable box / 180^0.
17	Cable entry on HV side	Bottom entry of cables. **Cable supply in bidder scope.**
18	Cable entry on LV side	Bottom entry of cables. **Cable supply in bidder scope.**
19	Cables and accessories	Cables, Cable glands cable lugs (Dowell/Comet/3D make) and connecting hardware shall be in bidder scope of supply.
20	Tapping on HV winding	Off circuit tap changer (OCTC) switch with five tap positions: +5%, +2.5%, 0, -2.5%, -5%.

	21	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10%. Transformer shall be capable of being loaded in accordance with IS: 6600 / IEC 60076-7.
	22	Ambient temperature	Max 50 deg C
	23	Temperature rise	90 deg C. (class F) 115 deg C. (class H)
	24	Flux density	Not to exceed 1.9 Wb/sq.m at any tap position with +/-10% voltage variation from voltage 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 characteristics up to 150%
	25	Air Clearance	As per CBIP
	26	Load loss principal tap at 75^0C, with IS tolerance	This shall be provided by bidder.
	27	No Load loss at rated voltage on principal tapping and at rated frequency, with IS tolerance	This shall be provided by bidder.
	28	No load current at rated voltage and rated frequency	This shall be provided by bidder. To be indicated as percentage.
	29	Efficiency at 75^0C, UPF	As per IS 1180 and CBIP
	30	Regulation at full load, 75 ^{o}C	< 2 % for UPF For 0.8 PF lagging, to be indicated by bidder.
	31	Harmonics	Shall be designed to suppress harmonics especially 3^{rd}& 5^{th}.
	32	Vibration & noise	Noise level shall be according to NEMA TR-1 standard
	33	Highest system voltage	LV side: 1.1 kV HV side: 3.3 kV
	34	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC Creepage distance : 35 mm/kV
	35	Overall dimensions in mm Length x Breadth x Height	This shall be provided by bidder.

37	Weight of transformer in Kg	This shall be provided by bidder.
38	Painting	The inside of enclosure and accessories (except M. Box) shall be painted with two coats of fully glossy white colour with total DFT of 25 to 60 microns. The external paint colour of transformer & accessories shall be blue corresponding to **RAL 5012**. The external surface of transformer & accessories shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of polyurethane finish paint with total DFT of 80 to 150 microns. The internal surface of Marshalling Box shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of chemical & thermal resistant epoxy enamel white paint with total DFT of 80 to 150 microns.
39	Constructional features	As per relevant clause of this specification
40	Fittings and accessories	As per relevant clause of this specification

2.0 Tests on auxiliary transformer

2.1

Sl.No.	ROUTINE TESTS
1	All routine test shall be carried out in accordance with IEC 60076.
2	Measurement of Voltage Ratio & phase displacement
3	Measurement of winding resistance on all the taps (as per IEC 60076-1)
4	Vector group and Polarity Check
5	Magnetic Balance and Magnetising Current Test
6	Measurement of no load current with 415 V, 50 Hz AC supply
7	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage
8	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps
9	IR measurement (As per IEC 60076-1)
10	Separate Source Voltage Withstand Test /Applied voltage test.
11	Induced overvoltage test/Induced voltage withstand (IVW) test .
12	Repeat no load current/loss & IR after completion of all electrical test
13	Oil leakage test on completely assembled transformer along with radiators (as per relevant clause of this sub section)
14	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
15	IR measurement on wiring of Marshalling Box.

2.2 Type Tests

Sl.No.	TYPE TESTS
1	Temperature Rise test at a tap corresponding to maximum losses as per IS 2026.
2	Tank Vacuum & Pressure Test (as per CBIP norms)

3.0 Constructional features and details of transformer components

3.0	Dry Type Transformer shall be constructed in accordance to IS: 2026, IS: 11171 or equivalent to any other international standard, Indian Electricity Act 2003, BEE Guideline & CEA notifications. Transformer rating and all related technical parameters including tap changer (if applicable) shall be as per system requirement/SLD and relevant standards. Transformer shall be suitable for continuous indoor duty application. Transformer shall be complete & functional in all respect. The other important construction particulars shall be as below. All materials / components used shall be of best quality and class most suitable for working under the conditions specified. These shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion or deterioration, without development of stresses in any part and also without affecting the strength and suitability of the various parts for the work that they have to perform.

3.1 Core

3.2.1	The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations equivalent to M4 grade steels or better.
3.2.2	The insulation structure of the core to clamp plates shall be such that it withstands a voltage of 2kV (rms) for one minute in air.
3.2.3	Adequate lifting lugs will be provided to enable the core & windings to be lifted.

3.2 Windings

3.3.1	Windings shall be of electrolytic grade copper free from scales and burrs.
3.3.2	Windings shall be subjected to a shrinking and seasoning process so that no further shrinkage occurs during service.
3.3.3	Windings shall have uniform insulation.
3.3.4	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
3.3.5	The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.
3.3.6	Windings shall be made in dust proof and conditioned atmosphere. Bidder shall indicate those details of facilities (as available at the winding works) that will ensure meeting this requirement.

3.4 Internal earthing

3.4.1	The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.

3.5 Bushings

3.5.1	a) Bushing below 52 kV shall be oil communicating type with porcelain insulator. b) No arcing horns to be provided on the bushings.

3.6 Bushing CTs

1.Shall be of adequate rating for protection as required, WTI (WTI CTM applicable for transformer above 50 KVA) etc.
2. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

3.7 Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above)

(a) HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers (for 3.3 kV and above side)

(b) Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs.

(c) A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box

(d) The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron.

(e) The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.

(f) The minimum length provided for terminating 33 kV, 11KV & 3.3 KV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV and 11 kV) from cable gland plate to the cable lug) for the cable boxes, for 433V side suitable length shall be provided (shall be discussed during

detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering.

(g) Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports (as applicable).

(h) Cable boxes shall have removable top cover (for transformer above100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

3.8 Fittings and accessories

Following fittings per transformer shall be provided. Bidder shall indicate compliance (Yes / No) for each line item. In case of non-compliance or deviation, bidder shall indicate and provide comments.

a	Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb. Single Indicating meter may be provided for display of temperature of all limbs. Accuracy class of Indicating meter shall be +/- 1% or better and it shall have least count of 0.1 °C or better. 1 no. 4-20 mA signal shall be provided for remote monitoring of winding Temperature.
b	RTD/Thermistors	1 No. PT-RTD shall be embedded in each limb with alarm and trip contacts for remote annunciation. Additional 1 No. thermistor/RTD shall be embedded in each limb.
c	Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Insulating Oil, Cooling equipment.	
d	Cover lifting eyes, transformer lifting lugs, towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc.	
e	Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.	
The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.		

4.0 Inspection and testing of transformers at bidder works

4.0	Bidder shall provide inspection call to BHEL for the type and routine tests. Prior to the call, bidder shall submit the routine test results as per Manufacturing Quality Plan (MQP) for scrutiny of BHEL/NTPC.

5.0 Documents to be submitted after receipt of purchase order

5.1	Following documents shall be submitted for BHEL approval within seven days from date of purchase order. (1) GA drawings including foundation details (2) GTP (3) MQP (4) Valid type test report as above

6.0 Documents to be submitted along with consignment

		6.1	Following documents shall be submitted to BHEL at the time of delivery of the consignment: (1) As built drawings of transformer (2) Routine test reports on transformer (3) Type test reports on transformer (4) Test certificate for transformer oil (5) Operations and maintenance manual of transformer

1.0 Introduction

This technical specification provides BHEL requirements for LT Switchgear system for the solar photovoltaic project.

1.1 Technical specification

The scope of work under this specification covers the design, manufacture, assembly, testing at manufacturer's works, transportation, transit insurance, delivery at site, storage, installation, testing, and commissioning of indoor type following 415V LT Switchgear complete with all accessories and spares.

The Scope shall include supply of 415 V (3 phase, 1 neutral and single phase for lighting etc.) power distribution line for the entire area from the LT switchgear with necessary breaker, switch fuse unit as and when required, Boards as above along with gland plates for all power and control cables, base frames, special tools i.e. operating handles, trolley necessary for removing the circuit breakers for maintenance etc. Isolators should be provided in the line to connect or isolate the connection from both the station auxiliary transformer.

The scope shall include all associated devices, components, relays, contactors, switches etc. required for satisfactory operation of the switch boards as per the proposed logic control scheme. The scope of supply shall also include necessary spares required for operation & maintenance of switchgear equipments for a period of 5 (five) years & special tools & plants required for erection & maintenance.

Corresponding parts of all the equipments & spares shall be of the same material & dimensions, workmanship & finish and shall be interchangeable. All the material & workmanship shall be of suitable commercial quality as have proven successful in their respective uses in similar services & under similar condition.

1.2 STANDARDS

The equipments covered under this chapter shall comply with the requirement of latest edition of following IS/BS/IEC specifications as amended up to date except where specified otherwise.

Sl. No.	Standards	Description
1	IEC 60947/IS13947	Specification for Low-Voltage Switchgear and Control gear.
2	IS: 10118 (Part 1 to 4)	Code of practice for selection, installation and maintenance of switchgear & control gear.
3	IS 3043	Code of practice for earthing.
4	IS 3072	Code of practice for installation and maintenance of Switchgear
5	IS: 2705	Current Transformers
6	IS: 3156	Voltage Transformers
7	IS: 3231	Electrical Relays for Power System Protection
8	IEC 60255	Electrical Relays
9	IS 3202	Code of practice for climate proofing of electrical equipment.
10	IS: 8828	Circuit breakers for over current protection for household and similar installations
11	IS: 13703 / IEC 60269	HRC Cartridge fuses
12	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.

2.0 TECHNICAL PARAMETERS		
A. POWER SUPPLY (AC SYSTEM)		
(i)	Voltage	415V + 10%, 3 Phase, 4 wire,Neutral Solidly Earthed
(ii)	Frequency	50 Hz +/- 5%
(iii)	Minimum system fault level	As per system fault current (for 1 sec)
(iv)	Short time rating for bus bars,ckt.breakers,current transformers and swgr. Assembly.	As per system fault current (for 1 sec)
(v)	Maximum ambient air Temperature	50 deg. C
BUS BARS		
(vi)	Continuous current rating at 50ºC ambient:	As Per Requirement

(vii)	Temperature Rise allowed above ambient	40^0C for plain joints 55^0C for Silver plated joints
B. MCCB		
(i)	Rated voltage	415V
(ii)	Rated Insulation Level	690V
(iii)	Rated ultimate and service SC breaking capacity(As per system requirement)	As per system fault current (for 1 sec)
(iv)	Rated making capacity	2.1 times of System fault current
(v)	Utilization category	A
C. DIGITAL MFM		
(i)	Accuracy class	0.5
(ii)	MFM shall be provided at LT incomer feeder. MFM shall have suitable communication port for integration with SCADA system.	
D. CURRENT TRANSFORMERS		
(i)	Type	Cast Resin Bar Primary
(ii)	Voltage class and frequency	650V, 50HZ
(iii)	CT Secondary Current	1:00 AM
(iv)	Class of insulation	E or better
(v)	Accuracy class & burden	
	a) For Protection	5P20, 5VA
	b) For Metering	Class 1.0, 5VA (min)
(vi)	Instrument Security Factor for metering CT	5
E. VOLTAGE TRANSFORMERS		
(i)	Type	Cast Resin
(ii)	Voltage Ratio	415 / 110V for line PT
		415/√3 / 110/√3V for Bus PT
(iii)	Neutral Solidly Earthed	Vee Vee
(iv)	Accuracy Class	0.5
(v)	Rated Voltage factor	1.1 continuous, 1.5 for 30 sec.
(vi)	Class of insulation	E or better
(vii)	One minute power frequency withstand voltage	2.5 KV
F. HRC FUSES		
(i)	Voltage Class	650 Volts

(ii)	Rupturing capacity	80kA (RMS) for AC circuits
G. CONTACTORS		
(i)	Type	Air break electro magnetic
(ii)	Utilising Category	AC3 of IS/IEC 60947 for nonreversible AC4 of IS/IEC 60947 for reversible drives
H. SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS		
(i)	Colour finish	
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers) ,The paint thickness shall not be less than 50 microns
	Cable entry	
(ii)	Power Cables	Bottom
	Control Cables	Bottom

3.0 DETAILS OF INDOOR DISTRIBUTION BOARDS

Applicable for Auxiliary Power Supply system and String Inverter distribution board of rating upto & including 400A.

3.1 Switchboards shall be of metal enclosed, indoor, floor-mounted, free-standing type.

3.2 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

3.3 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.

3.4 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut outs shall be true in shape and devoid of sharp edges.

3.5 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. All cutouts shall be provided with EPDM / Neoprene gaskets. Feeder Pillar with IP 55 enclosure protection meeting the technical requirement is also acceptable.

3.6 All switchboards shall be of uniform height not exceeding 2450 mm.

3.7 Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates.

3.8 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. Replacement /Maintenance of individual equipment/ component shall be possible without switching off or isolating the other equipments/components.

3.9 Each switchboard shall be provided with undrilled, removable type gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall be provided with gasket to ensure enclosure protection.

3.10 The minimum clearance in air between phases and between phases and earth for the entire busbars shall be 25mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses/MCCB shall be fully insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits. All busbars and jumper connections shall be of high conductivity aluminium alloy / copper of adequate size.

3.11 All switchboards shall be provided with three phase and neutral busbars. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105°C.

3.12 The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.

3.13 All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet molded compound or equivalent type polyester fiber glass molded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.

3.14 All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-

silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminium joints shall be provided with suitable bimetallic washers.

3.15 All busbars shall be colour coded as per IS: 375.

3.16 Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.

3.17 The Bidder shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.

3.18 Panel space heaters shall be provided and the supply for this shall be tapped from incomer, before the isolating switch/circuit breaker. Incoming circuit to space-heater shall have an isolating switch, HRC fuse and neutral link of suitable rating. Panel illumination and plug-socket shall also be tapped from the space heater supply.

3.19 A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.

3.20 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth without exceeding the allowable temperature rise.

3.21 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.

3.22 All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.

3.23 VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that

earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

3.24 All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.

3.25 All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.

3.26 All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm2 (min.) for control circuit wiring and 2.5 mm2 (min) for CT and space heater circuits.

3.27 Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.

3.28 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.

3.29 All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.

3.30 Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.

3.31 Cable termination arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminium conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc., shall be provided by the contractor, to suit the final cable sizes.

3.32 All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.

3.33 All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations etc. shall be provided with prominent, engraved identification plates.

3.34 All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Employer's approval.

3.35 Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.

3.36 The gaskets, wherever specified, shall be of good quality EPDM / neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.

3.37 The bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per indian standards / specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

3.38 ON/OFF status and protection trip status of incomers and bus coupler (if available) be provided for SCADA system.

3.39 Suitable changeover and interlocking arrangement shall be provided for incomers and bus coupler.

3.40 It shall be the responsibility of the contractor to fully coordinate the overload and short circuit breakers/fuses with the upstream and downstream circuit breakers / fuses, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of type ii class of co-ordination as per IS: 8544.

3.41 All sheet steel work shall be pretreated, in tanks, in accordance with is: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-c" as specified in is: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, electrostatic powder coating shall be used. Powder should meet requirements of is 13871 (powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the employer. The paint thickness shall not be less than 50 microns.

4.0 MCCB

a. MCCB shall be fixed type module, air break type, having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.

b. MCCB shall have inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off etc).

C. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.

5.0 FUSES

5.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 240V DC.

5.2 Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.

5.3 Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.

5.4 The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.

6.0 INDOOR LT SWITCHGEAR FOR STRING INVERTER

In addition to the above clauses (relevant), the following shall also be applicable for switchgear ratings more than 400A

6.1 All switchboards shall be divided into distinct vertical sections (panels), each comprising of the following compartments

(a) BUSBAR COMPARTMENT:- A completely enclosed bus bar compartment shall be provided for the horizontal and vertical busbars. Bolted covers shall be provided for access to horizontal and vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing any feeder compartment. Auxiliary and power busbars shall be in separate compartments.

(b) SWITCHGEAR / FEEDER COMPARTMENT:- All equipment associated with an feeder of rating above 400A shall be housed in a

separate compartment of the vertical section. ACB shall be provided for feeders of rating 1000A and above. The design of the vertical section for such an arrangement shall ensure ease of termination of power cables of size & quantity as per system requirement. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. Insulating sheet at rear of the compartment is also acceptable. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure.

CABLE COMPARTMENT/CABLE ALLEY:- A full-height vertical cable alley of minimum 250mm width shall be provided for power and control cables. Cable alley shall have no exposed live parts and shall have no communication with busbar compartment. Cable terminations located in cable alley of capacity more than 400 A shall be designed to meet the Form IVb and for less than 400A A shall be designed to meet the Form 3b (as per IEC 61439) for safety purpose. Wherever cable alleys are not provided for distribution boards, segregated cable boxes for individual feeders shall be provided at the rear for direct termination of cables. For circuit breaker external cable connections, a separately enclosed cable compartment shall also be acceptable. The contractor shall furnish suitable plugs to cover the cable openings in the partition between feeder compartment and cable alley. Cable alley door shall be hinged.

(d) CONTROL COMPARTMENT:- A separate compartment shall be provided for relays and other control devices associated with a circuit breaker.

6.2 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. However, the busbar chambers having a degree of protection of IP: 42 are also acceptable where continuous busbar rating is 1600A and above. Provision shall be made in all compartments for providing IP: 5X degree of protection, when circuit - breaker or module trolley has been removed. All cutouts shall be provided with EPDM / Neoprene gaskets.

6.3 Provision of louvers on switchboards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating is 1600 A and above.

6.4 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. EPDM / Neoprene gasket shall be provided between the panel sections to avoid ingress of dust into panels.

6.5 The minimum clearance in air between phases and between phases and earth for the entire busbars. and bus-link connections at circuit-breaker shall be 25mm. All busbars and jumper connections shall be of high conductivity aluminum alloy / copper of adequate size.

6.6 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose. Wherever two breaker compartments are provided in the same vertical section insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

6.7 All switchgear (circuit-breaker) panels shall be of single-front type. The covers shall be provided with "DANGER" labels. All panel doors shall open by 90 deg or more.

6.8 All circuit-breaker modules shall be of fully draw out type having distinct 'Service' and 'Test' positions. Suitable arrangement with cradle / rollers, guides along with tool / lever operated racking in / out mechanism shall be provided for smooth and effortless movement of the chassis.

6.9 All switchboards shall be provided with three phase and neutral busbars. Two separate sets of vertical busbars shall be provided in each panel of double front DBs. Interleaving arrangement for busbars shall be adopted for switchboards with a rating of more than 1600A. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105°C.

6.10 ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door cannot be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.

6.11 The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear switchgear also.

6.12 Temperature raise test of LT switchgear of rating more than 400A:- The temperature rise of the horizontal and vertical busbars and main bus links including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current.

6.13 The carriage and breaker frame shall get earthed while being inserted in the panel and positive earthing of the breaker frame shall be maintained in all positions, i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel.

6.14 Electrically controlled circuit breaker boards shall be provided with DC control supply.

7.0 CIRCUIT BREAKERS

7.1 Circuit breakers shall be three pole, air break, horizontal draw out type, and shall have fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified.parameters of continuous current rating and fault making / breaking capacity only after provision of cooling fans or special device shall not be acceptable.

7.2 Circuit breakers along with its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.

7.3 There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "Test" position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLLY WITHDRAWN" position. Circuit Breaker rack-in and rack-out from Service to Test, Test to Isolated position, or vice-versa shall be possible only in the compartment door closed condition.

7.4 Separate limit switches, each having required numbers of contacts shall be provided in both "SERVICE" and "TEST" position of the breaker. All contacts shall be rated for making, continuously carrying and breaking 10 Amp at 240 V AC and 1 Amp (Inductive) at 240 V DC respectively.

7.5 Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE ", "TEST" AND "SPRING CHARGED" positions.

7.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half a cycle of rated frequency.

7.7 Movement of a circuit breaker between "SERVICE" and "TEST" position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In case the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exists between the fixed and drawout contact at the time of breaker trip so that no arcing takes place even with the breaker carrying its full rated current.

7.8 Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position or in "FULLY WITHDRAWN" position.

7.9 Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.

7.10 Breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

7.11 Circuit breakers shall be provided with coded key / electrical interlocking devices, as per requirements.

7.12 Circuit breaker shall be provided with anti-pumping feature and trip free feature, even if mechanical anti-pumping feature is provided.

7.13 Mechanical tripping shall be possible by means of front mounted Red "trip" push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

7.14 Complete shrouding / segregation shall be provided between incoming and outgoing bus links of breakers. In case of bus coupler breaker panels the busbar connection to and from the breaker terminals shall be segregated such that each connection can be approached and maintained independently with the other bus section live. Dummy panels if required to achieve the above feature shall be included in the Bidder's scope of supply.

7.15 Circuit breaker open/close shall be possible from SCADA and open/close status and all other important signal status shall be provided for SCADA monitoring.

7.16 Power operated mechanism shall be provided with a Universal motor suitable for operation on DC Control supply. In case of DC supply motor should satisfactorily operate with voltage variation between 85% to 110% nominal control supply voltage. Motor insulation shall be class "E" or better.

7.17 The motor shall be such that it requires not more than 30 Seconds for fully charging the closing spring at minimum available control voltage.

7.18 Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.

7.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

7.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

7.21 All circuit breakers shall be provided with closing and trip coils. The closing coil shall operate correctly at all values of voltage between 85% to 110% nominal control supply voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% nominal control supply voltage.

7.22 Provision for mechanical closing of the breaker only in "Test" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.

7.23 The ACB Panel door shall not be possible to open in breaker closed condition. Further, the racking mechanism shall be accessible only after opening the breaker panel door.

7.24 Telescopic trolley or suitable arrangement shall be provided for maintenance of circuit-breaker module in a cubicle at each location. 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 of particular switchgear.

7.25 Electrical Parameter of Circuit Breaker

1)	Type	Air break spring charged stored energy type
2)	Operating duty	O-3 MIN-OC-3 MIN-OC
3)	Symmetrical interrupting	As per system fault current (for one sec)
4)	Short circuit rating	2.1 times of System fault current (peak)
5)	Short Circuit Breaking current	
	a) AC Component	As per system fault current (for one sec)
	b) DC Component	As per IS:13947
6)	Short time withstand	As per system fault current

8.0 AC JUNCTION BOXES (for use with string inverters)

8.1 Separate AC Junction box shall be used for string inverters AC output connection. Protection class for AC junction box shall be IP 54 or better protection. All components of junction box shall be suitable for rated output

voltage (with + 10% variation) of string inverter, grid frequency of 50 Hz +/- 5%, ambient temperature 50 deg. C and system fault current for 1 sec.

8.2 AC junction box shall be of metal enclosed type. All frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material. The minimum clearance in air between phases and between phases and earth shall be at least twenty five (25) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers.

8.3 All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.

8.4 EPDM / Neoprene gasket shall be used to prevent ingress of dust into panels.

8.5 All non-current carrying metal work of the junction box shall be effectively connected to the system earth bus.

8.6 Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns.

9.0 TEMPERATURE-RISE (For LT Switch-gear having capacity more than 400A)

The temperature rise of the horizontal and vertical busbars and main bus links including all power draw out contacts when carrying 90% of the rated current along the full run shall in no case exceed 55 deg C with silver plated joints and 40 deg C with all other types of joints over an outside ambient temperature of 50 deg C. The temperature rise of the accessible parts/external enclosures expected to be touched in normal operation shall not exceed 20deg. C. The temperature rise of manual operating means shall not exceed 10deg. C for metallic & 15 deg. C for insulating material. Temperature rise for the busbars shall be carried out at 90% of the rated current.

10.0 DERATING OF COMPONENTS

The Bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

The Bidder shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and amb. Temperature of 50 deg C.

Purshotam Profiles Private Limited

CONFIDENTIAL

Installation Manual

Contents

- **Site Preparatory Works**
- **Delivery of Material and Storage**
- **Preparation of Launch Site**
- **Assembly of Floating Structures**
- **Safety Considerations**
- **Assembly View**
- **Detailed Specification of Floats**
- **Installation Steps**

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Site preparatory works

Project implementation begins with site preparation, when the EPC contractor starts building access roads for equipment delivery, clears the site, and removes objects that might impede construction. Usually all the activities related to site clearance, landfill, evacuation, and debris removal is done during this phase. In addition, the EPC contractor establishes site security and a security office and erects fencing and gates

Delivery of materials and storage

Floats can be unpacked and stored at the launching site with a sufficiently large staging area. Electrical equipment like inverters, LV switchboards, and transformers should be stored indoors or under a canopy to protect them from dust or rain until their deployment.



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Preparation of launching area

Before construction begins, identify a suitable launching area by the water body with a gentle slope. This important supporting infrastructure is where the floating structure is assembled and launched. In general, working on land is easier than assembling the components directly on water. The launching area always needs some preparation. A launch ramp can be constructed on the bank's natural slope into the water body. This temporary infrastructure could be built with metal or wooden scaffolding and slats at minimal investment. Although not mandatory in all cases, a launch ramp can ease deployment efforts and reduce float damages; hence, it is highly recommended. Workers can gently push the assembled floats into the water, so lifting machinery is not necessary.





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Assembly of floating structures

Once the materials are delivered onsite, the assembly work of the floating structure commences. Assembly is usually done as smaller single blocks of floating units. Single units are assembled first by multiple teams of workers. The construction varies depending on the floating structure design.

The following steps are carried out for the construction of a single block of floating units:

- Layup of floating component
- Assembly of floats together and interconnection of floats, where relevant
- Assembly of module support structures
- Installation of modules Once assembled, the single units are linked together
- Connection of wires to the modules and ready for connection with combiner box
- **After a few units are linked, the entire row is pushed**

Subsequent rows are built and launched until the floating island is completed

The next steps of construction could be outlined as:

- Interconnection of single units/block to a larger row
- Electrical interconnection as per the design
- Launching or sliding into water
- Towing to designated position
- Mooring and anchoring Upon completion, the entire FPV island is towed to its final location by motor boat The system is ready for mooring and anchoring.

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Safety considerations

▲ Workers should undergo Mandatory Basic Safety Training for land-based construction work

▲ Job specific safety training and regular refresher training should be provided to workers to enhance/maintain their safety awareness of potential hazards associated with work over water/near water, including those during inclement weather.

▲ Specific safety training should be provided to workers on the use and checking procedures of life jackets, and rescue arrangements for persons who fell into water.

▲ Supervisors/workers should be trained on emergency and evacuation procedures, including the conduct of regular drills, in respect of work over water/near water.

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Assembly View

Below is a reference picture of a small floating array. The image highlights the various floats that are combined together to form the floating structure. This installation manual guides the user step by step on how to connect the different floating pontoons to form a bigger array.

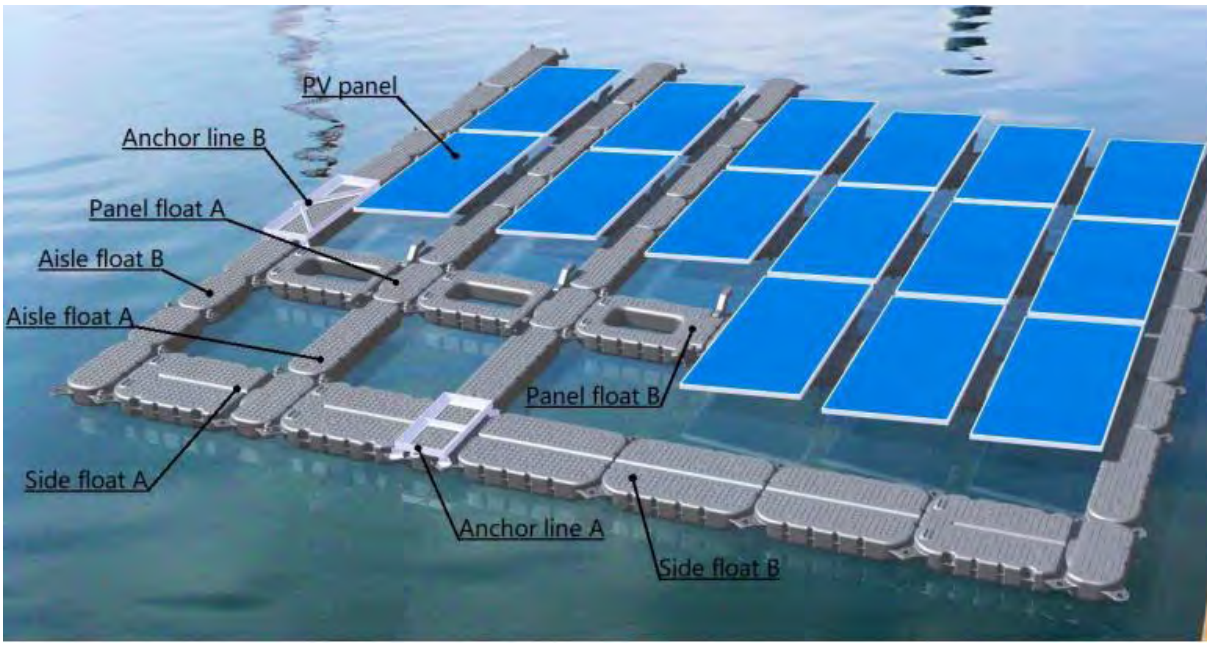


Image 1 : Source: Prabh Dayal Om Parkash Infra Ltd

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2) Detailed Specification of Floats

The table below depicts the different type of floats and accessories. These components when joined together form an array (Refer to Image 1). The table highlights the dimensions and material of every item

II. Product information

NO.	PIC	ITEM	Material	Dimension (mm)	unit
1		Aisle Float A	HDPE	1420×520×184	Pcs
2		Aisle Float B	HDPE	1520×520×184	Pcs
3		Side Float A	HDPE	1570×870×200	Pcs
4		Side Float B	HDPE	1270×870×200	Pcs
5		Panel Float A	HDPE	1570×870×200	Pcs
6		panel Float B	HDPE	1270×870×200	Pcs
7		Support Float	HDPE	365×232×70	Pcs
8		Conneting Screw	HDPE	¢75×120	Pcs
9		Nuts	PE	¢78×38	Pcs
10		anchorline A	Q235b+HDG	950×520×150	Set
11		anchorline B	Q235b+HDG	1400×580×150	Set

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3) Installation Steps

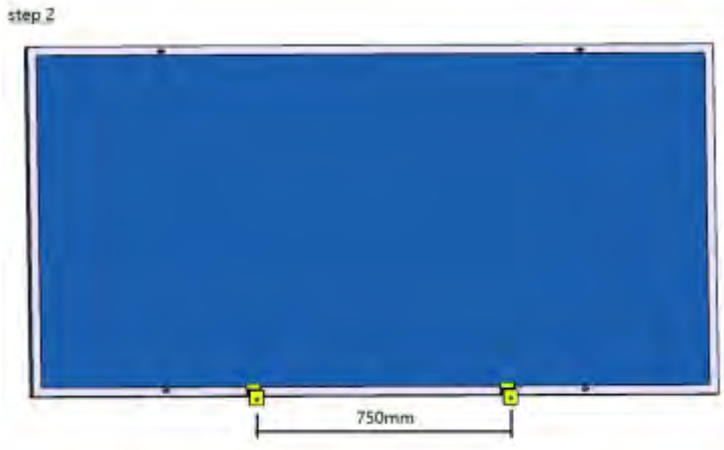
The installation of the floating pontoons requires ample space and a clear area. Please refer to the preparation of launch area and site preparatory work. Before beginning installation, the contractor should ensure they have a spacious area more than 2000m2 for assembly near the site.

Please follow the steps below for installation

Step 1) Place the photovoltaic module on a flat surface



Step 2) Install two clamp（with SS screw) at specific position keeping distance of 750mm on the back face of the panel



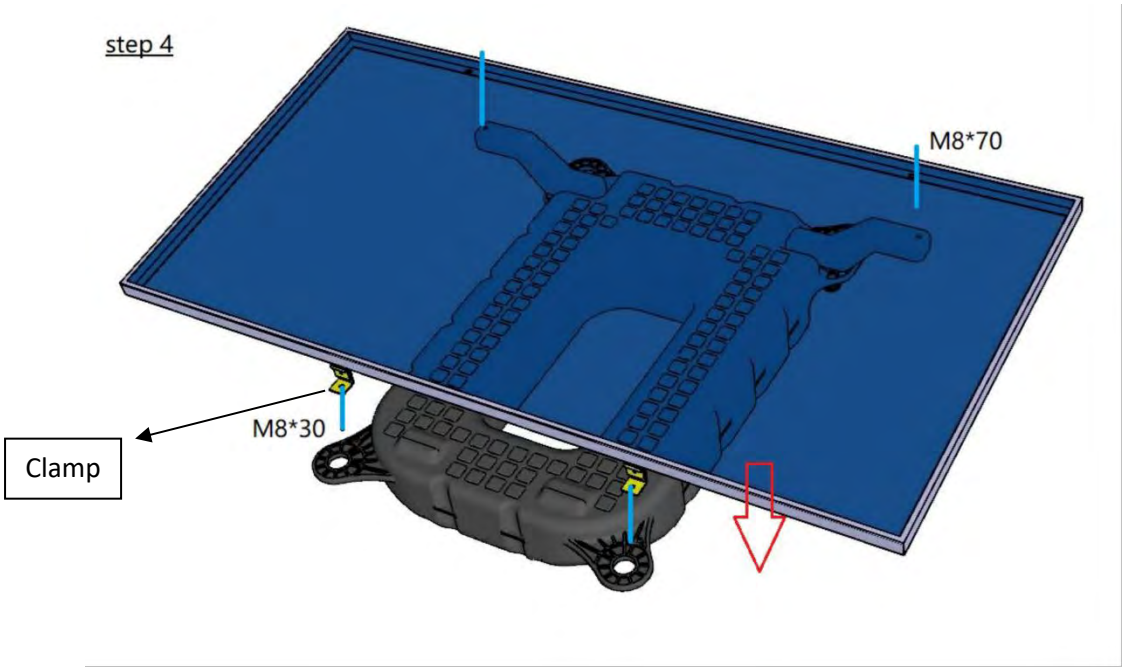
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Step 3) Connect a Support float on panel float B on each side and Fasten Nuts under lugs

Refer to the image below

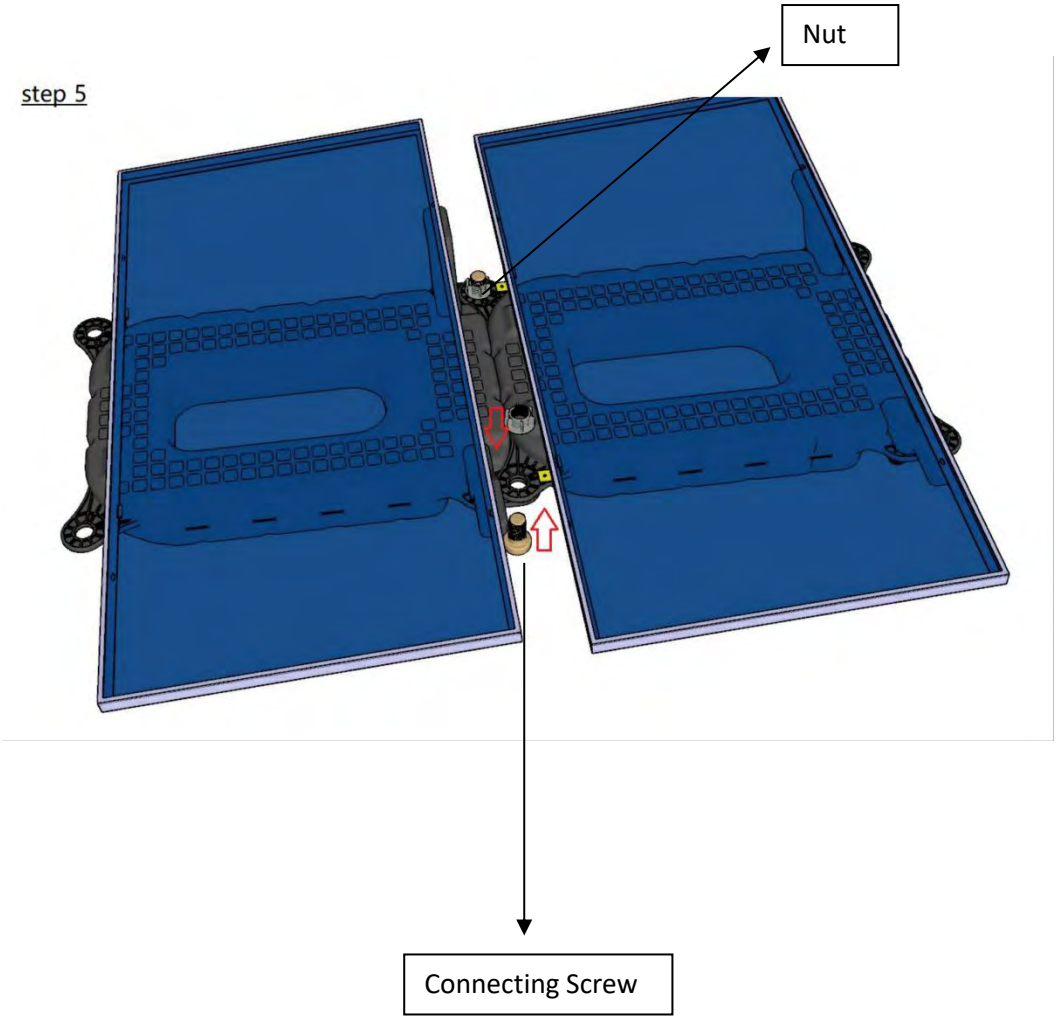


Step 4) Lift the photovoltaic module and place it on panel float B such that they perfectly align together on all fours points， next screw the module with stainless steel screw M8



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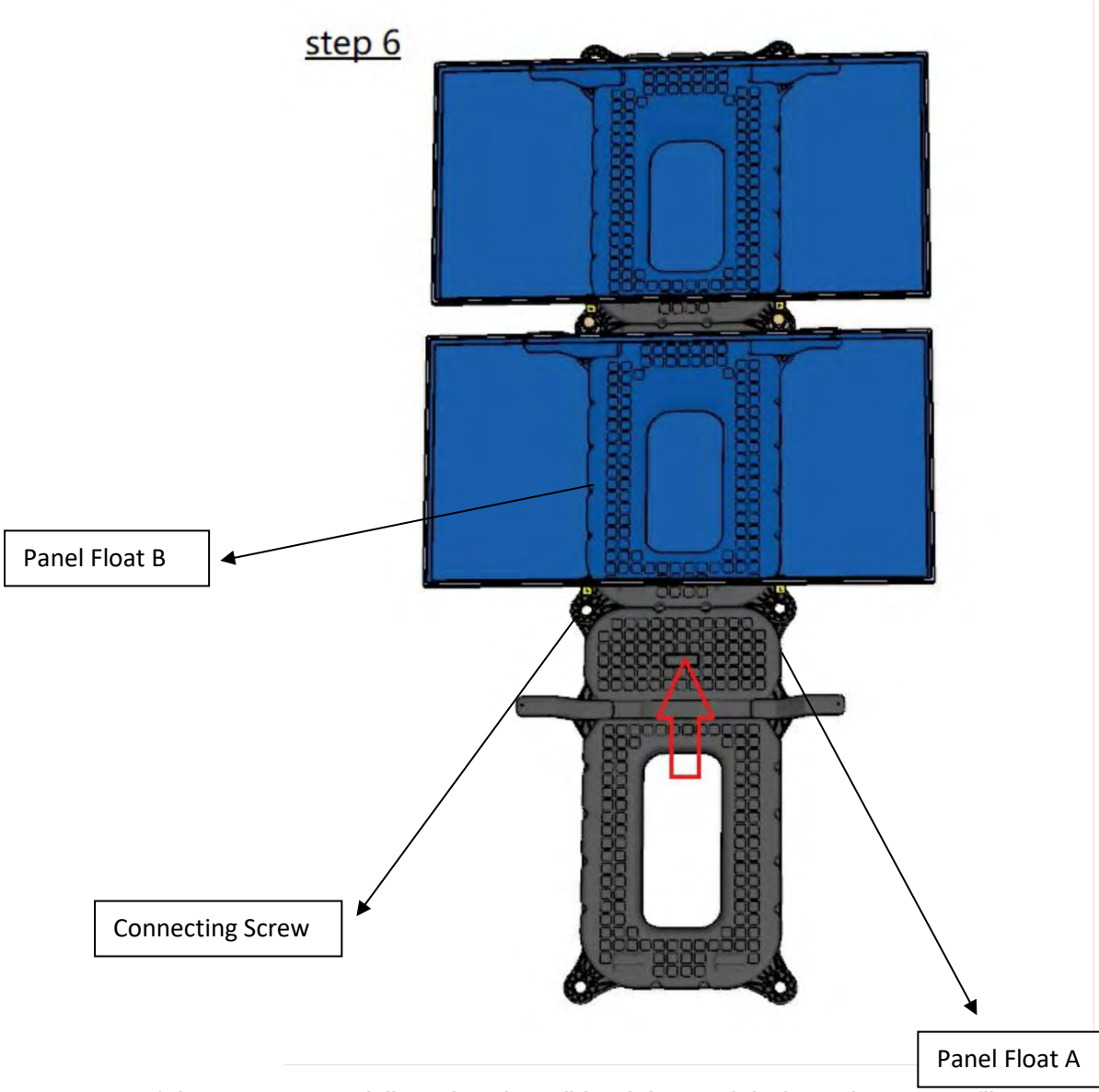
Step 5) Repeat the process to mount another module on panel float B and then using the connecting screw and nuts, join two panel float B on land



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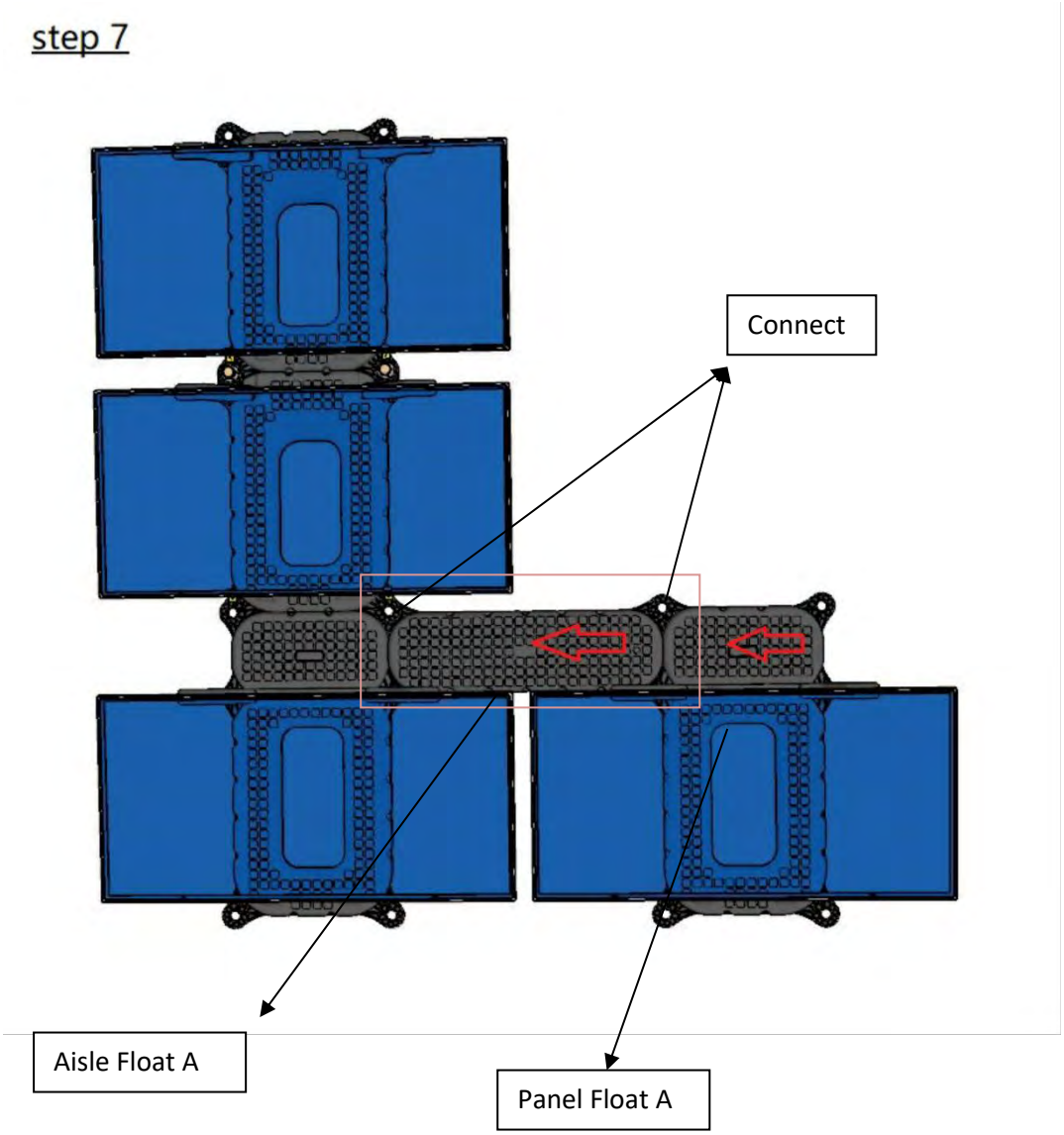
Step 6) Now, follow step 1-3 and mount a photovoltaic module on panel float A

After mounting a module on panel float A, connect panel float A to panel float B as below



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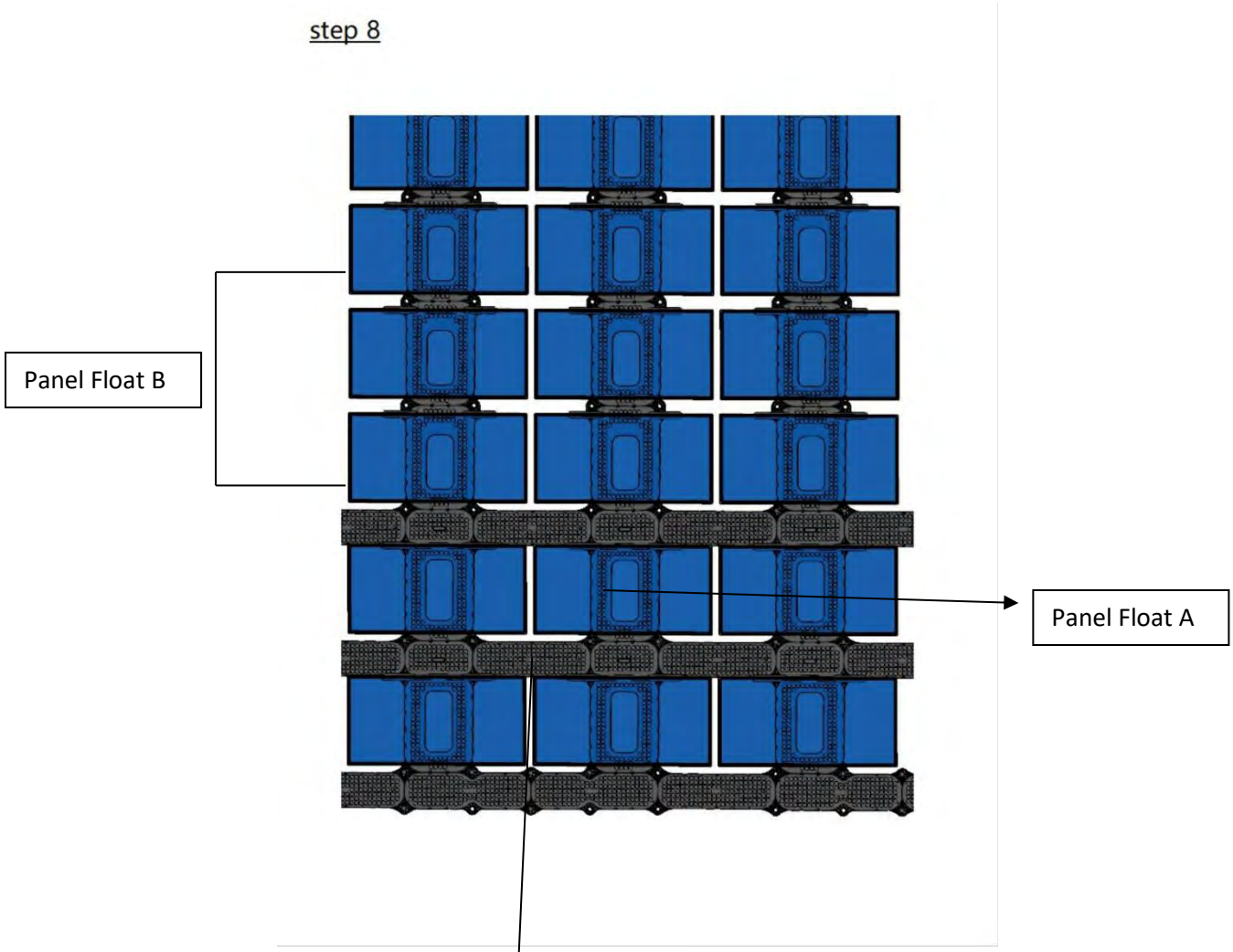
Step 7) After connecting Panel Float A with Panel Float B, Connect an Aisle Float A between two Panel Float A



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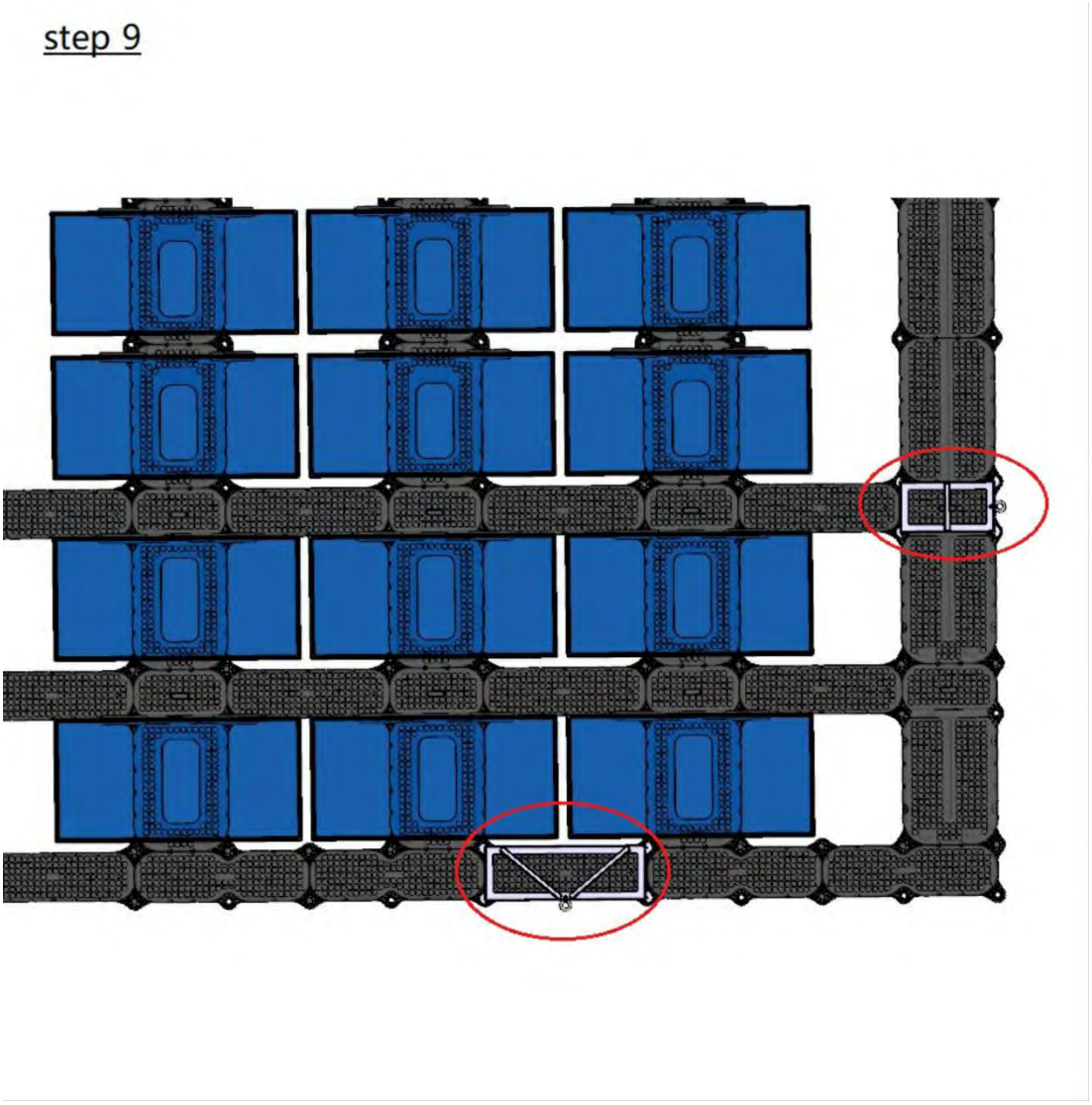
Step 8) The bottom of each array will have two rows with panel float A. After that, each row will have three rows of panel float B, followed by one row of panel float A. This procedure will be followed till the assembly reaches the top of array as per the drawing.

Repeat the steps above 1-7, and form an array as per the drawing. There should be four modules after every walkway. There should be three panel float B after every panel float A in vertical alignment. There should be one aisle float A between each panel float A in horizontal alignment. Refer to image below.



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Step 9) Final step is installation of anchor line nuts as per drawing, We need to push float array into water gradually.



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Float Installation Manual - Adtech Systems Ltd

ADTECH
SYSTEMS LIMITED

Version - 2 Date: 02nd December, 2019

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A. Float Specification:

1

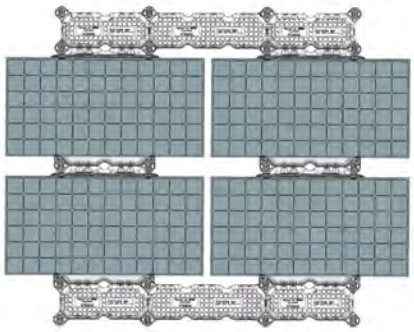


Figure 1

Big Walkway		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Average Wall Thickness (in mm)	3
	Design Weight (in kg)	4
	Max Use Buoyancy (in kg/sq.m)	180
	Dimension (in mm)	As per approved drawing
	Manufacturing Process	Blow Molding
	Function	• Forms maintenance walkways • Non-Slippery Surface

Small Walkway		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Average Wall Thickness (in mm)	3
	Design Weight (in kg)	3
	Max Use Buoyancy (in kg/sq.m)	180
	Dimension (in mm)	As per approved drawing
	Manufacturing Process	Blow Molding

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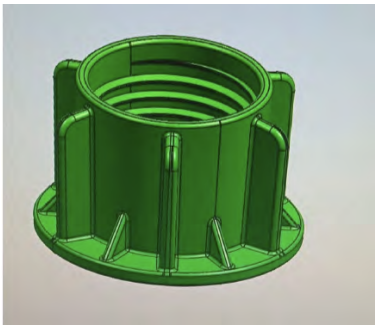
	Function	• Forms maintenance walkways • Non-Slippery Surface

Connecting Float		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Average Thickness	3mm
	Design Weight	7.5
	Max Design Buoyancy (in kg/sq.m)	180
	Dimension	As per approved drawing
	Manufacturing Process	Blow Molding
	Function	Give Support to the PV module

Support Piece		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Average Thickness	3mm
	Design Weight	1.2
	Design Buoyancy	-
	Dimension	As per approved drawing
	Manufacturing Process	Blow Molding
	Function	Give an Optimum degree 5 to the panel

Equipment Float		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Average Thickness	3mm
	Design Weight	8
	Design Buoyancy (in kg/sq.m)	180
	Dimension	As per approved drawing
	Manufacturing Process	Blow Molding
	Function	For the Cable arrangement and junction box location

Note - All dimensions and weights provided have a tolerance of +/- 5%

HDPE Nut		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Design Weight	55g
	Dimension	D80*50
	Manufacturing Process	Injection Molding
	Function	Holding the Support Float

Sleeve		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Design Weight	2g
	Dimension	D17*26
	Manufacturing Process	Injection Molding
	Function	Alignment of SS nut&bolt

HDPE Gasket		
	Raw material	High Density Polyethylene (HDPE),with UV stabilizer
	Design Weight	29g
	Dimension	D85*14
	Manufacturing Process	Injection Molding
	Function	Spacer between the walkway.

Note - All dimensions and weights provided have a tolerance of +/- 5%

B. Panel Fixing Hardware:

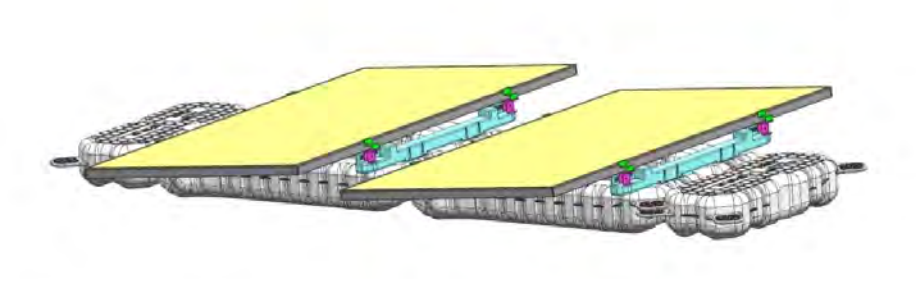


Figure 2

Upper clamp(Top Right and Left)		
	Raw material	Anodized Aluminum
	Count per panel	2 sets
	Technical Features	Length 50 mm Hole Ø9 mm
	Manufacturing Process	Aluminum Extrusion
	Function	Holding the Solar panels and it is connected to the “L” profile of the Support float

Lower clamp(Bottom Left and Right)		
	Raw material	Anodized Aluminum
	Technical Features	Length 50mm Hole Ø9 mm
	Count per Panel	2 sets
	Manufacturing Process	Aluminum Extrusion
	Function	Holding the Solar panels and it is connected to the “L” profile of the Connecting float

Nut ,Bolt and washer		
	Raw material	Stainless steel
	Count / module	Nut 8 Bolt 8 Plain Washer 16 Spring Washer 8

	Type	M8- SS 304
	Function	Holding the Solar panels and it is connected to the “L” profile of the Connecting float

C. Mooring clamps and Lines

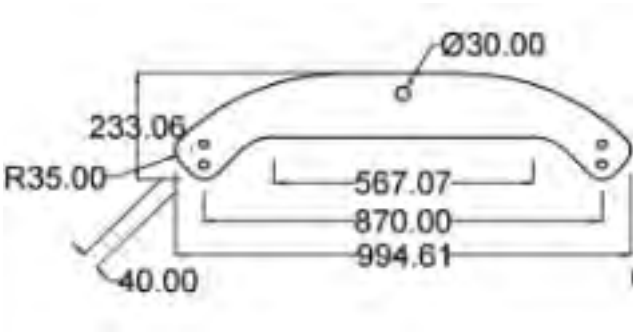


Figure 3

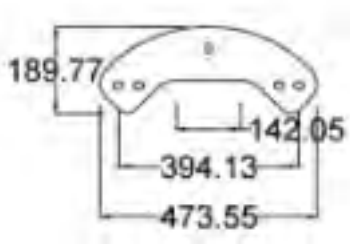


Figure 4

D. Tools and Tackles Required:

1. Injection Nut Wrench (drawing of Injection Nut can be provided on request)
2. M12 and M8 Nut Wrench
3. Drilling Machine

E. Instructions for Installation:

1. **Solar Panel Installation:**

The solar module is connected to the connecting float on the bottom side and support float on the top side. The panels are connected to the floats using Al. extruded clamps connected at the 4 designated points on the float using SS304 - M8 hardware.

The following are the components used for the connection:

A. L clamp (Bridge Clamp)
B. Upper Base Clamp
C. Lower Base Clamp
D. SS304 M8 - Nut, Bolt, Spring Washer and Plain Washer (2)

Installation Recommendations:

A. It is recommended to use a table for the module assembly on the float and to conduct the installation check for the same
B. Ensure the DC cables on the module are opened and loose before mounting the module on the float

Installation Procedure:

A. Place a rubber mat on top of the table
B. Place the Connecting Float on the rubber mat so that the portion where the Support Piece will be connected is exposed from the table
C. Connect the Support Piece on the Connecting Float and use the D80*50 nut to screw the Support Piece to the Connect Float (need to add torque info) (as shown)



Figure 5

D. Connect the 2 Lower Base Clamps to the bottom of the Connecting Float (as shown) using SS304 M8

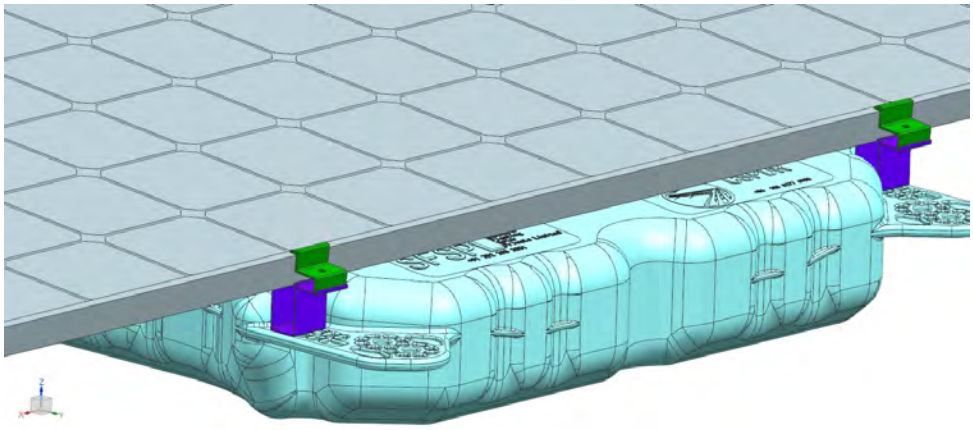


Figure 6

E. Connect the 2 Upper Base Clamps to the top of the Support Float (as shown) SS304 M8

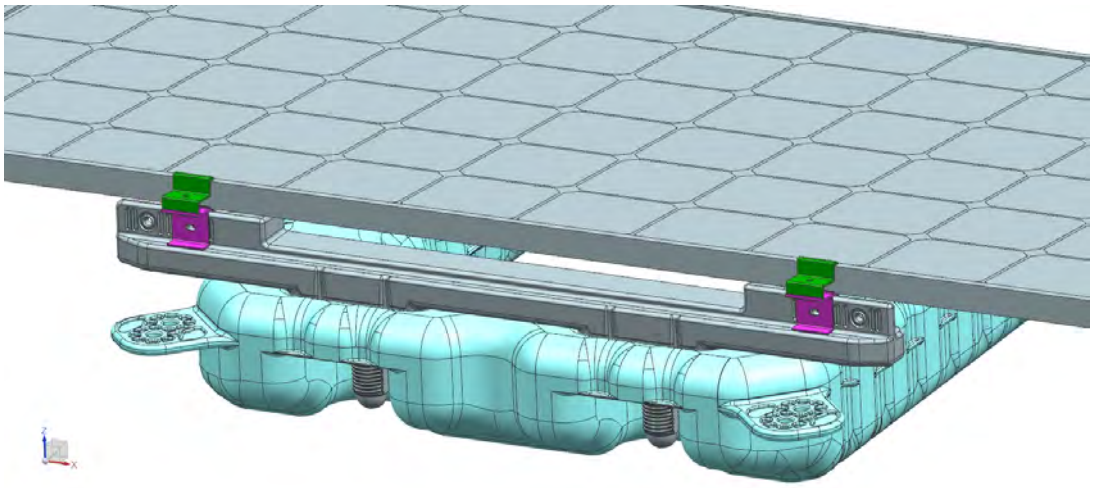


Figure 7

F. Connect the 4 L Clamp (Bridge Clamp) to the Lower Base Clamps and Upper Base Clamps loosely using SS304 M8

G. Take care to mount the panel on the float making sure that the midpoint of the panel is aligned with midpoint of the Connecting Float
H. Tighten the M8 fasters on the L Clamp after placing the module to ensure the module is tightened (mention torque)

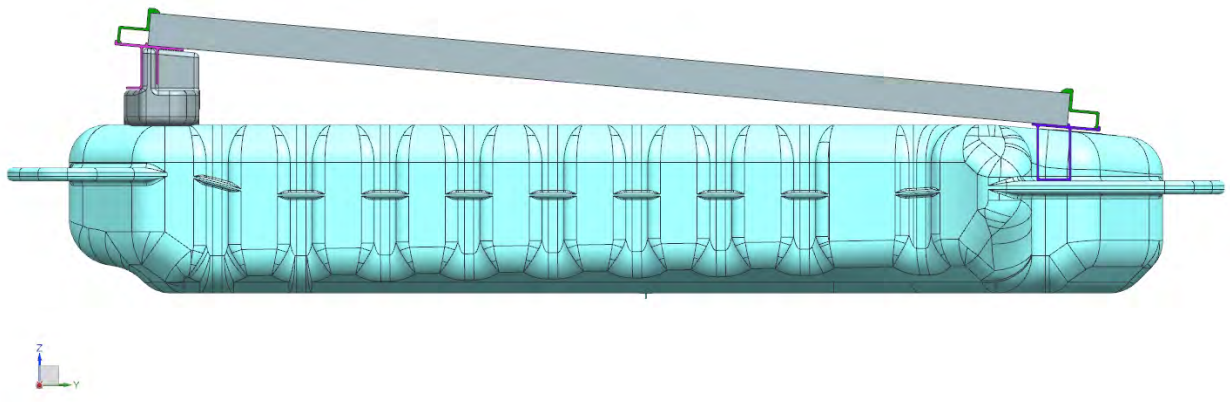


Figure 8

2. **Float Interconnection:**

Typically our floating structures are designed to have one row of Walkways at the periphery on the top and bottom portion and columns of Equipment Float at the periphery on the left and the right of the floating solar system. The Connecting Floats are installed inside the peripheral layers.

The following are the components used:

A. Connecting Float (CF)
B. Equipment Float (EF)
C. Small Walkway Float (SWF)
D. Big Walkway Float (BWF)
E. Support Piece (SP)
F. SS304 M12 - Nut, Bolt, Spring Washer and Plain Washer (2)

Installation Recommendations:

A. Ensure sufficient quantity of all floats are available to complete the portion of the total floating system which you wish to assemble

B. Ensure sufficient quantity of fasteners, sleeves and gaskets are available to complete the portion of the total floating system which you wish to assemble

C. Ensure that anchoring spreader bar is connected correctly to the outer peripheral floats before pushing into the water

D. Start the assembly from the last row onwards to ensure ease of installation while pushing into the water

E. While pushing the floats into the water, ensure not to exert excessive force on the ears of the float which may damage the same

F. Split the total assembly into sections and complete each section on the ground and then connect the completed sections together in the water to ensure proper connectivity. We recommend connecting 2-3 rows at any point of time on the shore and tugging a maximum of 5 rows by connecting both ends to ropes connected to the tug boat (say with a 10 HP motor)

G. Create a smooth surface at an angle of approximately 20 degree to help sliding the connected floats into the water. The platform should be lined with smooth plates or rubber sheets to avoid scratching of the floats with the ground

H. Use the logo on the floats as well as orientation marking on each float to ensure the correct orientation of the floats is followed during interconnection of the same

Float Installation Procedure:

A. Check the design of each float to see the height differences of the ears marked on the side of each float (as marked in orange)

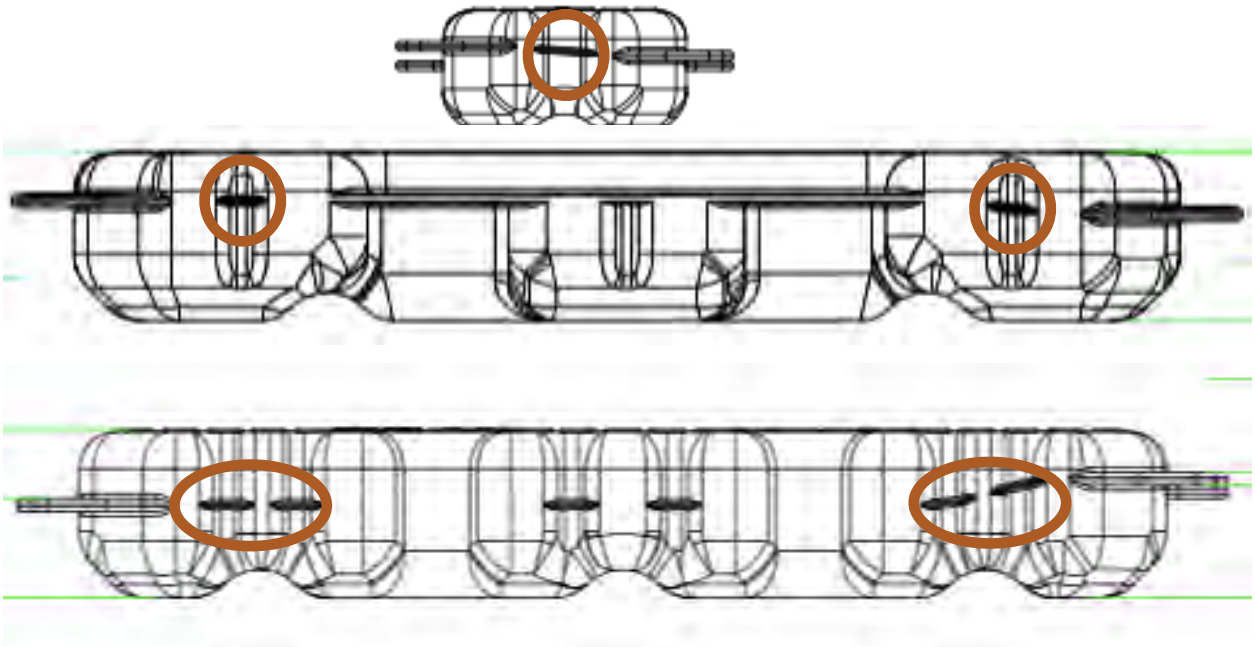


Figure 9

B. The assembly is to be started from the right most corner of the entire plant (with panels facing towards you - assume you are standing on south side facing north side with panels facing south (towards you)).

C. Test assemble 2 to 3 rows of floats first before tightening any fasteners to check alignment and use the sleeve in the holes of the ears to align the holes for inserting M12 nut

D. Connect the SWF such that the bottom right ear and the top right ear of the SWF always come on the bottom of the interconnecting ears. The bottom left ear of the SWF will be in the middle and top left ear of the SWF will be on the top

E. Connect the EF/CF in front of the SWF such that the top ears of EF/CF always come at the top of the interconnection of ears and the bottom ears always come at the middle of the interconnection of ears

F. Keep in mind that when 2 EF/CF are connected together the top ears of the second EF/CF will come on top of the bottom ears of the first EF/CF

G. Connect the BWF such that the right ears are always on the bottom of the interconnection of ears and the bottom left ear is in the middle and top left ear is in the top of the interconnection of ears

Connection Points Table

Small Walkway	**Interconnection Ear Position**		**Interconnection Ear Position**
Top Right Ear	Bottom	**Top Left Ear**	Top
Bottom Right Ear	Bottom	**Bottom Left Ear**	Middle
Big Walkway	**Interconnection Ear Position**		**Interconnection Ear Position**
Top Right Ear	Bottom	**Top Left Ear**	Top
Bottom Right Ear	Bottom	**Bottom Left Ear**	Middle
Panel Float/ Equipment Float	**Interconnection Ear Position**		**Interconnection Ear Position**
Top Right Ear	Top	**Top Left Ear**	Top
Bottom Right Ear	Middle	**Bottom Left Ear**	Middle

H. The above procedure can be repeated to connect all the floats together
I. Take care to align all holes with sleeve before connecting M12 fasters



Figure 10

J. Connect 3 rows on the shore and then push the assembly such that the floats touch the water surface
K. Connect the adjacent rows on the shore and push the assembly into the water
L. Tow the portion of assembly complete to the project location

M. Repeat the steps given above for the next portion of the assembly and then tow this assembly to the project location and interconnect at the location
N. The ears for the interconnecting points will align as provided above during the interconnection of the 2 floating portions
O. These steps may then be repeated to complete the entire assembly

3. Junction Box Installation Procedure:

A. Place the Equipment Float on the table
B. Mount the additional structure on the equipment float using the 4 M12 holes
C. Now mount your junction box on the structure and connect the equipment float on the array as described above



Figure 11

4. Electrical Connections Procedure:

A. While forming each row of the array of floaters, one must interconnect the module to module looping of DC Cables and use UV resistant cable ties on the hole provided on the supporting float or on the modules based on the available cabling length
B. Ensure to complete the module to module earthing looping during the connection of each row on the ground

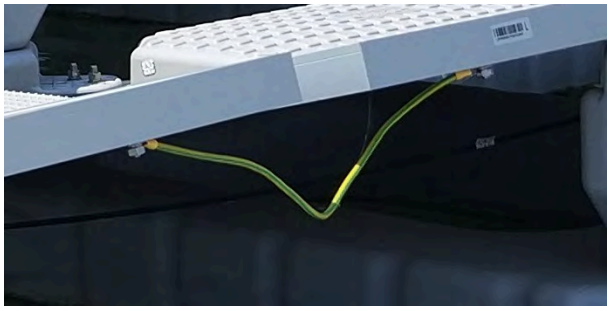


Figure 12

C. Take care to ensure that the loose ends of the cables do not touch with water when floated out and also to ensure the cables are properly tied using UV resistant cable ties to ensure no cables touch the water surface



Figure 13

D. The cables can then be taken on either cable tray or flexible conduits to the shore through equipment floats



Figure 14

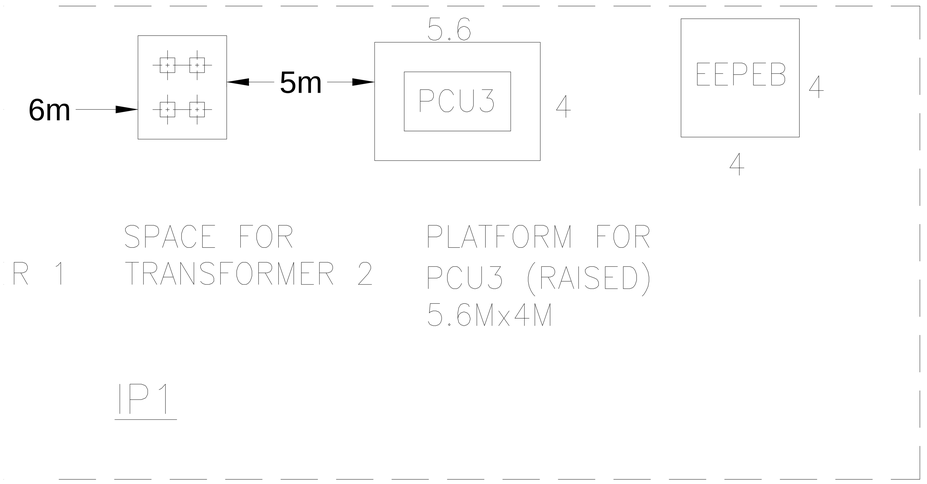
5. Installation Checklist:

- Check the connection of the injection nut with support piece on the connecting float
- Check if the solar panel is aligned to the centre of each connecting float so as to have equal overhang on both sides
- Check if aluminium clamps are tightened properly using the M8 hardware to the panel
- Check if aluminium clamps are tightened properly using the M8 hardware with the float
- Check that all interconnection ears are connected as per this manual
- Check the correct tightening of the M12 hardware at each interconnecting point
- Check the if the anchoring / mooring spreader bars are connected as per design to the peripheral floats using interconnection ears
- Check to ensure that the module to module looping of the DC cable and Earthing is done properly before pushing the floats into the water
- Check to ensure the cables are sufficiently spaced above the water by use of cable ties to ensure no damages to the cable
- Check the floats for any damages during assembly before pushing the arrangement into the water

6. Safety Recommendations:

A. It is recommended to always use life jackets while boarding and walking on the floating platform
B. While connecting the floats please ensure to always connect the floats properly before floating into the water
C. During regular maintenance ensure that the connections of the floats are checked for any disparity
D. All cables being used in the solar system must have sufficient slack to prevent damage due to motions and variations in level of water
E. Follow the relevant standards for lighting protection and system earthing
F. All cables used must be water proof as complete contact with water may not be avoided. Having this in mind, please ensure cable management systems are used to provide sufficient distance from water by use of cable ties
G. Cable conduits used to take cables from the floating island to the shore shall be water proof to avoid unnecessary risk during evacuation

H. The floating structure shall not be approached by untrained manpower and shall not be approached without personal safety equipment such as jackets and helmets



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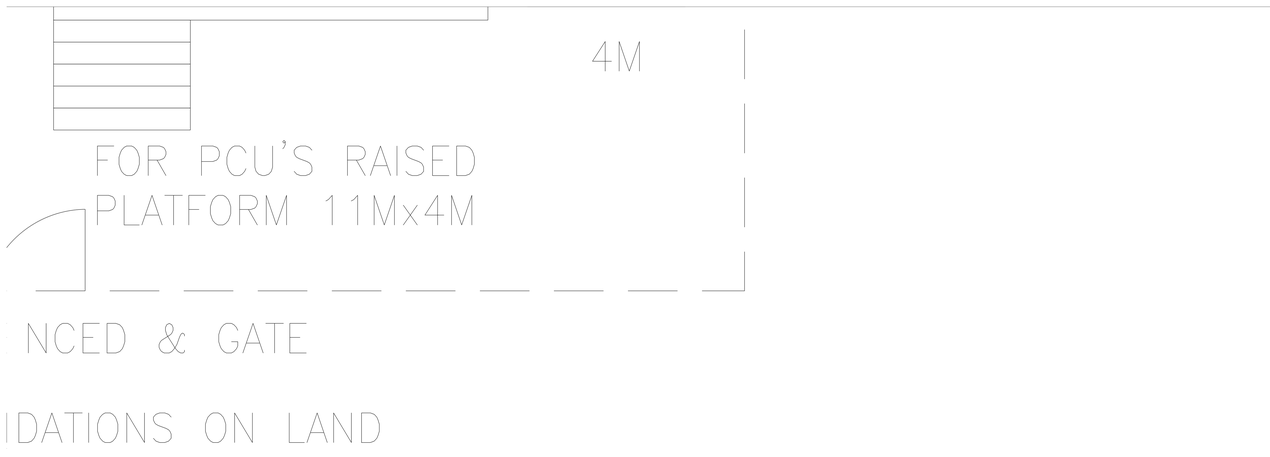
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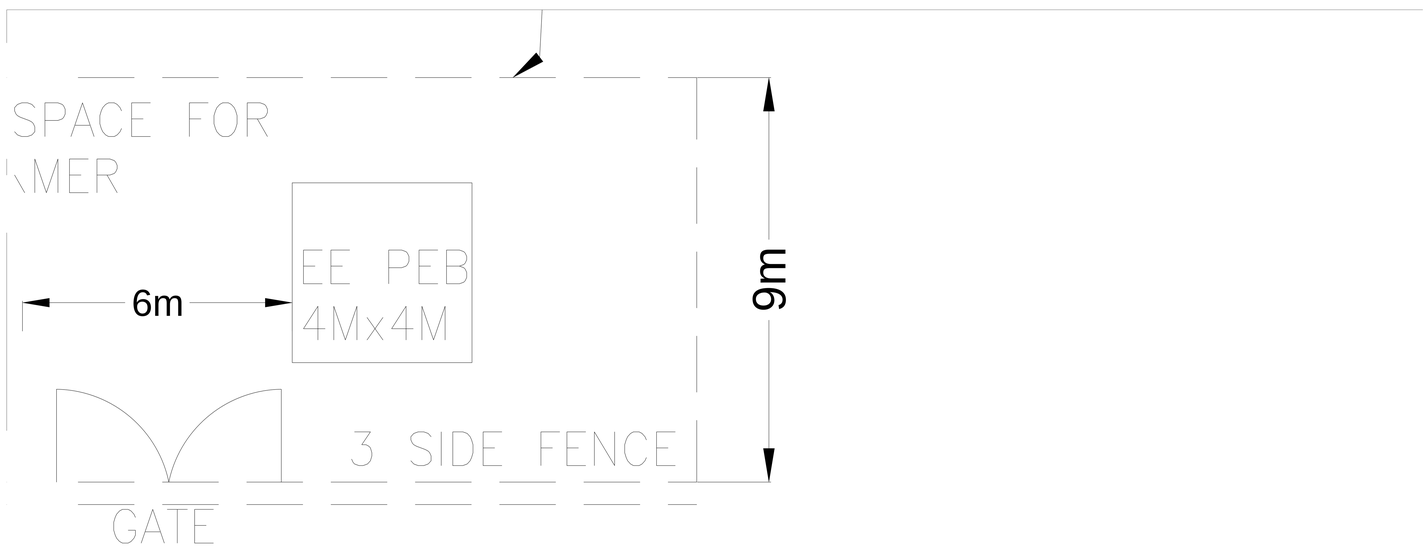
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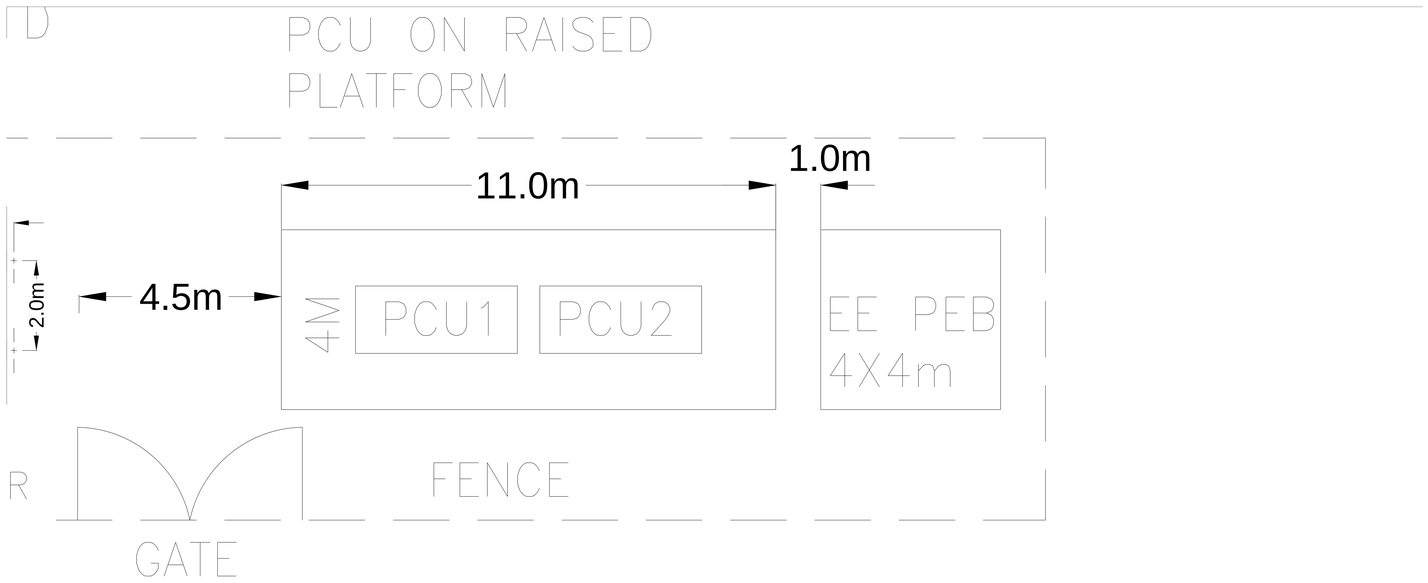
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D-3 GENERAL CIVIL WORKS

1. GENERAL

This chapter covers the Specific technical and functional requirements.

The design calculations and drawings for RCC structure, PEB Inverter Rooms, Steel structure, foundation system, road work, drainage, etc. shall be submitted for prior approval of NTPC before commencement of construction. The construction methodology for road works, drains shall be also be submitted for NTPC approval before start of works.

All design of RCC and Steel structures shall be carried as per IS: 456 and IS 800 respectively and other specific code as applicable to specific structures.

2. CMCS, INVERTER ROOMS, SECURITY ROOM:

The following structures shall be designed and provided by the bidder:

(I) **CMCS Building**: For the operation and maintenance of SPV Plant one Central Monitoring and Control Station (CMCS) with 33 KV switchgear room shall be provided. The CMCS building shall consist of the following:

1. Air conditioned SCADA Room
2. Inverter, battery room, ACDB and 33 KV Switchgear Room,
3. Store Room.
4. Supervisor room.
5. Toilets (Male and female).
6. Pantry.

Inverter(s), battery room, ACDB and 33 KV Switchgear room shall be based on manufacturer recommendation, easy passage of O&M persons and cable trench layout required. The CMCS shall be RCC framed structure with bricks/concrete blocks masonry walls. The CMCS shall have entry lobby and portico with roof for vehicle stoppage.

The minimum size & requirements of the CMCS Building & all items shall be as per tender drawing **5742-004-POC-A-003**.

(II) **Inverter Rooms**: Inverter rooms consist of PCU's, LT panels, batteries, etc. shall be provided based on manufacturer recommendation, easy passage of O&M persons and cable trench layout required. The inverter rooms shall be RCC building.

The battlery and its associated equipment shall be suitably segregated inside the Inverter room with proper ventilation arrangement.

The equipment inside the inverter room shall be placed so as to provide sufficient space for their maintenance.

The layout, design and drawings for all RCC structure, etc. and foundation system shall be approved from NTPC before start of works. The buildings and allied works shall be designed to meet national building code **2005** requirements.

2.1 **Specification for RCC Building for CMCS and Inverter room.**

The CMCS building shall be made of RCC framed structure with bricks/concrete blocks masonry walls. The thickness of outer masonry walls shall be minimum 230mm in case of bricks and minimum 200mm thick in case of concrete blocks. The following detailed specification shall also be followed for RCC works:

2.1.1 **Floor Finishes**

Switchgear/Inverter rooms	: Cement concrete flooring with ironite hardener.
SCADA room	: Heavy duty vitrified ceramic tiles
Battery room	: Acid Alkali resistance tile flooring or acid alkali resistant epoxy coating over concrete flooring with ironite hardener
Lobby	: Heavy duty vitrified ceramic tiles and skirting
Toilet	: Heavy duty anti-skid ceramic Tiles and dodo 210 mm
Steps	: Kota stone/Granite- 20 mm thick
Store room	: Cement concrete flooring with ironite hardener.

Flooring for air conditioned areas area shall be provided with vitrified ceramic tiles of size 600X 600 mm of min 9 mm thickness, laid with 3 mm ground joints as per approved pattern. Cement concrete flooring shall conform to IS 2571.

The floor finish for toilet shall be vitrified ceramic anti-skid tiles and Dado glaze ceramic tiles upto 2.1m shall be used. The normal size of Ceramic tiles shall be 300 mm X 300 mm X 9 mm and shall comply IS: 15622.

Finish floor level of all building shall be minimum 600 mm above from Finish graded level.

2.1.2 **False Celling**

The SCADA room shall be provided with false ceiling of 15 mm thick mineral fiber board, in tile form of size 600mm x 600mm, along with galvanized light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and color, to give grid of maximum size of 1200x600 mm as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts(if required), return air grills(if required), light fixtures, etc., all complete.

2.1.3 **Roof Finishes**

Roof of the Building shall consist of Cast-in-situ RCC slab with decking sheet (RCC slab with permanent formwork) The slab formwork decking sheet shall be permanently colour coated profile sheet with minimum 0.6mm thickness of grade SS255 as per ASTM A653M / grade G250 as per AS 1397 coated with zinc of class designation Z275 or aluminium zinc alloy of class designation AZ150 or similar. The decking sheet shall meet the strength, deflection and other functional requirements.

Bidder can also provide Roof of the building as Cast-in-situ RCC slab conforming to Indian code.

The roof of the building shall be water proof with Polymeric membrane type waterproofing as per DSR 2013, Items no. 22.16. The roof shall be designed for minimum superimposed load to 150 kg/m2.

For efficient disposal of rainwater, the run off gradient for the roof shall not be less than 1:100 and the roof shall be provided with PVC/RCC water gutter, wherever required. Gutter shall be made water tight using suitable watertight treatment. This gradient can be provided either in structure or subsequently by screed concrete 1:2:4 (using 12.5 mm coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. The roof of all building shall be projecting out by at least 750 mm all around the building for its external walls protection from rain water and parapet wall above the roof beam. Height of parapet wall shall be minimum 300 mm above top of roof level. Structural steel hand railings of minimum 700mm height shall also be provided over the parapet wall.

The bidder shall also provide rain water harvesting system consisting of ground water recharge pits for CMCS building roof.

2.1.4 **View point**

RCC terrace of CMCS building shall also work as view point. View point shall be used for security purposes and viewing gallery. Suitable RCC half landing staircase shall be provided for access to roof of the RCC CMCS building.

2.1.5 **Windows, Doors, Ventilators and Rolling Shutters**

Doors, windows and ventilators of air-conditioned areas, entrance lobby of all buildings, and all windows and ventilators of CMCS building shall have, powder coated (minimum thickness of powder coating 50 micron) aluminum framework with glazing. Window shall be provided with suitable aluminum grill.

All doors of toilet areas shall be of steel framed solid core flush shutter as per IS 2202. Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However, for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20 m.

Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade over the openings with 300 mm projection on both side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings except for main entrance door to the control room where the projection shall be 1500 mm.

Rolling shutter (Mechanical gear operated). Rolling shutters shall be fabricated from 18-gauge steel and machine rolled with 75 mm rolling centers with effective bridge depth of 12 mm lath sections, interlocked with each other and ends locked with malleable cast iron clips to IS: 2108 and shall be designed to withstand a wind load without excessive deflection. Metal rolling shutters and rolling grills as IS: 6248

2.1.6 **Glazing**

All accessible ventilators and windows of all buildings shall be provided with min. 4mm thick float glass, tinted for preventing solar radiations, unless otherwise specified.

For single glazed aluminium partitions and doors, toughened float glass of 10 mm thickness shall be used. All glazing work shall conform to IS: 1083 and IS: 3548.

The glass to used should be from reputed brand / manufacturer and as approved by NTPC. The glass should be free from distortion and thermal stress.

2.1.7 **Paintings of wall and ceilings**

Internal wall surfaces: SCADA room All other rooms in plant buildings	 -Acrylic Emulsion -Acrylic Distemper
External faces of walls:	-Exterior emulsion paint
Walls of battery room	-Acid alkali resistant paint, an exposed wall above Dado -2100 mm high Dado of acid alkali resistant tiling.
All Ceiling	-Acrylic Distemper

The paint shall be anti-fungal quality of reputed brand suitable for masonry. All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush, then same shall be finished off with roller. For painting on concrete, masonry and plastered surface, IS: 2395 shall be followed. Minimum 2 finishing coats of paint shall be applied over a coat of primer.

For painting on steel work and ferrous metals, BS: 5493 and IS: 1477 shall be followed. The type of surface preparation, thickness and type of primer, intermediate and finishing paint shall be according to the painting system adopted.

Ceiling of all rooms except Battery room shall be white washed. The ceiling of Battery room (if provided) shall be acid/alkali resistant paint. CMCS building outside colors of paining shall be similar to PEB painting colors.

A standard color scheme for the different buildings/structures shall be prepared by the Contractor and the approval of the Owner shall be obtained, before commencement of work.

2.1.8 **Plumbing and sanitary**

CMCS building room shall have attached toilet for both gender. Each toilet shall have the following minimum fittings of ISI approved of reputed brand (subject to approval from Engineer in charge).

a) Wall mounted WC (Western type) 390 mm high with toilet paper roll holder and all fittings.
b) Wall mounted Urinal (430 x 260 x 350 mm size) with all fittings for male toilet only.
c) Wash basin (550 x 400 mm) above platform with all fittings.
d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing.
e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets.
f) Soap holder and liquid soap dispenser.

Wash basin provision for hand wash shall also be provided in **battery room**.

All fittings, fastener, grating shall be brass with chromium plated as per relevant IS code. Necessary plumbing lines shall be provided for CMCS room building and Security room near main gate.

The bidder shall design & provide packaged sewerage treatment plant/septic with soak pit for CMCS and Security room assuming that a total of 15 people shall use the facility. The waste water/effluents from the sewerage plants/septic tank shall meet the state pollution board requirement.

2.2 **Water Supply**

GI pipes of Medium quality conforming to IS 1239 (Part I-1990) or CPVC pipes conforming to IS 15778 shall be used for all portable hot and cold water distribution supply and plumbing works.

The Syntax or equivalent make PVC storage water storage tank conforming to IS: 12701 shall be provided over the roof of the CMCS with adequate capacity for 10 No person and 24 hr requirement, complete with all fitting including float valve, stop cock etc. The capacity of the tank shall be minimum 500 liters.

2.3 **Plastering**

All external surfaces shall have 18 mm cement plaster in two coats, under layer 12 mm thick cement plaster 1:5 and finished with a top layer 6 mm thick cement plaster 1:6 (DSR 2013-13.11).

White cement primer shall be used as per manufacturer's recommendation.

At least one coat of plaster shall be applied to interior walls by hand or mechanically, to a total thickness of 12 mm using 1:6, 1 cement and 6 sand. Plastering shall comply to IS: 1542, IS: 1661, IS: 1630. Oil bound washable distemper on smooth surface applied with minimum 2 mm thick Plaster of Paris putty for control room. Plaster of Paris (Gypsum Anhydrous) conforming to IS: 2547 shall be used for plaster of paris punning.

2.4 **Masonry Work**

Brick works shall be using at least class designation 7.5 of approved quality as per IS: 1077, IS: 2212 and IS: 3495. Concrete blocks shall be of minimum compressive strength of 7.5 N/mm2 and shall be of Grade-A as per IS: 2185. Stone masonry work with hard stone in building works, foundation, plinth and drains shall be Coursed Rubble or Random Rubble masonry work with stone of good quality and durability. The masonry surface shall be plastered with minimum 18mm plaster in case of CMCS walls. The stone masonry work shall be in line with IS: 1597, IS: 1122 and IS: 1126.

The cement mortar for all kind of masonry work shall be in the ratio 1 cement and 6 sand by weight.

Bricks/blocks required for masonry work shall be thoroughly soaked in clean water tank for approximately two hours. Brick shall be laid in English bond style. Green masonry work shall be protected from rain. All masonry work shall be kept moist on all the faces for a period of seven days.

Bricks of class designation 50 and 35 may be permitted to have slight distorted & rounded edges provided no difficulty shall arise on this account in laying of uniform courses in non-load bearing structures and shall be subjected to approval of NTPC. Tolerances on dimensions up to +/- 8% shall be permitted. Dimension test to be carried out as per IS code.

The external wall for the building shall be 230 mm thick walls and internal wall 230/115 thick as per requirements. The external wall of CMCS facing the transformer area shall be as per IS: 1646 - Code of practice for fire safety of buildings (general): electrical installations.

Use of fly ash brick for masonry shall be subjected to approval of NTPC.

Suitable damp proof course shall be provided the proportion of cement, sand & aggregate shall be 1:2:4 using 6 mm down stone chips with a water proofing admixtures. The thickness of damp-proof course shall be minimum 40 mm.

2.5 **Reinforced Concrete Structure, Allied Works and Foundation**

All RCC works shall be design mix as per IS: 456-2000. For structural concrete items, Ordinary Portland cement (43 Grade) conforming to IS: 8112 and Fly ash based Portland pozzolana cement conforming to IS: 1489 (Part-1) shall be used for superstructure. Type of cement for sub-structures shall be decided based on the final Soil Investigation report.

Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.

Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116

Reinforcement steel shall be of high strength deformed TMT steel bars **with corrosion inhibitors, Corrosion Resistant Steel (CRS) re-bars, Fusion Bonded Epoxy Coated (FBEC) re-bars or Zinc Coasted re-bars** of grade minimum Fe-500 shall conform to IS: 1786. Ductile detailing in accordance with IS: 13920 shall be adopted for superstructure and substructure of all RCC buildings / structures. Dense concrete around reinforcement, provision of thick covers, and addition of corrosion protection with re-bars shall be provided to the RCC structures.

The following minimum grades of concrete for design mix and nominal mix shall be adopted for the type of structures noted against each unless not specified elsewhere.

M 30 - All RCC structural elements above and below ground level, precast concrete, foundation, cable trench, oil pit, Grade Slab, Paving, culverts & road.

M-20 (Equivalent nominal Mix of 1:1.5:3) * - Plain Concrete Cement

The bidder shall carry out the design mix of M-30 grade concrete on priority. The design mix shall be approved from NTPC before start of work.

In case Geotechnical investigations requires any special kind of cement or higher grade of concrete, the same shall be provided.

The foundation system shall be made which transfer loads safely to the soil for the module mounting structures, depending on soil conditions, geographical condition, regional wind speed, bearing capacity, slope stability etc. All foundation system and foundation depth shall be decided based on the approved geotechnical investigation report. No foundation allowed on back filled soil and the foundation depth to reach upto NGL.

All loads shall be considered in line with IS: 875. Seismic loads for design shall be in accordance with IS: 1893 and relevant Standards.

IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete Reinforcement must be complied for reinforcements. IS: 5525 and SP: 34 shall be followed for reinforcement detailing.

A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456.

2.6 **Structural Steel**

All structural steel design shall be carried out as per IS 800. Structural steel shall conform IS 2062, Pipe shall be as per medium/high grade of IS 1161, Chequered plates shall conformed to 3502 and Hollow steel sections for structural use shall conform to IS: 4923.

2.7 **Grouting**

Cement mortar (1:2) grout with non-shrink additives shall be used for grouting below base plate of column. The grout shall be high strength grout having a minimum characteristic compressive strength of min 30 N/mm2 at 28 days.

3.0 **Transformer Yard Civil Works**

Transformer and equipment's foundations shall be founded on piles/isolated spread footings depending on the final geotechnical investigation report.

Transformer foundations shall have its own pit which would cover the area of the transformer and cooler banks, so as to collect any spillage of oil or oil drainage in case of emergency. The oil pit shall be filled with granite stones of 40 mm size uniformly graded.

The bidder can propose soak pit under Transformer or Burnt oil pit at a distance connected to transformer soak pit depending upon oil quantity in Transformers. It shall be sized to accommodate oil volume of the transformer connected to it, without backflow. Gravel filled level under transformer shall be in accordance with FGL outside pit and transformer bottom level.

The area around the transformer and equipment's shall be covered with gravel and galvanized chain link fence of height min 1.8 m with fence posts and gates shall be provided. All fence posts shall be 50X50X6 MS angles spaced at 2.5m c/c distance and all other specification mentioned in Tender drawing **5742-004-POC-A-004** shall be followed. M.S. angle posts shall conform to IS: 2062. The portion of the fence covering towards rail track shall be made of removable type for movement of transformer during erection /removal. In addition, a small gate, 1.2 m wide shall be provided for man entry. The transformer yard fencing work shall conform to CEIG requirements.

Transformer track rails shall conform to IS: 3443. The requirement of fire barrier wall between transformers shall be as per Electricity Rules and IS: 1646 recommendations.

4.0 **Pipe /Cable Racks & Trenches**

Trenches shall be constructed in reinforced cement concrete of M-20 grade of wall thickness min 150 mm. The top of trenches shall be kept at least 100 mm above the gravel level so that rain water does not enter the trench. Trench walls shall not foul with the foundations.

Outdoor Cable Trenches: RCC cable trenches shall be constructed in the switchyard and pre-cast RCC removable covers with lifting arrangement, edge protected with suitable galvanized angle iron designed to withstand self-weight of top slab + concentrated load of 150 kg at center of span on each panel.

Indoor Cable Trenches: RCC indoor cable trenches shall be provided with 50X50X4 mm angles grouted on the top edge of the trench wall for holding minimum 6 mm thick mild steel checkered plate covers (600 mm in length except at ends & bends) conform to IS: 3502 with lifting arrangement. Angle or channels shall also be grouted at distances of 600 mm across the indoor cable trenches to support the checkered plates.

Trench Drainage: The trench bed shall have a slope of approx. 1/500 along the run & 1/250 perpendicular to the run. In case straight length exceeds 30 m, suitable expansion joint shall be provided at appropriate

distances. The expansion joint shall run through vertical wall and base of trench. All expansion joints shall be provided with approved quality PVC water stops. Suitable drainage at lowest point of the trench shall be provided.

5.0 **ROAD AND PATHWAY**

5.1 **Road:** The approach road to the Solar Power Plant shall originate from the main approach road and connect to all Inverter rooms, CMCS building and gates. Approach road shall be 3.0 meter wide with 1meter wide shoulder on both side. Red moorum/brick, minimum 100 mm thick shall be provided for shoulder. The crown of the road shall be minimum 150 mm above FGL. The final finished roads shall have a camber of 1 in 50.

The minimum road section shall be as follows:

1) Topping: Wearing course of premix carpet 20 mm thick.
2) WBM, compacted 75 mm thick (Grade-III).
3) WBM, compacted 100 mm thick (Grade-II).
4) Granular Sub-base, compacted 150mm thick granular sub-base (Gr-I).
5) Sub-grade under road and its shoulders shall be compacted to achieve 95% or more of standard proctor's MDD. CBR value of the sub grade level should be minimum 4%. If actual CBR is less than 4% in a particular stretch then GSB thickness shall be increased suitably.

The methodology of road construction with material specifications shall be in line with IRC/MORTH and shall be submitted for approval before starts of works. Road works shall be carried out as per tender drawing **5742-004-POC-A-002**

6.0 **DRAINAGE SYSTEM:**

Surface drainage system shall be designed considering “maximum hourly rainfall intensity” at the site area considering latest 25 years return period however the minimum value of “maximum hourly rainfall intensity” shall be maintained as 60 mm in the drainage system design. The minimum value of surface run off coefficient shall be considered as 0.6 in the design of drainage system. The drainage system shall be designed as per the IRC specifications and prevailing industry practices. The drainage scheme shall be designed considering the bidder’s plot area and nearby catchment area contributing to the plot drains. Drainage scheme with detention ponds which allows for groundwater recharge & maintains the existing drainage pattern as far as possible is desired. A network of open drains shall be designed & provided to carry surface run off. The drains shall be trapezoidal or rectangle section lined with concrete slabs/brick

masonry/stone masonry/stone slabs. The minimum thickness of these lining shall be 115mm for brick masonry, 75mm thick for concrete slab, 150mm thick for stone masonry and 100mm thick for stone slab.

Grade level shall be fixed with due reference to highest high flood level of the receiving body of water. Laying of Hume pipe shall be in line with IS: 783.

7.0 ELECTRIFICATION OF BUILDING

Electrification of all building shall be carried out as per IS 732-1989, IS: 4648-1968 and other relevant standards.

8.0 LIST OF APPLICABLE INDIAN STANDARDS:

Indian codes, and/or standards shall govern, in all the cases wherever they are available. In case of a conflict between such codes and/or standards and the specifications, the stringent provisions shall govern. Such codes and/or standard referred to shall mean the latest revision, amendments/changes adopted and published by the relevant agencies. In case of any further conflict in this matter the same shall be referred to the Engineer-in-charge, whose decision shall be final and binding.

Other internationally acceptable standards shall be accepted, only if, no Indian Standards are existing. However, other standards also will be accepted if the Contractor establishes that the works are meeting the requirements of Indian Standards also.

A brief list of Indian Standards applicable to these works is as below:

General

IS: 875-I	Code of Practice for Design Dead Loads for Building and Structures
IS: 875-II	Code of Practice for Design Imposed Loads for Building and Structures
IS: 875-III	Code of practice for design loads (other than earthquake) for buildings and structures.
IS: 1893	Criteria for earthquake resistant design of structures.
IS: 4326	Code of Practice for earthquake resistant design and construction of buildings

Foundations

IS: 1080	Code of practice for design and construction of shallow foundations in soils (other than raft, ring and shell)
IS: 1904	Code of practice for structural safety of building foundations
IS: 2950	Code of practice for design and construction of raft foundations.
IS: 4091	Code of Practice for Design and Construction of Foundations for Transmission Line Towers and Poles
IS: 6403	Code of Practice for determination of bearing capacity of shallow foundations
IS: 8009	Code of Practice for foundation settlement calculations
IS: 2911	Design & Construction of Pile Foundation - Code of Practice

Concrete Structures

IS: 456	Code of practice for plain and Reinforced concrete
IS: 3370	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of Practice for design and installation of joints in buildings
IS: 5525	Recommendation for detailing of reinforced concrete works
IS: 6313	Code of practice for anti-termite measures in buildings
IS: 13920	Ductile detailing of Reinforced Concrete Structures subjected to Seismic forces
IS: 1904	Code of practice for design and construction of foundations in soils general requirements

Steel Structures

IS: 800	Code of practice for use of structural steel in general building construction
IS: 801	Code of practice for use of cold-formed light gauge steel structure members
IS: 802	Code of Practice for use of Structural Steel in over Head Transmission Line Towers.
IS: 806	Code of practice for use of steel tubes in general building construction.
IS: 808	Dimensions for hot rolled steel beam, column channel and angle section
IS: 811	Specification for Cold Formed Light Gauge Structural Steel Sections

IS: 813	Scheme of symbols for welding
IS: 1079	Hot Rolled carbon Steel Sheet and Strip - Specification
IS: 2062	Hot Rolled Medium and High Tensile Structural Steel - Specification
IS: 4923	Hollow steel sections for structural use.
IS 1161	Steel tubes for structural purpose
IS: 2721	Galvanized steel chain link fence fabric - Specification

Painting and Coating

IS: 4736	Hot-dip zinc coatings on mild steel tubes
IS: 4759	Hot-dip zinc coatings on structural steel and other allied products – Specification
IS:1868	Anodic coatings on aluminum and its alloys
IS 2395-I	Painting of Concrete, Masonry and Plaster Surfaces - Code of: Operations and Workmanship
IS 2395-II	Code of practice for painting concrete, masonry and plaster surfaces: Schedule
IS 1477-I	Code of Practice for Painting of Ferrous Metals in Buildings: Pre-treatment
IS:1477-II	Code of practice for painting of ferrous metals in buildings: Painting

Water supply and sanitary

IS: 1239	Mild steel tubes and tubulars and other wrought steel fittings
IS: 1172	Code of basic requirements for water supply, drainage and sanitation
IS: 1742	Code of Practice for building drainage
IS: 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS: 15778	Chlorinated polyvinyl chloride pipes for potable hot and cold water distribution supplies
IS: 16088	Chlorinated polyvinyl chloride pipes for automatic sprinkler fire extinguishing system
IS: 10124	Fabricated PVC fittings for potable water supplies
IS: 4985	Un-plasticized PVC pipes for potable water supplies

IS: 13592	Un-plasticized Polyvinyl Chloride (PVC-U) Pipes for Soil and Waste Discharge System Inside and Outside Buildings Including Ventilation and Rainwater System
IS: 12818	Un-plasticized polyvinyl chloride (PVC-U)screen and casing pipes for bore/tubewell
IS: 2470	Code of Practice for installation of septic tanks

Miscellaneous

IS: 1905	Code of Practice for structural use of un-reinforced masonry
IS: 3067	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
SP: 6	Handbook for structural engineers (all parts)
SP: 7	National Building Code of India
SP: 16	Design Aids for reinforced concrete to IS:456
SP: 20	Handbook on masonry design and construction
SP: 22	Explanatory handbook on codes for earthquake engineering
SP: 24	Explanatory handbook on Indian Standard Code of Practice for plain and reinforced concrete
SP: 25	Handbook on causes and prevention of cracks in buildings
SP: 32	Handbook on functional requirements of industrial buildings
SP: 34	Handbook of concrete reinforcement & detailing
IRC: 37	Guidelines for design of flexible pavements
IRC: 42	Guidelines on Road Drainage
IRC: 58	Guidelines for the design of rigid pavements for highways
IRC: 73	Geometric design of roads

GENERAL DESIGN DATA

A. **VICINITY MAP**:

B. **WIND**: Basic wind speed shall as per Cl. 2.0 of Chapter A-2.

C. **SEISMIC** shall be as per IS: 1893 (Part-1)

D. The **CMCS building** shall consist of the following with area:

Sl No:	Room	Minimum Area
1	Air conditioned SCADA Room	16 sqm
2	Inverter, battery room, ACDB and 33 KV Switchgear Room	manufacturer recommendation
3	Store Room	25 sqm
4	Supervisor room	12 sqm
5	Toilets (Male and female)	16 sqm
6	Pantry	05 sqm

E. ALL BUILDINGS ARE OF RCC.

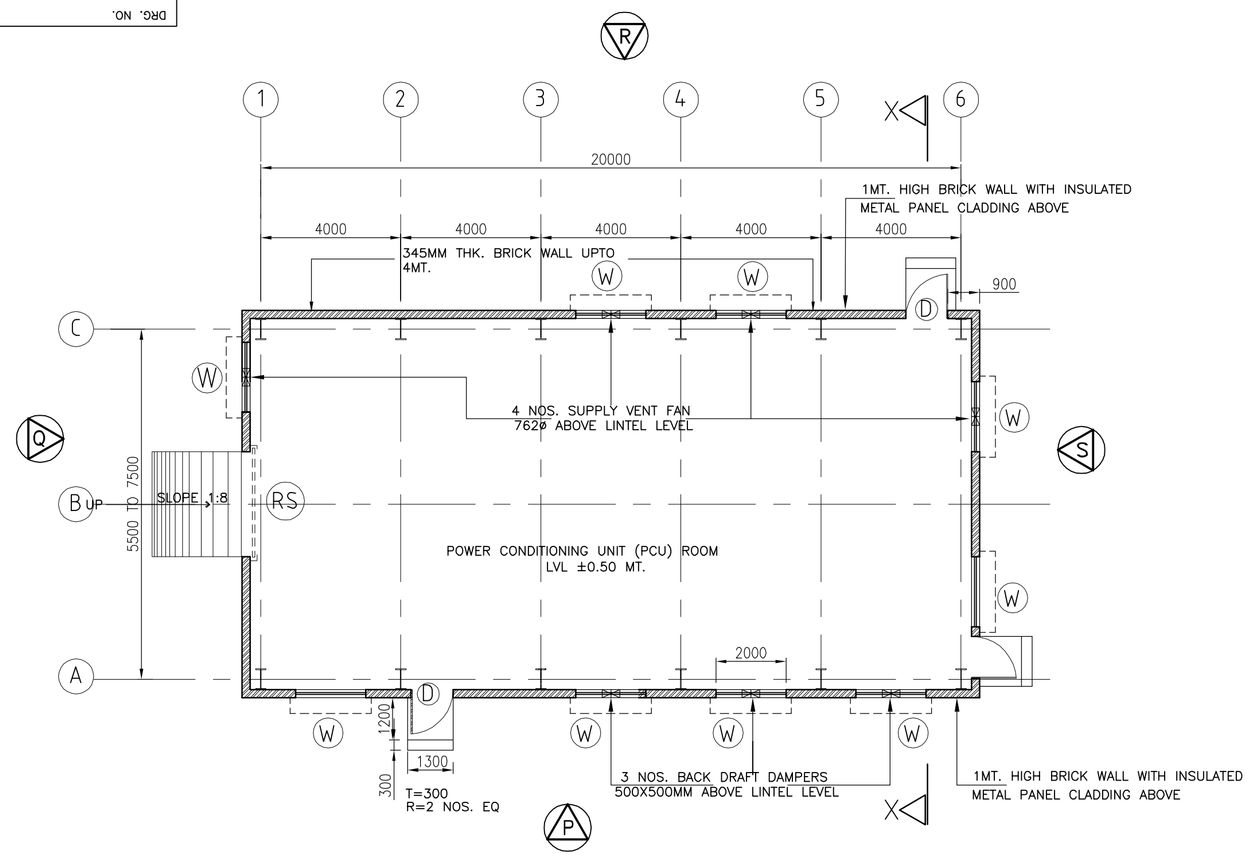
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As per NTPC Technical Amendment

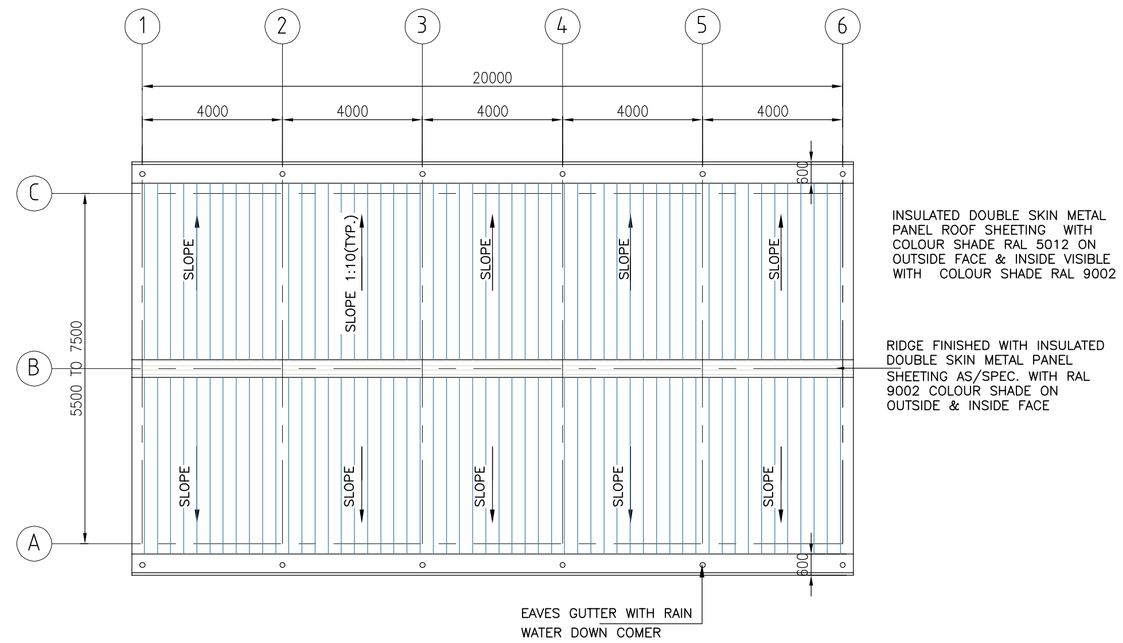
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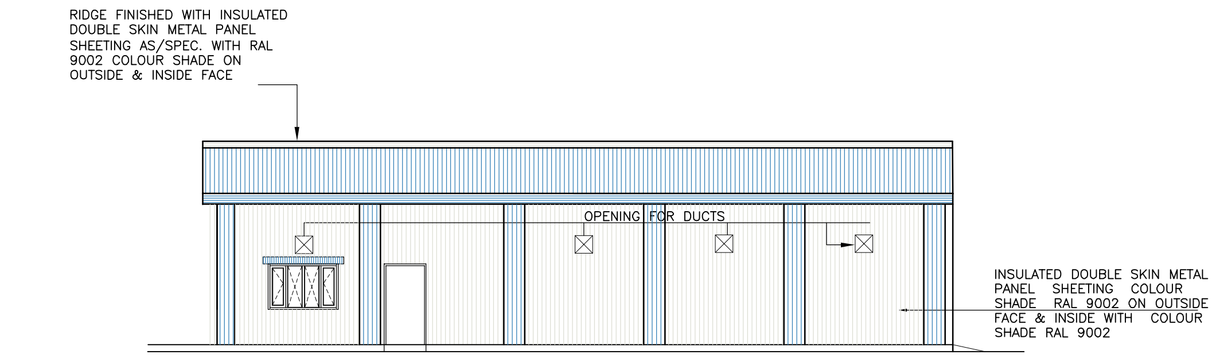
REV. NO.



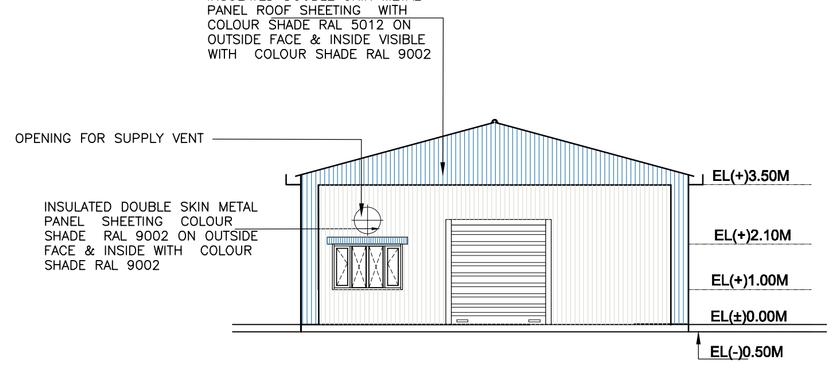
PLAN AT ± 0.0 MTS. LVL.



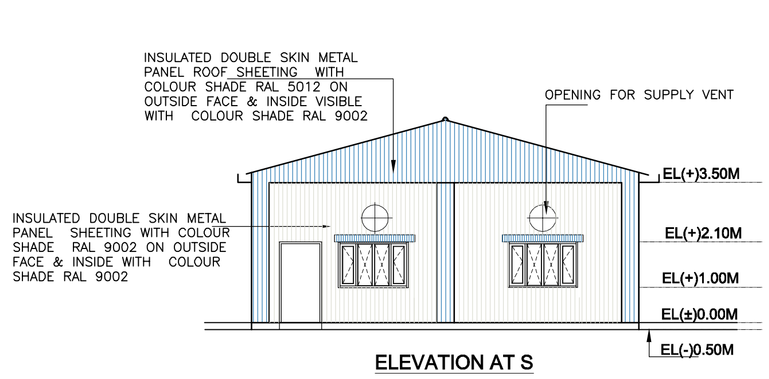
ROOF PLAN



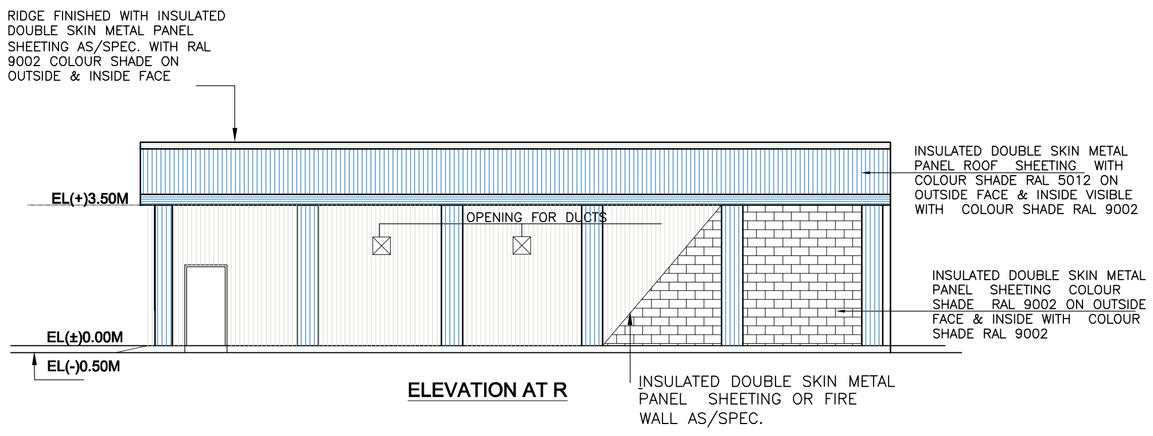
ELEVATION AT P



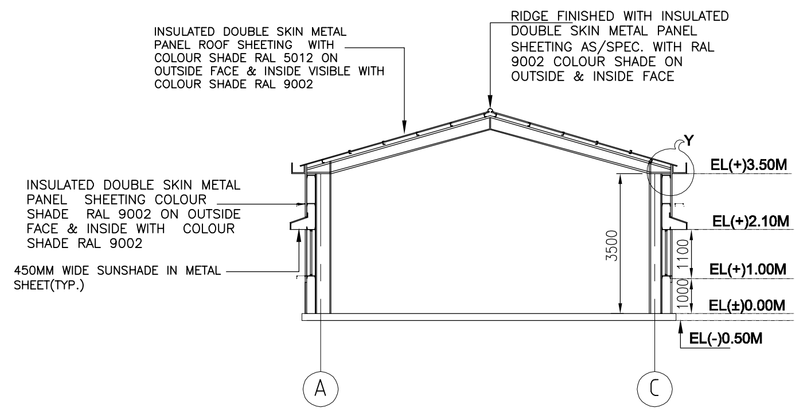
ELEVATION AT Q



ELEVATION AT S



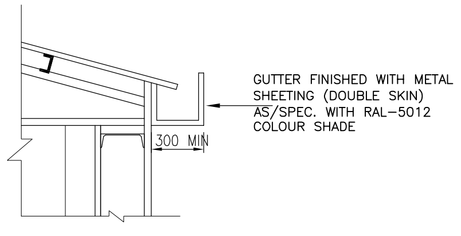
ELEVATION AT R



SECTION AT X-X

DOOR/ROLLING SHUTTER/WINDOWS/VENTS/DUCTS

TYPE	SIZE	CILL LVL.	LINTEL LVL.	DESCRIPTION
D	1200X2100	0.00	2100	1200, D, 2100
RS	**REFER NOTE 5 & 6**	0.00	H	W, RS, H
WINDOWS VENTILATORS DUCTS	**REFER NOTE 5 AND 6.**			HEIGHT, WIDTH, W, VENT, DUCT



DETAIL AT Y

NOTES:-

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS.
2. DRAWING SHALL NOT BE SCALED ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.
3. ANY DOUBT OR DISCREPANCY IN THE DRAWING SHALL BE BROUGHT TO THE NOTICE OF THE ENGINEER-IN-CHARGE BEFORE EXECUTING THE WORK.
4. WORK SHALL BE CARRIED OUT BASED ON DETAIL WORKING DRAWINGS TO BE PREPARED BY THE VENDOR & GOT APPROVED FROM NTPC, BEFORE EXECUTION.
5. OPENING FOR ROLLING SHUTTER, DUCT'S AND VENTILATOR'S SHALL BE AS PER INVERTER (PCU) MANUFACTURER RECOMMENDATIONS AND VENDOR DESIGN SUBJECT ON NTPC APPROVAL.
6. LOCATIONS OF DOOR, ROLLING SHUTTER, WINDOWS, VENTS & DUCTS ARE INDICATIVE ONLY. VENTILATIONS AND DUCTS SHALL BE DESIGN CONSIDERING HEAT CALCULATION OF PEB ROOM.
7. REFER TECHNICAL SPECIFICATION FOR PEB-INVERTER ROOM IN CIVIL WORKS.

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	GEOTECH	REDG	ELEC.	APPD.	DATE
A		RAM	AT						14.08.18
		CLEARED BY							

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NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
(ENGINEERING DIVISION)

PROJECT: DEVELOPMENT OF 22MW FLOATING SOLAR AT RGCCPP KAYAMKULAM

TITLE: PEB INVERTOR ROOM

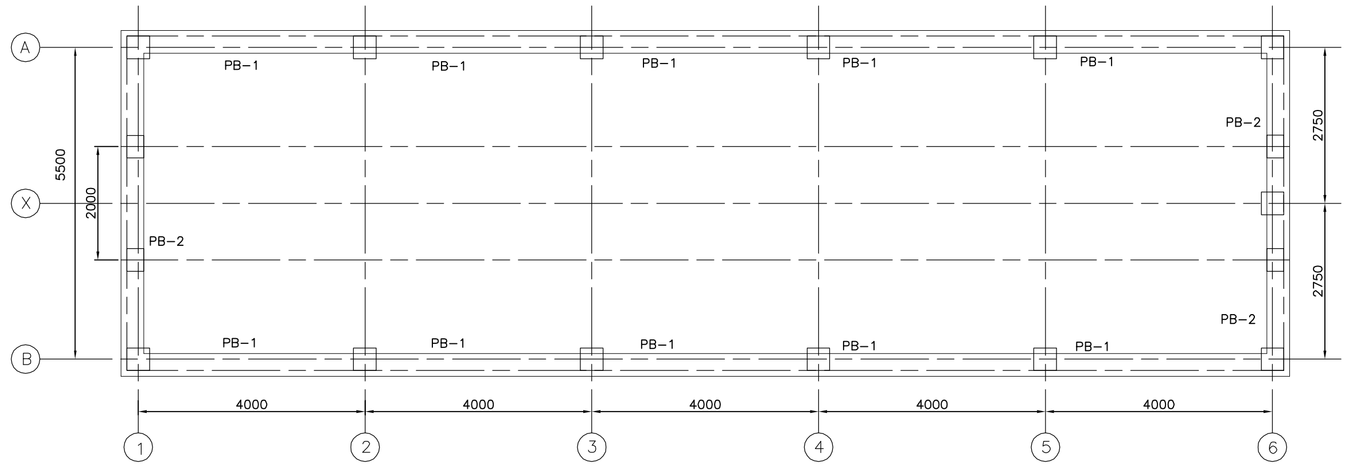
SIZE	SCALE	DRG. NO.	REV.NO.
		5742-004-POC-A-005	A

SHEET 1 OF 3

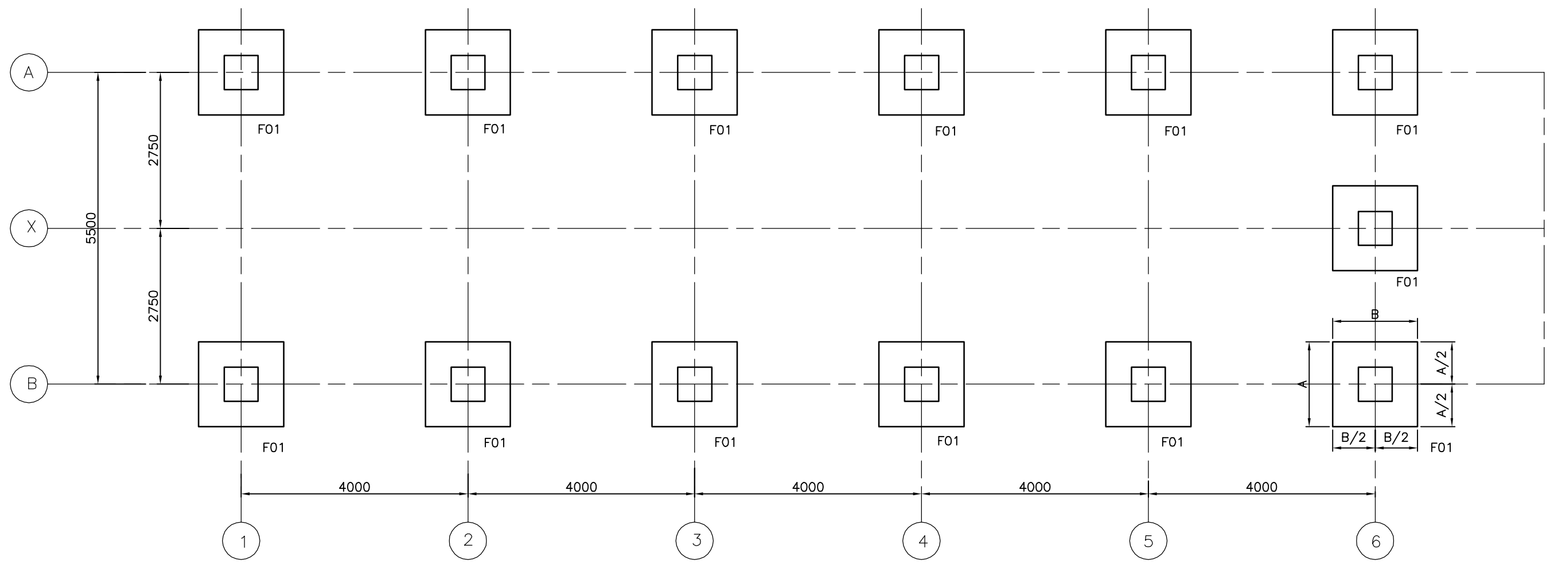
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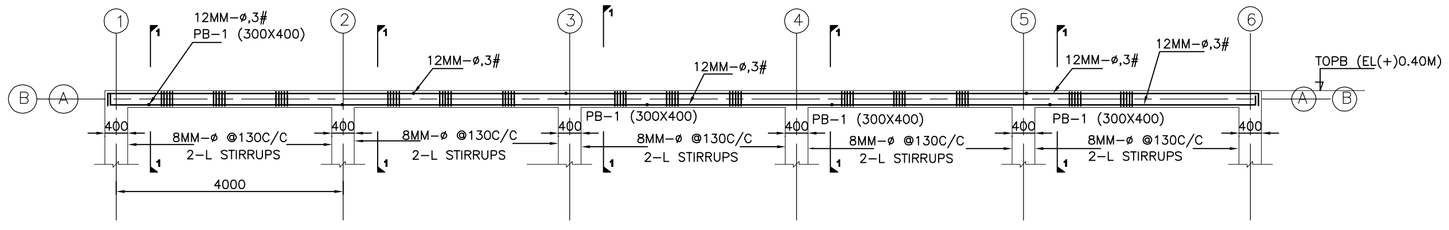
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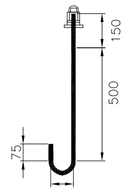
PLINTH BEAM PLAN AT ELEVATION +0.40M



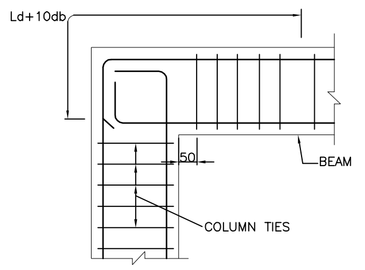
FOUNDATION FOR INVERTER ROOM
AT EL. (- 1.20M)



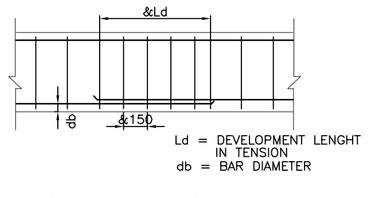
ALONG GRID A & B



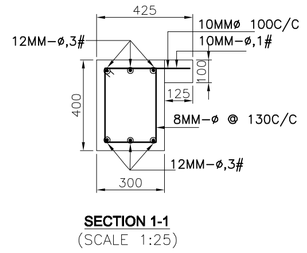
J-BOLT (M16) 4#
HDG MINIMUM 5.6 GRADE
(TYPICAL)



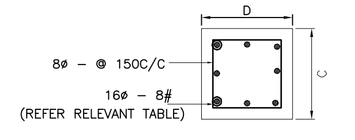
FIXED EAND JOINT IN A COLUMN (TYP)



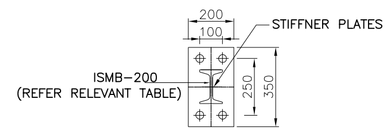
LAPPING LENGTH DETAILS (TYP)



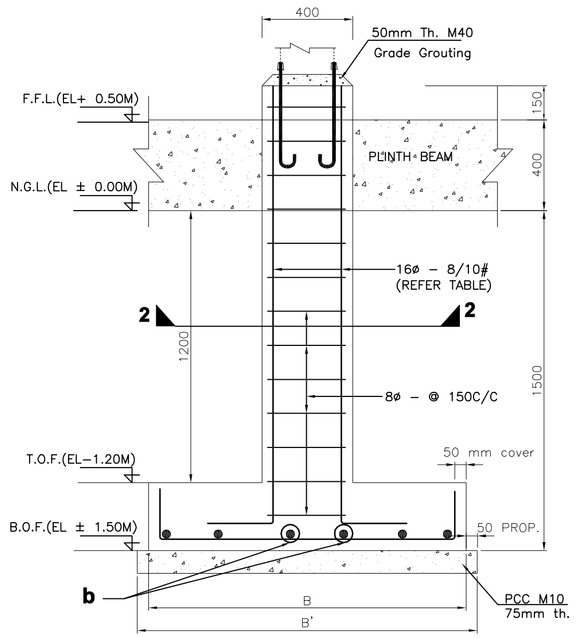
SECTION 1-1
(SCALE 1:25)



COLUMN
SECTION 2-2



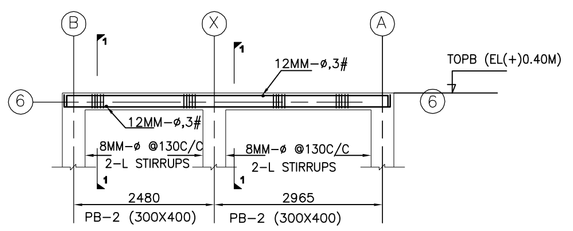
BASE PLATE DETAILS
(18ø - HOLE, 4#)



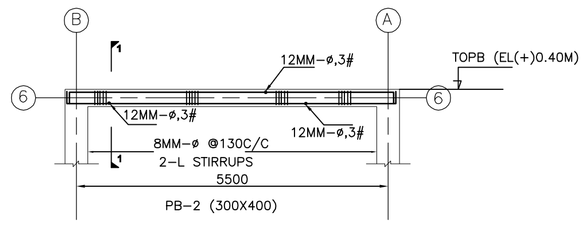
SECTION 1-1
FOUNDATION DETAILS

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE SPECIFIED.
2. GRADE OF CONCRETE SHALL BE M-30 WITH 20mm DOWN GRADED AGGREGATES
3. REINFORCEMENT SHALL BE OF HIGH YIELD STRENGTH DEFORMED BAR OF GRADE Fe500 CONFORMING TO IS:1786
4. MIN CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS FOOTING - 50MM , COLUMN - 50MM, PLINTH BEAM-50MM, SLAB-20MM.
5. LAP LENGTH SHALL BE 50D WHERE D IS THE DIA OF THE SMALLER BAR BEING LAPPED
6. LAPPING OF BARS SHALL BE SUITABLY STAGGERED AND IN NO CASE MORE THAN 50% BARS SHALL BE LAPPED AT ANY SECTION.
7. ALL HOOKS, BENDS, LAPS AND SPLICES SHALL BE AS PER RELEVANT IS CODE
8. BIDDER MAY CHOOSE BUILDING SPAN (C/C) FROM 5.5M TO 7.5M. FOUNDATION DETAILS HAVE BEEN MENTIONED FOR DIFFERENT RANGES OF SAFE BEARING CAPICITY(SBC). FOUNDATION COLUMN PEDESTAL, BASE PLATE, REINFORCEMENT DETAILS. SIZES ETC.SHALL BE DECIDED BASED ON TABLE-1 & TABLE-2 CONSIDERING THE SBC AND C/C SPAN. IN CASE OF SBC LESS THEN 5 T/SQM, FOUNDATION SHALL BE DESIGN BY BIDDER CONSIDERING PROJECT SPECIFIC CONDITIONS AND SHALL BE SUBMITTED FOR NTPC APPROVAL.
9. NO FOUNDATION SHALL BE LAID ON BACK FILLED SOIL.
10. IF ROCK IS ENCOUNTERED AT SHALLOW DEPTH THEN FOUNDATION MAY BE PLACED AT TOP OF ROCKY STRATA, HOWEVER IN NO CASE DEPTH OF FOUNDATION SHALL BE LESS THAN 1M. SBC SHALL BE DECIDED BY GEOTECHNICAL INVESTIGATION WORK CARRIED OUT BY CONTRACTOR AND APPROVAL BY NTPC IN GEOTECHNICAL INVESTIGATION REPORT.
11. DRAWING SHALL NOT BE SCALED. ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
12. PERIPHERAL GARLAND DRAIN SHALL BE MADE ALL AROUND THE PEB INVERTOR ROOMS AND CONNECTED TO NEAR BY DRAINS.
13. 750MM WIDE PLINTH PROTECTION WITH 75MM THK. PCC LAID OVER WELL COMPACTED 75MM DRY BRICK BALLAST ALL AROUND THE PEB ROOM IN LINE WITH TECHNICAL SPECIFICATION.
14. THE FGL OF PEB ROOM SHALL BE MINIMUM 500MM ABOVE SURROUNDING NGL.
15. ALL STRUCTURAL STEEL MEMBERS SHALL BE GALVANISED.THE THICKNESS OF GALVANIZATION SHALL BE IN LINE WITH IS4759. HOWEVER MINIMUM THICKNESS OF GALVANIZATION SHALL BE MAINTAINED AS 85 MICRON FOR ALL MEMBERS.
16. BIDDER SHALL SUBMIT THE DETAILED FABRICATION DRAWING AND PUFF PANAL DETAILS (DEVLOPED BASED ON NTPC TENDER DRAWING AND TECHNICAL SPECIFICATION) FOR NTPC INFORMATION BEFORE START OF WORK. ALL WORKS SHALL BE EXCUTED IN LINE WITH APPROVED DRAWING'S.
15. ALL BRACINGS LIKE BRC-1,BRC-2 SHALL BE CONTINUED IN EVERY ALTERNATE BAY IN CASE THE NO. OF BAYS ARE INCREASED. THE NO OF BAYS MAY BE REDUCED BASED ON BIDDER REQUIREMENT MAINTAINING THE BRACING IN EVERY ALTERNATE BAY. BIDDER SHALL ENSURE THAT THE BRACING IN BOTH THE DIAGONAL DIRECTIONS ARE PORVIDED IN PEB.
18. THE OPENINGS SHOWN IN PEB ARE TENTATIVE VENDOR SHALL FINALIZE THE SAME DURING DETAILED ENGG. BASED ON NTPC APPROVAL. VENTILATIONS AND DUCTS SHALL BE DESIGN CONSIDERING HEAT CALCULATION AND SUBMIT FOR NTPC APPROVAL BEFORE EXECUTION/MANUFACTURING.
19. THE SIZES OF FOUNDATION MENTIONED IN TABLE-1 FOR DIFFERENT RANGES OF SBC ARE MINIMUM SIZE TO BE ADOPTED BY BIDDER.
20. THE SIZES OF STRUCTURAL STEEL MEMBERS IN TABLE-2 ARE MINIMUM SIZES TO BE ADOPTED FOR DIFFERENT RANGES OF SPAN.



PLINTH BEAM ALONG GRID-6



PLINTH BEAM ALONG GRID-1

TABLE -1, PART-A (FOR SPAN S=5.5M)

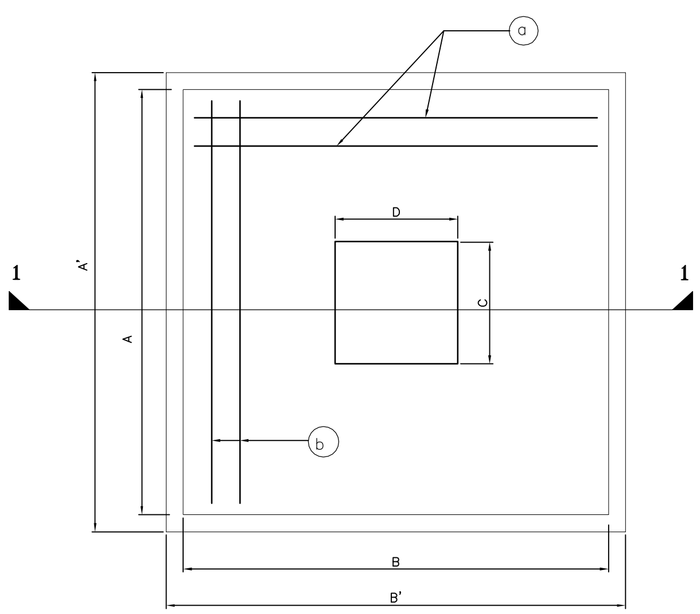
FOUNDATION REINFORCEMENT SCHEDULE										
S.NO.	SBC (IN T/SQM)	COLUMN	A	A'	B	B'	T	a	b
1	20 < = SBC	F01	1400	1500	1400	1500	300	12ø - @250c/c	12ø - @250c/c
2	10 <=SBC < 20	F01	1800	1900	1800	1900	325	12ø - @250c/c	12ø - @250c/c
3	7 <=SBC < 10	F01	2000	2100	2000	2100	350	12ø - @200c/c	12ø - @200c/c
4	5 <=SBC < 7	F01	2200	2300	2200	2300	375	12ø - @200c/c	12ø - @200c/c

TABLE -1, PART-B (FOR 5.5M < SPAN < = 6.5M)

FOUNDATION REINFORCEMENT SCHEDULE										
S.NO.	SBC (IN T/SQM)	COLUMN	A	A'	B	B'	T	a	b
1	20 < = SBC	F01	1500	1600	1500	1600	325	12ø - @250c/c	12ø - @250c/c
2	10 <=SBC < 20	F01	1900	2000	1900	2000	350	12ø - @250c/c	12ø - @250c/c
3	7 <=SBC < 10	F01	2100	2200	2100	2200	375	12ø - @200c/c	12ø - @200c/c
4	5 <=SBC < 7	F01	2300	2400	2300	2400	400	12ø - @200c/c	12ø - @200c/c

TABLE -1, PART-C (FOR 6.5M < SPAN < = 7.5M)

FOUNDATION REINFORCEMENT SCHEDULE										
S.NO.	SBC (IN T/SQM)	COLUMN	A	A'	B	B'	T	a	b
1	20 < = SBC	F01	1600	1700	1600	1700	350	12ø - @250c/c	12ø - @250c/c
2	10 <=SBC < 20	F01	2000	2100	2000	2100	375	12ø - @250c/c	12ø - @250c/c
3	7 <=SBC < 10	F01	2200	2300	2200	2300	400	12ø - @200c/c	12ø - @200c/c
4	5 <=SBC < 7	F01	2400	2500	2400	2500	400	12ø - @200c/c	12ø - @200c/c



FOOTING PLAN (TYPE F01)

TABLE -2

SPAN (S)	COLOUMN / RAFTER	BASE PLATE SIZE	PEDESTAL SIZE	MAIN RAINFORCEMENT OF PEDESTAL
S = 5.5M	ISMB 200	350X200	400X400	16ø-8NOS
5.5M< S <=6.5M	ISMB 250	400X225	450X400	16ø-8NOS
6.5M< S <= 7.5M	ISMB 300	450X250	500X400	16ø-10NOS

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TITLE: PEB INVERTOR ROOM

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	GEOTECH	REDG	ELEC.	APPD.	DATE
A		RAVI	AT						14.08.18
			CLEARED BY						

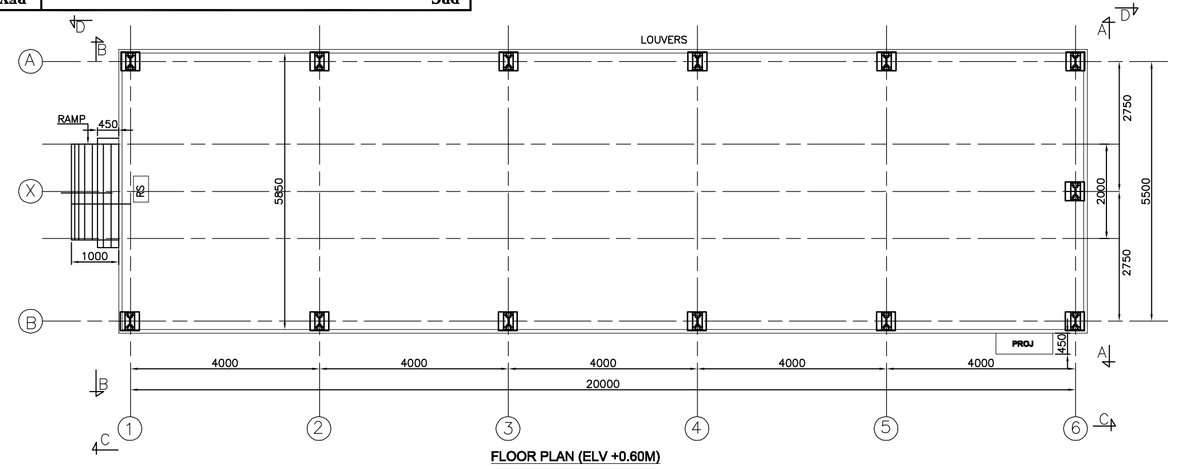
SIZE | SCALE | DRG. NO. 5742-004-POC-A-005 | REV.NO. A

SHEET 2 OF 3

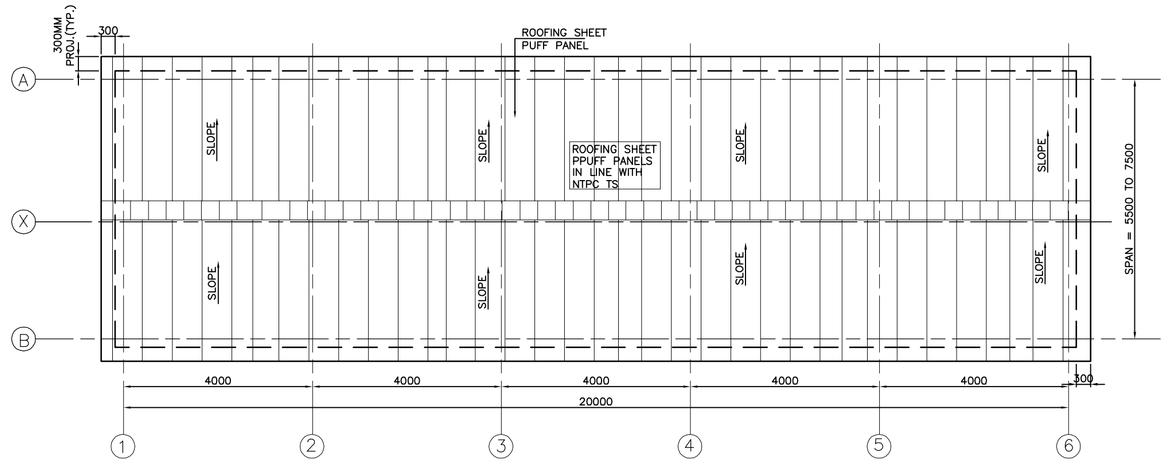
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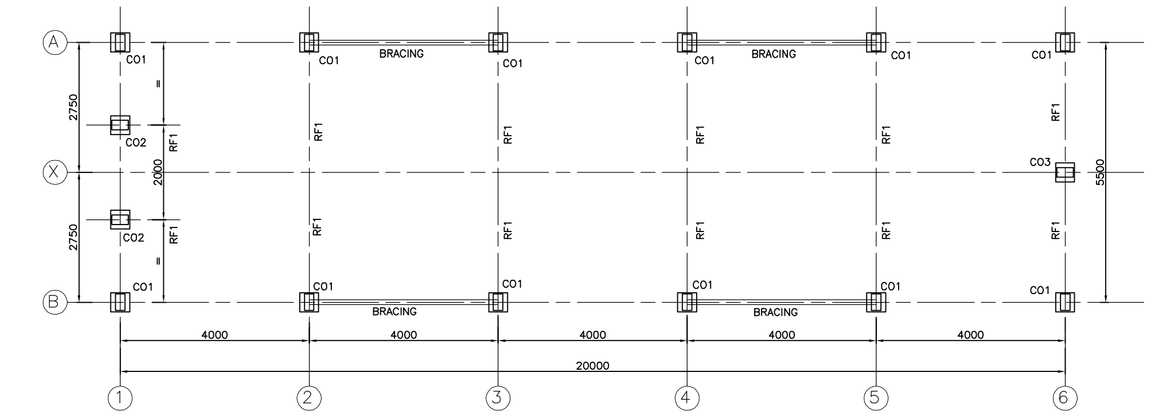
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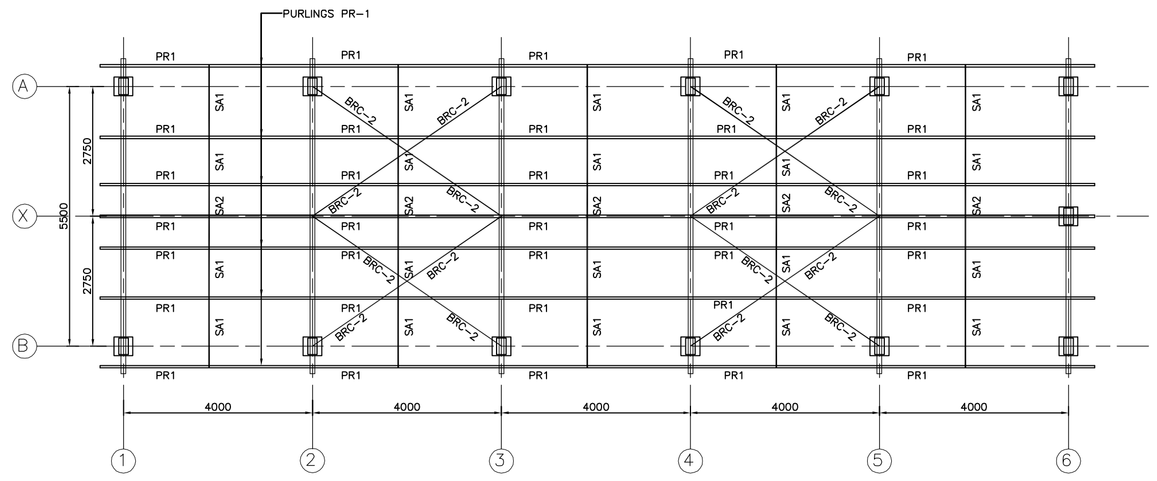
FLOOR PLAN (ELV +0.60M)



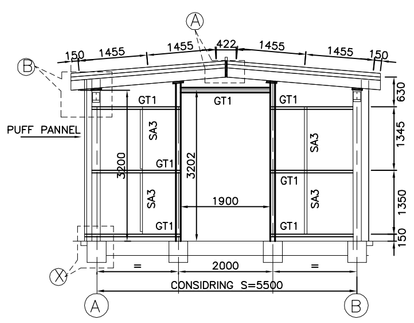
ROOF PLAN



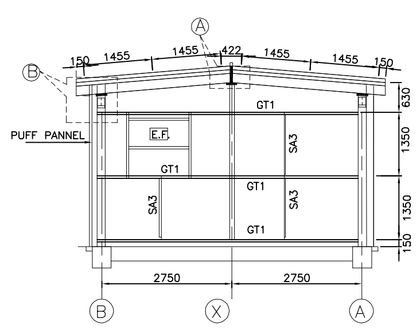
SIDE BRACING PLAN



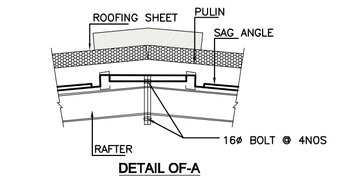
PURLINGS PLANS & TOP BRACING PLAN



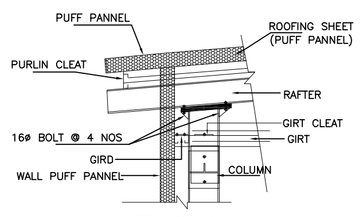
GABLE END ELEVATION ALONG GRID-1



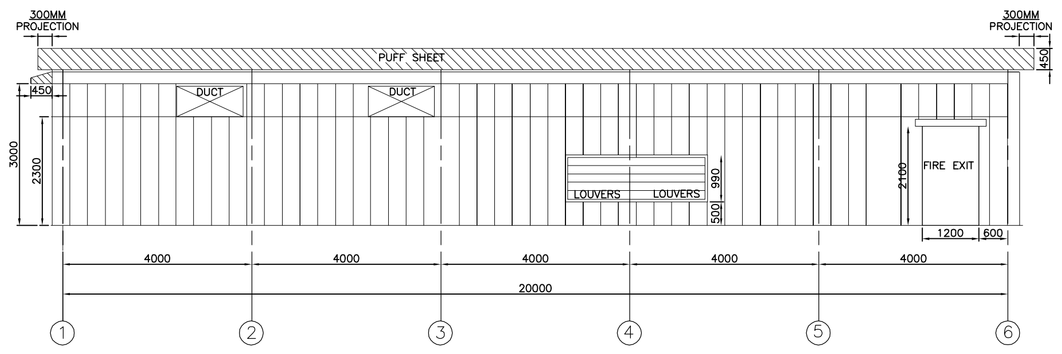
GABLE END ELEVATION ALONG GRID-6



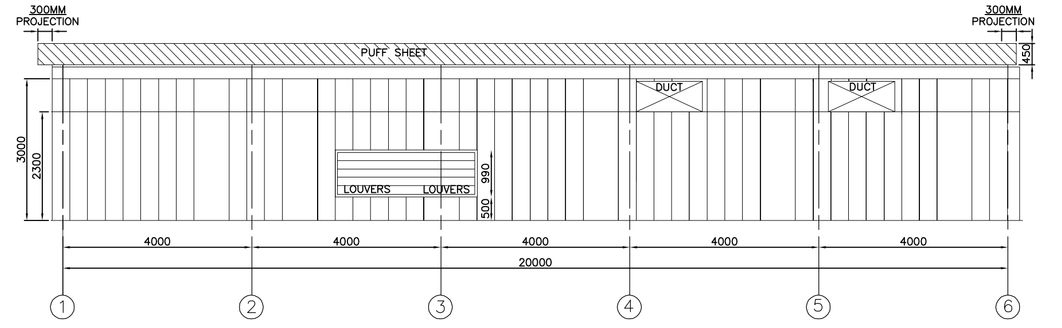
DETAIL OF-A



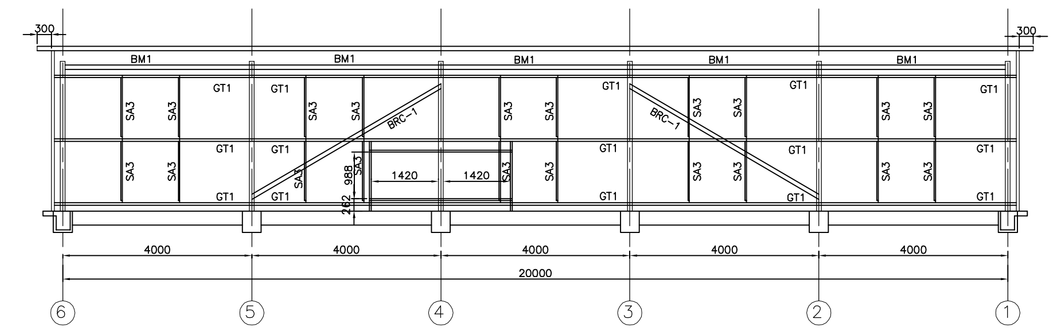
DETAIL OF - B



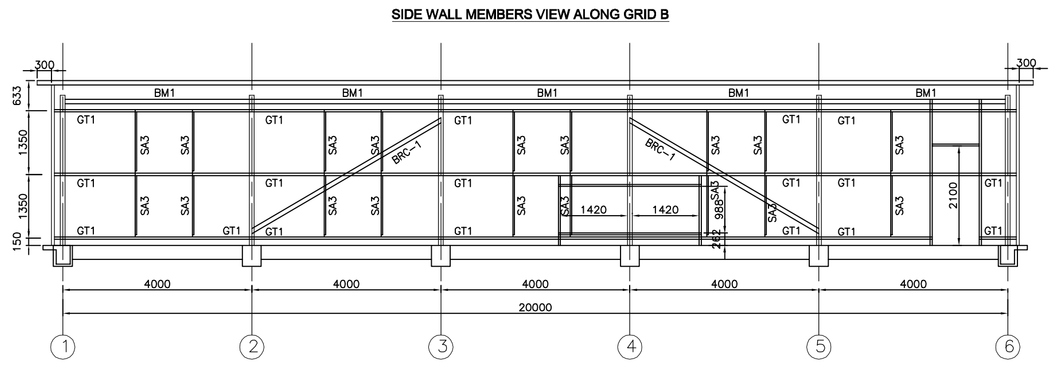
SIDE WALL ELEVATION ALONG GRID-B



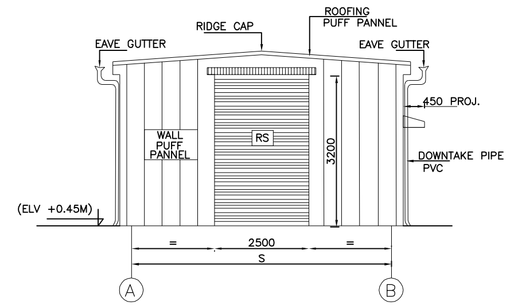
SIDE WALL ELEVATION ALONG GRID-A



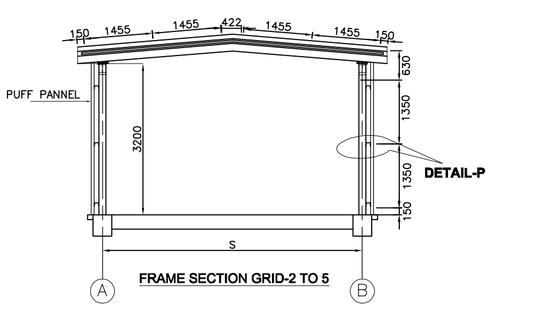
SIDE WALL MEMBERS VIEW ALONG GRID B



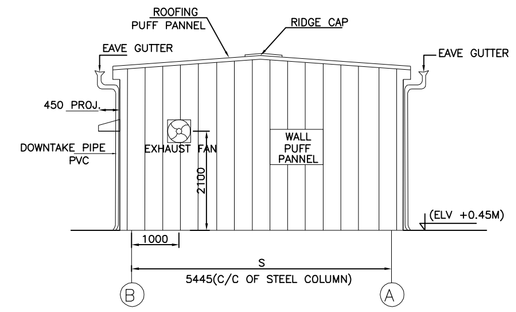
SIDE WALL MEMBERS VIEW ALONG GRID A



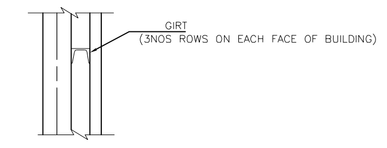
GABLE END ELEVATION ALONG GRID-1



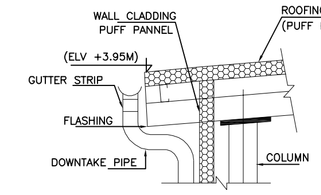
FRAME SECTION GRID-2 TO 5



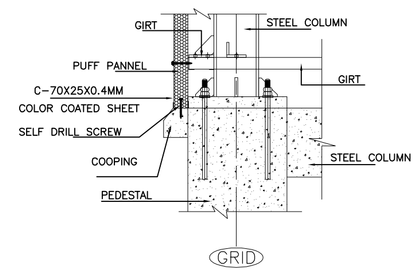
GABLE END ELEVATION ALONG GRID-6



DETAIL-P



DETAIL OF - B



DETAILS OF -X
FLOOR & PUFF PANEL CONNECTION DETAIL

TENTATIVE DETAIL OF OPENING			
R.S.	ROLLING SHUTTER	1900X3200	1. NOS
F.E.	DOOR	1200X2100	1. NOS
E.F..	EXHUAST FAN	1500X3000	3. NOS
	LOUVERS	3000X970	2. NOS

TABLE -2, BILL OF MATERIAL

S.NO.	PART MARK	DESCRIPTION	SPAN (S)			SHAPE	MATERIAL SPECIFICATION	GRADE OF MATERIAL	GALVANIZATION COATING THICKNESS
			S = 5.5M	5.5M< S <=6.5M	6.5M< S <= 7.5M				
1	PR1	C-PURLIN *	100x50x20x3.15	100x50x20x3.15	100x50x20x3.15		COLD FORM	350	AS PER IS 4759
2	GT1	C-GIRT	100x50x20x3.15	100x50x20x3.15	100x50x20x3.15		COLD FORM	350	AS PER IS 4759
3	RF1	RAFTER	ISMB-200	ISMB-250	ISMB-300		HOT ROLLED	250	AS PER IS 4759
4	CO1	COLUMN	ISMB-200	ISMB-250	ISMB-300		HOT ROLLED	250	AS PER IS 4759
5	CO2	COLUMN	ISMB-200	ISMB-250	ISMB-300		HOT ROLLED	250	AS PER IS 4759
6	CO3	COLUMN	ISMB-200	ISMB-250	ISMB-300		HOT ROLLED	250	AS PER IS 4759
7	SP1	STRUT ANGLE	ANGLE-65x65x5	ANGLE-65x65x5	ANGLE-65x65x5		HOT ROLLED	250	AS PER IS 4759
8	BM1	BEAM HEADER	ISMB-150	ISMB-150	ISMB-150		HOT ROLLED	250	AS PER IS 4759
9	SA-1	SAG ANGLE	50X50X3	50X50X3	50X50X3		HOT ROLLED	250	AS PER IS 4759
10	SA-2	SAG ANGLE	50X50X3	50X50X3	50X50X3		HOT ROLLED	250	AS PER IS 4759
11	SA-3	SAG ANGLE	50X50X3	50X50X3	50X50X3		HOT ROLLED	250	AS PER IS 4759
12	BRC-1,BRC-2	STRUT PIPE	89MM (OD)	89MM (OD)	89MM (OD)		HOT ROLLED	250	AS PER IS 4759

* PURLIN SPACING SHALL BE MAINTAINED AS MAXIMUM 1450 MM FOR ALL SIZES OF SPANS.

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETRES, UNLESS OTHERWISE SPECIFIED.
2 GRADE OF CONCRETE SHALL BE M-30 WITH 20mm DOWN GRADED AGGREGATES
3 REINFORCEMENT SHALL BE OF HIGH YIELD STRENGTH DEFORMED BAR OF GRADE Fe500 CONFORMING TO IS:1786
4 MIN CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS FOOTING - 50MM , COLUMN - 50MM, PLINTH BEAM-50MM, SLAB-20MM.
5 LAP LENGTH SHALL BE 50D WHERE D IS THE DIA OF THE SMALLER BAR BEING LAPPED
6 LAPPING OF BARS SHALL BE SUITABLY STAGGERED AND IN NO CASE MORE THAN 50% BARS SHALL BE LAPPED AT ANY SECTION.
7 ALL HOOKS, BENDS, LAPS AND SPLICES SHALL BE AS PER RELEVANT IS CODE
8 BIDDER MAY CHOOSE BUILDING SPAN (C/C) FROM 5.5M TO 7.5M. FOUNDATION DETAILS HAVE BEEN MENTIONED FOR DIFFERENT RANGES OF SAFE BEARING CAPICITY(SBC). FOUNDATION COLUMN PEDESTAL, BASE PLATE, REINFORCEMENT DETAILS. SIZES ETC.SHALL BE DECIDED BASED ON TABLE-1 & TABLE-2 CONSIDERING THE SBC AND C/C SPAN. IN CASE OF SBC LESS THEN 5 T/SQM, FOUNDATION SHALL BE DESIGN BY BIDDER CONSIDERING PROJECT SPECIFIC CONDITIONS AND SHALL BE SUBMITTED FOR NTPC APPROVAL.
9 NO FOUNDATION SHALL BE LAID ON BACK FILLED SOIL.
10 IF ROCK IS ENCOUNTERED AT SHALLOW DEPTH THEN FOUNDATION MAY BE PLACED AT TOP OF ROCKY STRATA, HOWEVER IN NO CASE DEPTH OF FOUNDATION SHALL BE LESS THAN 1M. SBC SHALL BE DECIDED BY GEOTECHNICAL INVESTIGATION WORK CARRIED OUT BY CONTRACTOR AND APPROVAL BY NTPC IN GEOTECHNICAL INVESTIGATION REPORT.
11 DRAWING SHALL NOT BE SCALED. ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
12 PERIPHERAL GARLAND DRAIN SHALL BE MADE ALL AROUND THE PEB INVERTOR ROOMS AND CONNECTED TO NEAR BY DRAINS.
13 750MM WIDE PLINTH PROTECTION WITH 75MM THK. PCC LAID OVER WELL COMPACTED 75MM DRY BRICK BALLAST ALL AROUND THE PEB ROOM IN LINE WITH TECHNICAL SPECIFICATION.
14 THE FGL OF PEB ROOM SHALL BE MINIMUM 500MM ABOVE SURROUNDING NGL.
15 ALL STRUCTURAL STEEL MEMBERS SHALL BE GALVANISED.THE THICKNESS OF GALVANIZATION SHALL BE IN LINE WITH IS4759. HOWEVER MINIMUM THICKNESS OF GALVANIZATION SHALL BE MAINTAINED AS 85 MICRON FOR ALL MEMBERS.
16 BIDDER SHALL SUBMIT THE DETAILED FABRICATION DRAWING AND PUFF PANAL DETAILS (DEVLOPED BASED ON NTPC TENDER DRAWING AND TECHNICAL SPECIFICATION) FOR NTPC INFORMATION BEFORE START OF WORK. ALL WORKS SHALL BE EXCUTED IN LINE WITH APPROVED DRAWING'S.
15 ALL BRACINGS LIKE BRC-1,BRC-2 SHALL BE CONTINUED IN EVERY ALTERNATE BAY IN CASE THE NO. OF BAYS ARE INCREASED. THE NO OF BAYS MAY BE REDUCED BASED ON BIDDER REQUIREMENT MAINTAINING THE BRACING IN EVERY ALTERNATE BAY. BIDDER SHALL ENSURE THAT THE BRACING IN BOTH THE DIAGONAL DIRECTIONS ARE PORVIDED IN PEB.
18 THE OPENINGS SHOWN IN PEB ARE TENTATIVE. VENDOR SHALL FINALIZE THE SAME DURING DETAILED ENGG. BASED ON NTPC APPROVAL. VENTILATIONS AND DUCTS SHALL BE DESIGN CONSIDERING HEAT CALCULATION AND SUBMIT FOR NTPC APPROVAL BEFORE EXECUTION/MANUFACTURING.
19 THE SIZES OF FOUNDATION MENTIONED IN TABLE-1 FOR DIFFERENT RANGES OF SBC ARE MINIMUM SIZE TO BE ADOPTED BY BIDDER.
20 THE SIZES OF STRUCTURAL STEEL MEMBERS IN TABLE-2 ARE MINIMUM SIZES TO BE ADOPTED FOR DIFFERENT RANGES OF SPAN.

एन टी पी सी लिमिटेड
NTPC Limited
(A GOVERNMENT OF INDIA ENTERPRISE)
(ENGINEERING DIVISION)

PROJECT: DEVELOPMENT OF 22MW FLOATING SOLAR AT RGCCPP KAYAMKULAM

TITLE: PEB INVERTOR ROOM

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	GEOTECH	REDG	ELEC.	APPD.	DATE
A		RAVI	AT						14.08.18
			CLEARED BY						

SIZE | SCALE | DRG. NO. 5742-004-POC-A-005 | REV.NO. A
SHEET 3 OF 3

SAFETY PLAN

PROJECT- 22 MW FLOATING SOLAR PV PROJECT
NTPC, KAYAMKULAM

Doc ref. No.: BHEL:NTPCKYM:HSE:01 Rev. 00 Dated 12.03.2020

Rev. 01 dated 19.05.2020





PREPARED BY:

PV SYSTEM ENGINEERING

AND

HSE DEPARTMENT

BHEL EDN BANGALORE

HSE POLICY



In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Atul Sobti
Chairman & Managing Director

June 5, 2018

Creating BHEL of tomorrow

BHARAT HEAVY ELECTRICALS LIMITED

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1.0 INTRODUCTION

The purpose of this Safety Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during execution of the 22 MW Floating Solar Project. This document shall be followed by M/s BHEL, Sub-Contractors & all persons at site at all installation and servicing sites. In case customer specific documents are to be referred, the same will be followed in conjunction with this document.

2.0 APPLICATION

The document is applicable for execution of the 22 MW Floating Solar Project and it is expected that Client and Sub-contractor are committed to the following guidelines:

- Ensure that the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment at the worksite.
- Ensure compliance at all times with the relevant statutory and contractual Safety requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including contractors in respects of Safety.
- Establish effective communication on SAFETY matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps. Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent authority.
- Ensure timely provision of resources to facilitate effective implementation of SAFETY requirements.
- Ensure continual improvements in SAFETY performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.

3.0 TERMINOLOGIES

❖ INCIDENT

Work- related event(s) in which an injury or ill health (regardless of severity) or fatality occurred, or could have occurred.

❖ **NEAR MISS**

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as “Near-Miss incident”.

❖ **MAN-HOURWORKED**

The total number of employee hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labors. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workday for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

❖ **FIRST AID CASES**

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time. Please refer Format 03 for requirement of items with respect to treatment for First Aid Cases.

❖ **LOST TIME INJURY**

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

❖ **MEDICAL CASES**

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

❖ **TYPE OF INCIDENT / ACCIDENT & THEIR REPORTING:**

The three categories of Incident / accident are as follows:

- **Non-Reportable Cases:**
  An accident, where the injured person is given medical help and discharged for work without counting any lost time.

- **Reportable Cases:**

  In this case the injured person is disabled for 48 hours or more and is not able to perform his duty.

- **Injury Cases:**

  These are covered under the heading of non-reportable cases. In these cases the accident caused injury to the person, but he still continues in his duty.

❖ **TOTAL REPORTABLE FREQUENCY RATE**

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

❖ **SEVERITY RATE**

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

❖ **INCIDENCE RATE**

Incidence Rate is the Number of LTI per one thousand manpower deployed.

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

❖ **MANAGEMENT REPRESENTATIVE:** Representative from Project Head

❖ **OCP:** Operation Control Procedures

❖ **PPE:** Personal Protective Equipment

4.0 ROLES & RESPONSIBILITIES

4.1 SAFETY CO-ORDINATOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, and other tools and tackles. Record observations as per Format 01 on a weekly basis.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Conduct investigation of all accident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of SAFETY permit systems & OCPs. Convene SAFETY meeting & minute the proceedings for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Facilitate administration of First-Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Notify site personnel for non-conformance to safety norms observed during site visits / site inspections.
- Recommend to Site In charge for immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.

4.2 ALL EMPLOYEES

- To adopt safe working practices
- To take corrective action and preventive action in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
- To report all incidents including near miss to Safety Coordinator.
- In case any particular activity / work has extremely high consequential risk or high environmental impact, the employee shall bring it to the notice of Site In charge before starting the work.

- To ensure that the workers are engaged by the contractor for the job after undergoing induction training.
- To ensure that the persons engaged in his area, follow the safety rules like using appropriate PPEs.
- To get involved in exercises like Job Safety Analysis and Work Permit System.
- To engage licensed electricians for site electrical works.
- To report any incident including near misses or safety lapses immediately to Safety Coordinator
- To support/co-operate with audit team members as & when safety audits are carried out.
- To involve in investigation, if any incident occurs in his work area.
- To participate in safety promotional programmers'.
- To attend the safety committee meeting, if he is a member/invitee
- To ensure that only suitable Tackles & Plants and qualified persons are engaged.

5.0 SUB-CONTRACTOR REPRESENTATIVE AT SITE

- Shall fill-up agreement form for compliance to relevant safety Plan for Site Operations.
- Shall ensure fulfillment of relevant safety requirements of 22 MW floating solar Project and practice very strictly in his area of work in consultation with his concerned engineer and the Safety Coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like life jackets, safety helmets, belts, safety shoes, face shield, high visibility vest, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in BOCW Rules and Regulations.
- Shall ensure that all Tackles & Plants engaged are tested for fitness and have valid certificates from competent authorities.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs Point No 8)
- Shall ensure that person working above 3.3 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Caution to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /Safety Coordinator of the 22 MW floating solar Project.
- Shall ensure that adequate illumination is arranged during all the time.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of mock drill, induction training and training on the site.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the worksite.

- Shall ensure adequate drinking water at work site
- Shall ensure adequate emergency preparedness.

5.1 DEPLOYMENT OF TOOLS & PLANTS

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.
- The machinery and equipment to be employed for this purpose shall include but not limited to the following:

o Mobile cranes.
o Side Booms.
o Forklifts.
o Grinding machine.
o Drilling machine.
o Air compressors.
o Welding machine.
o Generator sets.
o Dump Trucks, tractors.
o JCBs,Excavators.
o Hand tools.
o Road Rollers
o Vibration Compacters
o Boring Machine
o Chipping Machines
o Hammer Machines
o Breakers
o Boats
o Floating Machinery

5.2 DEPLOYMENT OF MANPOWER

- As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-contractors to fulfill contractual as well as legislative requirement.
- Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed. The Medical Examination reports are maintained by the Safety Coordinator of BHEL.
- Gate pass is linked with medical check-up fitness certificate and compulsory completion of safety induction training. For under water works valid diving certificates are compulsory.

5.3 DEPLOYMENT OF PPEs

The following matrix recommends usage of minimum PPEs against the respective job. The PPEs shall conform to the relevant standards as listed in the reference under clause 3.0 and bear ISI mark. All the PPEs shall be periodically checked for its quality before issue by safety coordinator. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced. The issuing agency shall maintain register for issue and receipt of PPEs. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front. The body harnesses shall be serial numbered.

Sl.no	Type of work	PPEs (Subject to applicability of process)
1	Concrete, asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Hand gloves
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, gloves
8	Painting	Plastic gloves, respirator for spray Painting)
9	Work on water for PV floaters, floating system	Life jackets, Rescue Boat with trained rescue team.
10	Work in water for anchoring and mooring system	SCUBA apparatus, Rescue Boat with trained rescue team

Rescue boat with trained and authorized boat operators with rescue team shall be available at site all the time till all persons involved reach the shore.

Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall be issued Helmet and any other PPEs as deemed appropriate for use in the area of work.

❖ **Color Code for Helmets:**

1. Workmen: Yellow.
2. Safety staff: Green.
3. Engg, supervisor, visitor, site in charge: White.

5.4 MEDICAL FACILITIES

➢ **FIRST AID PROVIDER**

- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.

- List of qualified first aiders and their contact numbers should be displayed at major locations by safety Coordinator.

➢ **FIRST AID BOX**

- First aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact number to be displayed on the box.
- The first aid box shall be distinctly marked with a Red Cross on white background.
- Details of contents of first aid box is given in Format No.02
- Monthly inspection of First Aid Box shall be carried out by the Site In charge as per format no 02.

➢ **HEALTH CHECKUP**

The persons engaged at the site shall undergo health checkup as per the **format no 03** before induction.

a. Height workers
b. Drivers/crane operators/riggers
c. Confined space workers
d. Shot/sandblaster
e. Welding and NDE personnel.
f. Divers for under water activity

➢ **PROVISION OF EMERGENCY VEHICLE**

A vehicle shall be stationed exclusively at workplace to handle emergencies. This shall be by way of tying up with customer's medical centre /local hospitals/ sub-contractors by mutual aid agreement.

6.0 SAFETY TRAINING & AWARENESS

❖ **SAFETY INDUCTION TRAINING**

All persons entering into project site shall be given safety induction training by the Safety Coordinator of 22 MW floating solar Project. In-house induction training subjects shall include but not limited to:

- Briefing of the Project.
- Safety objectives and targets.
- Site safety rules.
- Site safety hazards
- First aid facility.
- Emergency Contact No.
- Accident reporting.
- Fire prevention and emergency response.

- Proper safety wear & gear must be issued to all the workers being registered for the induction.
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear & gear requirement shall not qualify to attend.
- Risk of Drowning

Each employee shall undergo safety induction training.

❖ **TOOL BOX TALK**

- Tool Box talk shall be conducted by Safety Coordinator to work groups prior to the start of work. The agenda shall consist of the following:
- Details of the job being intended for immediate execution.
- The relevant hazards and risks involved in executing the job and their control and mitigating measures.
- Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
- Risk of drowning while working in water
- Recent non-compliances observed.
- Appreciation of good work done by any person.
- Record of Tool box talk shall be maintained as per format no 06

❖ **TRAINING ON HEIGHT WORK**

Training on height work shall be imparted to all workers working at height by in- house/external faculty. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, life line.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.

❖ **TRAINING ON WORK IN WATER**

Training on working in water shall be imparted to all workers working in water by in- house/external faculty. The training shall include following topics:

- Use of PPEs
- Risk of drowning
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue in case of accidents.

❖ **SAFETY PROMOTION-SIGNAGE, POSTERS**

➢ **Display of safety posters and banners.**

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/, English languages at workplace

➢ **Display of safety signage**

- Appropriate safety signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed.

➢ **Safety awareness program/safety training program**

- Site will arrange safety awareness program periodically on different topics including medical awareness for all personnel working at site.

- Safety Coordinator shall arrange training program based on site condition

7.0 SAFETY COMMUNICATION

❖ **MONTHLY SAFETY REPORTING**

- Safety information of Site shall be reported monthly through Monthly Site safety report (MSR) as per format 04.

- The period of reporting shall be 1st of each calendar month.

8.0 OPERATIONAL CONTROL

Permit applicant shall apply for work permit of particular work activity before starting of the work in the format 13.

8.1 EXCAVATION WORK SAFETY:

Excavation permit shall be taken before the start of the excavation work as per depth limits.

- Avoid damage / personal injury during excavation work at sites.
- Ensure proper barricading by ribbon or Hard barricading of the excavated area.
- Proper side slopes of the excavation as per the type of soil should be maintained.
- Where side slopes cannot be provided due to space constraints before excavation, sheet piling must be done to prevent the collapse of earth.
- As soon as the job is completed, immediate back filling to be done.
- No personnel be allowed within the swing area of mechanical excavator when work is in progress.
- Proper lighting to be arranged when the excavation is carried out at night.
- Excavated earth to be dumped/ stored in a designated place only.
- Surplus earth to be transported and disposed in the authorized area.

- Site safety department to identify all possible hazard areas related to excavation work and ensure control.
- Use proper PPE"s.
- Ensure adequate caution signs are displayed in the area of operation.

8.2 FLOATING WORK SAFETY

Floating work permit shall be taken before the start of any work in water.

- Ensure working with a partner or team when working around or on water. Preferably at least two people need to be in sight of each other at all times.
- Availability of communication devices to be ensured before going to work in water.
- Proper provision for first aid to be ensured.
- The availability of water rescue boat with team shall be ensured.
- Use of suitable personal buoyancy equipment, such as lifejackets shall be ensured.
- All persons who are going to work in water must trained to understand clearly any procedures in place and what action they must take to protect themselves, including in an emergency.

9.0 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System

a. Height working of 3.3 metre and above

b. Excavation more than 1.5 meter depth

c. Heavy lifting by machinery on land

d. Works of floaters involving activity in water other than shore

- "Safety Procedure for Work Permit System" shall be followed while implementing permit system.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work in the format 13.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit
- He will close the permit after completion of the work. The closed permit shall be archived with safety personnel of site.
- Permission for Works in water shall be permitted after checks related to compliance to wearing PPEs, availability of safety boat

10.0 HOUSEKEEPING

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.

- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from higher location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power lines.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

11.0 WASTE MANAGEMENT

❖ STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other workplaces.
- Construction rubbish should not be burnt near working site.

❖ SEGGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

❖ DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Maintain a schedule for collection and disposal of waste.

12.0 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into common sewage system.
- Waste disposal shall be in accordance with best practice.

13.0 EMERGENCY PREPAREDNESS AND RESPONSE (EPR)

❖ **DEFINITION**:

An emergency occurring at site is one that may affect work at site and / or may cause serious injuries, loss of life, extensive damage to property.

❖ **OBJECTIVE:**

This EPR aims at putting into place the system for early identification of the situation, classification and setting into motion action by the concerned Action teams to mitigate the situation and normalize the area.

❖ **NATURE OF EMERGENCIES AT SITE:**

Emergencies during the course of execution of Floating SPV Project is likely from following exigencies:

1. Fire: Fire can take place at site at storage area, DG powerhouse, site offices and other areas at site.

2. Water body related accidents: Drowning, slippage, Fall in water.

3. Medical emergencies: A medical emergency refers to any situation in which a person(s) requires medical intervention. Medical emergencies include complications from medical conditions and work injuries. Having trained staff and effective emergency response procedures will reduce the impact of a medical emergency on the individual and the organization.

❖ **MODE OF OPERATION IN EMERGENCY:**

i. **Raising an Alarm:**

In the event of emergency, the security guard on duty/work supervisor will identify the nature of emergency and raise an alarm.

ii. **Assessment of The Emergency Situation**

Assessing the Emergency situation is to be done primarily by the concerned work supervisor. He assesses the situation and convey information regarding the Emergency situation to BHEL Safety Coordinator and the BHEL Site In-charge and other important persons whose Telephone numbers are given as below, as feel necessary based on assessment of situation:

EMERGENCY CONTACT NOS		
Sr. No.	Name of person Agency	Contact Nos.
1	BHEL Project In-charge	
2	BHEL Safety Coordinator	
3	BHEL site/Area in-charge / Incident Controller	
4	Bhel EPC Vendor In-charge Contact no.	
5	NTPC CISF emergency contact	
6	NTPC Fire Fighting Department Contact	
7	Kayamkulam Fire Fighting Department Contact no.	
8	NTPC Medical Centre Contact	
9	Identified Hospitals Names : with address and no. and approx. distance	
10	BHEL Emergency site vehicle Driver :	

BHEL Site Incharge in consultation with the BHEL Project Incharge will take decision on any additional resources required from outside in handling the situation. Depending on level of emergency, his job will involve co-ordination of rescue and other emergency activities on site and liaison with the respective authorities (Fire services and Hospitals) for assistance in firefighting, hospitalization etc.

iii. **Termination of the Emergency:**

When the conditions causing Emergency are brought under control and residual situation can be tackled by the site's internal resources, Site Incharge will announce termination of emergency situation and inform the project In-charge and concerned NTPC officials.

❖ **EMERGENCY MITIGATION PROCEDURE:**

1. Fire Incident:

- The emergency alarm to be raised by the concern work supervisor/security guard on duty.
- After quick assessment of situation, work supervisor shall communicate to the concern persons.
- The available personnel at site will aid the fire suppression system with the available fire extinguishing equipment
- activating water pumping sets for spraying, as available
- Provide first aid to injured persons, if any
- Suspend all operations at that area of site
-Shut off the main power supply
- Evacuation of all contractors, visitors and motor vehicles on the site to a safe distance from the site at the identified assembly point at site
- Provide access for the special equipment of the Fire Safety to sources of water
- Provide assistance to the personnel of the Fire Safety with the extinguishing of the fire;

2. Water Incident:

- Immediate information about incident to be given to BHEL site In charge and Safety Coordinator by Work Supervisor
- Information to rescue team to point in water and bringing the affected person/s to shore
- Information to BHEL emergency Vehicle for shifting of injured to nearest hospital

3. Medical emergencies:

- Immediate information about incident to be given to BHEL site in charge and Project in charge by Work Supervisor
- First Aid to be given, if possible
- Information to BHEL emergency Vehicle for shifting of injured to nearest hospital

The EPP shall be tested once in two months through Mock drills as per Format No. 14 and 15.

14.0: FIRE SAFETY PROCEDURE

1. Site-in-charge / Safety Coordinator will make periodical review of the site Fire Protection, Prevention Preparedness, Site conditions and available fire protection equipment.

2. A mutual aid agreement with local Fire station for availability of Fire tender shall be made.
3. It is very imperative good contact with Local fire station for availability of Fire tender in case of emergencies, in additional to their own fire equipment.
4. Fire Protection, Prevention and Preparedness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities. Deficiencies will be corrected at once.
5. Emergency telephone number to be displayed at all important places.

15. CONTROL OF DOCUMENTS

All documents shall be controlled as per safety Procedure for Document Control and on water, in water have maintain required documents, certificates.

16.0 SAFETY INSPECTION

Inspection on safety for different activities being carried out at site shall be done to ensure compliance to safety requirements. Before start the work ensure all required PPEs on water, in water and other working locations.

❖ DAILY SAFETY CHECKS

Site Supervisors or safety Supervisors of BHEL's subcontractors are to conduct daily site safety inspection around work activities and premises to ensure that work methods and the sites are maintained to the acceptable standard.

❖ INSPECTION OF PPE

- PPEs shall be inspected by Safety Coordinator at random once in a week as per **Format no 07 for** its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.
- The IS standard to be complied to, for different PPEs, is given as follows:

RELEVANT IS-CODES FOR PERSONAL PROTECTION

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 3521 – 1983	Industrial Safety Belts and Harness
IROS (or MMD)	Life jackets/Vests

❖ INSPECTION OF TOOLS & PLANTS

- A master list of Tools & Plants shall be maintained by each subcontractor.
- All Tools & Plants being used at site shall be inspected by Safety Coordinator once in a month as per Format no 08 for its healthiness and maintenance.
- The Tools & Plants which require third party inspection shall be checked for its validity during inspection.
- The certificate of Tools & Plants shall be monitored as per Format no 09

❖ INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by Safety Coordinator once in a month as per Format no 10 for healthiness, maintenance and validity of third party inspection and SWL shall be displayed.
- The date of third party inspection and next due date shall be painted on cranes and winches.

❖ INSPECTION ON HEIGHT WORKING (ONLY FOR CMCS AS APPLICABLE)

- Inspection on height working shall be conducted by Safety representative of Construction agency before start of work to ensure safe working condition including provision of
    - o Safety Harness
    - o Fencing and barricading
    - o Warning signage
    - o Covering of opening
    - o Proper scaffolding with access and egress.
    - o Illumination
- Inspection on height working shall be conducted once in a week by Safety Coordinator as per format no 11
- Height working shall not be allowed during adverse weather.

❖ INSPECTION ON ELECTRICAL INSTALLATION /APPLIANCES

- Ensure proper earthing in electrical installation. Verify values per month.
- Use ELCB with 30 mille amps sensitivity at electrical booth.
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out for all ELCBs/RCCBs.

17. 0 MONTHLY SAFETY REVIEW MEETING

- Site shall hold SAFETY review meeting every month to discuss and resolve SAFETY issues of site and improve SAFETY performance. It will also discuss the incidents occurred since previous meeting its root cause and corrective action and preventive action.

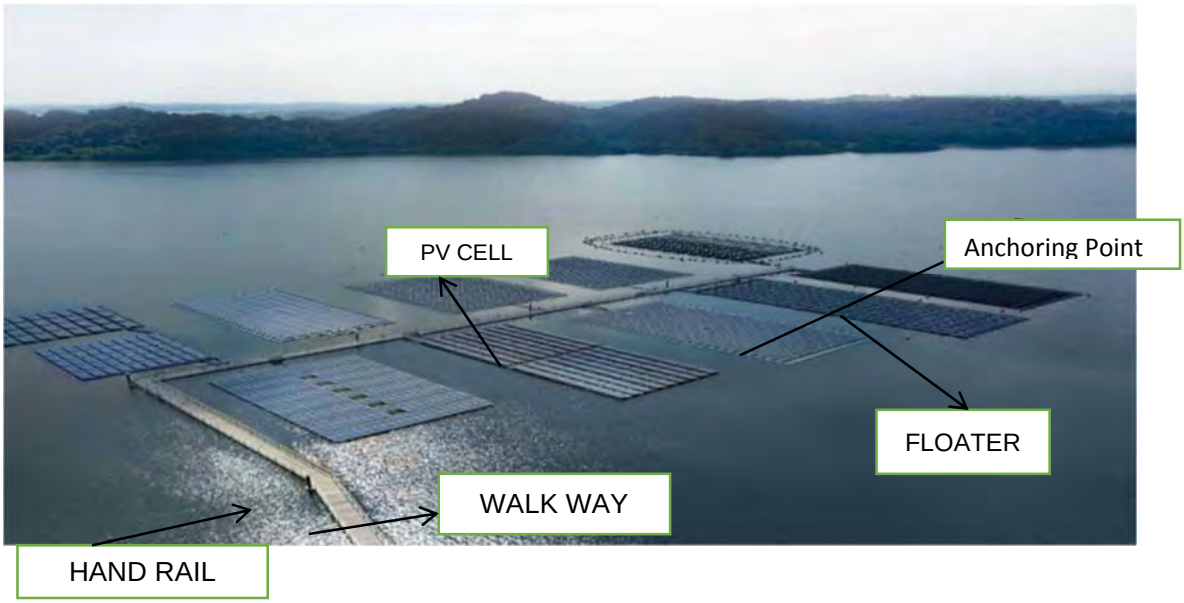
- The meeting shall be chaired by Site In charge, convened by Safety Coordinator and attended by all head of sections (HOS), Site In charge of Subcontractors and Safety representative of Subcontractors.

- MOM on the discussion will be circulated to the concerned for implementation.

18.0 TYPICAL DEPICTION OF FLOATING SOLAR PV SYSTEM (FOR GENERAL REFERENCE)

FLOATING SOLAR POWER ERECTION SAFETY

(Floating platform Under construction)





❖ **SYSTEM COMPONENTS**:

1. Solar PV modules for conversion of solar radiation to electrical energy/
2. Anchoring systems: Anchoring system refers to permanent under-water structure to secure floating platforms.
3. Pontoon: A pontoon is floatation device with enough buoyancy to float by itself as well as with a heavy load.
4. Floats: Multiple plastic hollow floats with effective buoyancy to self-weight ratio are combined over and over again, forming a giant pontoon. The floats are typically made of HDPE (high density polyethylene), known for its tensile strength, maintenance free property.
5. Mooring system: A mooring system usually refers to any permanent structure on the banks to which floats are secured.
6. Cables and connectors: Electricity is drawn from the solar array and transported to the land. Therefore, the power can be fed to the grid or stored in batteries.

19.0 RISKS AND HAZARD:

1. Identified as per Job Risk Assessment exercise and HIRA Documents attached based on planned construction activities. In case of requirement for erection or civil work of type not envisaged, JSA/HIRA for the same will be prepared and NTPC approval obtained to commence the activity.

❖ **PRECAUTIONS:**

1. As mentioned in enclosed HIRA Documents.

20.0 SITE RECORDING FORMATS: Enclosed

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HAZARD IDENTIFICATION AND RISK ASSESMENT (HIRA)	
Job Task: Tree felling and vegetation clearance	**Equipment #:** Hydra/Crane/JCB
Project/Location: 22 mw Floating Solar Project, NTPC, Kayamkulam	**Analysis done by: PV System Engg. Reviewed by: BHEL-HSE**
PPE required: Safety helmet, vest, shoes, hand gloves, goggles etc.	**Date Initiated: Revised date:**
Emergency Plan: Yes	
Tools used: Hand operated Power saws, Cutting tools	**Chemicals used:** Yes

Sequence of Job Steps	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Entry to forest area (Area Survey)	1.Common Natural Hazard : A) Snake Bite, Insect bites like mosquitoe, Honey bee sting etc B) Falling branches, trees C) Fall, trip	1. Injuries 2. Fatality 3. Property damage 4. Man days lost	1. Before entry to the forest check for valid permit, and submit all documents of workers like medical fitness certificates, Group insurance, etc. 2. Briefly discuss about the job and identify line and markings of area or path of work before commencing 3. Organize for presence of a local representative/employee from forest department before start of work. 4. Exercise caution while carrying out work and before commencement of works address the workers to be always careful. 5. Work is allowed during day hours only 6. Field First aid box along with required medical kit (incl. snake anti dot, insect repellant cream) shall be available near the site 7. Awareness of types of snakes in the vicinity (poisonous/ non-poisonous) by way of display of charts	Safety knee height shoes (Gumboot) Safety Helmet, Safety goggles, Safety vest, Hand gloves, Full body protective apron ,Nose mask

Sequence of Job Steps	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Cutting and shifting of heavy trees with the help of sawing machine, crane & rigging activity.	1.Pinching points. 2.Failure of lifting tools and tackles due to use of damaged / under capacity tools and tackles. 3. Failure of sawing machine. 4. Hit by load due to swinging. 5. Tree fall or collapse. 6.Electric shock 7. drowning due to sinking in swamp/ loose soil and falling in deep pits 8) Fall of logs during loading 9) Toppling of machinery due to loose soil 10) contact with Overhead live electric cable	1. Cut injuries 2. Man days lost 3. Serious injuries 4. Fatality	1.Check Submit all TPI certificates and check for proper working of cutting all machines 2.Critical Lift Permit and Lifting plan shall be prepared if use more than one crane, 75% of capacity of crane or above 50 MT material. 3. Ensure presence of an experienced and competent foreman/Signalman/Rigger. 4. Ensure that workmen keep their hands / leg away from pinching points. Proper communication & co-ordination with coworker. 5. Ensure proper supervisoin. 6. Ensure to use of certified and tested lifting tools and tackles with proper capacity. 7a. Safe working load should be displayed on all matl handling eqpt. 7. Softener or packing shall be provided in between slings and structural member. 8. While lifting ensure no one comes under suspended load. 9. Ensure use of tag lines to control the load. 10. Lifting affected area to be cordon off & caution sign to be posted to avoid unauthorized entery. 11. Only authorized operatior with valid licence to operate the crane.Authorized signal man with wearing reflective jacket shall be engaged. 12. Normal Lift Permit and Lifting plan shall be prepared if lifting Above 5 MT. 13. Daily Inspection checklist of crane/JCB/Cutting machine shall be ensured by users. 14. Stationary type Machinery shall be located in leveled platform and the same shall be ensured by the site engineer. 15.Ensure that soil bearing capacity is adequate to bear the load of machinery 16. Keep cutting tools sharp and in good condition. 17. Avoid work with oily hands. 18. Precautions for swamp/ loose soil / deep pits, etc.	Safety Knee height shoes(Gumboot), Safety Helmet, Safety goggles, Safety vest, Hand gloves, Reflective jacket, rain coat,
Housekeeping	1. Chances of fire during friction 2. Slip Trip Fall	1. Injuries 2. Fatality 3. Chances of damage natural balance.	1. Clean area properly 2. Not to dump bushes and trees in work area 3. Carry out stacking in designated area in orderly manner for further disposal.	Safety shoes (Gumboots), safety Helmet, Vest, goggles, Hand gloves.

Date	Reviewed By sub-contractor and or their authorized competent person		Is any additional precautions to be taken for the day
	Job Supervisor / Engineer	Safety Officer	

HAZARD IDENTIFICATION AND RISK ASSESMENT (HIRA)	
Job Task: Erection of materials and over all site work	**Equipment #:** Hydra/Crane, Welding M/c,
Project/Location: 22 MW Floating Solar Project, NTPC, Kayamkulam	**Analysis done by: PV System Engineering Reviewed by: BHEL- HSE**
PPE required: Safety helmet, vest, shoes, hand gloves, etc. (IS standard) **Emergency Plan:** Yes	**Date Initiated:** **Revised date:**
Tools used: Gas cutting set, Chain pulleys, Sling, D-shackle, Bow shackle.	**Chemicals used:** NO

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Structural materials shifting and Lifting.	1. Pinching of leg/hands of workmen while handling 2. Structural members. 3. Swinging of load. 4. Poor weather condition. 5. Overloading of crane. 6. Unauthorized operation of crane by helper.	1. Head injuries. 2. Cut injuries 3. Man days lost 4. Property damage. 5. Chances of Fatality	1. Pre work cautioning & proper Permit must be followed before starting the work. 2. Ensure that workmen keep their body parts away from pinching points. 3. Ensure proper stacking of Structural members. 4.While fit up work structural member must be secured safely. 5. Experienced rigger and signalman should be assigned. Ensure competence Validation card. 6. Ensure use of tag lines at both ends to control the load. 7. Use crane/Hydra within the capacity and do not over load. 7a. Safe working load should be displayed on all matl handling eqpt. 8. Avoid work in poor visibility / poor weather condition / Raining and in heavy wind. 9. Affected area to be cordon off and caution sign to be posted to avoid unauthorized entry. 10. Only authorized operatior with valid licence to operate the crane.	Safety shoes, Safety Helmet, Safety goggles, Safety vest, Hand gloves.
	7.Failure of lifting tools and tackles due to use of damaged / under capacity tools and tackles.	1. Serious injuries. 2. Property damage.	1. Only single person signaling to the hydra/crane operator. 2. Ensure to use of certified and tested lifting tools and tackles with proper capacity, color code &identification number. 3. While lifting ensure no one comes under suspended load. 4. Barricading the area.	

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Erections of structural materials with the help of crane& rigging activity.	1.Pinching points. 3.Failure of lifting tools and tackles due to use of damaged / under capacity tools and tackles. 4. Hit by load due to swinging.	1. Cut injuries. 2. Serious injuries. 3. Property Damage.	1. Critical Lift Permit and Lifting plan shall be prepared if use more than one crane, 75% of capacity of crane or above 50 MT material. 2. Ensure experience and competent of foreman/Signalman/Riggers. 3. Ensure that workmen keep their hands / leg away from pinching points. Proper communication & co-ordination with coworker. 4.Ensure proper supervisoin. 5. Ensure to use of certified and tested lifting tools and tackles with proper capacity. 6. Softener or packing shall be provided in between slings and structural member. 7. While lifting ensure no one comes under suspended load. 7a. Safe working load should be displayed on all matl handling eqpt. 8. Ensure use of tag lines to control the load. 9.Lifting affected area to be cordon off & caution sign to be posted to avoid unauthorized entery. 10. Only authorized operatior with valid licence to operate the crane.Authorized signal man with wearing reflective jacket shall be engaged**.** 11.Normal Lift Permit and Lifting plan shall be preparediflifingAbove 5 MT. 12.Daily Inspection checklist of crane/hydra shall be ensured by users.	Safety shoes, Safety Helmet, Safety goggles, Safety vest, Hand gloves. Full body harness.

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Erection/Dismantling of Scaffolding (Only for CMCS area)	1. Dropped objects 2. Slips, trips and falls 3. Striking against 4. Collapse 5.Fall of scaffold structure	1. Falling from height. 2. Head injuries. 3. serious injuries. 4. property Damage.	1.Performing group shall conduct check of tool box relevant to the job before the work start 2. Use tools belt for containment of loose objects 3. Secure the tubes, planks and other objects when lifting/lowering 4. Barricade the work area and place sign boards 5. Do not climb with components 6. All scaffold platforms shall be fully boarded, fixed with toe boards & handrails, boards to be secured/lashed 7. Ensure area is not congested. 8. Maintain safe distance from energized power lines and heat sources 9. Ensure that only authorized/certified personnel are engaged in erecting & dismantling scaffolding 10. Examine all scaffold components prior to use 11. Scaffold should be inspected & tagged by competent person prior to use 12. Only essential personnel are allowed to access on scaffold	Safety shoes, Safety Helmet, Safety goggles, Safety vest, Hand gloves, Full body harness and fall arrester
Work at height (Only for CMCS area)	1. Fall of person. 2. Fall of materials (hand tools, Nut, bolts etc.) 3. Slippery approach. 4. Fall of person.	1. Head injuries 2. Break bones fall from height 3. Fatality. 4. Property damage.	1. Safety Net shall be provided if required. 2. Ensure proper Access and Work platform. 3. All scaffolds must be checked before use by Civil works supervisor and cleared before use.	Safety shoes, Safety Helmet, Safety googols, Safety vest, Hand gloves. Full body harness.

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Gas cutting and Welding work	1.Fire and Explosion 2. Burn injury due to fire spatters. 3.Eye injury to nearby workers 4.Welding fumes 5.Person injury due to fall of gas cylinders while transporting	1. Property damage due to cylinder blast 2. Burn injuries due to fire.	1.Ensure flash back arrester /NRV on cylinder and torch side & fire blanket. 2. The combustible material shall be removed from site before starting the job. 3. No welding cable shall pass over the combustible materials/cylinders. 4. Provide fire extinguisher. 5. Check the leakage of cylinder with soap solution. 6. Hot work permit should be taken and Fire watch person should be identified & only authorized person allow to work. 7. Fire blanket must be provided to protect falling of hot spatters at height or barricaded the area. 8. Ensure safety goggles to all workers. 9. Especially Black goggles for Welder's helper. 10. Provide suitable face protection mask for welders. 11. Use gas cylinders trolley for internal shifting of gas cylinders. 12. Fixed the valve caps while shifting/storing the gas cylinders. 13. O2 and LPG Gas cylinders shall be stored separately chained and secured. 14. Cylinders must be stored in shed to avoid direct sun light exposure. 15. Ensure safe storage of diesel fuel if any	Safety shoes, safety helmet, gloves, goggles. Face shield.
Electrical work	1.Electrical Shock 2.Electrocution 3.Fire	1. Shock due to improper insulation. 2. Property damage. 3. Fatality.	1. Electric supply should be taken through ELCB of 30mA sensitivity. 2. All power cables should be protected from damage by improper laying. 3. All m/c and panel board should be protected against rain. 4. Proper Earthing shall be provided to all electrical equipment. 5. Ensure all portable power tools are tested and inspected by concern electrical engineer. 6. D.B Should not be overloaded.	Safety shoes, safety helmet, Rubber gloves, goggles.

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Removal Of Lifting Arrangement	1. Cut injury. 2. Fall of materials/objects from height.	1. cut injuries 2. serious damage. 3. property damage. 4.vertical reinforcement collapse may cause.	1. Trained and Authorized person only allow to perform the job. 2. All tools & tackles should be tightening by rope to prevent fall from height. 3. Safe lowering procedure should be ensured. 4 The area must be cordon off. 5. Life line must be provided for anchoring safety harness.	Full body harness, Safety shoes, safety helmet, gloves, goggles
Excavation Work by JCB/manually	1. Excavated depth greater than1.5 mtr. 2. Failure of breaks. 3. Dumper moving. 4. Soil collapse.	1. Serious head, hand or eye injuries. 2. Workers falling in to the depth. 3. Heavy earth mover heat by person, 4. Unknown person heat by dumper.	1. Install hard barricade around the excavated area. 2. No person allowed in during the excavation by JCB. 3. Work area clearance certificate and excavation permit must be taken before starting the work. 4. JCB inspection should be carried out before the job commencement 5. Use barrier tapes or safety net at edges in excavation area.	Safety shoes, safety helmet, goggles, hand gloves, vest.
Civil work	1. Slippery approach. 2. While work at height, fall hazard. 3. Electrical hazard for electric line/equipment's. 4. Sharp edges of construction materials.	1. Slip trip fall injuries requiring first aid. 2. Eye injuries. 3. Head injuries. 4. Property damage.	1. Preparation proper approach with proper slope, steps, hand railing. 2. Barricading the area. 3. Place safety posters in work area. 4. Inspection of all hand tools before use. 5. Working platform should be proper (board/proper ladder)	Safety shoes, safety helmet, goggles, gloves, full body harness, nose masks.
	5. Chemical component of cement.	5. Eye injuries, skin irritation		

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
Work on Water body (NTPC KAYAL)	1. Trip slip and fall hazard on floats 2. Chance of fall into water 3. Electrical hazard. 4. Effect of extreme weather condition such as Sun burn and heat stress.	1. Physical fall shock - chance of injury or fatality. 2. Fall from the work area in to the water resulting in suffocation or drowning. 3. Chance of fatality for over work and sun burn effect.	1. Before start the work check all documents (such as work permit, TPI certificates of all tools and tackles and test certificates of life saving boat. 2. Ensure all work men working in or very near to water to wear Life jackets 3. Ensure availability of rescue boat in water with spare life jackets and floatation air tubes 4. Make a proper approach into the water body with proper slope or steps 5. In case of emergency, rescue team consisting of expert swimmers and above rescue boat to be always prepared. 6. In case of underwater work such as diving related work, an expert for checking diving equipment prior to commencement of work and also he shall be present for observing and monitoring diving activity during dive sessions. 7. Arrangement to be in place to summon Ambulance on Call to site for emergency shifting of any injured person to the nearest hospital. 8. Ensure drinking water to avoid de-hydration 9. Ensure Wireless / mobile/ walky-talky arrangement between site to control room/office 10. Ensure non-contamination of water body during the activities	Safety shoes, safety helmet, goggles, hand gloves, Reflective life jackets. Certified and compliant Diving gear to be used by divers if required One dedicated Rescue boat with life jackets

Date	**Reviewed By sub-contractor and or their authorized competent person**		**Is any additional precautions to be taken for the day**
	Job Supervisor / Engineer	**Safety Coordinator**	

FORMATS USED IN SITE

SL. No.	Format Name	Format No.
01	Safety Check list cum compliance report	01
02	Inspection of First Aid Box	02
03	Health Check Up	03
04	Monthly Site Safety Report	04
05	Safety Induction Training	05
06	Tool Box Talk	06
07	Inspection of PPE	07
08	Inspection of T&Ps	08
09	Status of T&Ps	09
10	Inspection of Cranes and Winches	10
11	Inspection on Height Working	11
12	Inspection on Electrical installation.	12
13	Safe Work- Permit (For External Agency)	13
14	Mock Drill Format (Fire)	14
15	Mock Drill Format (Water Accident)	15

SAFETY CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ CONTRACTOR:_ DATE:_____

OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable. Inspection to be completed once in a month.

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
PERSONNEL PROTECTIVE EQUIPMENTS				
Goggles; shields				
Face protection				
Hearing protection				
masks etc.				
Safety harness/belts				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded, cordoned				
Excavations shored				
Excavations barricaded/ cordoned				
Overnight lighting provided				
SCAFFOLDING				
Fully secured and fastened				
Guard and intermediate rails in place				
Adequate shoring				
Adequate access				
LADDER				
Extension side rails 1 m above of landing				
Properly secured				
HOISTS, CRANES AND JCB				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				

				FORMAT 01 (Page 2 of 2)
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
ELECTRICAL				
Proper wiring				
ELCB's provided				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
FLAMMABLE GASES AND LIQUIDS	NA			
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				
WORKING AT HEIGHT				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rag sand combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.	NA			
Availability of first-aid Facilities				
Proper sanitation at site, office				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				

RECORD OF REVISION

Page No.	Rev No.	Brief of Revision	Date
All	00	New procedure introduced	

FORMAT – 02 (Page 1of2)

INSPECTION OF FIRST AID BOX
(Check with KFR 1969)

Name of Site :	
Name of Sub-Contractor:	
Inspected by :	
Date of Inspection:	

Number of employees on the site:-____

Sl.No.	**Item**	**No. Available**	**Remarks**
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of Larg sized sterilized burn dressinge s		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
14	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
15	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

FORMAT – 02 (Page 2of2)

INSPECTION OF FIRST AID BOX

Sl.No.	Item	No. Available	Remarks
16	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
17	Whether roll of adhesive plaster (6 cmX1 meter) available		
18	No of rolls of adhesive plaster (2 cmX1 meter)		
19	Whether snake bite lancet available.		
20	Whether (30 grams) bottle of potassium permanganate crystals available.		
21	Whether a pair scissors available		
22	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
23	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
24	Whether Ointment for burns available		
25	Whether bottle of a suitable surgical anti septic solution available		

Signature of SAFETY Coordinator

FORMAT – 03(Page 1 of 1)

HEALTH CHECK UP: AS PER CERTIFICATE OF MEDICAL EXAMINATION

FORM-XI
Certificate of Medical Examination

Certificate No.:
Date:

1. Name:

Identification Marks:
1……..

2. ……

2. Father's name: ……

3. Sex: ……

4. Date of Birth, if available certificate age: ……

5. Physical Fitness:
I hereby certify that I have personally examined (name)…….
son/daughter/wife of ……. residing at …….
Who is desirous of being employed in building and construction work and his/her age as nearly as can be ascertained from my examination ……. years and he/she is fit for employment in ……as an adult/adolescent.

BP: Height: Sugar:

Pulse: Weight:

Eye Vision Test:

Left:

Signature/Left hand Thumb Impression of Building worker

Signature & Seal of Medical Inspector/CMO

……
……

Note: 1. Exact details of cause of physical disability should be clearly stated.

2. Functional/productive abilities should also be stated, if disability is stated.

FORMAT -04 (1 of 4)

MONTHLY SITE SAFETY REPORT

				Report Month:			
A) Accidents/Incidents Details:-							
a	**Lost time in Accidents**	**No. of incidents**	**Man Hours Lost**	**No.of People Involved**	**No. of contractors involved**	**Client persons if any**	**No.of persons reporting to Govt.**
	For the Month						
	Cumulative						
b	**Minor Injuries**						
	For the Month						
	Cumulative						
c	**Fires**	**No. of Near-Misses**	**No. of First-Aid cases**	**No. of persons injured**	**No. of equipment's damaged**	**No. of Fire reporting Outside**	
	For the Month						
	Cumulative						
d	**Other mishaps not covered in a, b, c.**	**No. of Near-Misses**	**No. of First-Aid cases**	**No. of persons injured**	**No. of equipment's damaged**	**Total near misses and First-Aid**	
	For the Month						
	Cumulative						

Signature of Head (Site office)

Signature of Site safety Coordinator

FORMAT -04 (2 of 4)

MONTHLY SITE SAFETY REPORT

A) Status of Deployment of Safety Coordinators & electricians by Agencies:

Description	Name	Qualification & Experience
Safety Coordinators		
Electricians		

B) Lifting Tools, Tackles, Equipment and Pressure Vessels:

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

C) Reverse Horns in Construction Vehicles:

Item	Nos. Deployed	Nos. Having Functional reverse horns	Inspection Dates
Transit Mixers			
Hydra Cranes			
Dumpers/Trippers			
Backhoes			
Other Vehicles			

D) ELCBs:

No. Of ELCBs provided	Nos. Functional	When They were last Tested

Signature of Head (Site office)

Signature of Site safety -Coordinator

FORMAT – 04 (3 of 4)

MONTHLY SITE SAFETY REPORT

E) Electrical Earthing:

No. Of Earth resources	Whether Earthing provided to all equipment's	When they were last tested

F) Fire Extinguishers:

Name & designation of person responsible for maintenance of Extinguishers at different locations:(Individual Contractor's Safety Coordinators/Authorized executive).

FIRE EXITINGUISHERS AT ERECTION SITE & STORES:

TYPE	SIZE	QTY	HEALTHINESS	LOCATIONS
MECHANICAL FOAM				
WATER CO2				
DRY CHEMICAL POWDER (DCP)				
CARBON DIOXIDE				

G) Implementation of checklist, Work permits:

Item	During the Month	Major Deviations
Note:-Please attach photocopies of all filled Checklists & Work permits for that month.		

H) Personal Protective Equipment's Issued:

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor/Safety rope			
Other PPEs			

Signature of Head (Site office)

Signature of Site safety -Coordinator

MONTHLY SITE SAFETY REPORT	**FORMAT – 04 (4 of 4)**

No. of Observations received in the month	No of points complied	Cumulative no. of non-complied Points

I) Training programs on safety during the month:

1)Tool-Box talks/ Pep-talks on Safety:

Date	Tool Box Talk - No of Participants	Safety Induction - No. of Participants	Topic
Date	**Tool Box Talk No of Participants**	**Safety Induction No. of Participants**	**Topic**

k) Other Safety initiatives / Safety Activities conducted at sites:

Signature of Head (Site office)

Signature of Site safety -Coordinator

FORMAT -05 (Page 1 of 1)

SAFETY INDUCTION TRAINING

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training coordinator: NTPC/BHEL	

Sl No.	Name	Designation	Organisation	Signature

Signature of safety Coordinator:

FORMAT -06(Page 1 of 1)

TOOL-BOX TALK

Sub-Contractors Name :	
Date :	

Topic	**Name of person delivered Tool Box Talk**	**No. of Participants attended**	**Remarks**

Signature of safety Coordinator:

FORMAT -07(Page 1 of 1)

PERSONAL PROTECTIVE EQUIPMENTS

Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Item	Issued this Month	Nos. Issued up to the Month	Percentage of usage at site
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor/Safety rope			
Life jackets			
Other PPEs			

Signature of safety coordinator:

FORMAT -08

INSPECTION OF T&Ps

Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs / overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Site Safety Coordinator	**Signature-Subcontractor/ Subcontractor's Safety Coordinator**

FORMAT - 09(Page 1 of 1)

STATUS OF T&Ps

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Item	Nos. Deployed	Identification No.	Nos. Tested by competent person	Validity of Test Certificate
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of safety Coordinator: **Signature-Subcontractor/ Subcontractor's Safety Coordinator**

Signature of BHEL Site Supervisor

INSPECTION OF CRANES AND WINCHES

Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No(Make/Model) _____

Name of Driver/Operator _____

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers filly extendable		
20	Tire pressure		
21	Condition of Battery And Lamps		
22	Guards of moving and rotating parts		

23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?			
2	Is winch machine operator experienced enough to operate the winch machine?			
3	Is the winch machine operated by someone other than the winch machine operator?			
4	Is there guard provided in all moving parts like wheel and motor's shaft?			
5	Will it protect against unforeseen operational contingencies?			
6	Are brakes, clutch and locking arrangement working properly?			
7	Has it been ensured that the guard does not constitute a hazard by itself?			
8	Are the cranks and the connecting rods protected by guardrails?			
9	Is there provision for fully covered shed with wooden plank roof?			
10	Is wire rope free from any kind of damage or wear and tear?			
11	Is split pin provided for the protection of clutch and brake locking arrangement?			
12	Is pulley inspected by competent person and certified before use?			
13	Is pulley free from any wear and tear visually?			
	FORMAT -10(Page 1 of 3)			

14	Is winch rope barricaded with clipsheet for the protection of rope and person?			
15	Is the wire rope lubricated by cardium oil?			
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?			
17	Is there any oil leakage in the hydraulic system of the winch machine?			
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?			
	Total Number of NO:			
	Total Number of NA:			
	% Compliance :			

Signature of safety Coordinator: **Signature-Subcontractor/ Subcontractor's Safety Coordinator**

Signature of BHEL Site Supervisor

FORMAT -11(Page 1 0f 2)

INSPECTION OF HEIGHT WORKING

Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	Descriptions	Observation (Yes/No)
1	All the workers have been explained safe work method?	
2	An established communication system has been established and explained to the workers.	
3	Adequate illumination has been ensured.	
4	Work area inspected prior to the start of the work.	
5	Area below the work place barricaded, particularly below hot work.	
6	Workers provided with bags /box to carry bolts, nuts and hand tools	
7	Arrangement for fastening hand tools made.	
8	All work platforms ensured to be of adequate strength and ergonomically suitable.	
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.	
10.	Work at more than one elevation at the same segment is restricted.	
	ACCESS/EGRESS	
1	Walkways provided with handrail?	
2	All checkered plates, gratings properly welded/ bolted?	
3	Are ladders inspected and they are in good condition?	
4	Are ladders spliced?	
5	Are ladders properly secured to prevent slipping, sliding or falling?	
6	Do side rails extend 36” above top landing?	
7	Are built up ladders constructed of sound materials?	
8	Are rugs and cleats not over 12” on center?	
9	Metal ladders not used around electrical hazards.	
10	Proper maintenance and storage.	
11	Ladders placed at right slope.	
12	Ladders / staircases welded/ bolted properly.	

		FORMAT - 11(Page 1 0f 2)
13	Any obstruction in the stairs.	
14	Are landing provided with handrails, knee rails, toe boards etc.?	
15	Whether ramp is provided with proper slope.	
16	Proper hand rails / guards provided in ramps.	
	Housekeeping	
1	Walkways, aisles & all overhead workplaces cleared of loose material.	
2	Flammable materials, if any, are cleared.	
3	All the de shuttering materials are removed after de shuttering is done.	
4	Platforms and walkways free from oil/grease or other slippery material.	
5	Collected scrap are brought down or lowered down and not dropped from height.	
	PPE And Safety Devices	
1	Use of safety helmet, safety belts ensured for all workers	
2	Anchoring points provided at all places of work.	
3	Common lifeline provided wherever linear movement at height is required.	
4	Safety nets are use wherever required.	
5	Proper fall arrest system is deployed at critical workplaces.	

Signature of safety Coordinator **Signature-Subcontractor/ Subcontractor's Safety Coordinator**

Signature of BHEL Site Supervisor

FORMAT -12

INSPECTION OF ELECTRICAL INSTALLATION

Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Sr. No.	Contents	Yes/No	Remarks
A	**Cable**		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	**DBs/SDBs**		
1.	Is earth conductor continued upto DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	**ELCB**		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	**Grounding**		

1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	**Electrically operated Machines or Accessories**.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of safety Coordinator : **Signature-Subcontractor/ Subcontractor's Safety Coordinator**

Signature of BHEL Site Supervisor

Safe Work- -Permit (For External Agency)

Type of permit	Tick whichever is applicable
Height working of 3.3 metre and above at FSPV Site (Applicable for erection of communication towers/Electrical Towers, if any)	
Excavation more than 1.5 meter depth	
Heavy lifting by machinery (only on land)	
Works on Floating Platforms in Water	

Permit initiation

Permit no: _____ Date: _____

The following persons are here by engaged to undertake the above work (tick whichever is applicable) in the areas indicated below. The contractor and the workers will strictly adhere to the safety instructions contained in the annexure, as applicable.

Name of the work :-

Brief description of work:

Area/Location of work:

Period of work From _____ to _____

Time of work From _____ to _____

Name and Address of the contractor :

Work Order No. & Date

Details of Persons Engaged

Sl. No.	Name	Age	ESI No.	Id No.
1				
2				
3				
4				
5				

*The persons engaged are possessing certificate against Vertigo in their medical clearance certificate.

_____ _____

Signature of Contractor with contact no. Signature of BHEL Sup/Executive

Permit Clearance:

1.0 Clearance from – In-charge/ Services (BHEL)

_____
(Signature)

2.0 Clearance from Safety

_____
(Signature)

3.0 The above work is permitted subject to above clearance.

_____
(Signature of Site Incharge)/Authorised executive)

4.0 Permit Withdrawal / closure

4.1 The work has been completed, Men and Materials withdrawn. Intimation is given to Services Department and Concerned Supervisor / Area-Incharge

_____
(Signature of Executing Dept. Sup./Executive)

5.0 Withdrawal of Permit/Closure recordings

_____
(Signature of Safety Coordinator)

Note: Wherever Clearance Is Not Required, Write ‘Not Applicable’ (NA)

Annexure- Checklist for Work permit

Work Permit Checklist

A. Height working of 3.3 metre and above at FSPV Site (Applicable for erection of communication towers/Electrical Towers, if any)

Sl. No.	Criteria	Yes	No	NA	Remark
1	Have scaffolding/lacers/working platform been checked and provided.				
2	Is roof ladder /crawling board provided?				
3	Have safety belts and helmets inspected and provided.				
4	Is adequate illumination provided?				
5	Are safety nets erected at site to arrest falls when climbing up/down or moving at heights?				
6	Is barricading provided to avert fall of material down below.				
7	Is the work area clear and safe from overhead electrical lines/other protecting structures?				
8	Surrounding area checked.				
9	Have all combustibles within 35 ft. are removed and protected.				
10	Fire Fighting system readiness.				
11	Precautionary tags/ boards provided.				
12	Nearby working area, pipes checked for leakage and effectively protected against falling sparks.				
13	Condition of Hoses and Cylinders.				
14	Is he having phobia (Vertigo)				
15	All Employees involved have been informed of precautions.				
16	Work shall be closed before sunset.				
17	Ensure that continuous supervision				
18	Ensure that persons working at height should anchor harness to rigid support.				

B. Excavation more than 1.5 meter depth

Sl. No.	Criteria	Yes	No	NA	Remark
1	Cable route detection done at the place of excavation				
2	Free from water, hydrant, sprinkler pipes; telephone & sewer lines.				
3	Excavation work does not affect surrounding structures.				
4	Piling, shoring, bracing, walers and runners provided and of adequate strength to prevent cave in				
5	Excavated materials are placed >2 feet from edges of trench.				
6	Open sides of trench are barricaded to prevent fall .				

7	Warning signs are posted.				
	Annexures to Format-13 (Page 2 of 3)				
8	No person is working in trench during excavation.				
9	Suitable access to and egress from trench of 1.2 m and above is arranged.				
10	Banksman arranged				

C. Heavy lifting by machinery (only on land)

Sl. No.	Criteria	Observations	Measures
Readiness of Lifting Equipment:			
1	Over-Hoist Limit Switch		
2	Boom-Limit Switch		
3	Boom Angle indicator		
4	Boom-Limit cut-off switch		
5	Safe Load Indicator available		
6	Condition of boom		
7	Condition of Ropes		
8	Size and condition of the sling		
9	Stability of crane		
10	Soil Condition		
11	Swing Brake & Lock		
12	Propel Brake & Lock		
13	Hoist Brake & Lock		
14	Boom Brake & Lock		
15	Main clutch		
16	Leakage in hydraulic cylinders		
17	Out riggers fully extendible		
18	Tyre pressure		
19	Condition of Battery and Lamps		
20	Guards of moving and rotating parts		
21	Load chart provided		
22	Automatic Reverse horn/Swing Alarm (With nominal sound frequency)		
23	Load test details		
24	Fire Extinguisher in operators cabin		
Readiness of Lifting Slings:			
1	Tag number/ Identification number(with SWL marked)		
2	Validity		
3	Capacity & length of the Sling		
4	Check for any visual damaged outer sheath		
5	Check for any damages at the cuts/ threading		
6	Check for any damages at the eye portion of the sling		
7	Check the overall condition of the sling.		
8	Check for any twisted/ knotted condition		
9	Check the overall surface contour of the sling.		
10	Any Other Observations		

Readiness of Manpower/Area of work:					
	Annexures to Format-13 (Page 3 of 3)				
1	Operator Fitness and Licence				
2	Dedicated helper availability				
3	Work area to be cordoned off & caution sign to be posted to avoid unauthorized entry.				
4	PPEs availability for Manpower				
D.	**Works on Floating Platforms in Water**				
Sl. No.	**Criteria**	**Yes**	**No**	**NA**	**Remark**
1	Availability of life Jackets to all manpower going on water				
2	Availability of rescue boat in water with spare life jackets and floatation air tubes				
3	Safe access to floating platform from ground				
4	Availability of rescue team of expert swimmer, helper				
5	Arrangement of Emergency vehicle for quick shifting of any injured person to the nearest hospital.				
6	Availability of drinking water to avoid de-hydration				
7	Availability of communication sources such as Wireless / mobile/ walky-talky arrangement between site to control room/office				
8	For underwater work such as diving related work, Fitness of diving equipment				
9	Diver fitness and skill				
10	Training imparted to manpower for working on floating platform				

Signature of safety Coordinator : Signature-Subcontractor/ Subcontractor's Safety Coordinator

Signature of BHEL Site Supervisor

Format-14

MOCK DRILL FORMAT (FIRE)

VENUE/SITE: Date:

Time:

'FIRE MOCK-DRILL ON EMERGENCY SITE'

OBSERVATION SHEET

SL. NO.	PARTICULARS	DESIRED TIME (min.)	RECORDED TIME (min.)
A	INFORMATION TO IMPORTANT AGENCIES		
	Inform Emergency Main control room (NTPC-Security)	Immediate	
	Inform incident controller (BHEL Site In-Charge)		
	Inform Fire Pump House (by NTPC-Security)		
	Inform NTPC Safety (by BHEL Safety Coordinator)		
	Inform First Aid (by BHEL Safety)		
B	ARRIVAL OF THE SERVICE PERSONAL / ACTION		
	Incident controller reaching the site	5	
	Assembly of work teams at identified Assembly point at site	5	
	Safety personnel reaching the site/coordinating	5	
	NTPC-Security personnel reaching the site	5	
	Fire Guard/Engine reaching the site	5	
	Medical team reaching the site	5	
C	CLOSURE OF OPERATIONS		
	Rescue operation over (rescuing persons)	5	
	Fire-fighting operation over	5	

General Remarks:

Observation Name:

Designation:

Sign:

Format-15

MOCK DRILL FORMAT (WATER ACCIDENT)

VENUE/SITE: Date:
Time:

'WATER ACCIDENT MOCK-DRILL ON EMERGENCY SITE'

OBSERVATION SHEET

SL. NO.	PARTICULARS	DESIRED TIME (min.)	RECORDED TIME (min.)
A	INFORMATION TO IMPORTANT AGENCIES		
	Inform Emergency Main control room (NTPC-Security)	Immediate	
	Inform incident controller (BHEL Site In-Charge)		
	Inform Rescue Team (by work supervisor)		
	Inform BHEL Safety Coordinator (by work supervisor)		
	Inform NTPC Safety (by BHEL Safety Coordinator)		
	Inform First Aid (by NTPC-Security)		
B	ARRIVAL OF THE SERVICE PERSONAL / ACTION		
	Incident controller reaching the site	5	
	Safety personnel reaching the site/coordinating	5	
	NTPC-Security personnel reaching the site	5	
	Rescue team reaching the site	5	
	Medical team reaching the site	5	
C	CLOSURE OF OPERATIONS		
	Rescue operation over (rescuing persons)	5	

General Remarks:

Observation Name:

Designation:

Sign: