



**Bharat Heavy Electricals Limited  
ELECTRONICS DIVISION  
Mysore Road, Bangalore – 560026**

Ph.080-26998991  
SC&PV – PV-Eng- DEPT.

**NOTICE INVITING TENDERS**

1 TENDER NUMBER(RFQ) : EDN: PVENG:NTPC FSPV : 25MW: BOS Dt: 14.03.2020

2 NAME OF WORK : BOS (Balance of system) works for 25MW –AC (36 MW –DC) Grid-Connected Floating Power plant for NTPC at Simhadri, Andhra Pradesh.  
(All listed works shall be Undertaken and executed)

3 ESTIMATED COST : **Rs.11.75 Crore (Approx. for 25MW-AC (36MW-DC) Floating solar) Plus applicable GST.**

4 EARNEST MONEY DEPOSIT : **Rs.21.75 Lakhs (Mandatory for MSME also)**  
(a) Bidders can submit Rs.21.75 Lakhs EMD through DD/SBI Collect (Please refer point no.: 20 & 21 of "Instructions to tenderer" for guideline for payment through SBI Collect)  
(b) **Modes of deposit :**  
The EMD may be accepted only in the following forms:  
(i) Cash deposit as permissible under the extant Income Tax Act (before tender opening)  
(ii) Electronic Fund Transfer credited in BHEL account (before tender opening)  
(iii) Banker's cheque/ Pay order/Demand draft, in favour of BHEL (along with offer)  
(iv) 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)  
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 atleast six months**.

5. SECURITY DEPOSIT : 50% of SD shall be submitted before start of work; Balance will be recovered from running Bills at a rate of 10%. (SD= 5% of the work order amount); 50% of SD will be released after completion of all the works and remaining 50% after 6 months from the date of completion of all the works.

6. COMPLETION TIME : 05 Months (From the date of placement of Order/handing over of the site.)

7. LAST DATE AND TIME FOR THE SUBMISSION OF DULY FILLED IN TENDER DOCUMENT : 27.03.2020 Before 01:00 PM



8. PLACE OF SUBMISSION OF TENDER DOCUMENT : Shri. Sreenath M, AGM (SC&PV-PCG,M) 5th Floor, New Engineering Building, BHEL- Electronics Division Mysore Road, Bangalore -560 026.

9. ADDRESS TO BE SUPERSCRIBED ON TENDER ENVELOPE : Shri. Sreenath M, AGM (SC&PV-PCG,M) 5th Floor, New Engineering Building, BHEL- Electronics Division Mysore Road, Bangalore -560 026.

10. DATE AND TIME OF : 27.03.2020 – (01:30 P.M)  
TECHNICAL BID OPENING

11. TENDER MONITORING AUTHORITY (IEM) : Mr. Arun Chandra Verma, IPS (Retd.)

NOTE: The tenderer shall return the dully filled in tender document after affixing signature and seal on all pages and submit.



Bharat Heavy Electricals Ltd  
Electronics Division  
Mysore Road, Bangalore –  
560026

**Tender Document for**  
**BOS(Balance of system) works for 25MW-AC (36 MW DC) Floating Solar**

**Photovoltaic Grid-connected Power plant for NTPC at Simhadri, Andhra Pradesh.**

**TENDER NUMBER RFQ: EDN: PVENG:NTPC FSPV : 25MW: BOS**

**TECHNICAL BID DATE OF OPENING: 27.03.2020 (Price bid opening date intimation will be given separately)**

**Part – I**

- Technical cum
- Commercial Bid
- Unpriced Price Bid
- Technical and General Specification
- BHEL General Conditions of Contract 2019 (Items to be billed to EDN to have Karnataka GST and items to be billed to Nodal to have Andhra Pradesh GST and for Nodal items **wherever state Karnataka is mentioned in GCC it has to be read as Andhra Pradesh**). BHEL BOQ depicts the item bifurcation of billing to EDN/Nodal.
- Tentative Field
- Quality Plan
- Integrity Pact
- Annexure to Integrity Pact
- Bank Guarantee (On Rs 200 Stamp Paper) /FDR/SBI Collect .
- Site Inspection certificate
- PRE QUALIFICATION CRITERIA documents
- SPECIAL CONDITIONS OF CONTRACT and Its all Annexures (Annex.1 to 24) **except Annexure-25**
- Safety plan

**Part – II**      Price Bid { **Annexure-25 (6 Pages,1-6)** }

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)



Note:

1. Part – I: To be submitted in a separate sealed cover.
2. Part – II: To be submitted in a separate sealed cover.
3. Earnest Money Deposit of Rupees 21.75 Lakhs shall be submitted as per point No. 4 of page No. 1 of this tender document.
4. Tenders will be liable for rejection if the above mentioned EMD is not submitted along with the tender.
5. **Part-I, Part-II and Tender EMD all three separate sealed covers** should be put in an outer envelope and super scribing the Name of work and Name & Address of the Tenderer.



**BHARAT HEAVY ELECTRICALS LTD, ELECTRONICS DIVISION, BANGALORE-26**  
TENDER NUMBER RFQ: EDN: PVENG:NTPC FSPV : 25MW: BOS      Dt.: 14.03.2020

**PART-I TECHNICAL-CUM-COMMERCIAL BID**

(To be furnished by the Bidders)

01. NAME OF THE WORK : BOS works for 25MW-AC (36 MW-DC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Simhadri Andhra Pradesh  
(All listed works shall be Undertaken and executed)

02. APPROXIMATE ESTT.COST RS. : Rs. **11.75** Crore (APPROX.) plus applicable GST.

03. COMPLETION PERIOD : 05 Months (From the date of placement of Order/handing over of the site).

04. NAME OF THE CONTRACTOR :

05. ADDRESS

(A) OFFICE :

E-mail :

TEL. PH. NO. :

(B) RESIDENCE :

TEL.PH NO :

06. PAN NO :

07. GST NO :

08. STAFF STRENGTH :

09. PLANT/EQUIPMENTS : List enclosed/not enclosed



10. a) SCOPE OF WORK : UNDERSTOOD/ NOT UNDERSTOOD  
(As per schedule of items)

b) Accept to execute in total : YES/ NO

c) Bar chart be submitted : YES/ NO  
Individually for each work for whole work Scope.

e) In order to complete the project  
in the specified months schedule, vendor  
to deploy separate Four gangs/teams (or) more  
as per site requirement for each individual activities  
along with tools and machineries, Undertaking  
should be submitted along with offer : YES/ NO

11. a) EMD PARTICULARS (DEMAND DRAFT/  
SBI COLLECT REF NO. / BG DETAIL) :

b) Electronic Funds Transfer (EFT) form enclosed : Please fill up the form in ANNEXURE-II

12. Penalty as per BHEL General conditions of contract  
2019 clause No. 2.7.9 : Accepted / Not accepted

13. Constitution of Firm : Individual / Sole Proprietorship Concern /  
Partnership Firm / Public Ltd. Company/  
Private Ltd. Company.

14. BHEL reserves right to conduct reverse auction : Accepted / Not accepted

15. Accept to pay statutory payments like ESI, PF,  
BOCW, etc., as per terms and conditions of  
BHEL and Govt. guideline's / NTPC Biometric scheme. : Accepted / Not accepted

16. Tender signing Authority on company letter head : Submitted/Not Submitted

**Note:**

- 1. Bidders are advised to quote their best prices (% above/below the total estimate +/\_ (or) at par) as no further price bids will be accepted in case BHEL decides to open price bids instead of reverse auction.**
- 2. Reverse auction seal bid opening price should not be more than the manual quoted (hand written) price bid.**
- 3. In order to complete the works as per schedule and to execute specific specialized works awarded to the**  
NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)



contractor, he may subject to approval of BHEL engage other agency having qualifications and experience to carry out the particular work under direct supervision and quality control of the contractor.

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)



## **PRE QUALIFICATION CRITERIA**

(I) Bidders should have experience of similar nature of works during last ten 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:** List of similar works shall be as follows:

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

Or

Bidder to have any kind of experience in the execution of Floating Solar plants for 50kw 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 or works in the water reservoirs of thermal plants.

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. For above (evidence in the form of tax invoice or delivery challans or work completion certification or relevant documents to be furnished.)

(ii) Average annual financial turn over during the last 3 years, ending 31st March of the previous financial year, should be 30% of the maximum quantum of work envisaged on the contractor i.e Rs 3.525 crs. Audited Profit & loss account and balance sheet to be submitted for FY 2016-17, 2017-18 and 2018-19. 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.

**Note: Offers of the Tenderers not meeting the above requirements are liable to be rejected.**



#### Documents required to be submitted

1. Registration Certificate with ESI and PF Authority/Declaration.
2. Income Tax Returns for last Three years
3. Balance Sheet and Profit & Loss Account for the last 03 years by auditor.
4. Availability of Technical personnel in letter head.
5. List of equipment to be mobilized at site.
6. GST Registration details or Declaration.
7. Registration with BHEL/CPWD/other Government Organizations/PSUs if any
8. Declaration for full filing the BOCW requirements

**All the supporting documents to be signed and sealed by the bidder (BHEL have the rights to verify the original documents if required)**

#### **BIDDER TO NOTE FOR COMPLIANCE:**

Techno Commercial bid to be filled by the bidder.

S.no	Description	Confirmation	Remarks
1	Machineries to be deployed	YES/NO	List to be furnished.
2	BHEL Payment terms acceptance (Cl. no. 21, 22.1 & 22.2 of Special Conditions of Contract )	YES/NO	
3	BHEL reserves right to conduct reverse auction. Indicate acceptance.	YES/NO	
4	The bidder should encourage to use local labor that has the necessary skills as per the requirement of work.	YES/NO	
5	Signed unpriced copy of price bid format attached along with the techno commercial bid.	YES/NO	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.

6	<p>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).</p> <p>Contractor is required to comply with NTPC's CLIMS system for identification and movement of labour in their work site.</p>	YES/NO	
---	--	--------	--

**NOTE:**

(a) In any case, BHEL reserves the right to change the scope of work (or) re-float the tender.

**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 "Site Inspection Certificate" in Annexure-III 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.

**(vii) 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.

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.

**Mobilization at site:**

- 1) Requisite Material (SCB support structure, earthing wire, HDPE Pipe, MC4 & Y connectors etc.), men (electrician, welders, deep diving person, etc.) and machinery (All tools, tackles and Infrastructure like boats, welding machine, drilling machine, etc.) should be arranged in order to complete the project within stipulated time period.
- 2) The contractor shall carry the work as per the approved PV array layout issued by BHEL (Tentative Field quality plan enclosed with this tender for reference)



**Bharat Heavy Electricals Limited**  
**ELECTRONICS DIVISION**  
**mysore road- bangalore-26**  
**INSTRUCTIONS TO TENDERER**

1. Sealed Tender for the above noted work is hereby invited from bidder experienced in similar works like BOS work activity of minimum 5MW land/roof mounted solar plant or 50kw floating solar plant or work experience in field of reservoir/lake/river water activity or any water works such as dredging /silt removal/construction /cable or pipe laying.
2. Scope of work for 25MW: erection and commissioning work (BOS) for 25MW –AC(36 MW-DC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Simhadri, Andhra Pradesh .Detail scope of work is attached along with tender. However depending on site conditions minor modification in works may be necessary.
3. Project detail and Location:

<b>Site Detail</b>	<b>Project detail</b>	<b>Location</b>
NTPC Simhadri	25 MWp-AC-(36MW – DC) floating solar	25 MW –AC-(36 MW-DC) Floating Solar PV Project, NTPC Simhadri, Visakhapatnam, Andhra Pradesh 531020

4. Tenders should be addressed to: Shri. Sreenath M, AGM (SC&PV-PCG,M) , NEB 5<sup>th</sup> Floor, Electronics Division, Bharat Heavy Electricals Limited, Mysore road, Bangalore – 560 026. In three separate sealed cover for “Technical cum Commercial Bid”, Price Bid and DD for Tender document Cost (if applicable) & EMD duly super scribed and put in an outer envelope, super scribing the Name of work, Tender no. and Name and address of the Tenderer.
5. The local address of the Contractors, the name of the person to whom all the Correspondence are to be addressed should be indicated, with telephone number (both office and residence).
6. 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.



7. Tenderers shall fill in all the required particular in the blank space provided for this purpose in the tender documents and also sign in each and every page of the tender document including the drawings attached there to before submitting tender.
8. 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 items shown in the attached schedule. These rates shall be for the finished work at site. The rate shall include all taxes and duties payable on account of Octroi, tax on work contract etc., and also expenses towards PF and ESI contributions (see clauses 8, 40 and Enclosure 'C') .
9. 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.
10. The rate to be quoted by the tenderer shall be firm and shall cover and include all statutory levies such as "Octroi, excise duty etc., arising from Act passed by Parliament or State Legislature and rules framed there under. The rates shall further be deemed to include statutory levies arising from such Acts, Central or State, which may come into force, subsequent to submission of tenders.
11. (a) The rate quoted in the tender shall remain valid for a period of 'THREE MONTHS' from the date of opening tender.  
(b) Tenderer shall not increase quoted rates, once the tenderer has submitted offers/quotation/price and during execution of contract in case tender is accepted.  
(c) Successful bidder should execute the work strictly in accordance with Tender schedule quoted rates as accepted by BHEL.  
(d) **PRICE VARIATION clause not applicable.**
12. The rates quoted should be inclusive of all taxes arising on the transaction. If BHEL is required to discharge the liability of any taxes on the transaction like TDS(IT), TDS(WCT), TDS(GST) (as applicable) under reverse charge mechanism or any other similar taxes, which is or becomes payable by BHEL, the same shall be deducted from the bills of the contractor. **The rate/Percentage quoted by bidder shall be including all taxes but excluding GST which shall be shown separately in price bid.**
13. Quantities shown in the schedule are only approximate and are liable to variation without entitling the Contractors to any compensation.



14. Before tendering, the tenderer are 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 labour. They should be well versed with BHEL General Conditions of Contract instruction to the tenderers, drawing and specification and all other documents which form part of the agreement to be entered into subsequent to award of work. The tenderer should be specially note that it is tenderers responsibility to provide any items which is not specifically mentioned in the specifications and drawing, but which is necessary to complete the work.
15. 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.
16. Should a tenderer find discrepancies or omission in the drawing attached to the tender documents or should be in doubt as to their meaning he should at once address to the authority inviting the tender for clarifications. Every endeavor is made to avoid any error which can materially affect the basis of the tender but successful tenderer shall take upon himself to provide for the risk of any error which may be subsequently discovered and shall make no subsequent claim on account thereof.
17. 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 latter case, a copy of the power of Attorney duly attested by a Gazette Officer must accompany the tender.
18. If in any case, the date of Tender Opening falls on holiday, the Tender will be opened on the next working day.
19. Every tender must be accompanied by Earnest Money Deposit. This earnest money will be refunded to the unsuccessful tenderer after finalization of the award of work. In the case of successful tenderer, the earnest money will be retained as a part of Security Deposit for satisfactory completion of the work in accordance with Clause-16 of BHEL General Conditions of the Contract. Tenders without Earnest Money Deposit receipt are liable to reject. No interest will be paid on the earnest money deposit.



20. The Earnest money deposit may be furnished  
As specified at Pg-1 (Sl.no-4)

- a) Demand Draft in favour of BHEL EDN, Bangalore – 560026.
- b) The Earnest money deposit may be furnished through online from SBI Collect.
- c) EMD through BG : Please use attached Annexure-20(Heading as Annexure A )



## Guidelines for payment of EMD Fee

**Step-1:** Go to <https://www.onlinesbi.com/sbicollect/icollecthome.htm>

**Step-2 :**

The screenshot shows the homepage of the State Bank Collect website. At the top, there is a banner with the text "STATE BANK COLLECT" and "A MULTI-MODAL PAYMENT PORTAL". Below the banner, there is a "DISCLAIMER CLAUSE" section with a "Terms Used" link. The main content area contains a "Terms Used" section with several bullet points defining terms like "Corporate Customer", "User", and "Bank". Below this, there is a checkbox labeled "I have read and accepted the terms and conditions stated above." followed by the instruction "(Click Check Box to proceed for payment.)". A "Proceed" button is located below the checkbox. At the bottom of the page, there are links for "Privacy Statement", "Disclosure", and "Terms of Use".

Please click on "proceed" after Clicking "Check Box" to proceed for payment

**Step-3 :**

The screenshot shows a search interface for corporate/institution details. The top navigation bar includes "State Bank Collect" and "State Bank Mops". The main search area has fields for "State of Corporate / Institution \*" (set to "Karnataka") and "Type of Corporate / Institution \*" (set to "PSU - PUBLIC SECTOR UNDERTAKING"). A "Go" button is located below these fields. A red callout box contains instructions: "Mandatory fields are marked with an asterisk (\*)" and "State Bank Collect is a unique service for paying online to educational institutions, temples, charities and/or any other corporates/institutions who maintain their accounts with the Bank." At the bottom, there are links for "Privacy Statement", "Disclosure", and "Terms of Use".

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)



STEP-4



State Bank Collect - State Bank Mops

State Bank Collect / State Bank Collect

State Bank Collect

Exit

State Bank Collect

11-Feb-2020 [09:56 AM IST]

Select from PSU - PUBLIC SECTOR UNDERTAKING

PSU - PUBLIC SECTOR UNDERTAKING Name

BHARAT HEAVY ELECTRICALS LTD

Submit Back

- Mandatory fields are marked with an asterisk (\*)

© State Bank of India

Privacy Statement | Disclosure | Terms of Use

## Step-5

Select " OTHERS "



State Bank Collect

State Bank Collect - State Bank Mops

State Bank Collect / State Bank Collect

Exit

11-Feb-2020 [10:00 AM IST]



BHARAT HEAVY ELECTRICALS LTD  
BHEL HOUSE, SIRI FORT, NEW DELHI-110003

Provide details of payment

Select Payment Category \*

-- Select Category --

- Mandatory fields are marked with an asterisk (\*)
- The payment structure document if available will be uploaded
- Date specified(if any) should be in the format of DD/MM/YY

-- Select Category --

EMPLOYEES/ RETD EMPLOYEES/EX EMPLOYEES/TRAINEES  
OTHERS

© State Bank of India

Privacy Statement | Disclosure | Terms of Use

## Step-6



State Bank Collect

State Bank Collect - State Bank Mops

State Bank Collect / State Bank Collect

Exit

11-Feb-2020 [10:04 AM IST]



BHARAT HEAVY ELECTRICALS LTD  
BHEL HOUSE, SIRI FORT, NEW DELHI-110003

Provide details of payment

Select Payment Category \*

OTHERS

SUB CATEGORY \*

EMD

NAME \*

VENDOR CODE

AMOUNT \*

\* Contractors company Name\*

\* Not compulsory\*

\* EMD Amount\*

\* RFQ No. and work description\*

Remarks

Please enter your Name, Date of Birth (For Personal Banking) / Incorporation (For Corporate Banking) & Mobile Number.  
This is required to reprint your e-receipt / remittance(PAF) form, if the need arises.

Name \*

Date Of Birth / Incorporation \*

Mobile Number \*

Email Id

Enter the text as shown in the image \*

Submit Reset Back

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)

21. For reimbursement 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.
22. 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.
23. 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.  
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.
24. 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.
25. 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.
26. The tenderers should enclose relevant documents regarding constitution of firm i.e. Individual / Sole Proprietorship Concern / Partnership Firm / Public Limited Company / Private Limited.
27. The tenders should be enclosed with a list of contracts already held by the tenderer at the time of submitting the tender and giving the following particulars:
  - a) Name of the work, value and address.
  - b) The balance work remaining to be done on the same.
28. a) The filled in tender sealed cover shall be handed over/couriered/speed post to at office of **Shri Sreenath M, AGM (SC&PV- PCG,M), NEB 5<sup>th</sup> Floor, Electronics Division, Bharat Heavy Electricals Limited, Mysore road, Bangalore – 560 026** before the time fixed for submission of tender.  
b) Tenders received after the due date & time of opening of tenders will be rejected.
29. The Contractors responsibility under this contract shall commence from date of receipt of the order or acceptance of tender.

30. 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 of opening tenders are liable to be rejected.
31. 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.
32. 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.
33. 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.
34. Words imparting the singular number shall also be deemed to include the plural number and vice-versa where the context so require.
35. The General and Special Conditions are complementary to each other and where they are in conflict, the special condition shall prevail.
36. The expenses for completing the stamping agreement shall be paid by the contractor.
37. Unless or otherwise stated above tendered work includes men, material, machine and commissioning of equipment as agreed to in the contract.
38. After completing of the job, the contractor has to furnish actual drawings of work done in consultation with Engineer-in-charge.
39. Any covering letter and comments of the tenderer should be submitted along with the offer.
40. 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).



41. Contractor are required to follow Floater manual for module assembly and PV array layout for positioning as approved by BHEL/customer in respect of Tests to be carried out and reports and documents to be furnished.

42. 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.
43. 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. (Extracts of important clauses of BHEL GCC are enclosed).
44. 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.
45. 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".
46. 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.



45. 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.
46. 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.
47. 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.
48. 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.
49. Contractor shall produce necessary records, documents; explanation whenever he is called upon to do by any Government Agencies.
50. Contractor should obtain "Workmen Compensation Policy" for their Employees.
51. BOAT, SAFETY JACKET,TOOLS ETC.,
  - a) 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.
  - b) 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.
  - c) No separate payment will be made for curing including pumping of curing water where ever necessary.
52. 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 under clause 50 as per terms and conditions of BHEL.



**BHARAT HEAVY ELECTRICALS LIMITED**

(ELECTRONICS DIVISION)

MYSORE ROAD- BANGALORE-26

**GENERAL CONDITIONS OF CONTRACT/TECHNICAL SPECIFICATION**

It is hereby agreed by me/us that the BHEL General Conditions of Contract including 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 General Conditions of Contract/ Technical Specification for BOS works which has been read and accepted by me/us.



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 or 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 by 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



## SPECIAL CONDITIONS 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. SCOPE OF WORK**

Details Scope of work is attached along with following other relevant Annexures-

Please note that these Annexures are indicative only , the final Annexures shall be provided with the Work Order Only.

1. SLD\_NTPC\_Simhadri\_25MW(AC) :.....Annexure-1 {1Page }
2. Tentative\_array\_layout\_with\_Inverter\_Room :.....Annexure-2 { 1Page }
3. 3.1. Module Data Shheet\_Econess :.....Annexure-3.1 { 2Pages }
- 3.2. Module Data Sheet \_ Risun :..... Annexure-3.2 { 2Pages }
4. Main control room (MCR) layout:.....Annexure-4 { 1 Page }
5. Technical Spec CABLE INSTALLATION METHODOLOGY:..... Annexure-5 { 15 Pages, 92-106 }
6. Technical Spec. WEATHER MONITORING STATION :.....Annexure-6 {6 Pages,2-7 }
7. Purchase Spec UPS WITH Ni-Cd BATTERY BANK:.....Annexure-7 { 7 pages, 1-7 }
8. Technical Spec. FIRE FIGHTING AND ALARM SYSTEM : .....Annexure-8 {3 Pages,8-10 }
9. Technical Spec. 33 kV OUTDOOR METERING YARD EQUIPMENT:...Annexure-9 {41 Pages,1-41 }
10. TECHNICAL SPECIFICATIONS EARTHING SYSTEM :..... Annexure-10 {11 Pages,140-150}
11. PURCHASE SPECIFICATION ESE LIGHTNING ARRESTOR SYSTEM:..... Annexure-11 {4 Pages,1-4 }
12. TECHNICAL SPECIFICATIONS PLANT ILLUMINATION SYSTEM:.....Annexure-12 {8 Pages,151-158 }
13. a.) INDICATIVE VENDOR LIST Subsystem- Electrical & Mechanical: Annexure-13 {27 Pages,1-27 }  
b.) LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER  
APPROVAL SUB SYSTEM: C & I :.....Annexure-13 {3 Pages,1-3 }  
c.) INDICATIVE FIELD QUALITY PLAN :.....Annexure-13 {6 Pages,1-13 }  
d.) LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL:...{4 Pages,1-4 }
14. PURCHASE SPECIFICATION: AUXILIARY TRANSFORMER :.....Annexure-14 {7 Pages,1-7 }



15. PURCHASE SPECIFICATION LT SWITCHGEAR :..... Annexure-15 {16 Pages,1-16 }

16. Installation Manual(i) & (ii) :..... Annexure-16 {17 Pages,1-17 }
17. Inverter platform and Transformer yard :..... Annexure-17 {1 Page,}
18. TECHNICAL SPECIFICATIONS: GENERAL CIVIL WORK :..... Annexure-18 {16 Pages, 4-19 }
19. NTPC\_Simhadri\_HT\_cable\_route\_07 :..... Annexure-19 {1 Page }
20. BG Format\_EMD :..... Annexure-20 {2 Pages, 9-10 }
21. Guidelines for Reverse Auction-2016 :..... Annexure-21 {10 Pages,1-10 }
22. HAZARD IDENTIFICATION AND RISK ASSESMENT (HIRA) DOC.1 :... Annexure-22 {6 Pages,1-6 }
23. HAZARD IDENTIFICATION AND RISK ASSESMENT (HIRA) Doc 2 :....Annexure-23 {3 Pages,1-3 }
24. UNPRICED PRICE-BID (25 MW NTPC SIMHADRI) :..... Annexure-24 {6 Pages,1-6 }
25. PRICE-BID (25 MW NTPC SIMHADRI ) :..... Annexure-25 {6 Pages,1-6 }

### **3. SITE CONDITIONS**

- a) Before tendering the Contractor shall get themselves acquainted with site conditions such as quality of reservoir 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) The site of work is as mentioned in the Tender document.

### **4. SITE FACILITES**

#### **A. Reservoir and Floating Details**

Reservoir details:

Full reservoir depth : 3.35 M  
Minimum water level :0.5 M

The Employer will allot land near reservoir as available free of cost to the contractor for his office stores. 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 vendor. 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.

#### **5. 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.

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.

#### **6. BENCH MARKS AND REFERENCE POINTS**

The contractor shall construct and maintain proper benchmarks and reference points at the allotted area near bank of reservoir 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.

#### **7. 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.

#### **8. 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 reservoir 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.

## **9. LABOUR COLONIES**

Labour camp will not be permitted within the project premises.

## **10. 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.

## **11. 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 entertained on this account.

## **12. 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.

### **13. MATERIALS**

BHEL will not supply any materials unless otherwise specified.

### **14. 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 or 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).

## **15. 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.

## **16. 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.

## **17. 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 be 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.

## **18. 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.

## **19. SECURITY DEPOSIT**

Upon acceptance of the tender, the successful tenderer shall remit the security deposit with Bharat Heavy Electricals Ltd within the time as specified in the Letter of Intent.

The rate of Security Deposit will be 5% of work order value.

The contractor should submit the Security Deposit before the start of the work by

- i) Cash (as permissible under the Income Tax Act).
- ii) Pay order, demand draft in favour of BHEL.
- iii) Local cheques of scheduled banks, subject to realization.
- iv) Securities available from Post Offices such as National Saving Certificates, Kisan Vikas Patras etc., (Certificate should be held in the name of contractor furnishing the security and duly pledged in favour of BHEL and discharged on the back).
- v) Bank Guarantee from scheduled Banks/Public financial Institutions as defined in the Companies Act subject to a maximum of 50% of the total security deposit value. The balance 50% has to be remitted either by cash or in the other form of security. The Bank Guarantee format should have the approval of BHEL.
- vi) Fixed Deposit Receipt issued by scheduled Banks/Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL, duly discharged on the back.
- vii) Security Deposit can also be recovered at the rate of 10% from the running bills. However in such cases at least 50% of the Security Deposit should be collected before start of the work and balance 50% may be recovered from the running bills.
- viii) EMD of the successful tenderer shall be converted and adjusted against the Security Deposit. The Security Deposit shall not carry any interest.

**NOTE:** Accepting of Security Deposit against Sl. No. (iv) and (vi) above will be subject to hypothecation or endorsement on the documents in favour of BHEL. However, 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.



For extra items of work and deviated quantities, security deposit will be recovered at 10% of the value of deviated amount. The security deposit will be released as stipulated under relevant clause of GCC 2019.

## **20. 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.

### **22.1 MOBILIZATION ADVANCE/ADVANCE PAYMENT - NOT APPLICABLE**

### **22.2 INTEREST & RECOVERY - NOT APPLICABLE**

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

**24.** 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.

**25.** 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.

## **25. 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.

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

**27.** 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.

## **28. SPECIAL 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.

## **29. 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.

## **30. 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.



## **LIST OF INDIAN STANDARD**

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

---

### **1. ELECTRICAL WORK**

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

### **2. SAFETY CODE**

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

### **3. FIRE FIGHTING CODES**

- 1) IS 4736-1986 Galvanizing G.I. Pipes
- 2) IS 2189-1962 Code of practice for Automatic Fire alarm system
- 3) 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.



### FORM OF TENDER

Having examined the invitation to bid, Instructions to Bidder, General conditions of contract, Special conditions, Specifications tender schedule, Contract drawings and other 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 elsewhere in the contract documents.

We undertake if our bid is accepted, to commence the works within 7 days from the date of issue of award 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 agreement is prepared and executed this bid, together with your award thereof shall constitute a binding contract between us.

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

ENCLOSURE: C  
CONTRACTOR (SIGN & SEAL)



## **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.



Annexure - I

**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-II) ..... dtd: .....  
Category: ..... (Micro/Small)). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the latest audited financial year ..... as per MSMED Act 2006 is as follows:

1. **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.1722(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 S.O. 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 II

### 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 authorise 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:

Authorised 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:

(.....)

Signature

Please return completed form along with a blank cancelled cheque or photocopy thereof to:

Bharath 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

NIT Issued By  
PUNAM MISHRA,  
Sr. Manager- SC & PV - ENGG.

CONTRACTOR (SIGN & SEAL)



### ANNEXURE-III

Ref.

Date:

#### **SITE INSPECTION CERTIFICATE**

This is to Certify that, I / We.....

..... had inspected the proposed  
Construction site thoroughly and understood the scope of works to be carried out in  
line with construction drawings/designs/data/Bill of quantities/schedule of items /  
Specifications as brought out in the Tender as desired by BHEL.

Agreeable to all Terms & Conditions of Contract and assure to complete the work  
Within the stipulation time frame.

Signature of the contractor

Name:  
Seal

## **Additional Clauses for GST:**

### **1. BHEL GST Number of Nodal Agency:**

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

2. HSN (Harmonized System of Nomenclature) / SAC (Services Accounting Code) to be mandatorily mentioned in all quotations & invoices submitted.
3. 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.
4. Payment of GST to vendors as applicable will be made only if it is matching with data uploaded by Vendors
5. Vendors 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
6. For invoices paid on Reverse charge basis – that it is “payable on reverse charge basis” to be mentioned on the invoice.
7. With respect to supplies, vendor should intimate BHEL immediately on dispatch for parallel billing on customer
8. Vendor should get GST registration, if not available, in the state of Andhra Pradesh immediately after placement of order.

# SAFETY PLAN

PROJECT- 25 MW Floating Solar Project ,NTPC, Simhadri

Prepared by

PV Sys Engg and HSE Dept, BHEL EDN Bangalore

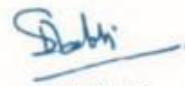


# HEALTH SAFETY ENVIRONMENT POLICY



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 Sobe  
Chairman & Managing Director

June 5, 2018

Creating  of tomorrow  
**BHARAT HEAVY ELECTRICALS LIMITED**



## CONTENTS

Sr. No.	Description
1.0	INTRODUCTION
2.0	APPLICATION
3.0	TERMINOLOGIES
4.1	ROLES AND RESPONSIBILITIES.
4.2	SAFETY OFFICER (SAFETY COORDINATOR)
4.3	ALL EMPLOYEES
5.0	SITE INCHARGE OF SUBCONTRACTOR
5.1	DEPLOYMENT OF TOOLS & PLANTS
5.2	DEPLOYMENT OF MANPOWER
5.3	PROVISION OF PPEs
5.4	PROVISION OF INFRASTRUCTURE
6.0	SAFETY TRAINING & AWARENESS
7.0	SAFETY COMMUNICATION
8.0	OPERATIONAL CONTROL
8.1	EXCAVATION SAFETY
9	WORK PERMIT
10	HOUSE KEEPING
11	WASTE MANAGEMENT
12	WARNINGS & SIGNS



13	EMERGENCY PREPAREDNESS
14	FIRE SAFETY PROCEDURE
15	CONTROL OF DOCUMENTS
16	SAFETY INSPECTION
17	MONTHLY SAFETY REVIEW MEETING
18	TYPICAL DETAILS OF FLOATING SOLAR POWER PLANT
19	ANNEXURES 1. Formats to be used at site 2. JSA (HIRAs) for PV floating system work, Tree felling and clearance work



## 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 25 MW Floating Solar Project.

This document shall be followed by Client's Sub-Contractors 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 25 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-HOUR WORKED**

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 OFFICER/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 officer or



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 officer/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 programmes'.
- 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 25 MW floating solar Project and practice very strictly in his area of work in consultation with his concerned engineer and the safety officer.
- 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 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 officer of the 25 MW floating solar Project.
- Shall ensure that adequate illumination is arranged during night work.
- 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:
  - Mobile cranes.
  - Side Booms.
  - Forklifts.
  - Grinding machine.
  - Drilling machine.
  - Air compressors.
  - Welding machine.
  - Generator sets.
  - Dump Trucks, tractors.
  - JCBs, Excavators.



- Hand tools.
- Road Rollers
- Vibration Compactors
- Boring Machine
- Chipping Machines
- Hammer Machines
- Breakers

## 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.

## 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. 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 only)
1	Concrete and 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)



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.

## **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.

### **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.

### **PROVISION OF EMERGENCY VEHICLE**

- In case of any emergency a vehicle shall be made available at



workplace on short notice to handle any emergency. 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 officer of 25 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.
- Each employee shall undergo safety induction training

### TOOL BOX TALK

- Tool Box talk shall be conducted by safety officer/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.
  - 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.
- Dos & Don'ts during height work.

### **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 officer 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

### 8.1 EXCAVATION WORK SAFETY:

- 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.

## 9..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 4 meter depth
  - c. Heavy lifting by machinery
- "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 with Job Hazard Analysis.
- 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.

## 10. 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. 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.

### SEGREGATION

- 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. WARNING AND SIGNS**

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.

## **13.0 :EMERGENCY PREPAREDNESS AND RESPONSE**

- Emergency preparedness and response capability of site shall be developed as per project requirement.
- Availability of adequate number of first aid providers and fire fighters shall be ensured by sub-contractors
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape in Stores area and office area.
- Appropriate type and number of fire extinguishers shall be deployed as per fire extinguisher deployment plan of BHEL and validity shall be ensured periodically through inspection
- First aid boxes shall be strategically placed at work places to cater to emergency needs.

## **14.0 : FIRE SAFETY PROCEDURE**

1. Site-in-charge / Safety Officer 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 addition 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.

## **16.0 SAFETY INSPECTION**

Inspection on SAFETY for different activities being carried out at site shall be done to ensure compliance to safety requirements.

### **DAILY SAFETY CHECKS**

Both the Site Supervisors and SAFETY Supervisors 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 officer/Supervisor 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



## 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 officer 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 officer 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 Coordinator of Construction agency before start of work to ensure safe working condition including provision of
  - Safety Harness
  - Fencing and barricading
  - Warning signage
  - Covering of opening
  - Proper scaffolding with access and egress.
  - Illumination
- Inspection on height working shall be conducted once in a week by SAFETY officer 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
- Use ELCB 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 as per format no 12

## 17. 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 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)





(Typical View of completed Solar PV Floating platform)

### **SYSTEM COMPONENTS:**

1. Solar PV modules for conversion of solar radiation to electrical energy/
2. Anchoring systems: Anchoring system refers to permanent on shore 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.

### **RISKS AND HAZARDS:**

1. Identified as per Job Risk Assessment exercise and HIRA Doc 1 and 2 attached.

### **PRECAUTIONS:**

1. As mentioned in HIRA Doc 1 and 2.

## **19.0 SITE RECORDING FORMATS**

\*\*\*\*\*



# **GENERAL CONDITIONS OF CONTRACT**

**2019**

ಭಾರತ ಸರ್ಕಾರಿ ವ್ಯಾಪಾರಿಕ್ ಸರ್ಕಾರ ಲಿಮಿಟೆಡ್, ಎಂಎಎಂಎಂಎಂ ವೆಂಫಾಗ್,  
ಒರ್ನೆಂಟೆಂಟ್ ಬೆಂಗಳೂರು

ಭಾರತ ಹಿನ್ದಿ ಇಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಲಿಟ್ಟೆಡ್, ಇಲೆಕ್ಟ್ರಾನಿಕ್ಸ್ ಇಂಡಿಸ್ಟ್ರಿಸ್,  
ಬೆಂಗಳೂರು

*Bharat Heavy Electricals Limited, Electronics Division, Bengaluru*



## **CONTENTS**

### ***Chapter-1***

- 1. General Instructions to Tenderers*
  - 1.1. Dispatch Instructions*
  - 1.2. Submission of Tenders*
  - 1.3. Language*
  - 1.4. Price Discrepancy*
  - 1.5. Evaluation of Bids*
  - 1.6. Data to be enclosed*
  - 1.7. Authorisation and Attestation*
  - 1.8. Earnest Money Deposit*
  - 1.9. Security Deposit*
  - 1.10. Return of Security Deposit*
  - 1.11. Bank Guarantee*
  - 1.12. Validity of offer*
  - 1.13. Execution of Contract Agreement*
  - 1.14. Rejection of Tender and other Conditions*
  - 1.15 BHEL Fraud Prevention Policy*



## **2. Chapter-2**

*2.1. Definitions*

*2.2. Law Governing Contract and Court Jurisdiction*

*2.3. Issue of Notice*

*2.4. Use of land*

*2.5. Commencement of Work*

*2.6. Measurement of Work and Mode of Payment*

*2.7. Rights of BHEL*

*2.8. Responsibilities of Contractor in respect of Local Laws, Employment of Workers etc*

*2.9. Progress Monitoring, Monthly Review and Performance Evaluation*

*2.10. Time of Completion*

*2.11. Extension of Time for Completion*

*2.12. Over Run Compensation*

*2.13. Quantity Variation*

*2.14. Extra Works*

*2.15. Supplementary Items*

*2.16. Strikes & Lockout*

*2.17. Force Majeure*

*2.18. Arbitration and Reconciliation*

*2.19. Payments*

*2.20. Performance Guarantee for Workmanship*

*2.21. Closing of Contracts*

*2.22. Reverse Auction*

*2.23. Suspension of Business Dealings*

*2.24. Other Issues*



## **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 deducting 10% 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, NEWDELHI – 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 work 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*

## **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 principles mentioned above.

## **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 for Suspension 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 demand from his sub-contractors a commitment consistent with this Integrity Pact. 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.
- 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 when both parties have legally signed it. 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  
(Office Seal)

---

For & On behalf of the Bidder/Contractor  
(Office Seal)

Place-----

Date-----

Witness: \_\_\_\_\_  
(Name & Address) \_\_\_\_\_

---

Witness: \_\_\_\_\_  
(Name & Address) \_\_\_\_\_

---



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 1 OF 30

**COPYRIGHT AND CONFIDENTIAL**

**The information on this document is the property of Bharat Heavy Electricals Limited.**

**It must not be used directly or indirectly in anyway detrimental to the interest to the company.**

**Technical specification  
for  
Supply of Balance of System items, Installation & Commissioning  
of  
25MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for  
NTPC at Simhadri Thermal Power Plant, Andhra Pradesh**

Revision details: Rev:00	Prepared  Krishna J	Checked  Vipindas CP	Approved:  M SREENATH	Date:  11.03.2020
-----------------------------	---------------------------	----------------------------	-----------------------------	-------------------------



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 2 OF 30

## INDEX

1.0	Introduction
	1.1 Overall project outline of 25MW (AC) Floating solar photovoltaic power plant
	1.2 Scope of this tender specification
	1.3 Enclosures to this tender specification (Tender purpose only)
	1.4 Location / address of power plant
2.0	Scope of work
	2.1 Bidder scope –Supply and I&C
3.0	3.0 BHEL scope of Supplies (I&C in bidder scope)
4.0	List of documents to be submitted along with the technical bid
5.0	Technical specification for supply , installation and commissioning
	5.1 Electrical power / water for construction
	5.2 Construction of temporary yards for safe storage of bidder supplied items
	5.3 Movement of items received at BHEL stores to site location
	5.4 Installation of floating pontoons with module mounting mechanism
	5.5 Launching platform base Details (sequence work details for floaters assembly)
	5.6 Series interconnection of SPV modules to form strings
	5.7 Interconnection of SPV module strings to 1Cx6sq.mm. cable
	5.8 Ferruling for 1Cx6sq.mm cable
	5.9 Installation of SCBs on floating pontoons
	5.10 Routing of 1Cx 6sq.mm cable up to SCB
	5.11 Termination of 1Cx6sq.mm. Copper cables on input side of SCBs
	5.12 Termination of 2 run 1Cx400 DC power cables at SCBs
	5.13 Walkways to embankment
	5.14 Laying of 2 runs of 1Cx400sq.mm Al cable through cable trays upto inverter platform and terminations at PCU
	5.15 Laying of DC and Earthing Cables over the bund
	5.16 Laying and Termination of 1Cx400sq.mm LT AC power cables at PCU and Inverter Transformer
	5.17 Laying and termination of 33KV(E), 1CX240 sq.mm XLPE Al cable from Inverter transformer to HT panel and to local pooling stations
	5.18 Laying and termination of 33KV(E), 9 (3 no.s of 3 phase lines) runs of 1CX240 sq.mm XLPE Al cable from HT panels near reservoir to outdoor switchyard approx. 4.2 km away
	5.19 Termination of 9 runs of HT cables at outdoor switchyard and to existing panels at NTPC Switchgear room
	5.20 Identification marking of cables using cable tags
	5.21 Installation of electrical panels at platforms constructed for PCUs, Inverter transformers and HT Panels, and SCADA and other indoor panels in EER-Electrical Equipment Room at each PCU location and at CMCS building
	5.22 Design, Supply, Laying and installation of Control / data / instrumentation cables
	5.23 Erection of 33kV transformer yards
	5.24 Specification of Earthing system



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 3 OF 30

	5.25	Specification of Firefighting and alarm system
	5.26	Specification of cable installation methodology for Bund area, crossing Canal etc.
	5.27	Specification of UPS with battery bank
	5.28	Specification of Auxiliary Transformers
	5.29	Specification of ESE type LAs
	5.30	Specification of 33KV outdoor switchyard with metering
	5.31	Specification of illumination system
	5.32	Auxiliary AC/DC power supply system
	5.33	I&C of electrical connections to CMCS and EERs
	5.34	Supply and installation of Weather monitoring system
	5.35	Installation and commissioning of SCADA and Telemetry systems
	5.36	Earthing of solar PV modules and SCBs
	5.37	Earthing system for main control room and 33kV transformer yard
	5.38	Water washing system for SPV modules (Module cleaning system)
	5.39	Identification marking of electrical items using painting
	5.40	Cable markers and cables tags
	5.41	Display boards and sign boards
	5.42	Electrical insulation mat
	5.43	Supply and Installation Miscellaneous Items for Control Room
	5.44	Tool kits and instruments
	5.45	Pre-commissioning and commissioning facilities
	5.46	Spares required to be supplied along with main consignment
	5.47	Spares required to be supplied along with main consignment
6.0		General conditions applicable during supply, installation and commissioning phase
7.0		Documents to be submitted for BHEL/NTPC approval during detailed engineering



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 4 OF 30

## 1.0 Introduction

### 1.1 Overall project outline of 25MW (AC) Floating solar photovoltaic power plant

Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 25MW (AC) Floating solar photovoltaic (SPV) power plant for NTPC at Simhadri Thermal Power Plant at Andhra Pradesh.

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 upto 33KV level. The combined output at 33KV level shall be terminated in the Simhadri TPP switchyard which is approximately 4200 meters away. Laying of 3 runs of 33KV(E), 1CX240 sq.mm/Phase cables between inverter transformer yards, and from local pooling stations upto termination points shall be in the scope of bidder. Also SCADA communication (OFC) cable laying from plant CMCS to switch yard panel room is also in bidder scope. From the outdoor switchyard, the cables shall be taken to final termination at Panel Room close to the yard and terminated in available panels.

### 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 CMCS
5	Cable installation methodology
6	Weather monitoring system
7	UPS-Battery specification
8	Fire Fighting & Alarm System
9	33KV outdoor metering yard equipment specification
10	Earthing system specification



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 5 OF 30

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	Tentative cable arrangement on bund

#### **1.4 Location/ address of power plant:**

25MW (AC) Floating Solar Photovoltaic Power Plant,  
NTPC - Simhadri Thermal Power plant,  
Andhra Pradesh

#### **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.

#	<b>Bidder scope of work (as briefly outlined)</b>	<b>Qty</b>
<b><i>List of Supply items</i></b>		
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	2000 pairs
3	Supply of M/s. Multi contact make Y Connectors	1900 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.	218220 sets
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	10 Kms
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	5 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 mounting SCBs on HDPE floating pontoons	90 Nos
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter connecting 30 modules in a row	60 Kms
11	Supply of Hume pipes(NP2 or better) for 36 no.s of DC cables and earthing cables for crossing over the bund at 5 locations near inverter platforms	5 sets
12	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



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 6 OF 30

13	Supply of double compression weatherproof metallic cable gland, bi-metallic strip or washer, SS304 hardware for 400 sq.mm cable- PCU DC side	200 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	180 set
15	Supply of UPS systems (5 KVA), with 1 hour backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	1 set
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)	4 sets
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformer for CMCS	1 set
18	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 20 KVA Dry Type Auxiliary Transformers for EERs	4 sets
19	Supply of LT switchgear /ACDB inside EER (RCC building) for electrical equipment	5 Sets
20	Supply of 33KV outdoor switchyard equipment as per specification and SLD- 1. Metering CTs. 2. Metering PTs 3. LAs 4. three no.s of ABT meter with outdoor cubicle ( locable type) 5. ACSR conductor 6. Isolator with earth switch 7. Earthing systems 8. Necessary support structures with foundations. (All Structure surface protection suitable for surviving harsh environmental conditions- C5 corrosive category).	3 sets
21	Supply of Structural steel support columns (HDG) with column foundations along Canal bed and under road bridge for crossover of HT cables from pooling stations to termination yard. Distance of canal to be covered is about 400 meters upto opposite side. Aluminium /FRP Cable trays, trapezoidal clamps, steel anchor bolts for securing by grouting to bridge RCC columns are covered in scope of supply.	400 M
22	Supply of Structural steel support columns (HDG)/ Cable Trestle with Aluminium /FRP Cable Tray and foundation along cable laying route adjacent to RCC Cable trench of NTPC for IDCT Cables. (Refer Google Map with proposed HT Cable route from PCUs upto Outdoor yard approx. 4.2 km away). For 3 Runs of trefoils with center to center spacing of 200MM. Vendor can consider 1 tier/2 tier tray arrangement.	300M
23	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70 Nos
24	Supply of indoor cable termination kit for 33KV(E), 1CX240 sq.mm	70 Nos
25	Supply of outdoor cable termination kit for 33KV(E), 1CX240 sq.mm	24 Nos
26	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	42 Nos
27	Supply of straight through joint kits for 3.3KV(E), 1CX400 sq.mm cable	6 Nos
28	Supply of earthing electrodes with chemical compound for all electrical equipment i.e. termination hardware, cover with inspection lids for solar array, inverter platforms, EERs, CMCS and outdoor switchyard	150 sets



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 7 OF 30

29	Supply of module washing system- Battery/diesel/petrol operated hand held/portable pump motor set system with pressure nozzle for cleaning SPV modules	5 sets
30	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS etc. to SCADA panel (all OFC cable supplies shall be in BHEL scope)	5 sets
31	Supply of items for LED based outdoor lighting system covering Inverter platforms.	20 no.s
32	Supply of weather monitoring system (WMS)	1 set
33	Supply of safety related items including fire alarm systems for building, fire extinguishers, sand buckets, safety gadgets etc	1 set
34	Supply of ESE type lightning arrester including 5 meter pole, counter, base plate and hardware etc. (20 sets on water and 1 set on main control room)	21 sets
35	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	7 Km
36	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1 Km
37	Supply of air conditioners for CMCS room- Capacity 1.5 Ton/5 star	2 Nos
38	Supply of life jackets as per IS 6685.(IROS/ SOLAS approved makes)	40 Nos
39	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. Bidder shall provide for a boat driver till completion of contract period.	1 No
40	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)
41	Supply of spare items	1 set
42	Supply of Water supply system with bore-well having submersible pump set, starter with protections (both of reputed make). Bore-well shall be with casing and filters for bore piping with valves etc. upto water storage tank located on top of CMCS building. Bore well shall be located adjacent to CMCS. Depth shall be such as to ensure permanent supply of clean water and may be decided as per Hydrological investigation	1 set
43	Supply of Emergency lamps and associated cabling with conduits for CMCS (to be connected with UPS)	4 no.s
<b><i>List of Works (I&amp;C activities)</i></b>		
1	<b>I&amp;C:</b> 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 109110 Nos.  All tools, tackles and Infrastructure like boats required for Installation of Floater 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	10 AU



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 8 OF 30

	the required time duration. (1 AU= 2.5MWAC Block consisting of approx. 10920SPV modules)	
2	<b>I&amp;C:</b> Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10 AU
3	<b>I&amp;C:</b> Interconnection of SPV modules, installation of 90 Nos of SCBs, laying/termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works. (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10 AU
4	<b>I&amp;C:</b> Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays (For SCB to PCU cabling). Also laying of Hume pipes with road concreting and preparation of bund after laying.  (On the pathway array, at the entrance of embankment to Hume pipes, at the exit of Hume pipes and at the input side of PCU at inverter platform.)  (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10 AU
5	<b>I&amp;C:</b> Earthing of 3030 nos of modules and 2.5 nos of SCBs using combination of earthing cables of adequate size and earthing strips. SCB-SPD earthing cables shall be connected to array earthing grid.  (1 AU= 1 earth pit)	36 AU
6	<b>I&amp;C:</b> Installation of 20 Nos of ESE type LA on separate floating platform and 1 No on CMCS. LAs on pond shall be placed as per tentative layout. The earth pits for LA shall be suitably placed on the ground near embankment. 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 21 LAs)	1 AU
7	<b>I&amp;C:</b> 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= 2.5MWAC Block)	10 AU
8	<b>I&amp;C:</b> Erection of 33kV transformer yard - Erection of 5.3MVA inverter transformers, cable trays, drain pipes and stone jelly spreading.  (1 AU= 5MWAC Block)	5 AU
9	<b>I&amp;C:</b> Erection of 33kV HT power cables from transformer to HT panels and to Local pooling stations (1 AU= 25MWAC Block)	1 AU
10	<b>I&amp;C:</b> Laying of 33kV HT power cables from Local pooling stations to 33kV evacuation point. Also laying of SCADA communication (OFC) cable from plant CMCS to switch yard panel room. Conducting of detailed route survey is in Vendor scope. Based on the route study, Cables shall be laid suitably (underground in trenches and over cable trays with required steel structural supports (Corrosion resistance treated) and Civil foundations and Steel reinforcements while crossing the Canal and bridge section of the route.). Some of the reference photos are attached for vendor reference.  3 trefoils of HT cables laid from the PV plant shall be terminated on the 2 or 4 pole structures and further laid through available trenches and terminated at Panels in nearby panel room of customer.  (1AU = laying of 1 KM)	4.2 AU
11	<b>I&amp;C:</b> Erection of Auxiliary transformers, ACDB, UPS/ battery bank, SCADA panels etc. in EER (Electrical Equipment Room) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables.	5 AU



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 9 OF 30

	(1 AU= 5MWAC Block)	
12	<b>I&amp;C:</b> Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment (WMS) of the power plant at the data logger/ PLC panel / HMI computer control desk at CMCS, Metering end at termination point etc (1 AU= for 25MWAC Block).	1 AU
13	<b>I&amp;C:</b> Earthing system for Inverter platforms (including CMCS and EERs) 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 5MWAC Block)	5 AU
14	<b>I&amp;C:</b> Preparation of foundation and installation of 33KV switchyard CT, PT, isolator with earth switch, LA, ABT meter etc. (1 AU= for 1 feeder)	3 AU
15	<b>I&amp;C:</b> 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)	20 AU
16	<b>I&amp;C:</b> Emergency lighting system including cable laying, cable terminations at CMCS. (1 AU= for 1 LED fixture)	4 AU
17	<b>I&amp;C:</b> 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 25MWAC Block)	1 AU
18	<b>I&amp;C:</b> 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 25MWAC Block)	1 AU
19	<b>I&amp;C:</b> Installation of Water supply system for CMCS. (1 AU= for 25MWAC Block)	1 AU
20	Three-month I&C for SPV module washing (1AU=25 MW Block module wash per month)	3 AU
21	Deputation of Safety supervisor for duration of I&C ( 1 AU = 1 Month )	6 AU
22	Provision of emergency vehicle/Ambulance on standby for duration of I&C ( 1 AU = 1 Month )	6 AU



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 10 OF 30

**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	109110 Nos
3	Supply of floating pontoons for modules, SCBs and LAs	As per requirement
4	Supply of 1C x 6 sqmm Solar Cable	~150 Kms
5	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
7	Supply of 33kV(E) HT cable, 1C x 240 sq.mm, Al, XLPE, armoured as per IS: 7098	~40 Kms
8	Supply of power conditioning units (PCUs) of 2500 kW	10 Sets
9	Supply of String Combining Box (SCB)	90 Nos
10	Supply of inverter transformer 5.3 MVA, 33kV/***-*** V, ONAN	5 Nos
11	Supply of 33kV HT panels	9 panels
12	Supply of SCADA system including PLC panels, computers, software systems and related peripherals & accessories.	As per requirement
13	Construction of RCC CMCS and 5 nos. Electrical Equipment rooms (EER)	1 Set

**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

#	<b>BHEL purchase specification</b>
5.1	<b>Electrical power / water for construction</b> 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 and cleaning of module the pond water can be used.
5.2	<b>Construction of temporary yards for safe storage of bidder supplied items</b> 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	<b>Movement of items received at site:</b> 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 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.
5.4	<b>Installation of floating pontoons with module mounting mechanism:</b> <b>HDPE floaters and HDPE hardware, Total quantity = 109110 No.s (BHEL scope of supply)</b> 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.



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 12 OF 30

	<p>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.</p> <p><b>For more details, please refer attached installation manual of floater manufacturers (OEM).</b></p>
<b>5.5</b>	<p><b>Launching platform base Details (sequence work details for floaters assembly)</b></p> <p>a) For Assembly of floaters along with PV modules and formation of strings prior to launching in water, sloping platforms with ramp gradient of 5/10° shall be constructed at one or more locations over the bund slope as per location indicated.</p> <p>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.</p> <p>c) Care shall be taken not to damage the reservoir's bund or its surface, while constructing and securing the platform/s.</p> <p>d) Location for the platform shall be informed to the bidder by BHEL in consultation with customer as regards approach and movement</p>
<b>5.6</b>	<p><b>Series interconnection of SPV modules to form strings</b></p> <p>Type of module and rating: (Min 330 Wp). Total quantity = 109110 Nos. (BHEL scope of supply)</p> <p>Bidder shall interconnect the SPV modules as follows:</p> <p>a) Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm).</p> <p>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.</p> <p>c) In this manner 30 modules shall be connected in series. Each set of connections is called as a series string.</p>
<b>5.7</b>	<p><b>Interconnection of SPV module strings to 1Cx6sq.mm. cable:</b></p> <p>a) Vendor shall connect two series strings of 60(30+30) SPV modules to 1Cx6sqmm cable using <b>Y-connector</b>.</p> <p>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).</p> <p>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.</p>
<b>5.8</b>	<p><b>Ferruling for 1Cx6sq.mm cable:</b></p> <p>a) For 1Cx6 sq.mm DC solar array cable, bidder shall provide UV resistant ferrules printed with <b>source / destination</b> identification of cable. Printing details shall be submitted for <b>BHEL /NTPC</b> approval during detailed engineering.</p> <p>b) Printing shall be of appropriate size to ensure readability. Supply of ferrule shall be in bidder scope.</p> <p>c) Ferrules shall be provided on both the termination ends: module end and SCB end.</p>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 13 OF 30

5.9	<p><b>Installation of SCBs on floating pontoons:</b></p> <p>Supply of string monitoring boxes (SCB), 90 sets, is in BHEL scope. These are 22-in / 1-out type.</p> <ul style="list-style-type: none"><li>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.</li><li>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.</li><li>c) All necessary labour, tools, machinery etc. for erection work shall be in bidder scope.</li></ul>
5.10	<p><b>Routing of 1Cx 6sq.mm cable up to SCB:</b></p> <ul style="list-style-type: none"><li>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 <b>till SCB input side. The HDPE pipes for routing cables are only required in pathways where SCBs are mounted.</b> 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. The HDPE pipes shall be tied neatly to the pontoon lips at regular intervals.</li><li>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. <b>Specification:</b> 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 <b>BHEL/NTPC</b> approval during detailed engineering.</li><li>c) Cable ties shall be in bidder scope of supply. Width of the cable ties shall be min 4.5 mm.</li><li>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. <b>Cable ties shall be of make: 3M, Phoenix contact, Weidmuller, Hellermanntyton, Panduit or other reputed equivalent, subject to BHEL/NTPC approval.</b> Width and Length shall be so appropriate as to ensure that the bunched cables are held firmly to the mounting structure. During detailed engineering, <b>BHEL/NTPC approval shall be obtained for the selected brand and sizes of cable tie.</b></li><li>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</li></ul>
5.11	<p><b>Termination of 1Cx6sq.mm. Copper cables on input side of SCBs:</b></p> <ul style="list-style-type: none"><li>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.</li><li>b) Bidder scope includes removal of sleeve of cable, crimping at the cable end and fixed with MC4 connector to SCB.</li><li>c) MC4 connector for 6sqmm cable termination to SCB shall be in BHEL scope of supply</li><li>d) Any other hardware, if necessary for fulfilling the connection, such as bolts, nuts, screws, washers etc. shall be in bidder scope of supply. <b>All hardware shall be of SS304.</b></li><li>e) All necessary tools such as pliers, strippers, MC4 crimping tools etc. shall be within bidder scope.</li></ul>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 14 OF 30

	<p>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.</p>
5.12	<p><b>Termination of 2 run 1Cx400 DC power cables at SCBs</b></p> <ul style="list-style-type: none"><li>a) Cables of 2run, 1Cx400 (Al conductor, XLPE insulation, Un-armored) shall be terminated at the output side of SCBs (positive, negative terminals).</li><li>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.</li><li>c) Cable lug with bimetallic washers shall be in bidder scope of supply. Make shall be Dowell or COMET or 3D make. Other than these makes shall not be accepted.</li><li>d) SS304 bolts/ nuts/ plain washers and Zinc/epoxy coated spring washers shall be in bidder scope of supply.</li><li>e) All necessary tools such as pliers, strippers, crimping tool etc shall be within bidder scope.</li></ul>
5.13	<p><b>Walkways to embankment:</b></p> <ul style="list-style-type: none"><li>a) FRP/HDPE/Treated Wood slotted supports to be provided from Float end to the entry of Hume pipe on the Pond embankment. This shall be provided such that Cables can be guided on either side of the final walk-way from the floating platform upto embankment and such that walking space is available along the center of the walkway.</li><li>b) As indicated in array layout, walkways to be provided at five locations from bund to PV array.</li></ul>
5.14	<p><b>Laying of 2 runs of 1Cx400sq.mm Al cable upto inverter platform and terminations at PCU</b></p> <ul style="list-style-type: none"><li>a) 2 runs of 1Cx400sq.mm cables (Al conductor, XLPE insulation, Un-armoured: (BHEL scope of supply) running from SCBs shall be routed into the inverter platform and laid on the cable trays therein.</li><li>b) The cables shall be neatly routed through covered cable trays on floating pontoons without contact with water and has to be taken to the embankment through the walkways/cableways. The cables with trays shall cross over the embankment through hume pipes (5 crossings approx.) fixed on embankment of 5-meter-wide and necessary sloping on either sides.</li><li>c) Reinforced Surface Concrete work has to be provided over the Hume pipes (NP2) for safe vehicle movement on the bund road.</li><li>d) 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 (300mm wide) with HDPE floaters. The thickness of the cable tray shall be adequate enough to carry the cables without any dent/damage. The depth of the tray shall be 50 mm minimum.</li><li>e) 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 10 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.</li><li>f) 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.</li><li>g) Bidder shall carry out glanding of the cables following which the glands shall be fitted to the respective holes of gland plates.</li></ul>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 15 OF 30

	<ul style="list-style-type: none"><li>h) Bidder shall carry out the cable terminations for positive and negative inputs that include tasks such as unsleaving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Proper labelling/tagging is to be planned and fixed on cables.</li><li>i) 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.</li><li>j) 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.</li><li>k) Cable lugs shall be of Dowell or COMET or 3D make. Other than these makes shall not be accepted.</li><li>l) All tools/accessories such as crimping tools etc. required to carry out the termination shall be within scope of bidder.</li></ul>	
5.15	<b>Laying of DC cables and Earthing Cables/strips over the bund:</b> <ul style="list-style-type: none"><li>a) DC cables shall be laid over the bund slopes with cable trays/ <b>UV Resistant HDPE</b> pipes before entering/exiting hume pipes.</li><li>b) The tray shall be firmly clamped to the sloping sides of the bunds with suitable arrangement without damaging the bund surface. The cable trays have to be laid and fixed over the bund, without fouling with berm drains and toe drains provided throughout the bund structure.</li><li>c) Method to be finalized with BHEL/NTPC during detailed Engineering.</li></ul>	
5.16	<b>Laying and Termination of 1Cx400sq.mm LT AC power cables at PCU and Inverter Transformer</b> <ul style="list-style-type: none"><li>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.</li><li>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.</li><li>c) Cable lug make shall be Dowell, COMET or 3D. Other than these makes shall not be accepted.</li><li>d) Cable gland metallic type shall be of COMET or 3D make. Other than these makes shall not be accepted.</li><li>e) Quantity of lug and hardware shall also include contingency requirements arising out of shortage due to various reasons (damage, theft etc.) during installation.</li><li>f) All necessary tools such as pliers, strippers, crimping tool etc. shall be within bidder scope.</li></ul>	
5.17	<b>Laying and termination of 33KV(E), 1CX240 sq.mm XLPE Al cable from Inverter transformer to HT panel and to local pooling station</b> <ul style="list-style-type: none"><li>a) Laying and termination of 3 run 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.</li><li>b) Laying and termination of 3 run 33KV (E),1CX240 sq.mm XLPE Al armoured cables from each inverter platform to local pooling stations shall be in vendor scope.</li><li>c) 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</li></ul>	



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 16 OF 30

	<p>shall be COMET or 3D. Cable lugs make shall be Dowell or COMET or 3D. Other than these makes shall not be accepted.</p> <p>d) HT termination kits (indoor/ outdoor 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.</p>
5.18	<p><b>Laying and termination of 33KV(E), 9 (3 nos. of 3 phase lines) runs of 1CX240 sq.mm XLPE Al cable from HT panels near reservoir to outdoor switchyard approx. 4.2 km away</b></p> <p>a) Laying and termination of 9 runs (3 nos. of 3 phase lines) of 33KV(E), 1CX240 sq.mm XLPE Al armored cable from HT panel outgoer to outdoor switchyard nearly 4.2 Km away through underground cable trench as per standards, shall be in vendor scope. (through proper cable trefoil clamps at regular intervals as per relevant standards)</p> <p>b) Conducting of detailed route survey is in scope. Cables shall be laid underground in trenches and over cable trays with required steel structural supports (C5 Corrosion resistance category treated) and Civil foundations and reinforcements while crossing the Canal and bridge section of the route</p> <p>c) Cable glands, 33kV HT cable termination kits (indoor/ outdoor 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.</p> <p>d) HT termination kits (indoor/ outdoor 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.</p> <p>e) Proper HT cable route marker shall be used in regular intervals as approved by BHEL/NTPC.</p> <p>f) Steel column supports (Hot dip galvanized, anti-corrosion treated), Steel structure clamping system for Cable tray support to Bridge pillars, bolting system, RCC civil foundations to erect the steel columns on canal bottom for distance of approximately 400 m shall be erected by the vendor under his scope.</p> <p>g) Along cable laying route adjacent to RCC Cable trench of NTPC for IDCT Cables, bidder to lay cables in Underground method after digging trenches in soil wherever suitable or along Cable Trestle with Cable Tray and cover arrangement as required on case to case basis.</p> <p>h) Details of structural design, foundation for the above HT cable support system shall be submitted by vendor for approval of NTPC/BHEL.</p> <p>i) Some reference photos are attached for vendor reference.</p> <p>j) <b>All civil structures shall be complied for “C5” category Corrosive Environment</b></p>
5.19	<p><b>Termination of 9 runs of HT cables at outdoor switchyard and to existing panels at NTPC Switchgear room</b></p> <p>a) Termination of 9 runs (3 nos. of 3 phase lines) 33KV(E), 1CX240 sq.mm XLPE Al armored cable from HT panel outgoer to Outdoor Cable termination structures at Outdoor yard approx. 4.2 Km away and from these structures upto existing panels of customer at three different evacuation panels.</p> <p>b) All necessary equipment required for termination at evacuation points are in scope of vendor only. i.e. Cable glands, Cable lugs and termination kits, Outdoor structures.</p>
5.20	<p><b>Identification marking of cables using cable tags</b></p> <p>a) Cable tags shall be provided on all power cables at both ends just before entering the equipment enclosure.</p>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 17 OF 30

	<p>b) Cable tags shall be of rectangular shape.</p> <p>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.</p> <p>d) Bidder shall submit the technical details of cable tags, ID numbering scheme for BHEL/ NTPC approval during detailed engineering.</p>
5.21	<p><b>Installation of electrical panels at platforms constructed for PCUs, Inverter transformer, HT panel and CMCS, other indoor panels at EERs (Electrical Equipment Room) of electrical equipment.</b></p> <p>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</p> <p>(a) PCU: 10 Nos</p> <p>(b) 33kV HT panel: 9 set (5 incomers + 2 local pooling incomers + 2 outgoer)</p> <p>(c) SCADA panel: 1 No at CMCS and SCADA sub panels in EER (RCC buildings- BHEL scope) near Inverter platform</p> <p>(d) HMI SCADA control desk with PCs and accessories: 1 set</p> <p>(e) UPS with battery bank (Comprising 2 x100% redundancy) – 5 Set.</p> <p>(f) ACDB in EER– 5 No.</p> <p>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.</p> <p>b) PCUs, VCB panels shall be placed on cable trench of Inverter platform, with cable entry openings to match cable trench on bottom side.</p> <p>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.</p>
5.22	<p><b>Design, Supply, Laying and installation of Control / data / instrumentation cables</b></p> <p>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.</p> <p>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.</p> <p>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.</p> <p>d) Bidder shall lay and terminate the <b>RS485 cables</b> to SCADA from (a) MFM meters of VCB panels, (b) Weather monitoring station</p>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 18 OF 30

	<ul style="list-style-type: none"><li>e) Bidder shall lay and terminate the Ethernet cables to SCADA from (a) PCUs, (b) numerical relays of VCB panels.</li><li>f) Bidder shall lay and terminate OFC cables from CMCS till Termination Panels point or SCADA termination point of NTPC at Simhadri TPS</li><li>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.</li><li>h) All applicable/ relevant clauses under "<b>Cable installation methodology</b>" 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.</li></ul>
5.23	<p><b>Erection of 33kV transformer yards</b></p> <ul style="list-style-type: none"><li>a) Construction of Yard for 5 Nos of 5.3 MVA transformer, along with Earth mat, yard lighting are in the scope of bidder.</li><li>b) Bidder shall erect the transformers on RCC foundation as per transformer GA details. Bidder scope of I&amp;C of transformers shall include:<ol style="list-style-type: none"><li>1. Movement of transformers and its accessory parts such as radiators, cable boxes, hardware etc from interim storage yard and placement on foundation pedestal.</li><li>2. Assembly of transformer parts.</li><li>3. Cable laying and terminations at LV/HV/Marshalling boxes of transformers.</li><li>4. All activities applicable to oil filling and filtration including measurement of oil BDV and PPM in NABL accredited laboratory. Particularly for inverter transformers, filtration of oil shall be carried out to such an extent as to obtain the desired BDV (&gt;60 kV) and PPM (&lt; 15ppm) values.</li><li>5. Testing of transformers as per "<b>pre-commissioning checks</b>" section of this section.</li></ol></li><li>c) After installation of transformers at the transformer yard, bidder shall level/ compact the ground with an appropriate magnitude and direction of slope to facilitate draining of rain water away from transformer yard. Accordingly, to prevent stagnation of water within transformer yard, bidder shall implement suitable civil works in and around the transformer yard. This shall include filling up the land (wherever necessary) with suitable soil and compact the filled-up portions either manually or with rollers, as applicable, as per site conditions, to achieve required compaction/slope.</li><li>d) Bidder shall provide the 100 mm layer of stone gravels in transformer yards as per relevant IS standards / CBIP/ CEIG requirements etc. Also, PVC pipes shall be provided at appropriate locations along the periphery of transformer yard fencing for draining out of water from the yard. PVC pipe of appropriate size shall be in bidder scope of supply.</li><li>e) Bidder shall provide applicable earthing connections to transformers, fencing / gates etc. in the yard as per relevant clauses under the "<b>Earthing system</b>" section of this specification.</li><li>f) All other items (if any, other than the above) that are required to meet the technical requirements of transformer yard as per applicable standards / electricity rules shall be incorporated by the bidder.</li></ul>
5.24	<p><b>Specification of Earthing system: As per attached Annexure</b></p>
5.25	<p><b>Specification of Firefighting and alarm system : As per attached Annexure</b></p>
5.26	<p><b>Specification of cable installation methodology: As per attached Annexure</b></p>
5.27	<p><b>Specification of UPS with battery bank: As per attached Annexure</b></p>
5.28	<p><b>Specification of Auxiliary Transformer: As per attached Annexure</b></p>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 19 OF 30

5.29	<b>Specification of ESE type LAs :As per attached Annexure</b>
5.30	<b>Specification of 33KV outdoor switchyard with metering: As per attached Annexure</b>
5.31	<b>Specification of illumination system: As per attached Annexure</b>
5.32	<p><b>Auxiliary AC/DC power supply system</b></p> <ul style="list-style-type: none"><li>a. For CMCS power requirement, <b>30 KVA</b> type Auxiliary Transformer (<b>Dry type</b>) for tapping power from LV side of nearest PCU for connecting to ACDB (providing LT supply of 3 phase, 415 V).</li><li>b. <b>ACDB of Nearest PCU</b> 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).</li><li>c. <b>20 KVA</b> type Auxiliary Transformer (<b>Dry type</b>) 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</li><li>d. 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).</li><li>e. Connections of the same with all necessary protection system shall be vendor scope.</li></ul> <p>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.</p> <p>Following DB boards for application in main control room and EERs (RCC buildings) shall be in bidder scope of supply, installation and commissioning:</p> <ol style="list-style-type: none"><li>1. UPS DB for 230V AC UPS supply to SCADA, weather monitoring system, fire alarm system, emergency loads, CR DB (room utilities) - 1 Set</li><li>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.</li><li>3. Above DBs shall be of reputed make such as Legrand, Siemens, Schneider or any other reputed make as approved by BHEL/NTPC.</li><li>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.</li><li>5. Installation of all the above items including all necessary cables, cable terminations/ installation shall be in bidder scope.</li><li>6. Constructional features of the connections shall be as per specification "<b>LT switchgear</b>".</li><li>7. LT switchgear component of reputed make such as L&amp;T, Siemens, ABB, Schneider or any other NTPC approved makes are only accepted.</li><li>8. MFM meter with RS485 communication feature to facilitate SCADA connection shall be provided in LT SWITCHGEAR.</li></ol>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 20 OF 30

5.33	<p><b>I&amp;C of electrical connections to CMCS and EERs</b></p> <p>Bidder shall provide all necessary electrical connections and laying of LT power cable to CMCS, EERs, which are in BHEL scope. Laying of Power cables upto local distribution boards in CMCS is in bidder scope only.</p>
5. 34	<p><b>Supply and installation of Weather monitoring system</b> <b>As per attached Annexure "Weather monitoring system"</b></p>
5.35	<p><b>Installation and commissioning of SCADA integration systems</b></p> <p>(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:</p> <ul style="list-style-type: none"><li>(a) SCADA panels placed on the inverter platforms.</li><li>(b) Power conditioning units (10 Nos): DC input / AC output parameters of inverters, grid data, fault status and events logged, etc.</li><li>(c) Inverter transformers (5 Nos): Alarm/Trip signals, WTI/OTI temperature values.</li><li>(d) 33kV VCB breaker panels (as per SLD): status of VCB breakers, status of protection relays of transformers, oil / winding temperatures, AC parameters.</li><li>(e) Fire alarm system at main control room: status signals</li><li>(f) Weather monitoring equipment</li></ul> <p>(2) <b>BHEL scope of SCADA:</b></p> <ul style="list-style-type: none"><li>(a) Data station panels with necessary data loggers / PLCs and other accessories such as power supply etc to integrate the data signals.</li><li>(b) Desktop PCs (HMI control desks) provided with necessary software packages and remote monitoring features.</li><li>(c) Supply of SCADA related communication/ data / LAN cables as brought out in other clauses of this specification.</li></ul> <p>(3) <b>Bidder scope of supply and installation of SCADA system:</b></p> <ul style="list-style-type: none"><li>(a) Bidder shall install the BHEL supplied SCADA system in the air-conditioned SCADA room in CMCS.</li><li>(b) Cable laying/ terminations of all SCADA cables at respective panels / equipments shall be in bidder scope of supply. <b>SCADA communication (OFC) cable laying from plant CMCS to switch yard panel room and to 400 KV switchyard room is also in bidder scope (length is 4.2 Kms approx.).</b> BHEL will provide the necessary cabling schedule during detailed engineering.</li></ul>
5.36	<p><b>Earthing of solar PV modules and SCBs</b></p> <p>As per attached Annexure "Earthing system"</p> <p>The solar PV modules, SCBs and various electrical equipments installed by the bidder shall be provided with appropriate earthing for protection against faults as guided by IEC 60364.</p> <p>The earthing electrodes shall be as per the technical specification. For each electrode, earth chamber shall be constructed using brick masonry/precast material.</p>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 21 OF 30

	<p>Bidder shall use min 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for connecting 30 modules in a row. All rows shall be interconnected using suitable earthing Aluminium cables or GI strips. <b>Bidder shall submit for approval detailed earthing plan with earthing cable sizing and break proof methodology for linking solar PV modules and SCBs earthing.</b> The main earthing cables/strips shall be laid upto shore along with DC cables and shall be terminated at 36 Nos of chemical earthing electrodes at mutually agreed locations. 90 Nos of SCB earthing shall be connected in parallel to the main earthing grid. Proper tools and clamps shall be used for connecting the earthing branches to the main earthing grid.</p> <p>Bidder has to provide the earth chamber precast/ prefab type for each earth electrode with following details.</p> <p>(a) Minimum Inner diameter shall be 300mm. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc.</p> <p>(b) Projection of chamber above FGL = 150mm minimum</p> <p>(c) Top of electrode shall have minimum clearance of 100 mm below cover plate.</p> <p>(d) Cover plate with suitable lifting hooks and padlocking arrangement.</p>	
5.37	<p><b>Earthing system for main control room and 33kV transformer yard</b> <b>As per attached Annexure "Earthing system"</b></p>	
5.38	<p><b>Water washing system for SPV modules (Module cleaning system)</b></p> <ul style="list-style-type: none"><li>Vendor shall provide water washing system with Portable Pressure pump (AC/DC motor or engine powered pump) for drawing water from below the floater and providing water jet to clean the PV modules.</li><li>The pump set shall be complete with nozzle and flexible hose of atleast 20 m length and with flexible power cable of sufficient length in case of AC motor.</li><li>The pump shall be capable of providing water jet of atleast 2 kg/sqcm pressure to clean the PV modules in two to four adjacent rows at a time. Refer the PV array layout provided for view the Module arrangement.</li></ul> <p><b>SPV module washing id for Three cycles only.</b></p> <p>Bidder shall wash the SPV modules with the help of supplied Pressure pump (AC/DC motor) once in a month. He has to carry out this activity for three cycles i.e three months.</p>	
5.39	<p><b>Identification marking of electrical items using painting</b></p> <p>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.</p> <ol style="list-style-type: none"><li>(1) String Combiner boxes: 90 Nos</li><li>(2) Size/ source/ destination of DC cable 1Cx400 with arrow mark (power flow direction) to be painted on SCBs and PCUs</li><li>(3) PCUs front side: PCU ID number (1 to 10) with rating 2500kW, AC chamber/ DC chamber, Danger text/symbol.</li><li>(4) PCUs DC chamber back side: SCB ID numbers, cable size (1Cx400 +,-) with upward arrow mark, danger text/symbol</li><li>(5) PCUs AC chamber back side: Inv Trnfmr ID, cable size (10Rx1Cx400 / ph) with downward arrow mark, danger text/symbol</li><li>(6) Same way as above, the corresponding panel ID with rating, cable destination with arrow</li></ol>	



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 22 OF 30

	<p>mark in power flow direction, danger text/symbol shall be painted for all VCB panels, Inverter transformers (HV and LV sides).</p> <p>(7) For UPS/ SCADA/ ABT metering panels, 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.</p> <p>(8) For earth chambers of main control room ID number shall be painted.</p> <p>(9) All switchboards shall be painted with ID number.</p>																									
5.40	<p><b>Cable markers and cables tags</b></p> <p>(1) Cable markers and joint markers for underground cables shall be provided along the route of the cables as per section “<b>Cable installation methodology</b>” of this specification.</p> <p>(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 “<b>Cable installation methodology</b>” of this specification.</p> <p>(3) Bidder shall submit the respective schemes of marking and tagging for BHEL/NTPC approval during detailed engineering.</p>																									
5.41	<p><b>Display boards and sign boards</b></p> <table border="1"><thead><tr><th>Sl. No</th><th>Description</th><th>Qty for Control room</th></tr></thead><tbody><tr><td>1</td><td>Board displaying instruction chart for restoration from Electric Shock</td><td>5 No</td></tr><tr><td>2</td><td>Board displaying instruction chart for artificial respiration</td><td>5 No</td></tr><tr><td>3</td><td>Board displaying dos and don'ts.</td><td>5 No</td></tr><tr><td>4</td><td>Board displaying fire extinguishers details and operations</td><td>5 No</td></tr><tr><td>5</td><td>“No smoking” board</td><td>5 Nos</td></tr><tr><td>6</td><td>Danger boards: 33000V with danger symbol in Hindi, Telugu and English</td><td>As required</td></tr><tr><td>7</td><td>Identification boards, of suitable sizes, within and outside control room such as Main control room, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room etc. BHEL will provide list.</td><td>As required</td></tr></tbody></table>	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 control room such as Main control room, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room etc. BHEL will provide list.	As required	<p>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.</p>
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 control room such as Main control room, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room etc. BHEL will provide list.	As required																								
5.42	<p><b>Electrical insulation mat</b></p> <p>(1) Bidder shall supply electrical insulating mats as follows:</p> <ul style="list-style-type: none"><li>(a) Reputed make as shall be approved by BHEL/ NTPC</li><li>(b) As per IS: 15652:2006</li><li>(c) Class B</li><li>(d) Thickness 2.5 mm minimum</li><li>(e) Size = 2m x 1m minimum, exact size shall be as approved by BHEL/NTPC during detailed engineering.</li><li>(f) Colour: to be approved by BHEL/NTPC</li><li>(g) Max use voltage = 33 kV</li><li>(h) Marking of IS standard on the mat</li></ul> <p>(2) Test certificate shall be provided by bidder</p> <p>(3) Bidder shall lay the mats in front of all the indoor electrical panels viz. PCUs, VCB panels, SCADA panels, UPS panels etc.</p>																									



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 23 OF 30

5.43	<p><b>Supply and Installation Miscellaneous Items for Control Room</b></p> <p>(1) Split Air conditioner of 1.5 tonne (2 Nos) of split type for SCADA room, of Voltas/ Hitachi/ Samsung/LG make.</p> <p>(2) Furniture for SCADA room as below</p> <ul style="list-style-type: none"><li>Control desk for OWS and EWS – 1 No</li><li>Chair, industry standard, revolving type, with wheels, arm rest, provisions for adjustment of height (hydraulic/ gas lift): 4 Nos</li><li>Storage almirah: 1 No</li><li>Storing rack (slotted metal frame) 1 no. in store room.</li><li>Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon.</li><li>One Printer Table made of Laminated Wood or Heavy Duty MDF shall be provided for printer.</li><li>All the furniture shall be of reputed make (Godrej or Equivalent).</li></ul>
5.44	<p><b>Tool kits and instruments:</b></p> <p>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:</p> <ul style="list-style-type: none"><li>Screw driver and / or Allen key suitable for the connectors, power distribution blocks, Circuit breaker terminals and surge arrestor terminals.</li><li>Spanners / box spanners suitable for the removal of solar PV modules from the solar PV module support structure.</li><li>Digital multimeter- 2 Nos</li><li>AC/DC clamp meter – 2 Nos</li><li>Meggering kit (5 KV) – 1 No.</li><li>Cable crimping tool – 1 no. 2.5/4/6/10 sq.mm and 1 no. 240-400 sq.mm (hydraulic type)</li><li>Crimping tool for MC4 connectors-2 no.s</li><li>MC4 joint disconnection tool – 10 no.s</li><li>Rechargeable LED type water proof Flash lights – 5 nos.</li><li>Discharge rods for 33KV – 1 no.</li><li>33 KV safety gloves – 5 no.s</li><li>Vacuum cleaner cum blower – 1 no.</li></ul> <p>Note: Make / model number etc shall be approved by BHEL/NTPC prior to procurement.</p>
5.45	<p><b>PRE-COMMISSIONING AND COMMISSIONING FACILITIES</b></p> <ol style="list-style-type: none"><li>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.</li><li>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</li></ol>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 24 OF 30

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.

5.46	<p><b>Spares required to be supplied along with main consignment:</b></p> <p><b>Spares on DC side</b></p> <ul style="list-style-type: none"><li>• Indicating lamp set of all types: 1% of total population of respective items</li><li>• Surge protection devices/ MOV: 1% of total population of respective items</li><li>• Lighting LED lamps: 5% each type.</li><li>• Indicating lamp set of all types: 1% of total population of respective items</li><li>• Straight-through jointing kit for 3.3 kV 1Cx400 cable (Al, XLPE, un-armoured, PVC): 4 kits for DC side.</li></ul>
5.47	<p><b>Spares on AC side</b></p> <ol style="list-style-type: none"><li>1) 33 KV indoor Current transformer (if applicable)</li><li>2) 33 KV outdoor Current transformer</li><li>3) 33 KV bus potential transformer (if applicable)</li><li>4) 33 KV outdoor potential transformer</li></ol>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 25 OF 30

- 5) 33 KV indoor surge arrestor (if applicable)
- 6) 33 KV outdoor surge arrestor (if applicable)
- 7) Auxiliary Transformer (Highest size)
- 8) 33kV(E) termination kit for 1Cx240 cable: 3 Nos
- 9) 33kV(E) straight through jointing kit for 1Cx240 cable: 3 Nos
- 10) Fuses of all types: 10% of total population of respective items
- 11) MCCB, MCB of all types: 10% of total population of respective items
- 12) Indicating lamp set of all types: 10% of total population of respective items
- 13) Surge protection devices/ MOV: 10% of total population of respective items
- 14) 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 ( <b>including heavy duty tools for crimping copper/ aluminium cables up to 400 sq-mm</b> ), 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.



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 26 OF 30

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	<p>Special instruction for earthing:</p> <p>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.</p>
6.17	<p>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.</p> <p>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.</p>
6.18	<p>Field Quality Plan / Quality control system (if applicable)</p> <p>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.</p> <p>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.</p>
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	<p><b>General Guidelines</b></p> <ul style="list-style-type: none"><li>a) <b>All civil structures shall be complied for “C5” category Corrosive Environment.</b></li><li>b) 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.</li><li>c) Bidder shall prepare all designs / drawings based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard.</li><li>d) Bidder shall provide type test reports and datasheet/ GTP for all equipments covered under bidder scope of supply.</li><li>e) BHEL reserves right to modify the design at any stage to meet local site conditions / project requirements.</li></ul>



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 27 OF 30

f) 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.

## **7.0 Documents to be submitted for BHEL/NTPC approval during detailed engineering**

7.1	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).
7.2	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.
7.3	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. (10) Any other designs/ schemes/ layouts etc as applicable as per BHEL / NTPC requirements that will be discussed during detailed engineering.
7.4	Manufacturing Quality Plans for all the bidder supplied items
7.5	Field quality plan for the field work: civil works, electrical works
7.6	Detailed activity-time chart for project implementation
7.7	Detailed manpower deployment schedule
7.8	Operation and maintenance manuals of bidder supplied items.



**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 28 OF 30

**PROJECT TITLE: NTPC SIMHADRI 25 MW FOLATING SOLAR POWER PLANT**

DESCRIPTION:TENTATIVE HT CABLE ROUTE FROM SOLAR PLANT TO METERING YARD





**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

PAGE : 29 OF 30





**TECHNICAL SPECIFICATION:  
SUPPLY OF BOS ITEMS AND I&C OF 25MW(AC)  
FLOATING SOLAR PV POWER PLANT FOR NTPC AT  
SIMHADRI TPP**

PS-439-1333

Rev No: 00

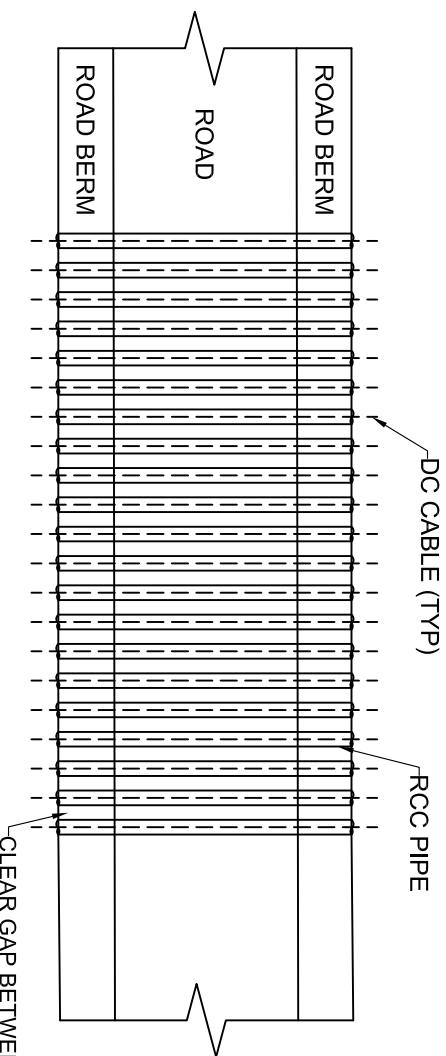
PAGE : 30 OF 30

**PROJECT:NTPC SIMHADRI 25MW FLOATING SOLAR POWER PLANT**

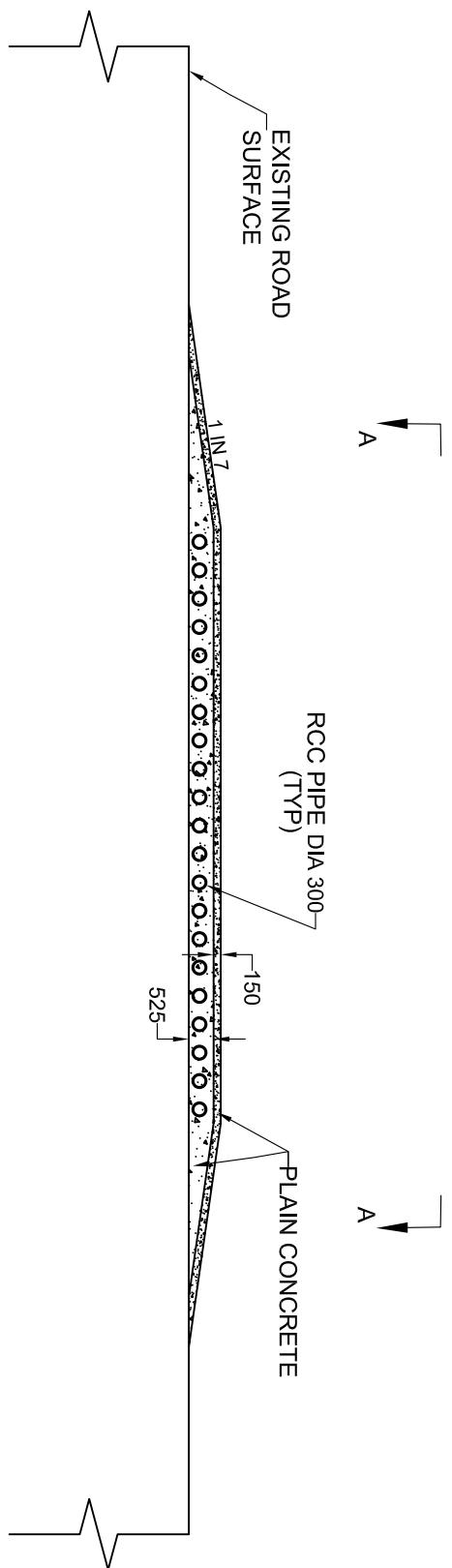
**DESCRIPTION: PROPOSED LOCATION FOR 33KW OUTDOOR SWITCH YARD**



NOTE: 1. ALL DIMENSIONS ARE IN MM



VIEW A-A



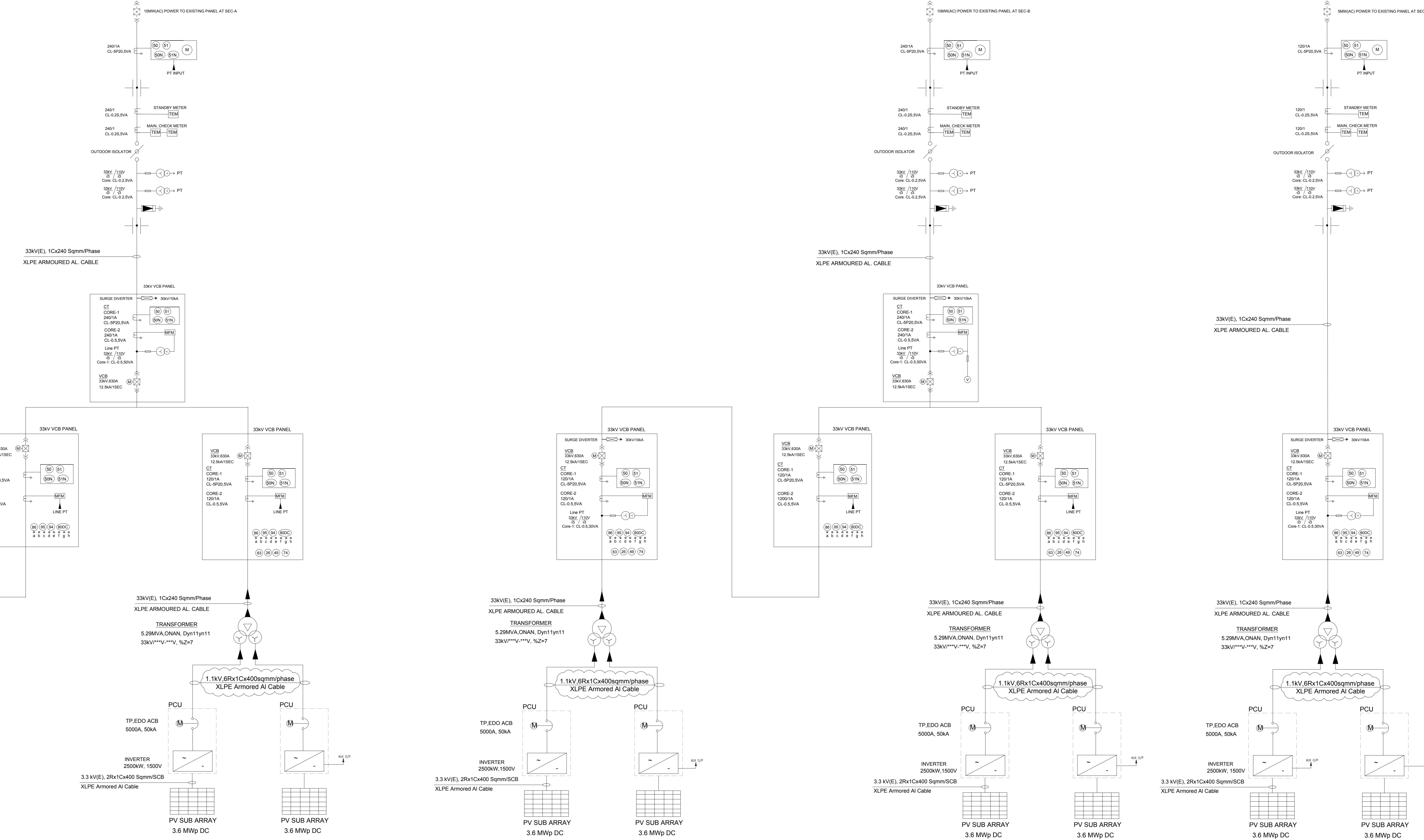
TYP. DETAIL OF DC CABLES ROAD CROSSING  
ARRANGEMENT ON BUND

# ANNEXURE-1

## ANNEXURE - 1

## LEGEND DETAILS

SL. NO.	SYMBOL	DESCRIPTION
1		INVERTER DUTY TRANSFORMER
2		VCB 33kV, 630/1250A 21kA/1SEC
3		SURGE DIVERTER, 33kV/10kA
4		MASTER TRIP RELAY
5		TRIP CIRCUIT SUPERVISION RELAY
6		ANTI PUMPING RELAY
7		BUCHHOLZ RELAY
8		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		INST OVER CURRENT RELAY
18		IDMT OVER CURRENT RELAY
19		NEUTRAL INSTANTANEOUS OVER CURRENT RELAY
20		IDMT EARTH FAULT RELAY
21		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		TARIFF ENERGY METER
29		DC FAILURE INDICATION
30		WINDING TEMP INDICATOR AND OIL TEMP INDICATOR
31		PRESSURE RELIEF DEVICE



PROJECT : 25MW (AC) FLOATING SOLAR POWER PLANT							
CUSTOMER : NTPC-SIMHADRI							
<p style="text-align: center;"><b>BHARAT HEAVY ELECTRICALS LIMITED.</b></p> <p style="text-align: center;"><b>ELECTRONICS DIVISION, BANGALORE</b></p>							
<b>SINGLE LINE DIAGRAM-AC</b>							
TPC G.NO.	BHEL DRG. No. 5746-004-PVE-P-006						
<table border="1" style="width: 100px; border-collapse: collapse;"> <tr> <td style="width: 50px; text-align: center;">No. OF SHEETS</td> <td style="width: 50px; text-align: center;">01</td> </tr> <tr> <td style="text-align: center;">SHEET No.</td> <td style="text-align: center;">01</td> </tr> <tr> <td style="text-align: center;">REV</td> <td style="text-align: center;">01</td> </tr> </table>		No. OF SHEETS	01	SHEET No.	01	REV	01
No. OF SHEETS	01						
SHEET No.	01						
REV	01						
16							

L  
REV.  
M

E

D

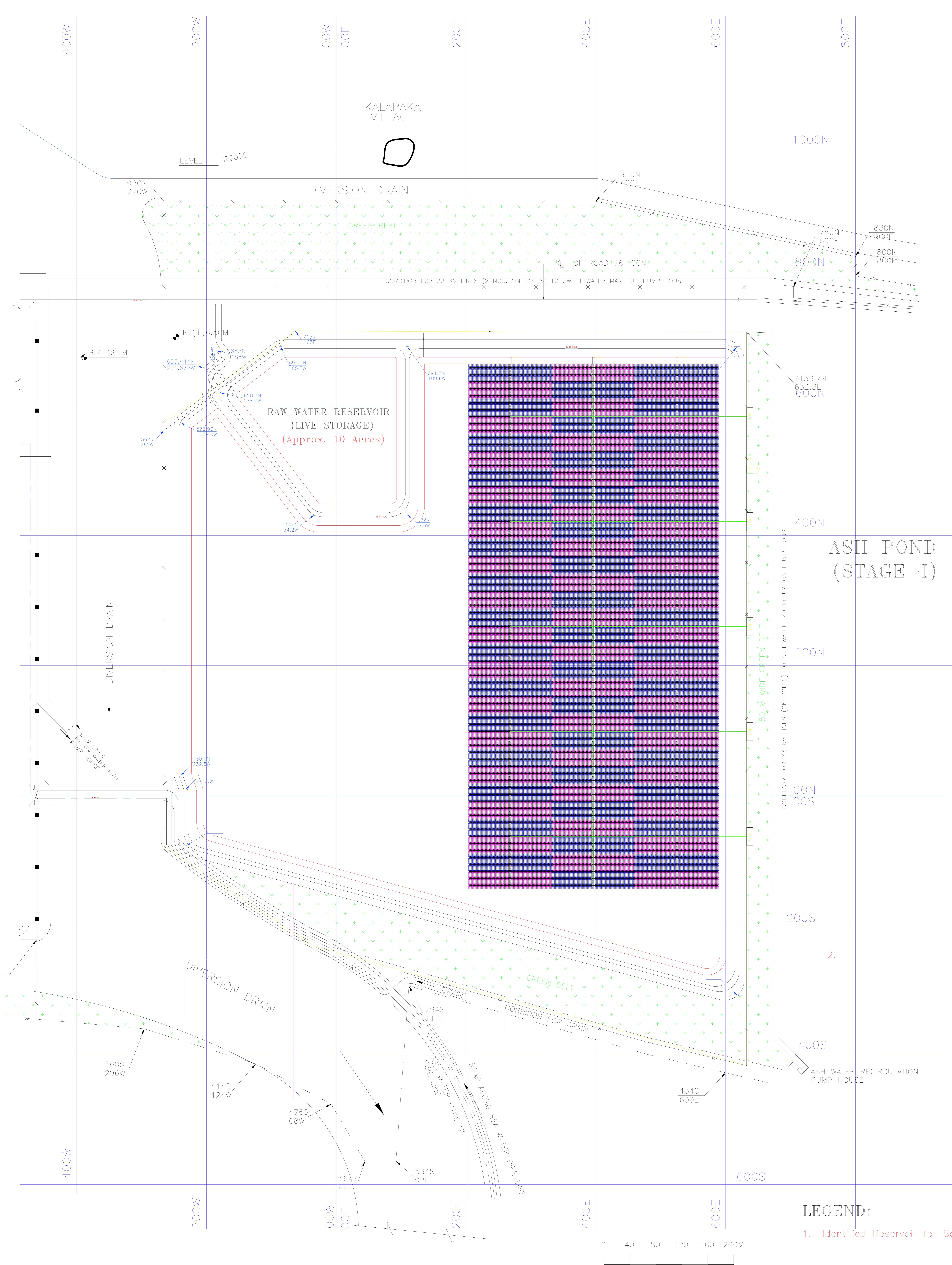
C

B

A

## ANNEXURE-2

ANNEXURE-2



LEGEND:	
SYMBLES	DESCRIPTION
	INVERTER PLATFORM
	CMCS ROOM
	PV MODULE
	SCHEMATIC FLOATER

## LEGEND:

1. Identified Reservoir for Solar Floating . . .

## NOTES:

1. ALL DIMENSIONS AND LEVELS ARE IN METRES.
2. SIMHADRI BEING A COSTAL PROJECT, POSSIBILITY OF CYCLONE LIKE 'HUDHUD' CANNOT BE WISHED AWAY IN FUTURE. HENCE, PROPER CARE SHALL BE TAKEN BY HAVING ENOUGH SAFETY MARGIN IN DESIGNING ANCHORING TO AVOID ANY DAMAGE TO FLOATING SOLAR PV PROJECT.
3. MAXIMUM DEPTH OF WATER IN THE RAW WATER RESERVOIR IS 3.35 M FROM BED LEVEL. RAW WATER RESERVOIR IS LINED WITH HDPE SHEET AND CONCRETE BLOCKS IS PLACED AT INVERT LEVEL AND SIDE OF EMBANKMENTS.
4. POSITION OF INVERTER PLATFORM ,CMCS AND PV MODULE LAYOUT IS FINAL.

## NOTES:

1. ALL DIMENSIONS AND LEVELS ARE IN METRES.
2. SIMHADRI BEING A COSTAL PROJECT, POSSIBILITY OF CYCLONE LIKE 'HUDHUD' CANNOT BE WISHED AWAY IN FUTURE. HENCE, PROPER CARE SHALL BE TAKEN BY HAVING ENOUGH SAFETY MARGIN IN DESIGNING ANCHORING TO AVOID ANY DAMAGE TO FLOATING SOLAR PV PROJECT.
3. MAXIMUM DEPTH OF WATER IN THE RAW WATER RESERVOIR IS 3.35 M FROM BED LEVEL. RAW WATER RESERVOIR IS LINED WITH HDPE SHEET AND CONCRETE BLOCKS IS PLACED AT INVERT LEVEL AND SIDE OF EMBANKMENTS.

CUSTOMER

25MW(AC) FLOATING SOLAR PV PLANT AT  
NTPC SIMHADRIBHARAT HEAVY ELECTRICALS LTD  
ELECTRONICS DIVISION, BANGALOREDEPT. : SC&PV  
STATUS : CONTRACT  
DISTRIBUTION

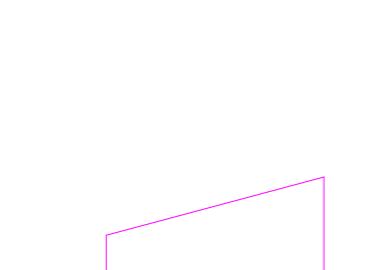
CUSTOMER'S CONSULTANT :

First issue.

TITLE

OVERALL SOLAR BLOCK LAYOUT

SCALE :



DRAWING NO.

5746-004-PVE-F-001

SHEET 1 OF 1

REV. 00

REV. DATE DRWN CHD APPD REV. DATE DRWN CHD APPD REV. DATE DRWN CHD APPD

00 27.01.20 JN PM SM

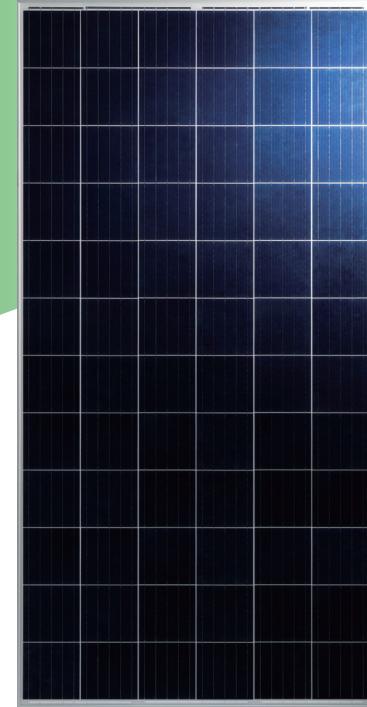


# EN156P-72-320/325/330/335/340W

## Polycrystalline Solar Module 72-Cell Series

### ABOUT ECONESS ENERGY

Established in 2009 by Jiangsu Huadong Group (founded in 1997), Econess Energy is a world's leading solution provider for solar energy. With annual production capacity of 800MW cells and 1.2GW modules. Econess Energy now distributes its PV products to over 36 countries with cumulative module shipment of 3GW. As a strong, bankable partner, we are committed to building strategic, mutually beneficial collaboration with installers and developers.



### KEY FEATURES

-  **Maximize limited space**  
Maximum power output 340W
-  **IP68 junction box**  
The highest waterproof level
-  **Excellent Anti-PID performance**  
2 times of industry standard  
Anti-PID test by TUV
-  **Lower temperature coefficients**  
Enhance power generation
-  **Highly reliable due to stringent quality control**  
In-house testing goes well beyond certification requirements
-  **Certified to withstand the most challenging environmental conditions**  
2400 Pa wind load · 5400 Pa snow load · 25mm hail stones at 82 km/h

### SYSTEM & PRODUCT CERTIFICATES

- IEC 61215 / IEC 61730 / UL 1703
- ISO 9001 : 2015 Quality Management System
- ISO 14001 : 2015 Environment Management System
- OHSAS 18001 : 2007 Occupational Health and Safety Management System

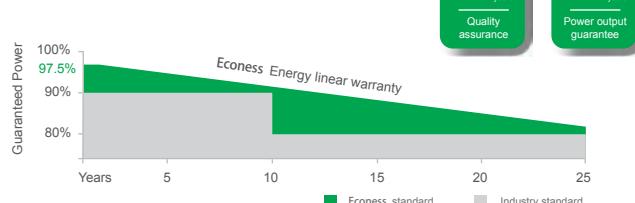


### QUALITY WARRANTY

ECONESS Energy guarantees that defects will not appear in materials and workmanship defined by IEC61215, IEC61730 or UL1703 under normal installation, use and maintenance as specified in Econess Energy's installation manual for 10 years from the warranty starting date.

### PERFORMANCE WARRANTY

#### Polycrystalline Solar Module



**10**  
years  
Quality  
assurance

**25**  
years  
Power output  
guarantee

## ELECTRICAL PARAMETERS

### Performance at STC (Power Tolerance 0 - +3%)

Maximum Power(Pmax/W)	320	325	330	335	340
Operating Voltage (Vmpp/V)	37.11	37.43	37.73	38.04	38.31
Operating Current(Impp/A)	8.63	8.69	8.75	8.81	8.88
Open-Circuit Voltage (Voc/V)	45.52	45.71	45.90	46.23	46.44
Short-Circuit Current(Isc/A)	9.16	9.23	9.29	9.33	9.40
Module Efficiency $\eta_m$ (%)	16.46	16.72	16.97	17.23	17.49

### Performance at NMOT

Maximum Power(Pmax/W)	236	240	243	247	251
Operating Voltage(Vmpp/V)	34.07	34.34	34.45	34.84	35.06
Operating Current(Impp/A)	6.93	6.99	7.05	7.10	7.16
Open-Circuit Voltage(Voc/V)	41.95	42.16	42.28	42.55	42.74
Short-Circuit Current(Isc/A)	7.43	7.47	7.52	7.56	7.62

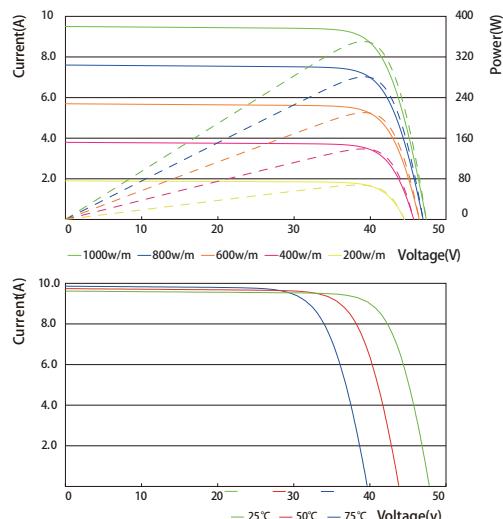
STC: Irradiance 1000W/m<sup>2</sup>, Cell Temperature 25°C, Air Mass AM1.5

NMOT: Irradiance at 800W/m<sup>2</sup>, Ambient Temperature 20°C, Wind Speed 1m/s

## MECHANICAL SPECIFICATION

Cell Type	Poly
Cell Dimensions	156.75*156.75mm(6inch)
Cell Arrangement	72(6*12)
Weight	21.5kg(47.4lbs)
Module Dimensions	1960*992*35mm(77.17*39.06*1.38inch)
Cable Length	1200mm(47.24inch)
Cable Cross Section Size	4mm <sup>2</sup> (0.006sq.in)
Front Glass	3.2mm High Transmission, Tempered Glass
No.of Bypass Diodes	3/6
Packing Configuration (1)	31pcs/Pallet,682pcs/40hq
Frame	Anodized Aluminium Alloy
Junction Box	IP68

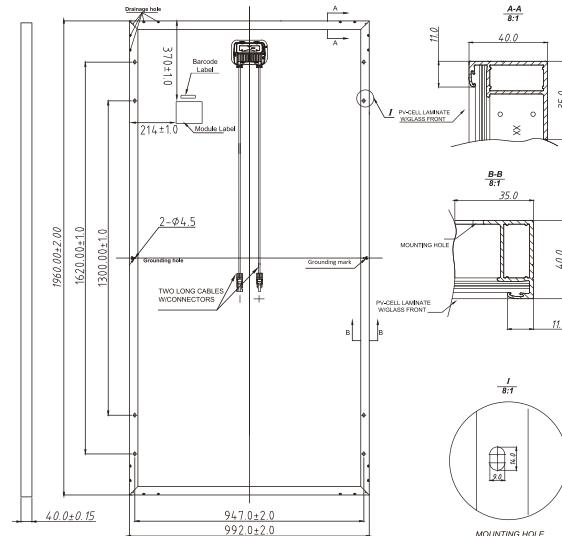
## I-V CURVE



## OPERATING CONDITIONS

Maximum System Voltage	1000V/DC(IEC)/1500V/DC(IEC)
Operating Temp	-40°C-+85°C
Maximum Series Fuse	15A/20A
Static Loading	5400Pa
Conductivity at Ground	$\leq 0.1\Omega$
Safety Class	II
Resistance	$\geq 100M\Omega$
Connector	MC4 Compatible

## TECHNICAL DRAWINGS



## TEMPERATURE COEFFICIENT

Temperature Coefficient(Pmax)	-0.40%/°C
Temperature Coefficient(Voc)	-0.31%/°C
Temperature Coefficient(Isc)	+0.06%/°C
NMOT	45±2°C

Econess Energy Co., Ltd.

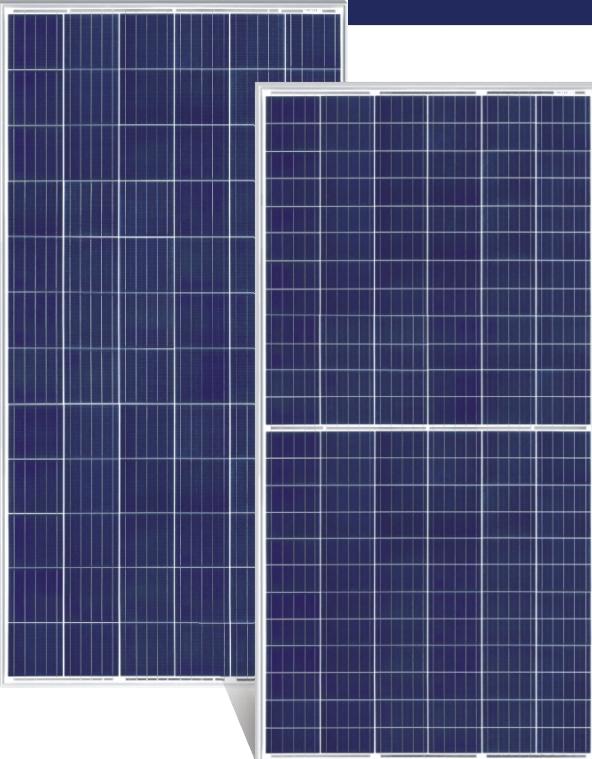
58 Haida Road, Huashi, Jiangyin, Jiangsu, P.R. China 214421 +86-510-86076868 sales@eco-pv.com www.eco-pv.com

\* This is preliminary datasheet and for reference only. The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. Econess Energy reserves the right to make necessary adjustment to the information described herein at any time without further notice.

Green Risun Grasp future

# RSM72(H)-156P

## 315 – 345W



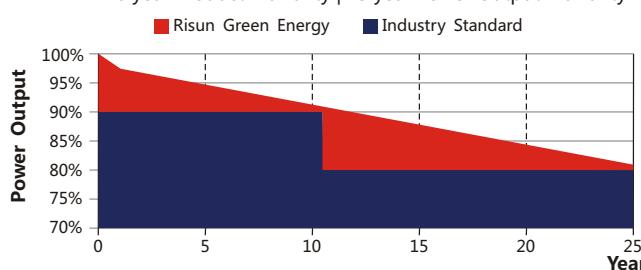
### KEY FEATURES



- PID resistant**
- Excellent module efficiency**  
System Voltage 1000V/1500V
- Positive power tolerance to +5W**
- 100% electroluminescence**
- Heavy snow load 5400 Pa**  
Wind load 2400 Pa
- IP67 junction box for long term endurance**
- 10 years product warranty**
- 25 years linear power warranty**

### LINEAR PERFORMANCE WARRANTY

10 year Product Warranty | 25 year Power Output Warranty



**Jiangxi Risun Green Energy Co.,ltd**, is a high-tech PV enterprise dedicated to research & development, production , sales & after sales service, mainly engaged in crystalline silicon solar cells, solar panels, photovoltaic systems, and PV applications. Risun is committed to offer high quality solar components, systems and services to customers around the world.

### MANAGEMENT SYSTEMS CERTIFICATES

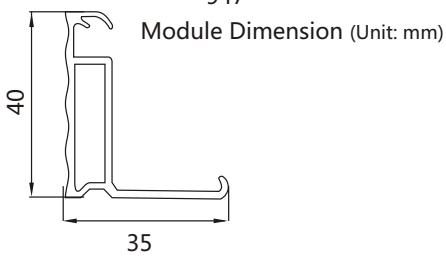
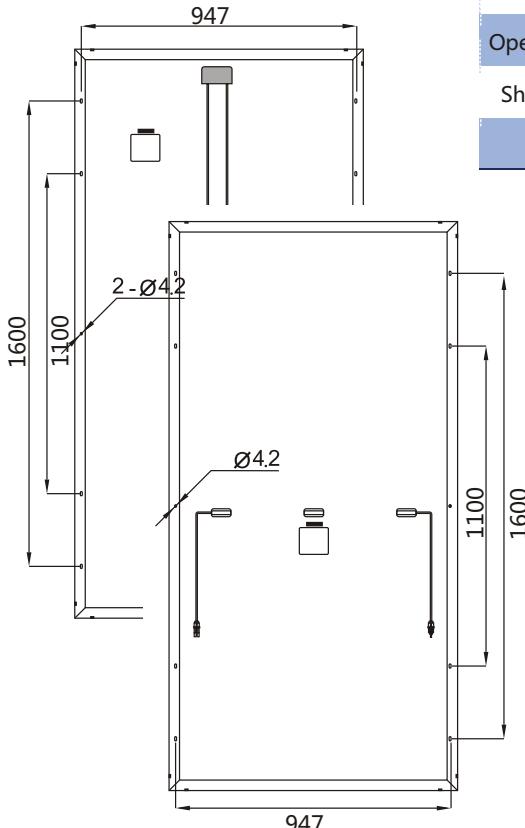


### PRODUCT CERTIFICATES



Consider: 330Wp (Full Cell Module)

# RSM72(H)-156P 315 – 345W



## ELECTRICAL CHARACTERISTICS

Maximum Power P <sub>mp</sub> , [Watt]	315	320	325	330	335	340	345
Power Tolerance, [W]				0 / +5			
Voltage at Maximum Power Point V <sub>mp</sub> , [V]	36.97	37.25	37.53	38.21	37.80	38.41	38.11
Current at Maximum Power Point I <sub>mp</sub> , [A]	8.52	8.59	8.66	8.51	8.73	8.59	8.79
Open Circuit Voltage V <sub>oc</sub> , [V]	45.60	45.80	46.00	45.58	46.20	45.78	46.40
Short Circuit Current I <sub>sc</sub> , [A]	9.04	9.09	9.15	8.93	9.23	9.03	9.27
Module Efficiency, [%]	16.2	16.5	16.7	16.4	17.0	16.6	17.3

Measurements under Standard Test Conditions (STC)  
Irradiance 1000W/m<sup>2</sup>, AM1.5G Spectrum and Cell Temperature 25°C

## MECHANICAL CHARACTERISTICS

Cell Type	Poly-crystalline, 156.75×156.75mm(78.375×2 Half Cell)
Cell Configuration	72 cells (6×12)/144 cells (12×12)
Module Dimension	1956/2000mm × 992mm × 40mm
Module Weight	21.5 kg / 22 kg
Glass	3.2mm, low Iron tempered Solar Glass
Frame	Anodized Al alloy Type 6063 T5; Silver grey
J-Box	Potted, IP67, 1000V/1500V DC, IEC & UL certified
Cable	4.0mm <sup>2</sup> / 12 AWG, 1000 mm, IP67
Connectors	QC4.10

## THERMAL CHARACTERISTICS

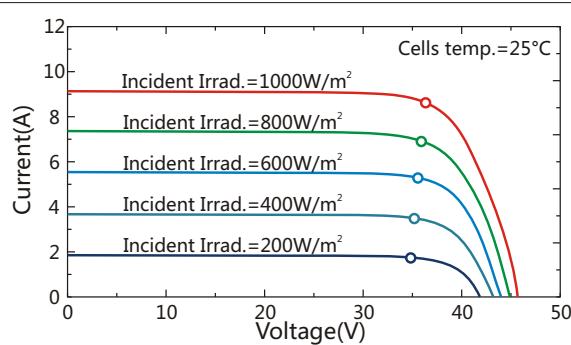
Nominal Operating Temperature NOCT	45 ± 2°C
Temperature Coefficient of I <sub>sc</sub> , $\alpha$	+0.049 %/°C
Temperature Coefficient of V <sub>oc</sub> , $\beta$	-0.309 %/°C
Temperature Coefficient of P <sub>max</sub> , $\gamma$	-0.416 %/°C

## MAXIMUM OPERATING INSTRUCTIONS

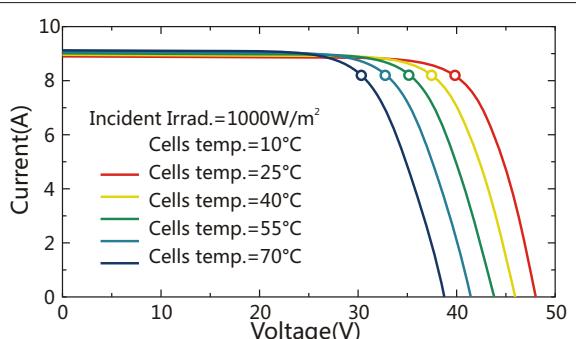
Operating Temperature	-40°C to +85°C
Maximum System Voltage	1000V/1500V
Maximum Series Fuse Rating	15A

## PACKING INSTRUCTIONS

Number Of Modules Per Box / Pallet	27
Number of Pallets / 40' Container	22



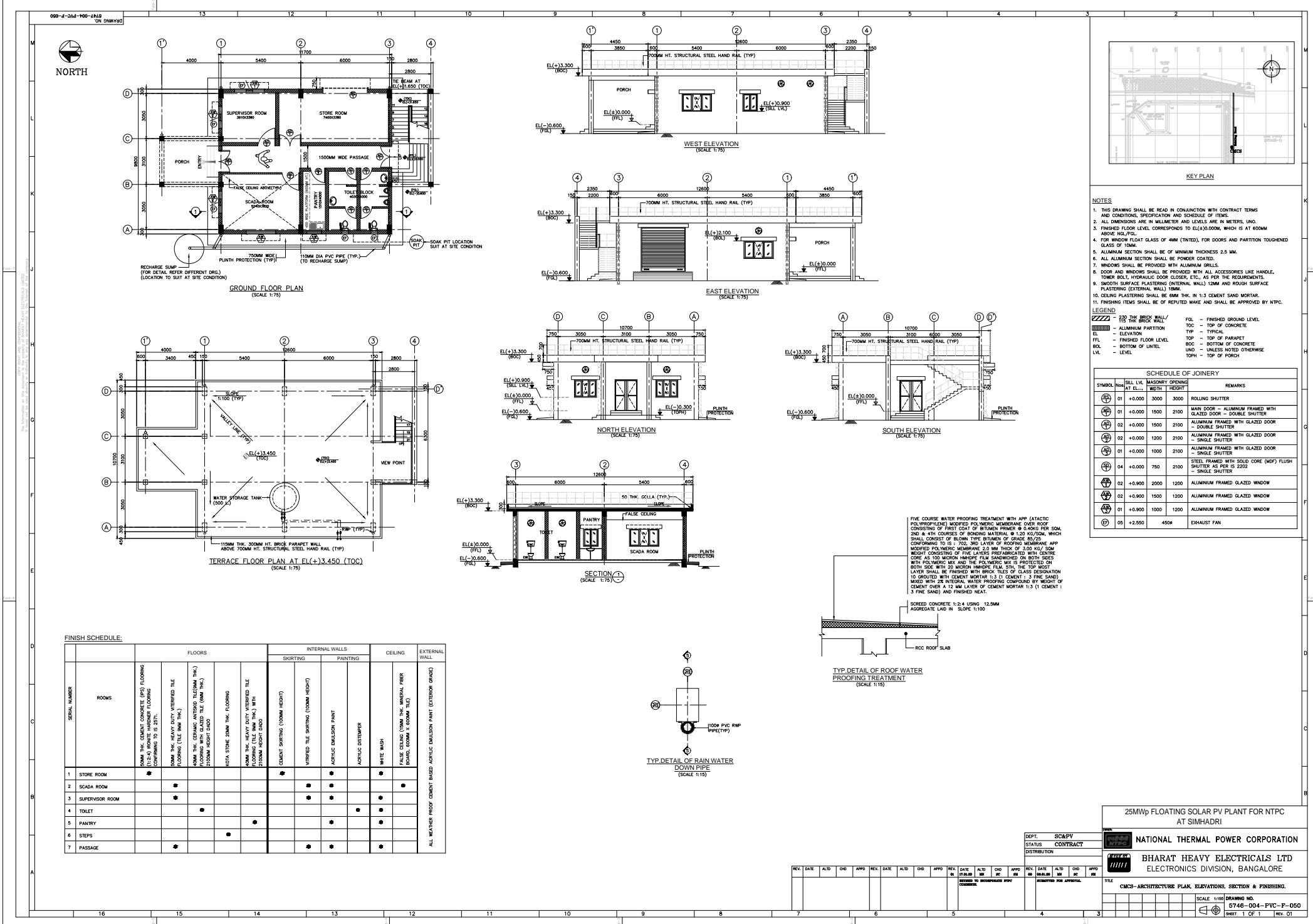
Best performance at Low Irradiance, +97% relative Module Efficiency from an Irradiance of 1000W/m<sup>2</sup> to 200W/m<sup>2</sup>



**DISCLAIMER:** Specifications included in the datasheet are subject to change without prior notice owing to continuous innovation on the Product Development and R&D activities. Risun Green Energy reserves the right to make any adjustment to the information described here. Dataset contained in this specification do not form a representative of a single module's data.

[ Rev.01 ]

## **ANNEXURE - 4**



CLAUSE NO.	TECHNICAL SPECIFICATIONS	NTPC	
<b>C-6 CABLE INSTALLATION METHODOLOGY</b>			
<b>1.0</b>	<b>CODES &amp; STANDARDS</b>		
	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		



CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>	
2.0	<p>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.</p> <p><b>DESIGN AND CONSTRUCTIONAL FEATURE</b></p> <p><b>Inter Plant Cabling</b></p> <p>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</p> <p><b>Cable Sizing Conditions</b>  <b>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 35° C and 45° C for cables laid in air.</b></p> <p><b>All XLPE cables shall be rated at 90° C conductor temperature for AC Voltage drop calculation and 80° C for DC Voltage calculation. However, for Voltage drop calculation in DC Cable, actual conductor temperature as per loading can be used.</b></p> <p><b>Trenches</b></p> <p>PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.</p> <p><b>General</b></p> <p>The cable slits to be used for motor/equipment power/control supply shall be sand filled &amp; covered with PCC after cabling.</p> <p>Sizing criteria, derating factors for the cables shall be met as per respective chapters. However for the power cables, the minimum</p>		

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<p>conductor size shall be 6 sq.mm. for aluminium conductor and 2.5 sq.mm. for copper conductor cable.</p> <p>Conscious exceptions to the above guidelines may be accepted under special conditions but suitable measures should be taken at such location to:</p> <ul style="list-style-type: none"> <li>• Meet all safety requirements</li> <li>• Safeguard against fire hazards, mechanical damage, flooding of water, oil accumulation, electrical faults/interferences, etc</li> </ul>		
3.0	<p><b>EQUIPMENT DESCRIPTION</b></p> <p><b>Cable trays, Fittings &amp; Accessories</b></p> <p>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 &amp; control cables and perforated for instrumentation cables.</p> <p>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.</p> <p>Cable trays shall have standard width of 150 mm, 300 mm &amp; 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.</p> <p>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 &amp; 75 mm with depth of 25 mm</p> <p><b>Support System for Cable Trays</b></p> <p>Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".</p> <p>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</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 95

CLAUSE NO.	TECHNICAL SPECIFICATIONS	
	<p>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:</p> <ol style="list-style-type: none"> <li>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 with springs, fixing studs, etc.</li> <li>b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised.</li> <li>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 &amp; aluminium paint shall be applied</li> <li>d. All steel components, accessories, fittings and hardware shall be hot dip galvanised after completing welding, cutting, drill ing and other machining operation.</li> <li>e. Support system shall be able to withstand <ul style="list-style-type: none"> <li>• weight of the cable trays</li> <li>• weight of the cables (75 Kg/Metre run of each cable tray)</li> <li>• Concentrated load of 75 Kg between every support span.</li> <li>• Factor of safety of minimum 1.5 shall be considered.</li> </ul> </li> </ol> <p><b>Pipes, Fittings &amp; Accessories</b></p> <p>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</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	
	<p>GI Pipes shall be of medium duty as per IS:1239</p> <p>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.</p> <p>Hume pipes shall be NP3 type as per IS 458</p> <p><b>Junction Boxes</b></p> <p>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.</p> <p>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.</p> <p><b>Terminations &amp; Straight Through Joints</b></p> <p>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 &amp; ferrule as per DIN standard.</p>	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6 PAGE 97

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC	
	<p>Straight through joint and termination shall be capable of withstanding the fault level for the system.</p> <p>1.1KV grade Straight Through Joint shall be of proven design.</p> <p><b>Cable glands</b></p> <p>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.</p> <p><b>Cable lugs/ferrules</b></p> <p>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</p> <p><b>Trefoil clamps</b></p> <p>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.</p> <p><b>Cable Clamps &amp; Straps</b></p> <p>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</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 98

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>	
4.0	<p><b>Receptacles</b></p> <p>Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped galvanised 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 polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity.</p> <p><b>Galvanising</b></p> <p>Galvanising of steel components and accessories shall conform to IS:2629 , IS4759 &amp; IS:2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.</p> <p>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</p> <p><b>Welding</b></p> <p>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</p> <p><b>INSTALLATION</b></p> <p><b>Cable tray and Support System Installation</b></p>		

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC	
	<p>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.</p> <p>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.</p> <p>The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated.</p> <p>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.</p> <p>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.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 100

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>										
	<p><b>Conduits/Pipes/Ducts Installation</b></p> <p>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 <b>either with any proven fire sealing system rated for one hour or</b> Modular multi-diameter cable sealing system consisting of frames, blocks, Compression wedge and its accessories. <b>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.</b></p> <p>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.</p> <p>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</p> <p>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</p> <table> <thead> <tr> <th><b>Conduit /pipe size (dia).</b></th><th><b>Spacing</b></th></tr> </thead> <tbody> <tr> <td>Upto 40 mm</td><td>1 M</td></tr> <tr> <td>50 mm</td><td>2.0 M</td></tr> <tr> <td>65-85 mm</td><td>2.5 M</td></tr> <tr> <td>100 mm and above</td><td>3.0 M</td></tr> </tbody> </table> <p>For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.</p> <p><b>Junction Boxes Installation</b></p>	<b>Conduit /pipe size (dia).</b>	<b>Spacing</b>	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above	3.0 M	
<b>Conduit /pipe size (dia).</b>	<b>Spacing</b>											
Upto 40 mm	1 M											
50 mm	2.0 M											
65-85 mm	2.5 M											
100 mm and above	3.0 M											
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 101									

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC
	<p>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.</p> <p><b>Cable Installation</b></p> <p>Cable installation shall be carried out as per IS:1255 and other applicable standards.</p> <p>For Cable unloading, pulling etc following guidelines shall be followed in general :</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul> <p>Cables shall be laid on cable trays strictly in line with cable schedule</p>	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6 PAGE 102

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<p>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.</p> <p>Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.</p> <p>Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ HDPE pipe.</p> <p>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.</p> <p>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.</p> <p>Wherever few cables are branching out from main trunk route troughs shall be used.</p> <p>Wind loading shall be considered for designing support as well Cable trays wherever required.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 103

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC										
	<p>Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures.</p> <p>The installation work shall be carried out in a neat workman like manner &amp; 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.</p> <p><b>Separation</b></p> <p>At least 300mm clearance shall be provided between:</p> <ul style="list-style-type: none"> <li>- HT power &amp; LT power cables,</li> <li>- LT power &amp; LT control/instrumentation cables,</li> </ul> <p>Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:</p> <table> <thead> <tr> <th>No. of cores in cable</th><th>No. of spare cores</th></tr> </thead> <tbody> <tr> <td>2C,3C</td><td>NIL</td></tr> <tr> <td>5C</td><td>1</td></tr> <tr> <td>7C-10C</td><td>2</td></tr> <tr> <td>14C and above</td><td>3</td></tr> </tbody> </table> <p><b>Directly Buried Cables</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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</li> </ul>	No. of cores in cable	No. of spare cores	2C,3C	NIL	5C	1	7C-10C	2	14C and above	3	
No. of cores in cable	No. of spare cores											
2C,3C	NIL											
5C	1											
7C-10C	2											
14C and above	3											
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-6	PAGE 104									

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC
	<p>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.</p> <p>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</p> <p>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.</p> <p><b>Cable Terminations &amp; Connections</b></p> <p>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.</p> <p>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.</p> <p>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.</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>	
	<p>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.</p> <p>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.</p> <p>All cable terminations shall be appropriately tightened to ensure secure and reliable connections</p>		
<b>DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH</b>	<b>TECHNICAL SPECIFICATION</b> <b>BID DOC. NO:RE-CS-5746-004-9</b>	<b>C-6</b>	<b>PAGE</b> <b>106</b>

CLAUSE NO.	TECHNICAL SPECIFICATIONS														
	<h3>E-1 WEATHER MONITORING STATION</h3> <p>As a part of weather monitoring station, Bidder shall provide following measuring instruments with all necessary software &amp; 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.,) to be provided by OEM of the sensors only.</p> <p>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.</p> <p>All the instruments to be supplied shall have valid calibration certificate.</p> <p>Single sensor for measuring combination of Wind Speed, Wind Direction, Relative humidity and Rainfall is also acceptable however offered sensor shall meet the specification as mentioned in following sections.</p>														
1.0	<h4>SOLAR RADIATION SENSORS</h4> <p>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.</p>														
1.1	<h4>Pyranometer</h4> <p>Bidder shall provide minimum <b>03 (Three) numbers</b> of Secondary Standard Pyranometers as per ISO 9060 <b>for measuring incident solar radiation as for following</b></p> <ul style="list-style-type: none"> <li>• <b>Global Horizontal Irradiance (GHI)- 1 Nos.</b></li> <li>• <b>Global Inclined Irradiance (GII)-1 Nos</b></li> <li>• <b>Diffuse Horizontal Irradiance (DHI)- 1 Nos</b></li> </ul> <table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>Thermopile</td></tr> <tr> <td>2.</td><td>Spectral Response.</td><td>310 to 2800 nm</td></tr> <tr> <td>3.</td><td>Sensitivity</td><td>Min 7 micro-volt/w/m<sup>2</sup></td></tr> </tbody> </table>			Sl.No	Details	Values	1.	Principle	Thermopile	2.	Spectral Response.	310 to 2800 nm	3.	Sensitivity	Min 7 micro-volt/w/m <sup>2</sup>
Sl.No	Details	Values													
1.	Principle	Thermopile													
2.	Spectral Response.	310 to 2800 nm													
3.	Sensitivity	Min 7 micro-volt/w/m <sup>2</sup>													
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	E-1 PAGE 2												

CLAUSE NO.	TECHNICAL SPECIFICATIONS		एनटीपीसी NTPC																																																
	<table border="1"> <tr><td>4.</td><td>Time response (95%):</td><td>Max 15 s</td></tr> <tr><td>5.</td><td>Non linearity:</td><td><math>\pm 0.5\%</math></td></tr> <tr><td>6.</td><td>Temperature Response:</td><td><math>\pm 2\%</math></td></tr> <tr><td>7.</td><td>Tilt error:</td><td><math>&lt; \pm 0.5\%</math>.</td></tr> <tr><td>8.</td><td>Zero offset thermal radiation:</td><td><math>\pm 7 \text{ w/m}^2</math></td></tr> <tr><td>9.</td><td>Zero offset temperature change</td><td><math>\pm 2 \text{ w/m}^2</math></td></tr> <tr><td>10.</td><td>Operating temperature range:</td><td>0 deg to +80 deg.</td></tr> <tr><td>11.</td><td>Uncertainty (95% confidence Level):</td><td>Hourly- Max-3%, Daily-Max-2%</td></tr> <tr><td>12.</td><td>Non stability:</td><td>Max <math>\pm 0.8\%</math></td></tr> <tr><td>13.</td><td>Response Time(95% of final value)</td><td>&lt;5 sec</td></tr> </table>		4.	Time response (95%):	Max 15 s	5.	Non linearity:	$\pm 0.5\%$	6.	Temperature Response:	$\pm 2\%$	7.	Tilt error:	$< \pm 0.5\%$ .	8.	Zero offset thermal radiation:	$\pm 7 \text{ w/m}^2$	9.	Zero offset temperature change	$\pm 2 \text{ w/m}^2$	10.	Operating temperature range:	0 deg to +80 deg.	11.	Uncertainty (95% confidence Level):	Hourly- Max-3%, Daily-Max-2%	12.	Non stability:	Max $\pm 0.8\%$	13.	Response Time(95% of final value)	<5 sec																			
4.	Time response (95%):	Max 15 s																																																	
5.	Non linearity:	$\pm 0.5\%$																																																	
6.	Temperature Response:	$\pm 2\%$																																																	
7.	Tilt error:	$< \pm 0.5\%$ .																																																	
8.	Zero offset thermal radiation:	$\pm 7 \text{ w/m}^2$																																																	
9.	Zero offset temperature change	$\pm 2 \text{ w/m}^2$																																																	
10.	Operating temperature range:	0 deg to +80 deg.																																																	
11.	Uncertainty (95% confidence Level):	Hourly- Max-3%, Daily-Max-2%																																																	
12.	Non stability:	Max $\pm 0.8\%$																																																	
13.	Response Time(95% of final value)	<5 sec																																																	
<p>Shadow ring/ball for measuring DHI shall require no regular adjustment for of tracker and shadow ring/ball. Pyranometer shall be shaded throughout the day and shall be exposed to diffuse solar radiation only to provide DHI value without any calculation.</p> <p>Bidder shall provide 1 nos (one) Battery powered portable logger for pyranometer supplied by the OEM of the offered Pyranometer.</p>																																																			
<p><b>1.2 Pyrheliometer (Qty -1no)</b></p> <table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr><td>1.</td><td>Spectral Response (50 % Point)</td><td>200 to 4000 nm</td></tr> <tr><td>2.</td><td>Sensitivity</td><td>Min. 7 micro-volt/w/m<sup>2</sup></td></tr> <tr><td>3.</td><td>Time response (95%)</td><td>Max 10 s</td></tr> <tr><td>4.</td><td>Non linearity</td><td>Max <math>\pm 0.5\%</math></td></tr> <tr><td>5.</td><td>Temperature Dependence of sensitivity</td><td><math>\pm 1\%</math></td></tr> <tr><td>6.</td><td>Full viewing angle</td><td><math>5^\circ \pm 0.2^\circ</math></td></tr> <tr><td>7.</td><td>Zero offset thermal radiation</td><td><math>\pm 7 \text{ w/m}^2</math></td></tr> <tr><td>8.</td><td>Zero offset due to temperature change</td><td><math>\pm 2 \text{ w/m}^2</math></td></tr> <tr><td>9.</td><td>Operating temperature range</td><td>0 deg to +80 deg.</td></tr> <tr><td>10.</td><td>Daily Uncertainty (95% confidence Level)</td><td>1%</td></tr> <tr><td>11.</td><td>Non stability</td><td>Max <math>\pm 0.8\%</math></td></tr> <tr><td>12.</td><td>Response Time(95% of final value)</td><td>&lt;5 sec</td></tr> <tr><td>13.</td><td>Temperature Sensor</td><td>PT 100/Thermistor</td></tr> <tr><td>14.</td><td>Slope Angle</td><td><math>1^\circ \pm 0.2^\circ</math></td></tr> <tr><td>15.</td><td>Sun tracker accuracy</td><td>Max <math>0.5^\circ</math></td></tr> </tbody> </table>				Sl.No	Details	Values	1.	Spectral Response (50 % Point)	200 to 4000 nm	2.	Sensitivity	Min. 7 micro-volt/w/m <sup>2</sup>	3.	Time response (95%)	Max 10 s	4.	Non linearity	Max $\pm 0.5\%$	5.	Temperature Dependence of sensitivity	$\pm 1\%$	6.	Full viewing angle	$5^\circ \pm 0.2^\circ$	7.	Zero offset thermal radiation	$\pm 7 \text{ w/m}^2$	8.	Zero offset due to temperature change	$\pm 2 \text{ w/m}^2$	9.	Operating temperature range	0 deg to +80 deg.	10.	Daily Uncertainty (95% confidence Level)	1%	11.	Non stability	Max $\pm 0.8\%$	12.	Response Time(95% of final value)	<5 sec	13.	Temperature Sensor	PT 100/Thermistor	14.	Slope Angle	$1^\circ \pm 0.2^\circ$	15.	Sun tracker accuracy	Max $0.5^\circ$
Sl.No	Details	Values																																																	
1.	Spectral Response (50 % Point)	200 to 4000 nm																																																	
2.	Sensitivity	Min. 7 micro-volt/w/m <sup>2</sup>																																																	
3.	Time response (95%)	Max 10 s																																																	
4.	Non linearity	Max $\pm 0.5\%$																																																	
5.	Temperature Dependence of sensitivity	$\pm 1\%$																																																	
6.	Full viewing angle	$5^\circ \pm 0.2^\circ$																																																	
7.	Zero offset thermal radiation	$\pm 7 \text{ w/m}^2$																																																	
8.	Zero offset due to temperature change	$\pm 2 \text{ w/m}^2$																																																	
9.	Operating temperature range	0 deg to +80 deg.																																																	
10.	Daily Uncertainty (95% confidence Level)	1%																																																	
11.	Non stability	Max $\pm 0.8\%$																																																	
12.	Response Time(95% of final value)	<5 sec																																																	
13.	Temperature Sensor	PT 100/Thermistor																																																	
14.	Slope Angle	$1^\circ \pm 0.2^\circ$																																																	
15.	Sun tracker accuracy	Max $0.5^\circ$																																																	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	E-1	PAGE 3																																															

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC																		
2.0	<b>TEMPERATURE SENSORS</b>																			
2.1	<b>Ambient Air Temperature Sensor (Qty -1 no.)</b>	<table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>RTD (Platinum) Resistance proportional to temperature</td></tr> <tr> <td>2.</td><td>Range</td><td>0-50 °C</td></tr> <tr> <td>3.</td><td>Accuracy</td><td><math>\pm 0.2</math> °C</td></tr> <tr> <td>4.</td><td>Operating Temperature</td><td>0 to 50 °C</td></tr> <tr> <td>5.</td><td>Radiation Shield</td><td>Non-aspirated Radiation Shield</td></tr> </tbody> </table>	Sl.No	Details	Values	1.	Principle	RTD (Platinum) Resistance proportional to temperature	2.	Range	0-50 °C	3.	Accuracy	$\pm 0.2$ °C	4.	Operating Temperature	0 to 50 °C	5.	Radiation Shield	Non-aspirated Radiation Shield
Sl.No	Details	Values																		
1.	Principle	RTD (Platinum) Resistance proportional to temperature																		
2.	Range	0-50 °C																		
3.	Accuracy	$\pm 0.2$ °C																		
4.	Operating Temperature	0 to 50 °C																		
5.	Radiation Shield	Non-aspirated Radiation Shield																		
2.2	<b>Indoor Air Temperature Sensor (Qty – 1 no. at each Inverter room)</b>	<table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>RTD (Platinum) Resistance proportional to temperature</td></tr> <tr> <td>2.</td><td>Range</td><td>0-70 °C</td></tr> <tr> <td>3.</td><td>Accuracy</td><td><math>\pm 0.2</math> °C</td></tr> <tr> <td>4.</td><td>Operating Temperature and calibration</td><td>0 to 70 °C</td></tr> </tbody> </table>	Sl.No	Details	Values	1.	Principle	RTD (Platinum) Resistance proportional to temperature	2.	Range	0-70 °C	3.	Accuracy	$\pm 0.2$ °C	4.	Operating Temperature and calibration	0 to 70 °C			
Sl.No	Details	Values																		
1.	Principle	RTD (Platinum) Resistance proportional to temperature																		
2.	Range	0-70 °C																		
3.	Accuracy	$\pm 0.2$ °C																		
4.	Operating Temperature and calibration	0 to 70 °C																		
2.3	<b>Module Temperature Sensor (Qty – 1 no. per 10 MW)</b>	<table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>RTD (Platinum) Resistance proportional to temperature</td></tr> <tr> <td>2.</td><td>Range</td><td>0-100 °C</td></tr> <tr> <td>3.</td><td>Accuracy</td><td><math>\pm 0.2</math> °C</td></tr> <tr> <td>4.</td><td>Operating Temperature</td><td>0 to 100 °C</td></tr> </tbody> </table>	Sl.No	Details	Values	1.	Principle	RTD (Platinum) Resistance proportional to temperature	2.	Range	0-100 °C	3.	Accuracy	$\pm 0.2$ °C	4.	Operating Temperature	0 to 100 °C			
Sl.No	Details	Values																		
1.	Principle	RTD (Platinum) Resistance proportional to temperature																		
2.	Range	0-100 °C																		
3.	Accuracy	$\pm 0.2$ °C																		
4.	Operating Temperature	0 to 100 °C																		
3.0	Module temperature sensor shall be fixed on the back of module surface with adhesive or tape without using any mechanical fastener.																			
3.0	<b>WIND SPEED SENSOR (Qty- 1no)</b>	<table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>Frequency proportional to wind speed/Ultrasonic Sensor</td></tr> <tr> <td>2.</td><td>Velocity range</td><td>0-60 m/ sec</td></tr> <tr> <td>3.</td><td>Threshold</td><td>0.3 m/s</td></tr> <tr> <td>4.</td><td>Operating Temperature</td><td>0 to 50 deg C</td></tr> </tbody> </table>	Sl.No	Details	Values	1.	Principle	Frequency proportional to wind speed/Ultrasonic Sensor	2.	Velocity range	0-60 m/ sec	3.	Threshold	0.3 m/s	4.	Operating Temperature	0 to 50 deg C			
Sl.No	Details	Values																		
1.	Principle	Frequency proportional to wind speed/Ultrasonic Sensor																		
2.	Velocity range	0-60 m/ sec																		
3.	Threshold	0.3 m/s																		
4.	Operating Temperature	0 to 50 deg C																		
3.1	<b>Wind Direction Sensor (Qty- 1no)</b>																			
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9																		
		E-1																		
		PAGE 4																		

CLAUSE NO.	TECHNICAL SPECIFICATIONS																	
	<table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Principle</td><td>Potentiometric type sensor (Resistance proportional to Wind direction) /Ultrasonic Sensor</td></tr> <tr> <td>2.</td><td>Range</td><td>0-360 deg</td></tr> <tr> <td>3.</td><td>Accuracy</td><td><math>\pm 5^\circ</math></td></tr> <tr> <td>4.</td><td>Operating Temperature</td><td>0 to 50 deg C</td></tr> </tbody> </table>			Sl.No	Details	Values	1.	Principle	Potentiometric type sensor (Resistance proportional to Wind direction) /Ultrasonic Sensor	2.	Range	0-360 deg	3.	Accuracy	$\pm 5^\circ$	4.	Operating Temperature	0 to 50 deg C
Sl.No	Details	Values																
1.	Principle	Potentiometric type sensor (Resistance proportional to Wind direction) /Ultrasonic Sensor																
2.	Range	0-360 deg																
3.	Accuracy	$\pm 5^\circ$																
4.	Operating Temperature	0 to 50 deg C																
4.0	<b>RAIN GUAGE (Qty- 1no)</b> <p>Rain Gauge shall be of Self Recording Type and recording facility shall be provided in Electronics. The Gauge shall be rugged having material of construction resistant to atmospheric corrosion. The Instrument shall have automatic functions for computing rainfall for pre set time periods.</p> <table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Accuracy</td><td>5% or Below</td></tr> <tr> <td>2.</td><td>Sensitivity</td><td>1.0 mm</td></tr> <tr> <td>3.</td><td>Operating Temperature</td><td>0 to 50 deg C</td></tr> </tbody> </table>			Sl.No	Details	Values	1.	Accuracy	5% or Below	2.	Sensitivity	1.0 mm	3.	Operating Temperature	0 to 50 deg C			
Sl.No	Details	Values																
1.	Accuracy	5% or Below																
2.	Sensitivity	1.0 mm																
3.	Operating Temperature	0 to 50 deg C																
5.0	<b>RELATIVE HUMIDITY SENSOR (Qty-1 No.)</b> <table border="1"> <thead> <tr> <th>Sl.No</th><th>Details</th><th>Values</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Range</td><td>0-100 %</td></tr> <tr> <td>2.</td><td>Accuracy</td><td><math>\pm 3\%</math></td></tr> <tr> <td>3.</td><td>Resolution</td><td>1%</td></tr> <tr> <td>4.</td><td>Operating Temperature</td><td>0 to 50 deg C</td></tr> </tbody> </table>			Sl.No	Details	Values	1.	Range	0-100 %	2.	Accuracy	$\pm 3\%$	3.	Resolution	1%	4.	Operating Temperature	0 to 50 deg C
Sl.No	Details	Values																
1.	Range	0-100 %																
2.	Accuracy	$\pm 3\%$																
3.	Resolution	1%																
4.	Operating Temperature	0 to 50 deg C																
6.0	<b>METEOROLOGICAL MAST</b> <p>One Meteorological Mast of telescopic type and of specified height to be placed on an existing structure (such as Buildings etc) so that height of the Meteorological Sensors from the Ground Level (GL) is 10 meters. The Mast is required for mounting the Meteorological Sensors. Necessary Hangers and Holders along with electrical Grounding Set shall be provided by the vendor for installation of the Sensors. Material of Construction of the Mast shall be metallic and robust and shall be resistant to atmospheric corrosion. Fencing shall be provided for weather monitoring station.</p>																	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	E-1															
			PAGE 5															

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC																
7.0	<p><b>CALIBRATION</b></p> <p>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.</p>																	
8.0	<p><b>DATA LOGGER</b></p> <p>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:</p> <table border="1"> <tbody> <tr> <td>Processor</td><td>32 bits</td></tr> <tr> <td>Time synchronization</td><td>With Built in GPS Clock or with Solar SCADA GPC Clock</td></tr> <tr> <td>Wireless communication</td><td>GSM/GPRS Modem</td></tr> <tr> <td>Data storage</td><td>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.</td></tr> <tr> <td>Display</td><td>LCD display for easy maintenance and debugging for site engineer</td></tr> <tr> <td>Scan resolution</td><td>1 Sec</td></tr> <tr> <td>Analog to Digital Converter (ADC)</td><td>16 Bit, Sampling -10 Hz (Min)</td></tr> <tr> <td>I/P Channel</td><td>As required with 20 % spare of each type of channel</td></tr> </tbody> </table> <p>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.</p>	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	
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																	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 નાન્ટીપ્રોસી NTPC	
	<p>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.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	E-1	PAGE 7



# PURCHASE SPECIFICATION

## UPS WITH Ni-Cd BATTERY BANK

### 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 - 5KVA along with Ni-Cd Battery bank	1 set
2	UPS System - 3KVA, along with Ni-Cd Battery bank	4 set

**Note: NTPC approved vendors only are acceptable.**

### 3.0 Technical specifications

The UPS system shall meet the following minimum specifications.

1.0	<b>Type</b>	<ol style="list-style-type: none"> <li>1. UPS System - 5KVA along with Ni-Cd Battery bank shall be required for PCU (placed on Inverter platform) nearest to CMCS. Total requirement of CMCS and local PCU/HT panel and other auxiliary requirements are included.</li> <li>2. 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.</li> </ol>
2.0	<b>Configuration</b>	<p>UPS system shall have <b>2x100% configuration</b>, at a time one inverter 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.</p>
3.0	<b>Charger</b>	<p>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 <math>\pm 10\%</math> and</p>



## PURCHASE SPECIFICATION

### UPS WITH Ni-Cd BATTERY BANK

PS-439-UPS

REV NO: 00

PAGE: 2 OF 7

frequency variation of  $\pm 5\%$ .

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.



## PURCHASE SPECIFICATION

### UPS WITH Ni-Cd BATTERY BANK

PS-439-UPS

REV NO: 00

PAGE: 3 OF 7

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



## PURCHASE SPECIFICATION

### UPS WITH Ni-Cd BATTERY BANK

PS-439-UPS

REV NO: 00

PAGE: 4 OF 7

		<p>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.</p> <p>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 &amp; RAL 5012 for end covers.</p> <p>All acceptance and routine tests as per the manufacture recommendations and relevant standards shall be carried out.</p> <p>The cabinets shall be IP-42 protection class for indoor application and IP65 for outdoor application.</p> <p>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.</p> <p>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</p>
4.0	<b>Battery</b>	<p><b>BATTERY: NICKEL-CADMIUM BATTERY</b></p> <p>Ni-Cd vented type, pocket plate high discharge battery of adequate capacity to meet the requirement of UPS, generally conforming to IS-10918.</p> <p><b>BATTERY PARAMETERS</b></p> <ul style="list-style-type: none"><li>a) Battery Voltage : To be decide during Detail Engineering</li><li>b) No. of Cells : To be decide during Detail Engineering</li><li>c) Battery type : Nickel-Cadmium</li><li>d) Nominal discharge voltage per Cell: 1.2 V</li><li>e) Float voltage : 1.42V/Cell</li></ul> <p>Batteries should be suitable for continuous operation for the maximum ambient temperature as defined in technical parameters.</p> <p><b>CODES AND STANDARDS</b></p> <p>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:</p> <p>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</p> <p>Equipment complying with other internationally accepted standards such as</p>

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 I<sub>2</sub> 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.



## PURCHASE SPECIFICATION

### UPS WITH Ni-Cd BATTERY BANK

PS-439-UPS

REV NO: 00

PAGE: 6 OF 7

		<p>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.</p> <p><b>d) Sediment Space</b> Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.</p> <p><b>e) Electrolyte</b> 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.</p> <p><b>f) Connectors and Fasteners</b> 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.</p> <p><b>g) Battery racks</b> 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.</p> <p><b>h) Test</b> 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 &amp; Inspection table of battery.</p>
5.0	<b>Inverter</b>	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	<b>Efficiency</b>	a) 100% Full load- 80%
	<b>Synchronization</b>	Between inverter & standby AC source shall be within 47 Hz to 53 Hz field adjustable.



## PURCHASE SPECIFICATION

### UPS WITH Ni-Cd BATTERY BANK

PS-439-UPS

REV NO: 00

PAGE: 7 OF 7

7.0	<b>limit</b>	Inverter shall remain synchronized with the AC mains.
8.0	<b>Inverter protection</b>	Overload, short circuit and 100% loss of load.
9.0	<b>Load sharing</b>	<p>At a time one inverter 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.</p> <p>Power shall be transferred to the standby AC power without a break in synchronization if within limit in case of failure of both inverters.</p> <p>Asynchronous transfer to standby AC source in case inverters are being out of synchronism limit with AC mains.</p>
10.0	<b>Static switch</b>	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	<b>Enclosure</b>	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	<b>Spare feeders</b>	25%
13.0	<b>Accessories</b>	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.

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC																																																						
	<b>E-2 FIRE FIGHTING AND ALARM SYSTEM</b>																																																							
	<p>The SPV plant shall be equipped with suitable fire protection &amp; fire fighting systems for protection of entire equipment switchyard &amp; control room as per CEIG requirements.</p>																																																							
1.0	<p>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.</p>																																																							
2.0	<p>The fire fighting system for the proposed power plant for fire protection shall be consisting of:</p> <ul style="list-style-type: none"> <li>a) Sand buckets</li> <li>b) Portable fire extinguishers</li> <li>c) Microprocessor based fire alarm panel.</li> </ul>																																																							
2.1	<p><b>Portable Fire Extinguishers and Sand Buckets</b></p> <p>Bidder to provide following numbers of type tested portable fire extinguishers as per relevant code in the rooms mentioned below.</p> <table border="1"> <thead> <tr> <th>Rooms</th><th>DCP Type (ABC type) (10 Kg. Capacity)</th><th>CO<sub>2</sub> Type 9 kg capacity</th><th>Foam Type Hand 9 kg</th><th>Hand Portable pressurized water CO<sub>2</sub> 9 Litre</th><th>Sand Buckets</th></tr> </thead> <tbody> <tr> <td>Control Room</td><td>2</td><td>2</td><td>1</td><td>1</td><td>1</td></tr> <tr> <td>Each Inverter Room</td><td>1</td><td>1</td><td></td><td></td><td></td></tr> <tr> <td>ACDB Room (If applicable)</td><td>1</td><td>1</td><td></td><td></td><td></td></tr> <tr> <td>Each Transformer Yard</td><td>1</td><td>1</td><td>1</td><td></td><td>1</td></tr> <tr> <td>Switchyard/ Metering Yard</td><td>2</td><td>2</td><td></td><td></td><td>1</td></tr> <tr> <td>Security Room</td><td></td><td>1</td><td></td><td>2</td><td></td></tr> <tr> <td>Pantry</td><td></td><td></td><td></td><td>2</td><td></td></tr> <tr> <td>Storage Shed</td><td>1</td><td>1</td><td>1</td><td>1</td><td></td></tr> </tbody> </table>		Rooms	DCP Type (ABC type) (10 Kg. Capacity)	CO <sub>2</sub> Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water CO <sub>2</sub> 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	Switchyard/ Metering Yard	2	2			1	Security Room		1		2		Pantry				2		Storage Shed	1	1	1	1	
Rooms	DCP Type (ABC type) (10 Kg. Capacity)	CO <sub>2</sub> Type 9 kg capacity	Foam Type Hand 9 kg	Hand Portable pressurized water CO <sub>2</sub> 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																																																			
Switchyard/ Metering Yard	2	2			1																																																			
Security Room		1		2																																																				
Pantry				2																																																				
Storage Shed	1	1	1	1																																																				
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9																																																						
		E-2																																																						
		PAGE 8																																																						

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
2.2	<p><b>Microprocessor based fire alarm panel</b></p> <p>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</p> <ul style="list-style-type: none"> <li>a. Fire Alarm control Panel</li> <li>b. Multi Sensor smoke detector</li> <li>c. Heat Detectors</li> <li>d. Hooter cum strobe</li> <li>e. Manual call Point</li> <li>f. Hooter</li> <li>g. Fault isolation modules</li> <li>h. Control Modules</li> <li>i. Cables from Sensors to Fire panels.</li> <li>j. Digital output from the fire detection system shall be integrated with SCADA</li> <li>k. Network Control Module</li> <li>l. Interfacing of Fire Alarm System with SCADA for display and storage of status and alarm in SCADA</li> </ul> <p>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.</p> <p>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.</p>		
2.3	<p><b>Fire Alarm Control Panel Indication</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>ii. During an alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged.</li> <li>iii. If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated.</li> </ul>	E-2	PAGE 9

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 નાન્દીપાંડી NTPC	
	<p>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</p> <p>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.</p> <p>Bidder shall submit document to employer for approval that will include fire alarm system configuration, layout, BoM, Datasheet and necessary test report.</p> <p>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.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	E-2	PAGE 10

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
1.0	<p align="center"><b>C-14 33 KV OUTDOOR METERING YARD EQUIPMENT</b></p> <p><b>SCOPE AND GENERAL INFORMATION</b></p> <p><b>GENERAL INFORMATION</b></p> <p>This specification intends to cover the following activities, services and works in respect 33kV Metering yard equipments for Floating Solar Project at NTPC Simhadri situated in the state of Andhra Pradesh, India:</p> <p>This specification is applicable in case where contractor intends to implement metering through Outdoor yard equipments.</p> <p>In addition to the requirements indicated in this section (Technical specifications), all the requirements as stated in other sections shall also be considered as a part of this specification as if completely bound herewith.</p> <p>The Bidder shall be responsible for providing all material, equipment and services specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification. The systems, sub-systems and equipment shall conform in all respect to high standards of engineering, design and workmanship, and shall be capable of performing in continuous commercial operation.</p> <p>1.01.01 The scope of work comprises of</p> <ul style="list-style-type: none"> <li>i) Execution of 33 kV Metering yard equipments with suitable rating ACSR conductors/ IPS Al tube and terminal connectors.</li> <li>ii) Power evacuation from local pooling switchgears through Pot-head interface points and subsequent interconnection to Existing Misc. Switchgear as shown in the Single Line Diagram.</li> </ul> <p>The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacturer's works, packing, supply, transportation, transit insurance, and delivery to site, unloading, storage and equipment erection, associated civil and structural works. Further, it shall include cabling, lighting, lightning protection, earthing, association of sub vendors if any in the erection, supervision, site testing, inspection and commissioning 33 kV Metering yard.</p>
Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5746-004-9
C-14	PAGE 1

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
1.01.02	This scope covers all the work required for detailed soil investigation. It shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, carrying out field investigation and tests, laboratory tests, analysis and interpretation of data and results, collecting data regarding geographical conditions from local sources, giving flood details of the area (past history), preparations for the type of foundations and the safe bearing capacity for different sizes of foundations and different founding strata for the various locations.
1.01.03	The equipment and materials to be supplied by the Contractor shall form a complete 33 kV Metering yard. The equipment and services as detailed in all sections of the bidding documents and as shown on the tender drawings shall be within the scope of supply of the Contractor.
<b>1.02</b>	<b>DETAILED SCOPE OF WORK - ELECTRICAL</b>
1.02.01	Contractor shall be responsible for design and engineering of overall system/station, and all elements, systems, sub-systems, facilities, equipments, material, etc. The Contractor shall submit design calculations, drawings, codes, codes of practices, construction drawings, etc. for Employer's approval.
1.02.02	<p>The basic design shall include, but not limited to, the following:</p> <ul style="list-style-type: none"> <li>a) Development of general arrangement.</li> <li>b) Development of detailed layout (plan &amp; section/elevation) drawings.</li> <li>c) Development of single line diagram with parameters of equipment and details of protection.</li> <li>d) Protection and control philosophy and selection of protection, control and annunciation schemes.</li> <li>e) Development of interlocking schemes.</li> <li>f) Development of switchyard structure loading details.</li> <li>g) Development of earthing system</li> <li>h) Development of direct stroke lightning protection system.</li> <li>i) Insulation coordination of the HV equipment.</li> <li>j) Calculation of static and dynamic force load, and selection of spacer spans and equipment terminal loading.</li> <li>k) Development of clearance diagrams.</li> <li>l) Lighting design, Lux level calculation and conduit wiring diagram.</li> <li>m) Development of power &amp; control cable laying and termination schedules.</li> </ul>

CLAUSE NO.	TECHNICAL SPECIFICATIONS
	<p>n) Relay setting calculations.</p> <p>o) Development of erection key diagram with bill of material.</p> <p>p) Foundation design and construction drawings.</p> <p>q) Development of cable trench layout and sections and construction drawings.</p> <p>r) Effect of nearby conductors due to electric field adjoining building and providing shielding.</p>
1.02.03	<p>Contractor shall furnish detailed drawings for the various equipments covered in their scope for Employer's approval. The equipment shall conform to type tests as per specification and applicable standards and reports of the same shall be furnished for approval.</p>
1.02.04	<p>Contractor shall furnish design calculations and construction drawings for all civil works showing details of pockets to be left in foundations and embedments to be provided in cable trenches.</p> <p>Contractor shall furnish the schematics, general arrangement drawings, cable schedules, interconnection schedules, panel wiring diagrams, etc. for various control and relay panels for Employer's approval. Contractor shall also furnish the recommended relay settings to be adopted.</p>
1.02.05	<p>The Contractor shall note that the list of standards specified elsewhere in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specification, IS &amp; IEC. In case governing standards for the equipment is different from IS or IEC, the salient points shall be clearly brought out along with English language version of the same.</p>
1.02.06	<p>Exposed live parts shall be placed high enough above ground to meet the requirements of Indian Electricity Rules and other statutory codes. All responsibilities regarding co-ordination with Electrical Inspection Agencies and obtaining clearance certificate from them rests with the Contractor.</p>
1.02.07	<p>For 33kV metering yard, the equipment interconnections shall be through suitable rating ACSR conductor/3" IPS Al. tube. As far as possible, the conductor shall pass without cut/joints unless otherwise necessary for planned shutdown/ maintenance.</p> <p>All equipment shall be supplied with suitable terminal connectors. The terminal connector shall be well coordinated with the type/size of conductor</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>						
1.02.08	<p>and equipment to be connected. The conductor terminations for equipment shall be either rigid or expansion type suitable for 3" IPS Al. tube or horizontal or vertical take off suitable for sufficient rating ACSR conductor. The exact requirement &amp; type of terminal clamps would be finalized by the Contractor in consultation with Employer based on layout requirement. The terminal pads shall preferably be capable of taking the required conductor span under normal, short circuit and meteorological conditions, without effecting the performance of the equipment.</p> <p>The rigid busbars for equipment inter connections shall have rigid connections at one end and expansion /flexible at other end. The tubular Al connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall workout the cut lengths of Aluminum tube based on the finalized layout &amp; dispatch the same to site without requiring Owner's approval. Corona Bell shall be provided at the end of the rigid busbars. The connectors and clamps shall be rated same as the connected equipments.</p> <p>The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 meters</p> <p>The various minimum heights of the switchyard shall be as given below from plinth level:</p> <table border="1"> <thead> <tr> <th>Voltage level</th> <th>Eqpt./1<sup>st</sup> level</th> <th>2<sup>nd</sup> level</th> </tr> </thead> <tbody> <tr> <td>33 KV</td> <td>4000 mm</td> <td>----</td> </tr> </tbody> </table>	Voltage level	Eqpt./1 <sup>st</sup> level	2 <sup>nd</sup> level	33 KV	4000 mm	----
Voltage level	Eqpt./1 <sup>st</sup> level	2 <sup>nd</sup> level					
33 KV	4000 mm	----					
1.02.09	Circuit breakers (as applicable) shall be supplied with necessary interpole cabling and its cost shall be included in the cost of equipment.						
1.02.010	All equipment shall be suitable for hot line washing.						
1.02.011	The Contractor shall cooperate in all respects and exchange the necessary technical data/ drawings with other agencies and Employer's other Contractors under intimation to Employer to ensure proper coordination and completion of work in time.						
1.02.012	Short circuit force calculation shall be submitted by the bidder as per relevant IEC for flexible & rigid bus as applicable. This short circuit force						
Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5746-004-9	C-14	PAGE 4				

CLAUSE NO.	TECHNICAL SPECIFICATIONS
	<p>shall be considered for designing of Tower, Girder and equipment structure and their foundation as applicable.</p> <p>1.02.013 The sag tension, conductor spacing, short circuit forces, spacer location, conductor swing and clearances shall be carried out in accordance with IEC 60865 to achieve the specified clearances.</p> <p>1.02.014 In 33 kV metering yard, one no. of bay marshalling box (BMK) is to be provided for all feeders. The duplicated power supplies for two (2) BMKs shall be looped.</p> <p>1.02.015 All the cables used for the switchyard shall be armoured type.</p> <p>1.02.016 Gravel filling shall be provided in the entire Outdoor/metering yard area with broken stone filling which shall consist of two layers. The first layer shall be 75mm thick base course of 20mm of normal size and second layer shall be 75 mm thick surface course of 40 mm nominal size.</p> <p>1.02.017 The metering/outdoor yard shall be provided with roads for approach for major equipments for maintenance purpose.</p> <p>1.02.018 The cable trenches shall be provided for all the major equipments in the switchyard. The Contractor shall construct the common sections suitably of appropriate sizes upto common points so that the same can be extended in future.</p> <p>1.02.019 For earthing 50x6 mm GS flat shall be used in all cabinets, MOM boxes, panels and balance all other earthing such as all equipments, towers, LM, cable trenches etc shall be through 75x12mm GS Flat.</p> <p>1.02.020 The illumination level shall be 20 lux in general and 50 lux on equipment boxes. Lighting Mast/Lightning Mast shall be used for mounting lighting fixtures for metering yard lighting. No lighting fixture shall be mounted on towers/gantries.</p> <p>1.02.021 Voltage drop for sizing of power cables shall not be more than 6%. The connectors and clamps shall be rated same as the connected equipments.</p> <p><b>1.03 CLEARANCES</b></p> <p>The minimum clearances shall be as given below:</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																		
	<table border="1"> <tr> <td><b>Clearance</b></td><td><b>33 kV</b></td></tr> <tr> <td>Phase to earth clearance</td><td>320 mm</td></tr> <tr> <td>Phase to phase clearance</td><td>320 mm</td></tr> <tr> <td>Section clearance</td><td>3000 mm</td></tr> <tr> <td>Ground clearance</td><td>3700 mm</td></tr> </table>	<b>Clearance</b>	<b>33 kV</b>	Phase to earth clearance	320 mm	Phase to phase clearance	320 mm	Section clearance	3000 mm	Ground clearance	3700 mm								
<b>Clearance</b>	<b>33 kV</b>																		
Phase to earth clearance	320 mm																		
Phase to phase clearance	320 mm																		
Section clearance	3000 mm																		
Ground clearance	3700 mm																		
1.04	<p>The Contractor shall supply the structures suitable to meet the above clearances.</p> <p><b>SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING SUPPLIED</b></p> <p>All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.</p>																		
1.04.01	<p><b>SITE SUPERVISION OF EQUIPMENTS</b></p> <p>The contractor shall ensure that, erection, testing and commissioning of, Circuit Breaker, Isolator, Instrument Transformers, Surge Arrestor, Control &amp; Protection System and Protective relays is carried out, under the supervision of manufacturer of respective equipment.</p>																		
1.05	<p><b>SYSTEM PARAMETERS</b></p> <p>The system parameters shall be as under:</p> <table border="1"> <tr> <td><b>Parameter</b></td><td><b>33 kV</b></td></tr> <tr> <td>a) Highest system voltage</td><td>36 kV rms</td></tr> <tr> <td>b) Lightning Impulse voltage</td><td><math>\pm 170 \text{ kVp}</math></td></tr> <tr> <td>c) Power frequency withstand for 1 min.</td><td>70 kV (rms)</td></tr> <tr> <td>d) Max. fault level (1 sec)</td><td>As per SLD</td></tr> <tr> <td>e) Minimum creepage distance</td><td>1116 mm</td></tr> <tr> <td>f) Rated ambient temperature</td><td>50 deg. C</td></tr> <tr> <td>g) System earthing</td><td>Effectively earthed</td></tr> <tr> <td>h) Rated frequency</td><td>50 Hz</td></tr> </table>	<b>Parameter</b>	<b>33 kV</b>	a) Highest system voltage	36 kV rms	b) Lightning Impulse voltage	$\pm 170 \text{ kVp}$	c) Power frequency withstand for 1 min.	70 kV (rms)	d) Max. fault level (1 sec)	As per SLD	e) Minimum creepage distance	1116 mm	f) Rated ambient temperature	50 deg. C	g) System earthing	Effectively earthed	h) Rated frequency	50 Hz
<b>Parameter</b>	<b>33 kV</b>																		
a) Highest system voltage	36 kV rms																		
b) Lightning Impulse voltage	$\pm 170 \text{ kVp}$																		
c) Power frequency withstand for 1 min.	70 kV (rms)																		
d) Max. fault level (1 sec)	As per SLD																		
e) Minimum creepage distance	1116 mm																		
f) Rated ambient temperature	50 deg. C																		
g) System earthing	Effectively earthed																		
h) Rated frequency	50 Hz																		
1.06	<p><b>TYPE TEST REQUIREMENTS FOR EQUIPMENTS</b></p> <p>a) All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out</p>																		

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p>not earlier than ten years prior to the date of techno-commercial bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.</p> <p>b) However if contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.</p> <p>c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.</p> <p>d) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and 'No Design Change'. Minor changes if any shall be highlighted on the endorsement sheet.</p>
2.0	<b>33 kV MAIN EQUIPMENT</b>
2.01	<b>CIRCUIT BREAKER (If applicable)</b> <p>Circuit Breakers shall be outdoor type, comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to IEC- 62271-100 or equivalent Indian Standard.</p>
2.01.01	<b>DUTY REQUIREMENTS</b> <p>Circuit breaker shall be totally restrike free under all duty conditions and shall be capable of performing their duties without opening resistor. The circuit breaker shall meet the duty requirement of any type of fault or fault location and shall be suitable for line charging and dropping when used on 33 kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily.</p> <p>The circuit breaker shall be capable for breaking the steady &amp; transient magnetizing current corresponding to 33 kV transformers. It shall also be</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
2.01.02	<p>capable of breaking line charging currents as per IEC- 62271-100 with a voltage factor of 1.4.</p> <p>The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC:62271-100.</p> <p>The circuit breaker shall be reasonably quiet in operation. Noise level in excess of 140 dB measured at base of the breaker would be unacceptable. Bidder shall indicate the noise level of breaker at distance of 50 to 150 m from base of the breaker.</p> <p>The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic pressure etc. While furnishing the proof of the total break time of complete circuit breaker, the Bidder may specifically bring out the effect of non-simultaneity between same pole and poles and show how it is covered in the guaranteed total break time.</p> <p>While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC-62271-100 requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.</p> <p>The critical current which gives the longest arc duration at lock out pressure of extinguishing medium and the duration shall be indicated.</p> <p>All the duty requirements specified above shall be provided with the support of adequate test reports to be furnished along with the bid.</p> <p><b>OPERATING MECHANISM</b></p> <p>Circuit Breaker shall be operated by electrically spring charged mechanism only.</p> <p>The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas. The circuit breaker shall be able to perform the duty cycle without any interruption.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																																
	<p>Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local / remote' selector switch and close &amp; trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided.</p> <p>Operating mechanism and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables, etc.</p>																																
2.01.03	<p><b>GENERAL PARAMETER</b></p> <table border="1"> <tbody> <tr><td>Type of circuit breaker</td><td>Vacuum/SF6 type</td></tr> <tr><td>Highest system Voltage</td><td>36 kV</td></tr> <tr><td>Rated continuous current</td><td>Min. 630 A at rated ambient temperature current capacity</td></tr> <tr><td>Rated frequency</td><td>50 Hz</td></tr> <tr><td>Number of poles</td><td>Three (3)</td></tr> <tr><td>Rated/minimum power frequency Withstand voltage</td><td>70 kV</td></tr> <tr><td>Rated lightning impulse Withstand voltage</td><td>170 kV</td></tr> <tr><td>Minimum Creepage distance</td><td>31 mm/kV of highest system voltage</td></tr> <tr><td>Rated operating duty cycle</td><td>O - 0.3 sec. - CO - 3min. – CO</td></tr> <tr><td>Rated line charging breaking Current (voltage factor of 1.4)</td><td>As per IEC</td></tr> <tr><td>Reclosing</td><td>Three phase high speed auto reclosing</td></tr> <tr><td>Maximum fault level</td><td>As per SLD</td></tr> <tr><td>Total closing time</td><td>Not more than 150 ms.</td></tr> <tr><td>Auxiliary contacts</td><td>As required plus 4NO and 4NC contacts per pole as spare.</td></tr> <tr><td>Noise level</td><td>Maximum 140dB at 50m distance from base of circuit breaker</td></tr> <tr><td>Seismic acceleration</td><td>0.3g horizontal</td></tr> </tbody> </table>	Type of circuit breaker	Vacuum/SF6 type	Highest system Voltage	36 kV	Rated continuous current	Min. 630 A at rated ambient temperature current capacity	Rated frequency	50 Hz	Number of poles	Three (3)	Rated/minimum power frequency Withstand voltage	70 kV	Rated lightning impulse Withstand voltage	170 kV	Minimum Creepage distance	31 mm/kV of highest system voltage	Rated operating duty cycle	O - 0.3 sec. - CO - 3min. – CO	Rated line charging breaking Current (voltage factor of 1.4)	As per IEC	Reclosing	Three phase high speed auto reclosing	Maximum fault level	As per SLD	Total closing time	Not more than 150 ms.	Auxiliary contacts	As required plus 4NO and 4NC contacts per pole as spare.	Noise level	Maximum 140dB at 50m distance from base of circuit breaker	Seismic acceleration	0.3g horizontal
Type of circuit breaker	Vacuum/SF6 type																																
Highest system Voltage	36 kV																																
Rated continuous current	Min. 630 A at rated ambient temperature current capacity																																
Rated frequency	50 Hz																																
Number of poles	Three (3)																																
Rated/minimum power frequency Withstand voltage	70 kV																																
Rated lightning impulse Withstand voltage	170 kV																																
Minimum Creepage distance	31 mm/kV of highest system voltage																																
Rated operating duty cycle	O - 0.3 sec. - CO - 3min. – CO																																
Rated line charging breaking Current (voltage factor of 1.4)	As per IEC																																
Reclosing	Three phase high speed auto reclosing																																
Maximum fault level	As per SLD																																
Total closing time	Not more than 150 ms.																																
Auxiliary contacts	As required plus 4NO and 4NC contacts per pole as spare.																																
Noise level	Maximum 140dB at 50m distance from base of circuit breaker																																
Seismic acceleration	0.3g horizontal																																
2.02	<p><b>ISOLATORS</b></p> <p>The isolators and accessories shall conform in general to IEC 62271-102 (or equivalent Indian standard) except to the extent explicitly modified in specification.</p>																																

CLAUSE NO.	TECHNICAL SPECIFICATIONS																												
	 <p><b>TECHNICAL SPECIFICATIONS</b></p> <p>Earth switches shall be provided on isolators wherever called for.</p> <table border="1"> <tbody> <tr> <td>Operating mechanism of Isolator and earth switch</td> <td>Manual/Electrically Operated</td> </tr> <tr> <td>Nominal system voltage</td> <td>33kV</td> </tr> <tr> <td>Highest system voltage</td> <td>36kV</td> </tr> <tr> <td>Type</td> <td>Outdoor</td> </tr> <tr> <td>Rated continuous current</td> <td>Min. 630 A at rated ambient temperature current capacity</td> </tr> <tr> <td>Rated short time current of isolator and earth switch</td> <td>As per SLD</td> </tr> <tr> <td>Rated dynamic short time withstand current of isolator and earth switch</td> <td>Refer Chapter A-2, Clause 2.0</td> </tr> <tr> <td>Impulse withstand voltage with 1.2/50 micro sec. wave</td> <td>170kVp to earth &amp; 195 kVp across isolating distance</td> </tr> <tr> <td>One minute power frequency withstand Voltage</td> <td>70 kV (rms) to earth &amp; 80 kV (rms) between isolating distance</td> </tr> <tr> <td>Temperature rise</td> <td>As per Table-IV of IS: 9921</td> </tr> <tr> <td>Rated mechanical terminal load</td> <td>As per 62271-102</td> </tr> <tr> <td>Creepage distance (Total)</td> <td>1116 mm</td> </tr> <tr> <td>No. of Auxiliary Contacts</td> <td>2NO+2NC for each Isolator &amp; 2NO+2NC for each earth switch</td> </tr> <tr> <td>Material of fixed contact &amp; moving blade</td> <td>Silver plated electrolytic copper flat</td> </tr> </tbody> </table> <p>Isolator shall be gang operated for main blades and earth switches. The operation of the three poles shall be well synchronised and interlocked. The design of linkages and gears shall be such so as to allow one man to operate the handle with ease for isolator and earth switch.</p> <p>They shall be constructed such that they do not open under influence of short circuit current and wind pressure together. The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the isolator is open and vice-versa. The insulator of the isolator shall have a min. cantilever strength of 350 kg. In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of fail safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous</p>	Operating mechanism of Isolator and earth switch	Manual/Electrically Operated	Nominal system voltage	33kV	Highest system voltage	36kV	Type	Outdoor	Rated continuous current	Min. 630 A at rated ambient temperature current capacity	Rated short time current of isolator and earth switch	As per SLD	Rated dynamic short time withstand current of isolator and earth switch	Refer Chapter A-2, Clause 2.0	Impulse withstand voltage with 1.2/50 micro sec. wave	170kVp to earth & 195 kVp across isolating distance	One minute power frequency withstand Voltage	70 kV (rms) to earth & 80 kV (rms) between isolating distance	Temperature rise	As per Table-IV of IS: 9921	Rated mechanical terminal load	As per 62271-102	Creepage distance (Total)	1116 mm	No. of Auxiliary Contacts	2NO+2NC for each Isolator & 2NO+2NC for each earth switch	Material of fixed contact & moving blade	Silver plated electrolytic copper flat
Operating mechanism of Isolator and earth switch	Manual/Electrically Operated																												
Nominal system voltage	33kV																												
Highest system voltage	36kV																												
Type	Outdoor																												
Rated continuous current	Min. 630 A at rated ambient temperature current capacity																												
Rated short time current of isolator and earth switch	As per SLD																												
Rated dynamic short time withstand current of isolator and earth switch	Refer Chapter A-2, Clause 2.0																												
Impulse withstand voltage with 1.2/50 micro sec. wave	170kVp to earth & 195 kVp across isolating distance																												
One minute power frequency withstand Voltage	70 kV (rms) to earth & 80 kV (rms) between isolating distance																												
Temperature rise	As per Table-IV of IS: 9921																												
Rated mechanical terminal load	As per 62271-102																												
Creepage distance (Total)	1116 mm																												
No. of Auxiliary Contacts	2NO+2NC for each Isolator & 2NO+2NC for each earth switch																												
Material of fixed contact & moving blade	Silver plated electrolytic copper flat																												

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
2.03	<p>operation from DC supply and within a variation range as stipulated in relevant section. The interlock coil shall be provided with adequate contacts for facilitating permissive logic for 'DC' control scheme of the isolator as well as for AC circuit of the motor to prevent opening or closing of isolators when the interlocking coil is not energised.</p> <p><b>INSTRUMENT TRANSFORMER</b></p> <p><b>a) GENERAL REQUIREMENT</b></p> <p>The instrument transformers i.e. current and voltage transformers shall be single phase transformer units and shall be supplied with a common marshaling box for a set of three single phase units.</p> <p>The tank as well as top metallics shall be hot dip galvanised or painted Grey color as per RAL 9002. No oil shall come in contact with zinc galvanized surface.</p> <p>The instrument transformers shall be oil filled hermetically sealed units. The instrument transformers shall be provided with filling and drain plugs.</p> <p>Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.</p> <p>The insulators shall have cantilever strength of more than 350 kg.</p> <p><b>b) MARSHALLING BOX</b></p> <p>The wiring diagram for the interconnection of three phase instrument transformer shall be pasted inside the box in such a manner so that it is visible and it does not deteriorate with time. Terminal blocks in the marshaling box shall have facility for star/delta formation, short circuiting and grounding of secondary terminals. The box shall have enough terminals to wire all control circuits plus 20 spare terminals.</p> <p><b>c) CURRENT TRANSFORMERS (CTs)</b></p> <p>The CTs shall have single primary of either ring type or hair pin type or bar type. In case of "Bar Primary" inverted type CTs, the following requirements shall be met:</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p>The secondaries shall be totally encased in metallic shielding providing a uniform equi-potential surface for even electric field distribution.</p> <p>The lowest part of insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses. The upper part of insulation assembly sealing on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly and top dome.</p> <p>The insulator shall be one piece without any metallic flange joint. The CT shall be provided with oil sight glass/oil level indicator.</p> <p>The core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores shall produce undistorted secondary current under transient conditions at all ratios with specified parameters.</p> <p>Different ratios shall be achieved by secondary taps only, and primary reconnections shall not be accepted.</p> <p>The guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.</p> <p>The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CT/reactor is used, then all parameters specified shall be met treating auxiliary CTs/reactors as integral part of CT. The auxiliary CT/reactor shall preferably be in-built construction of the CT. In case it is separate, it shall be mounted in secondary terminal box.</p> <p>The secondary terminals shall be terminated on stud type suitable no's of non-disconnecting and disconnecting terminal blocks inside the terminal box of degree of protection IP:55 at the bottom of CT.</p> <p>The CTs shall be suitable for horizontal transportation.</p> <p>The CTs shall have provision for taking oil samples from bottom of CT without exposure to atmosphere to carry out dissolved gas analysis periodically. Contractor shall give his recommendations for such analysis, i.e. frequency of test, norms of acceptance, quantity of oil to be withdrawn, and treatment of CT.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																												
	<p>The CT shall have provision for measurement of capacitance and tan delta as erected at site.</p> <p><b>PARAMETERS FOR CURRENT TRANSFORMERS</b></p> <p><b>GENERAL PARAMETERS</b></p> <table border="1"> <tbody> <tr> <td>Highest system Voltage(Um)</td><td>36 kV</td></tr> <tr> <td>Rated frequency</td><td>50 Hz</td></tr> <tr> <td>System neutral earthing</td><td>effective earthed</td></tr> <tr> <td>Installation</td><td>Outdoor</td></tr> <tr> <td>Rated short time thermal current</td><td>As per SLD</td></tr> <tr> <td>Rated dynamic current</td><td>Refer Chapter A-2, Clause 2.0</td></tr> <tr> <td>Rated min power frequency withstand voltage (rms value)</td><td>70 kV</td></tr> <tr> <td>Rated lightning impulse withstand voltage (peak value)</td><td>170 kV</td></tr> <tr> <td>Partial discharge level</td><td>10 pico Coulombs max.</td></tr> <tr> <td>Minimum Creepage distance</td><td>31 mm/kV of highest system voltage</td></tr> <tr> <td>Temperature rise</td><td>As per IEC 60044</td></tr> <tr> <td>Type of insulation</td><td>Class A</td></tr> <tr> <td>Number of cores</td><td>Tariff CTs shall be single metering core with 0.2S accuracy class.</td></tr> <tr> <td>Number of terminals in marshalling box</td><td>All terminals of control circuits wired upto marshalling box plus 20 terminals spare</td></tr> </tbody> </table> <p>d) <b>VOLTAGE TRANSFORMERS (VTs)</b></p> <p>Voltage transformers shall be of Outdoor type, Oil filled, bottom and dead Tank type electromagnetic, with sealing arrangement as per IS-316-1992. It is also to be equipped with protective and damping devices Oil level indicator with danger level marking is also to be provided.</p> <p>They shall be of the oil immersed, self-cooled type and provided alternatively with an inert gas cushion or with metallic bellows above the insulating oil level. A pressure relief device valve type may also be provided if permitted to design.</p>	Highest system Voltage(Um)	36 kV	Rated frequency	50 Hz	System neutral earthing	effective earthed	Installation	Outdoor	Rated short time thermal current	As per SLD	Rated dynamic current	Refer Chapter A-2, Clause 2.0	Rated min power frequency withstand voltage (rms value)	70 kV	Rated lightning impulse withstand voltage (peak value)	170 kV	Partial discharge level	10 pico Coulombs max.	Minimum Creepage distance	31 mm/kV of highest system voltage	Temperature rise	As per IEC 60044	Type of insulation	Class A	Number of cores	Tariff CTs shall be single metering core with 0.2S accuracy class.	Number of terminals in marshalling box	All terminals of control circuits wired upto marshalling box plus 20 terminals spare
Highest system Voltage(Um)	36 kV																												
Rated frequency	50 Hz																												
System neutral earthing	effective earthed																												
Installation	Outdoor																												
Rated short time thermal current	As per SLD																												
Rated dynamic current	Refer Chapter A-2, Clause 2.0																												
Rated min power frequency withstand voltage (rms value)	70 kV																												
Rated lightning impulse withstand voltage (peak value)	170 kV																												
Partial discharge level	10 pico Coulombs max.																												
Minimum Creepage distance	31 mm/kV of highest system voltage																												
Temperature rise	As per IEC 60044																												
Type of insulation	Class A																												
Number of cores	Tariff CTs shall be single metering core with 0.2S accuracy class.																												
Number of terminals in marshalling box	All terminals of control circuits wired upto marshalling box plus 20 terminals spare																												

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>												
	<p>The VTs may be built up of high-grade non ageing cold rolled grain oriented silicon steel lamination, conforming to IS: 3024, of low hysteresis losses and high permeability to ensure high accuracy at both normal rated and above rated voltages.</p> <p>The limits of temperatures rise shall not exceed the values specified in Table 3 of IS: 3156 (Part-1) 1998. However, if the voltage transformers has an inert gas cushion above the oil at the top of the tank or housing shall not exceed 50° C. The oil shall be mineral insulating oil conforming to IS: 335-1983.</p> <p>The HV neutral end terminal shall not be earthed directly to the metal body of the VT but shall be brought out through a porcelain 2 KV class bushing. A tinned copper link of the bolted type shall be provided to connect the HV neutral end terminal and the earth bushing. Both the HV neutral end bushing and the earth bushing shall be housed in a. dust tight, vermin proof box with a front access bolted type gasketed cover.</p> <p>The secondaries shall be protected by HRC cartridge type fuses for all windings. In addition fuses shall also be provided for protection and metering windings for connection to fuse monitoring scheme. The secondary terminals shall be terminated on stud type non-disconnecting terminal blocks via the fuse inside the terminal box of degree of protection IP55. The access to secondary terminals shall be without the danger of access to high voltage circuit.</p> <p>The accuracy of metering core shall be maintained through the entire burden range upto 50VA on all three windings without any adjustments during operations.</p> <p><b>PARAMETERS FOR VOLTAGE TRANSFORMERS</b></p> <p><b>GENERAL PARAMETERS</b></p> <table border="1"> <tbody> <tr> <td>Highest System Voltage(Um)</td><td>36 kV</td></tr> <tr> <td>System neutral earthing</td><td>effective earthed</td></tr> <tr> <td>Installation</td><td>Outdoor</td></tr> <tr> <td>System Fault level (1 Sec)</td><td>As per SLD</td></tr> <tr> <td>Rated min power frequency withstand voltage (rms value)</td><td>70 kV</td></tr> <tr> <td>Rated lightning impulse withstand voltage (peak value)</td><td>170 kV</td></tr> </tbody> </table>	Highest System Voltage(Um)	36 kV	System neutral earthing	effective earthed	Installation	Outdoor	System Fault level (1 Sec)	As per SLD	Rated min power frequency withstand voltage (rms value)	70 kV	Rated lightning impulse withstand voltage (peak value)	170 kV
Highest System Voltage(Um)	36 kV												
System neutral earthing	effective earthed												
Installation	Outdoor												
System Fault level (1 Sec)	As per SLD												
Rated min power frequency withstand voltage (rms value)	70 kV												
Rated lightning impulse withstand voltage (peak value)	170 kV												

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>	
2.04	Standard reference range of frequencies for which the accuracy are valid	96% to 102% for protection and 99% to 101% for measurement
	Rated voltage factor	1.2 continuous & 1.5 for 30 sec
	Class of Accuracy	For tariff metering VT - 0.2 Other VTs – 0.2
	Stray capacitance and stray conductance of LV terminal over entire carrier frequency range	As per IEC:358
	One Minute Power frequency Withstand voltage for secondary winding	2 kV rms
	Temp. rise over an ambient temp. of 50 deg. C	As per IEC 60044
	Number of terminals in control spare.	All terminals of control circuits wired Cabinet upto marshalling box plus 10 terminals
	Min Creepage distance	31 mm/kV of Highest voltage
	Rated total thermal burden	350 VA
	Partial discharge level	10 pC max.
<b>SURGE ARRESTOR</b> <p>The surge arrestors (SAs) shall conform in general to IEC 60099-4 or IS: 3070 except to the extent modified in the specification. Arresters shall be of hermetically sealed units, self-supporting construction, suitable for mounting on lattice type support structures. Bidder shall furnish the technical particulars of Surge arrester.</p> <p>The SAs shall be of heavy duty station class and gapless Metal Oxide type without any series or shunt gaps. The SAs shall be capable of discharging over-voltages occurring during switching of unloaded transformers, and long lines.</p> <p>Arrestors shall be complete with insulating base for mounting on structure. Self-contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit with necessary connection. Suitable leakage current meters should also be supplied within the same enclosure. The reading of millimeter and counters shall be visible through an inspection glass panel</p>		
<b>Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh</b>		<b>TECHNICAL SPECIFICATION</b> BID DOC. NO: RE-CS-5746-004-9
		C-14
		PAGE 15

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																																				
2.05	<p>The surge arrestors shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC-60099-4. The cantilever strength of the insulator shall be min. 350 kg for 33 kV level.</p> <table border="1"> <tr><td>Rate System Voltage</td><td>36 kV</td></tr> <tr><td>Rate Arrester Voltage</td><td>30 kV</td></tr> <tr><td>Nominal discharge current</td><td>10 kA of 8/20 micro-sec wave</td></tr> <tr><td>Minimum discharge capability</td><td>5 kilo joule/kV(referred to rated arrester voltage corresponding to minimum discharge characteristics)</td></tr> <tr><td>Maximum continuous operating voltage</td><td>24 kV rms</td></tr> <tr><td>Max. residual voltage (1 kA)</td><td>70 kVp</td></tr> <tr><td>Max. residual voltage at 10 kA nominal discharge current (8/20 micro sec wave)</td><td>85 kVp</td></tr> <tr><td>Max. switching impulse residual Voltage at 500A peak</td><td>70 kVp</td></tr> <tr><td>Max. steep current residual voltage</td><td>93 kVp at 10kA</td></tr> <tr><td>Long duration discharge class</td><td>2</td></tr> <tr><td>High current short duration test value (4/10 micro-sec-wave)</td><td>100 kAp</td></tr> <tr><td>Low current long duration test value (2000 micro sec.)</td><td>As per IEC</td></tr> <tr><td>Current for pressure relief test</td><td>As per SLD</td></tr> <tr><td>Pressure relief class</td><td>Class A</td></tr> <tr><td>One minute power frequency withstand voltage of arrester housing (dry and wet)</td><td>70 kV (rms)</td></tr> <tr><td>Impulse withstand voltage of arrester housing with 1.2/50 micro sec. Wave</td><td>170 kVp</td></tr> <tr><td>Nominal creepage distance</td><td>1116 mm</td></tr> <tr><td>Partial discharge at 1.05 MCOV (continuous operating voltage)</td><td>Not more than 50 pc</td></tr> </table> <p><b>POST INSULATOR</b></p> <p>The post insulators shall conform in general to latest IS:2544 and IEC – 60815, 60168.</p>	Rate System Voltage	36 kV	Rate Arrester Voltage	30 kV	Nominal discharge current	10 kA of 8/20 micro-sec wave	Minimum discharge capability	5 kilo joule/kV(referred to rated arrester voltage corresponding to minimum discharge characteristics)	Maximum continuous operating voltage	24 kV rms	Max. residual voltage (1 kA)	70 kVp	Max. residual voltage at 10 kA nominal discharge current (8/20 micro sec wave)	85 kVp	Max. switching impulse residual Voltage at 500A peak	70 kVp	Max. steep current residual voltage	93 kVp at 10kA	Long duration discharge class	2	High current short duration test value (4/10 micro-sec-wave)	100 kAp	Low current long duration test value (2000 micro sec.)	As per IEC	Current for pressure relief test	As per SLD	Pressure relief class	Class A	One minute power frequency withstand voltage of arrester housing (dry and wet)	70 kV (rms)	Impulse withstand voltage of arrester housing with 1.2/50 micro sec. Wave	170 kVp	Nominal creepage distance	1116 mm	Partial discharge at 1.05 MCOV (continuous operating voltage)	Not more than 50 pc
Rate System Voltage	36 kV																																				
Rate Arrester Voltage	30 kV																																				
Nominal discharge current	10 kA of 8/20 micro-sec wave																																				
Minimum discharge capability	5 kilo joule/kV(referred to rated arrester voltage corresponding to minimum discharge characteristics)																																				
Maximum continuous operating voltage	24 kV rms																																				
Max. residual voltage (1 kA)	70 kVp																																				
Max. residual voltage at 10 kA nominal discharge current (8/20 micro sec wave)	85 kVp																																				
Max. switching impulse residual Voltage at 500A peak	70 kVp																																				
Max. steep current residual voltage	93 kVp at 10kA																																				
Long duration discharge class	2																																				
High current short duration test value (4/10 micro-sec-wave)	100 kAp																																				
Low current long duration test value (2000 micro sec.)	As per IEC																																				
Current for pressure relief test	As per SLD																																				
Pressure relief class	Class A																																				
One minute power frequency withstand voltage of arrester housing (dry and wet)	70 kV (rms)																																				
Impulse withstand voltage of arrester housing with 1.2/50 micro sec. Wave	170 kVp																																				
Nominal creepage distance	1116 mm																																				
Partial discharge at 1.05 MCOV (continuous operating voltage)	Not more than 50 pc																																				

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																						
	<p>Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators shall be accepted. Height of post insulator shall be preferably as given under parameters of this part.</p> <p>Other requirements of insulator as given under auxiliary requirements shall also be applicable.</p> <p>In accordance with the stipulations elsewhere the post insulators shall conform to type tests and acceptance, sample and routine tests as per IS:2544, IEC-60168 shall be carried out.</p> <table border="1"> <tr> <td>Type</td><td>Solid core</td></tr> <tr> <td>Voltage class</td><td>36 kV</td></tr> <tr> <td>Rated one minute power frequency withstand Voltage</td><td>70 kV (rms)</td></tr> <tr> <td>Rated Lightning Impulse withstand voltage with 1.2/50 micro sec. wave</td><td>170kVp</td></tr> <tr> <td>Total min. cantilever strength</td><td>350 kg</td></tr> <tr> <td>Min. torsional moment (Nm)</td><td>As per IEC 60273</td></tr> <tr> <td>Creepage distance (Total)</td><td>min. 1116 mm</td></tr> <tr> <td>i) Top p.c.d (mm)</td><td>76</td></tr> <tr> <td>ii) Bottom p.c.d (mm)</td><td>76</td></tr> <tr> <td>No. of bolts: Top : Bottom :</td><td>4 4</td></tr> <tr> <td>Diameter of bolt holes (mm) Top : Bottom :</td><td>M12 M12</td></tr> </table>	Type	Solid core	Voltage class	36 kV	Rated one minute power frequency withstand Voltage	70 kV (rms)	Rated Lightning Impulse withstand voltage with 1.2/50 micro sec. wave	170kVp	Total min. cantilever strength	350 kg	Min. torsional moment (Nm)	As per IEC 60273	Creepage distance (Total)	min. 1116 mm	i) Top p.c.d (mm)	76	ii) Bottom p.c.d (mm)	76	No. of bolts: Top : Bottom :	4 4	Diameter of bolt holes (mm) Top : Bottom :	M12 M12
Type	Solid core																						
Voltage class	36 kV																						
Rated one minute power frequency withstand Voltage	70 kV (rms)																						
Rated Lightning Impulse withstand voltage with 1.2/50 micro sec. wave	170kVp																						
Total min. cantilever strength	350 kg																						
Min. torsional moment (Nm)	As per IEC 60273																						
Creepage distance (Total)	min. 1116 mm																						
i) Top p.c.d (mm)	76																						
ii) Bottom p.c.d (mm)	76																						
No. of bolts: Top : Bottom :	4 4																						
Diameter of bolt holes (mm) Top : Bottom :	M12 M12																						
<b>3.0</b>	<b>REQUIREMENT OF AUXILIARY ITEMS</b>																						
<b>3.01</b>	<b>ALUMINIUM TUBULAR CONDUCTOR</b>																						
i.	The aluminium tube shall be grade 63401 WP (range2) as per IS 5082.																						
ii.	There shall be no negative tolerance on OD and thickness of the tube. Other tolerances shall be as per IS:2678 and 2673.																						
iii.	Tests: In accordance with stipulations of specification routine tests shall be conducted on tubular conductor as per IS:5082. Also, the wall thickness																						

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																																										
	<p>and ovality shall be measured by ultrasonic method. In addition 0.2% proof tests on both parent material and aluminium tube after welding shall be conducted.</p> <table border="1"> <thead> <tr> <th colspan="3"><b>33 KV</b></th> </tr> </thead> <tbody> <tr> <td>a)</td><td>Size</td><td>3" IPS (EH type)</td></tr> <tr> <td>b)</td><td>Outer diameter</td><td>88.90 mm with no negative tolerance</td></tr> <tr> <td>c)</td><td>Thickness of tube</td><td>7.62 mm with no negative tolerance</td></tr> <tr> <td>d)</td><td>Cross-sectional area</td><td>1947 sq. mm.</td></tr> <tr> <td>e)</td><td>Weight</td><td>5.25 kg/m</td></tr> <tr> <td>f)</td><td>Aluminum grade</td><td>63401 WP(range 2) conforming to IS:5082.</td></tr> </tbody> </table>	<b>33 KV</b>			a)	Size	3" IPS (EH type)	b)	Outer diameter	88.90 mm with no negative tolerance	c)	Thickness of tube	7.62 mm with no negative tolerance	d)	Cross-sectional area	1947 sq. mm.	e)	Weight	5.25 kg/m	f)	Aluminum grade	63401 WP(range 2) conforming to IS:5082.																					
<b>33 KV</b>																																											
a)	Size	3" IPS (EH type)																																									
b)	Outer diameter	88.90 mm with no negative tolerance																																									
c)	Thickness of tube	7.62 mm with no negative tolerance																																									
d)	Cross-sectional area	1947 sq. mm.																																									
e)	Weight	5.25 kg/m																																									
f)	Aluminum grade	63401 WP(range 2) conforming to IS:5082.																																									
3.02	<p><b>ACSR CONDUCTOR</b></p> <p>The conductor shall be Aluminium Core Steel Reinforced (ACSR) type. The conductor shall confirm to IS:398 (Part-II) except where otherwise specified herein</p> <table border="1"> <thead> <tr> <th colspan="3"><b>RABBIT CONDUCTOR</b></th> </tr> </thead> <tbody> <tr> <td>a)</td><td>Code and standard</td><td>IS 398</td></tr> <tr> <td>b)</td><td>Name</td><td>RABBIT ACSR</td></tr> <tr> <td>c)</td><td>Overall diameter</td><td>10.05 mm</td></tr> <tr> <td>d)</td><td>Weight</td><td>0.214 kg/m</td></tr> <tr> <td>e)</td><td>Ultimate tensile strength</td><td>18.25 kN minimum</td></tr> <tr> <td>f)</td><td>Strands and wire diameter of - Aluminium - Steel</td><td>6 / 3.35 mm 1 / 3.35 mm</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="3"><b>DOG CONDUCTOR</b></th> </tr> </thead> <tbody> <tr> <td>a)</td><td>Code and standard</td><td>IS 398</td></tr> <tr> <td>b)</td><td>Name</td><td>DOG ACSR</td></tr> <tr> <td>c)</td><td>Overall diameter</td><td>14.15 mm</td></tr> <tr> <td>d)</td><td>Weight</td><td>0.394 kg/m</td></tr> <tr> <td>e)</td><td>Ultimate tensile strength</td><td>32.41 kN minimum</td></tr> <tr> <td>f)</td><td>Strands and wire diameter of - Aluminium - Steel</td><td>6/4.72 mm 7/1.57 mm</td></tr> </tbody> </table>	<b>RABBIT CONDUCTOR</b>			a)	Code and standard	IS 398	b)	Name	RABBIT ACSR	c)	Overall diameter	10.05 mm	d)	Weight	0.214 kg/m	e)	Ultimate tensile strength	18.25 kN minimum	f)	Strands and wire diameter of - Aluminium - Steel	6 / 3.35 mm 1 / 3.35 mm	<b>DOG CONDUCTOR</b>			a)	Code and standard	IS 398	b)	Name	DOG ACSR	c)	Overall diameter	14.15 mm	d)	Weight	0.394 kg/m	e)	Ultimate tensile strength	32.41 kN minimum	f)	Strands and wire diameter of - Aluminium - Steel	6/4.72 mm 7/1.57 mm
<b>RABBIT CONDUCTOR</b>																																											
a)	Code and standard	IS 398																																									
b)	Name	RABBIT ACSR																																									
c)	Overall diameter	10.05 mm																																									
d)	Weight	0.214 kg/m																																									
e)	Ultimate tensile strength	18.25 kN minimum																																									
f)	Strands and wire diameter of - Aluminium - Steel	6 / 3.35 mm 1 / 3.35 mm																																									
<b>DOG CONDUCTOR</b>																																											
a)	Code and standard	IS 398																																									
b)	Name	DOG ACSR																																									
c)	Overall diameter	14.15 mm																																									
d)	Weight	0.394 kg/m																																									
e)	Ultimate tensile strength	32.41 kN minimum																																									
f)	Strands and wire diameter of - Aluminium - Steel	6/4.72 mm 7/1.57 mm																																									

CLAUSE NO.	TECHNICAL SPECIFICATIONS
<p><b>3.03 CLAMPS AND CONNECTORS</b></p> <p>3.03.01 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case equipment terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetal.</p> <p>3.03.02 The material of clamps and connectors shall be Galvanised mild steel for connecting to G.S.shield wire.</p> <p>3.03.03 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.</p> <p>3.03.04 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.</p> <p>3.03.05 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.</p> <p>3.03.06 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.</p> <p>3.03.07 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.</p> <p><b>3.04 INSULATORS &amp; INSULATOR STRING HARDWARES</b></p> <p>3.04.01 Porcelain insulator shall comply IS: 731-1976 or equivalent international standard and shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green &amp; fired stage</p> <p>3.04.02 Pin insulators shall be used on all poles in straight line and disc or shackle insulators on angle and dead end poles.</p> <p>3.04.03 Strain insulators shall be used at line sectionalizing locations, dead end locations, major crossings and locations where the angle of deviation of line is more than 100.</p>	

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>															
3.04.04	For 33KV lines, Ball & Socket type strain insulators with fittings shall be used.															
3.04.05	The pins for insulators shall be fixed in the holes provided in the cross-arms and the pole top brackets. The insulators shall be mounted in their places over the pins and tightened. In the case of strain or angle supports, where strain fittings are provided for this purpose, one strap of the strain fittings is placed over the cross-arm before placing the bolt in the hole of cross-arms. The nut of the straps shall be so tightened that the strap can move freely in horizontal direction.															
3.04.06	The insulator hardware shall be of bolted type and shall be of forged steel except for insulator cap, which can be of malleable cast iron. It shall also generally meet the requirements of clamps and connectors as specified above.															
3.04.07	In one span, Tension string assembly at one end shall be supplied with suitable turn buckle.															
3.04.08	<p><b>DISC INSULATOR</b></p> <p>The disc insulator shall meet the following parameters:</p> <table border="1"> <tbody> <tr> <td>a)</td><td>Type</td><td>Antifog type insulator</td></tr> <tr> <td>b)</td><td>Size of insulator</td><td>255x145</td></tr> <tr> <td>c)</td><td>Electro mechanical strength</td><td>120kN</td></tr> <tr> <td>d)</td><td>Leakage distance (mm)</td><td>430 mm minimum or as required to meet the total creepage.</td></tr> <tr> <td>e)</td><td>Power frequency withstand voltage</td><td>85 kV (dry), 50kV (wet)</td></tr> </tbody> </table>	a)	Type	Antifog type insulator	b)	Size of insulator	255x145	c)	Electro mechanical strength	120kN	d)	Leakage distance (mm)	430 mm minimum or as required to meet the total creepage.	e)	Power frequency withstand voltage	85 kV (dry), 50kV (wet)
a)	Type	Antifog type insulator														
b)	Size of insulator	255x145														
c)	Electro mechanical strength	120kN														
d)	Leakage distance (mm)	430 mm minimum or as required to meet the total creepage.														
e)	Power frequency withstand voltage	85 kV (dry), 50kV (wet)														
3.04.09	<p><b>INSULATOR STRING</b></p> <p>The insulator string shall meet the following parameters</p> <table border="1"> <tbody> <tr> <td>a)</td><td>Rated Voltage</td><td>33 kV</td></tr> <tr> <td>b)</td><td>Impulse withstand voltage (Dry &amp; Wet)</td><td><math>\pm 170</math> kVp</td></tr> <tr> <td>c)</td><td>Power frequency withstand voltage (dry and wet) (rms)</td><td>130 kV &amp; 80kV (rms)</td></tr> <tr> <td>d)</td><td>Total creepage distance i) For Porcelain insulators ii) For Polymer insulators</td><td>1116 mm 1116 mm</td></tr> </tbody> </table>	a)	Rated Voltage	33 kV	b)	Impulse withstand voltage (Dry & Wet)	$\pm 170$ kVp	c)	Power frequency withstand voltage (dry and wet) (rms)	130 kV & 80kV (rms)	d)	Total creepage distance i) For Porcelain insulators ii) For Polymer insulators	1116 mm 1116 mm			
a)	Rated Voltage	33 kV														
b)	Impulse withstand voltage (Dry & Wet)	$\pm 170$ kVp														
c)	Power frequency withstand voltage (dry and wet) (rms)	130 kV & 80kV (rms)														
d)	Total creepage distance i) For Porcelain insulators ii) For Polymer insulators	1116 mm 1116 mm														

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>									
	<table border="1"> <tr> <td>e)</td><td>Pollution level (as per IEC 71)</td><td>Class -III, Heavy</td></tr> <tr> <td>f)</td><td>Electro mechanical strength</td><td>120 kN/ String 160 kN/ String - Polymer</td></tr> <tr> <td>g)</td><td>No. of disc insulator/string (min.) (Porcelain Type)</td><td>4 nos.</td></tr> </table>	e)	Pollution level (as per IEC 71)	Class -III, Heavy	f)	Electro mechanical strength	120 kN/ String 160 kN/ String - Polymer	g)	No. of disc insulator/string (min.) (Porcelain Type)	4 nos.
e)	Pollution level (as per IEC 71)	Class -III, Heavy								
f)	Electro mechanical strength	120 kN/ String 160 kN/ String - Polymer								
g)	No. of disc insulator/string (min.) (Porcelain Type)	4 nos.								
3.05	<p><b>33 kV POLES (if applicable)</b></p> <p>All 33 kV pole shall be of Galvanised RSJ poles of appropriate grade &amp; size with min. galvanisation thickness of 610 gm/sq.m or 86 microns. All other structural members associated with the pole shall be Hot dip galvanised unless &amp; otherwise specified.</p> <p>Maximum span of HT Lines with proposed conductors shall be as per REC construction standards or as specified in the table below.</p> <p>The following types of pole configurations shall be used at respective locations given below after finalization of survey &amp; pole spotting</p> <table border="1"> <tr> <td>a</td><td>SP (Single Pole support)</td><td>i) 0° - 10° deviation.</td></tr> <tr> <td>b</td><td>DP (Double Pole support)</td><td>ii) 10° - 60° deviation.</td></tr> <tr> <td>c</td><td>FP (Four Pole support)</td><td>(iii) 60° - 90° deviation</td></tr> </table> <p><b>DESIGN PARAMETERS</b></p> <ul style="list-style-type: none"> <li>a) Factor of safety 2.0 in normal condition for 33 kV line &amp; LT line for PCC supports.</li> <li>b) Wind Pressure on Pole &amp; conductor– As per IS 802</li> <li>c) Wind load on cross-arms, insulators guy-wire etc. shall be considered.</li> <li>d) Wind load on full projected area of conductors and pole is to be considered for design.</li> <li>e) Ground clearance shall be minimum 5.2m for 33 kV line for bare conductor at locations other than along and across road crossings.</li> <li>f) All other clearance shall be as per IE.Rules.</li> <li>g) The live metal clearance shall be as per IS: 5613 and shall be min.330 mm for 33 kV line.</li> </ul> <p>Pole accessories like danger plates, phase plates, anti climbing device, shall be provided.</p>	a	SP (Single Pole support)	i) 0° - 10° deviation.	b	DP (Double Pole support)	ii) 10° - 60° deviation.	c	FP (Four Pole support)	(iii) 60° - 90° deviation
a	SP (Single Pole support)	i) 0° - 10° deviation.								
b	DP (Double Pole support)	ii) 10° - 60° deviation.								
c	FP (Four Pole support)	(iii) 60° - 90° deviation								

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p><b>1. Excavation of pole pit</b></p> <p>Excavation cost for pits shall be included by the contractor in the bid for following type of soils inclusive of dewatering of pits and shoring and shutting wherever necessary.</p> <p><b>a) All type of soils and soil conditions but excluding hard rock</b></p> <p>For the purpose of pole planting, normally pit size shall be 600x500x1500 (mm). In case bidder employs Earth augers, the Pit size can be considered 0.7 meter dia with 1.5 meter depth.</p> <p><b>b) Hard rock</b></p> <p>For hard rock locations, 1 meter deep hole of diameter 20% in excess of the longest dimension of the bottom most portion of pole shall be excavated. The pole shall be grouted in the pit with 1:2:4 nominal concrete mix at the time of pole erection. For hard rock, the excavation cost per location shall remain same for all type of foundations. Controlled blasting shall be permitted only in case of hard or rocky soil.</p> <p>The contractor shall be responsible for any damage or accidents arising out of the process of blasting. Blasting shall not be permitted if the area around location is inhabited. In such case, the contractor shall have to follow other methods like drilling etc.</p> <p><b>2. PCC footing and compaction of soil</b></p> <p>The planting depth of pole shall be 1500 mm in the ground except in wet soil and black cotton soil where depth shall be increased by 0.2 mtr. to 0.3 mtr. with reduced wind span.</p> <p><b>3. Earthing of Poles</b></p> <p>In 33 kV, each pole shall be earthed as per REC Construction Standard CS-J-2.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p>In rocky areas where digging of earth pits up to 1500mm is not possible spike earthing in horizontal configuration buried at a depth of not less than 800mm may be used.</p> <p>In rocky areas where individual earthing of poles is not possible, an overhead GI earth wire shall be run as per REC construction standard drawing- A5. This earth wire shall be earthed at three different points in one km using pipe earthing as per REC construction standard J2. The dimension of overhead GI earth wire 6mm dia. for 33 kV lines.</p> <p><b>Providing of Guys/Strut Poles to Supports</b></p> <p>The arrangement for guys shall be as per REC Construction. Strut poles/flying guys wherever required shall be installed on various pole locations as per REC construction standards. For selection of guying locations REC guidelines &amp; construction practices &amp; IS :5613 shall be followed. The stay rod should be placed in a position so that the angle of rod with the vertical face of the pit is <math>30^0/45^0</math> as the case may be.</p> <p>In this work anchor type guy sets are to be used. These guys shall be provided at</p> <ul style="list-style-type: none"> <li>(i) Angle locations</li> <li>(ii) Dead end locations</li> <li>(iii) T-off points</li> <li>(iv) Steep gradient locations.</li> <li>(v) Double Pole &amp; Four poles</li> <li>(vi) Wind stays along tangent locations at 40% of pole locations</li> <li>(vii) For double pole structure (DP), four stays along the line, two in each direction and two stays along the bisection of the angle of deviation (or more) as required depending on the angle of deviation are to be provided. Hot dip galvanized stay sets are to be used.</li> </ul> <p>G.I. stay wires of size 7/4 mm with GI turn buckle rod of 20 mm dia &amp; 20 mm dia GI stay rods shall be used for 33 KV line.</p> <p>Precast RCC anchor plate as per REC construction standard K1 shall be used for the purpose of anchoring the guy rod with a bolt arrangement at one end and other end is given shape of 40mm dia circle to bind one end of the stay wire.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p>The size of the stay pit shall be 500mmx500mmx1600mm with concrete mix of 1:2:4 having volume in stay pit of <math>800 \times 500 \times 500 = 0.2</math> cubic mtr for embedding RCC stay plate assembly and the balance pit to be filled with earth duly rammed.</p> <p>In case of firm soil, concreting is not required.</p> <p>The turn buckle shall be mounted at the pole end of the stay and guy wire so fixed that the turn buckle is half way in the working position, thus giving the maximum movement for tightening or loosening.</p> <p>If the guy wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night.</p> <p><b>4. Cross Arms</b></p> <p>Cross Arms for 33 kV Overhead Power Lines shall be made out of 100x50x6 mm M.S. channel.</p> <p>For 33 kV line, cross arms a MS strip of 100x50x5 mm shall be welded for providing additional mechanical strength at the seat of the pin insulator.</p> <p>All types of cross arms &amp; clamps shall be hot dip galvanized as per IS 2629 with galvanization thickness min. 610 gm/sq.m or 86 microns.</p> <p><b>Fixing of Cross Arms</b></p> <p>After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection can also be followed. In case, the cross-arm shall be mounted after the pole is erected, the lineman should climb the pole with necessary tools. The cross-arm shall then tied to a hand line and pulled up by the ground man through a pulley, till the cross-arm reaches the line man. The ground man should station himself on one side, so that if any material drops from the top of the pole, it may not strike him. All the materials should be lifted or lowered through the hand line, and should not be dropped.</p>

CLAUSE NO.	TECHNICAL SPECIFICATIONS
3.06	<p><b>EARTHING CONDUCTOR</b></p> <p>a. The main conductor buried in earth shall be 40mm dia MS rod for main and auxiliary mat. The earthing conductors over the ground shall be of 75x12 mm GS flat. The earthing leads for columns and auxiliary structures, cable trenches shall be of 75x12 mm GS flat. The earthing of the lighting fixtures shall be carried out by 16 SWG wire.</p> <p>b. All earthing conductors above the ground level shall be galvanised steel only.</p> <p>c. Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.</p> <p>d. Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided at 300 mm below ground the operating handles of the isolators/earth switch.</p> <p>e. Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop.</p>
3.07	<p><b>LIGHTNING PROTECTION</b></p> <p>Direct stroke lightning protection (DSLP) shall be provided in the switchyard by LM/shield wires.</p> <p>Lightning protection System down conductors shall not be connected to other conductors above ground level. Also, no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to earth electrode.</p> <p>Every down conductor shall be provided with a test joint at about 1000mm above ground level. The test joint shall be directly connected to the earthing system. Down conductors shall be cleated on the structures at 2000mm interval.</p> <p>The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																											
3.07.01	<p>Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.</p> <p><b>Earthwire for Lightning Protection</b></p> <table border="1"> <tbody> <tr> <td>a)</td><td>Number of strands</td><td>7 of steel</td></tr> <tr> <td>b)</td><td>Strand diameter</td><td>3.66 mm</td></tr> <tr> <td>c)</td><td>Overall diameter</td><td>10.98 mm</td></tr> <tr> <td>d)</td><td>Weight</td><td>583 kg/km approx.</td></tr> <tr> <td>e)</td><td>Ultimate tensile strength</td><td>68.4 kN minimum</td></tr> <tr> <td>f)</td><td>Total cross-sectional area</td><td>73.65 sq.mm.</td></tr> <tr> <td>g)</td><td>Calculated d.c. resistance</td><td>2.5 ohms/km at 20 deg.C.</td></tr> <tr> <td>h)</td><td>Direction of lay of outer layer</td><td>Right hand</td></tr> <tr> <td>i)</td><td>Protective coating for storage</td><td>Boiled linseed oil to avoid wet storage stains (white rust)</td></tr> </tbody> </table> <p>The earth wire shall be preformed and post formed quality.</p>	a)	Number of strands	7 of steel	b)	Strand diameter	3.66 mm	c)	Overall diameter	10.98 mm	d)	Weight	583 kg/km approx.	e)	Ultimate tensile strength	68.4 kN minimum	f)	Total cross-sectional area	73.65 sq.mm.	g)	Calculated d.c. resistance	2.5 ohms/km at 20 deg.C.	h)	Direction of lay of outer layer	Right hand	i)	Protective coating for storage	Boiled linseed oil to avoid wet storage stains (white rust)
a)	Number of strands	7 of steel																										
b)	Strand diameter	3.66 mm																										
c)	Overall diameter	10.98 mm																										
d)	Weight	583 kg/km approx.																										
e)	Ultimate tensile strength	68.4 kN minimum																										
f)	Total cross-sectional area	73.65 sq.mm.																										
g)	Calculated d.c. resistance	2.5 ohms/km at 20 deg.C.																										
h)	Direction of lay of outer layer	Right hand																										
i)	Protective coating for storage	Boiled linseed oil to avoid wet storage stains (white rust)																										
3.07.02	<p><b>Earthwire Compression type Tension Clamp &amp; Flexible Copper Bond Tension Clamp For Earthwire</b></p> <p>The details shall be as per IS:2121 part-3. Compression type tension clamp shall be used to hold 7/3.66 mm galvanised steel earthwire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates. The strain plates supplied with the towers will have a minimum thickness of 8 mm with a hole of 17.5 mm diameter. Suitable lugs for jumper connection shall also be supplied along with necessary bolts and nuts.</p> <p>The dimensions and the dimensional tolerance of the tension clamp shall be as given below:</p> <table border="1"> <thead> <tr> <th rowspan="2">Item</th> <th colspan="2">Dimensions before compression</th> <th colspan="2">Dimensions after compression</th> </tr> <tr> <th>Inner Dia (mm)</th> <th>Outer Dia (mm)</th> <th>Corner to Corner width (mm)</th> <th>Face to Face width (mm)</th> </tr> </thead> <tbody> <tr> <td>Steel Dead - end</td> <td>11.1±0.2</td> <td>21±0.5</td> <td>20.2±0.5</td> <td>17.5±0.5</td> </tr> </tbody> </table>	Item	Dimensions before compression		Dimensions after compression		Inner Dia (mm)	Outer Dia (mm)	Corner to Corner width (mm)	Face to Face width (mm)	Steel Dead - end	11.1±0.2	21±0.5	20.2±0.5	17.5±0.5													
Item	Dimensions before compression		Dimensions after compression																									
	Inner Dia (mm)	Outer Dia (mm)	Corner to Corner width (mm)	Face to Face width (mm)																								
Steel Dead - end	11.1±0.2	21±0.5	20.2±0.5	17.5±0.5																								

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p><b>Flexible copper bond:</b> as detailed in is: 2121 part 3. The flexible copper bond shall be fitted with 2 nos. Tinned copper connecting lugs which will be pressed jointed to either ends of the bond. One lug shall be suitable for 12 mm dia bolt and other for 16 mm dia bolt. The complete assembly shall also include one 16 mm dia 40 mm lug with ms bolt hot dip galvanised with nut and lock washer.</p> <p><b>3.08 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS</b></p> <p>3.08.01 Bushings shall be manufactured and tested in accordance with IS:2099&amp; IEC:60137 while hollow column insulators shall be manufactured and tested in accordance with IEC 62155/IS 5284. The support insulators shall be manufactured and tested as per IS:2544 / IEC 60168/IEC 60273. The insulators shall also conform to IEC 60815 as applicable having alternate long and short sheds. Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.</p> <p>3.08.02 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.</p> <p>3.08.03 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.</p> <p>3.08.04 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous parts shall be hot dip galvanised.</p> <p>3.08.05 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.</p> <p>3.08.06 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which</p>

CLAUSE NO.	TECHNICAL SPECIFICATIONS
3.08.07	may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
3.08.08	All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
3.08.09	In accordance with the requirements stipulated elsewhere, bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.
3.09	<b>SPACERS</b>
3.09.01	Spacers shall conform to IS: 10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel.
3.09.02	Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance.
3.09.03	In addition to the type tests as per IS:10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2 kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5 kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after the test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample.
3.10	<b>CABINETS, BOXES, KIOSKS, PANELS, ETC.</b>
3.010.01	All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.
3.010.02	They shall be of Stainless steel or Aluminium. The thickness of Stainless steel sheet shall be 1mm. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness. The paint shade shall be grey RAL 9002 outside and glossy white inside.

CLAUSE NO.	TECHNICAL SPECIFICATIONS
3.010.03	The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
3.010.04	The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.
3.010.05	The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.
3.010.06	Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
3.010.07	The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
3.010.08	Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm/50mmx6mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background.
<b>3.11</b>	<b>BAY MARSHALLING BOX</b>
3.011.01	Bay Marshaling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.
3.011.02	It shall have three separate distinct compartments for following purposes: - To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch.

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
3.12	<p>- To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.  - min. 200 nos. terminal blocks in vertical formation for interlocking facility.</p> <p><b>AUXILIARY SWITCH</b></p> <p>The auxiliary switch shall conform of following type tests:</p> <ul style="list-style-type: none"> <li>a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.</li> <li>b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination</li> <li>c) Heat run test on contacts</li> <li>d) IR/HV test, etc.</li> </ul> <p><b>Type tests Requirement for Auxiliary Items</b></p> <p>All equipment with their terminal connectors, control cabinets, main protective relays, etc. as well as insulators, insulator strings with hardwares, clamps and connectors, marshalling boxes, etc., shall conform to type tests as per relevant standards and shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections.</p> <p><b>TERMINAL BLOCKS</b></p> <p>3.013.01 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.</p> <p>3.013.02 The terminal blocks shall be of min. 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.</p> <p>3.013.03 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.</p>
<p><b>Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh</b></p>	
<p><b>TECHNICAL SPECIFICATION</b> BID DOC. NO: RE-CS-5746-004-9</p>	
<p><b>C-14</b></p>	
<p><b>PAGE</b> <b>30</b></p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS
3.013.04	The terminals shall be provided with marking tags for wiring identification.
3.013.05	Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:  All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor AC & DC power supply - Two 16 sq.mm. aluminium conductor Circuits Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor
3.013.06	The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.
<b>3.14</b>	<b>WIRING</b>
3.014.01	All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:  a) All circuits except CT circuits 2.5 sq.mm b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).
3.014.02	All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
3.014.03	Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.
3.014.04	All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.
3.014.05	All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be

CLAUSE NO.	TECHNICAL SPECIFICATIONS
	<p>wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.</p> <p><b>4.0 INSTALLATION</b></p> <p><b>4.01 EARTHING</b></p> <p>The earthing shall be done in accordance with requirements given in <b>Annexure-I</b> of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification.</p> <p><b>4.02 CIVIL WORKS</b></p> <p>The civil works shall be done in accordance with requirements stipulated elsewhere in the specification.</p> <p><b>4.03 STRUCTURAL STEEL WORKS</b></p> <p>The structural steel works shall be done in accordance with requirements stipulated elsewhere in the specification.</p> <p><b>4.04 EQUIPMENT ERECTION NOTES</b></p> <p>All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.</p> <p>Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.</p> <p>The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment,</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
	<p>sling ropes etc. should be tested before erection and periodically thereafter for strength.</p> <p>Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.</p> <p>Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.</p> <p>For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.</p> <p>The rigid busbars for equipment interconnections shall have rigid connections at one end and expansion / flexible at the other end. The tubular aluminium connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall work out the cut lengths of aluminum tube based on finalized layout and dispatch the same to site without requiring owners's approval. Corona bells shall be provided at the end of the rigid busbars.</p>
<b>4.05</b>	<b>CABLING</b>
4.05.01	Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc. in accordance with the requirements specified elsewhere in the specification.
4.05.02	Cables inside the switchyard shall be laid on GI angle supports at 600mm spacing with separate tiers for control and power cables. The GI angles shall be bolted / welded to galvanized insert plates inside RCC trenches.
4.05.03	Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.
4.05.04	Cabling in the control room shall be done on ladder type cable trays with supports at an interval of 2000mm.

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
4.05.05	All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be burried in the ground at a depth of 300mm.
5.0	<b>SITE TESTING AND COMMISSIONING</b>
5.01	<b>INTRODUCTION</b> <p>An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall get the list of instruments approved from the Employer.</p>
5.02	<b>GENERAL CHECKS</b> <ul style="list-style-type: none"> <li>a) Check for physical damage.</li> <li>b) Visual examination of zinc coating/ plating</li> <li>c) Check from name plate that all items are as per older/ specification.</li> <li>d) Check tightness of all bolts, clamps and connecting terminals using torque wrenches.</li> <li>e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up.</li> <li>f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.</li> <li>g) Check cleanliness of insulator and bushings.</li> <li>h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection.</li> <li>j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.</li> </ul>
5.03	<b>CIRCUIT BREAKERS</b> <ul style="list-style-type: none"> <li>a) Insulation resistance of each pole.</li> <li>b) Check adjustments, if any, suggested by manufacturer.</li> <li>c) Breaker closing and tripping time.</li> <li>d) Slow and power closing operation and opening</li> <li>e) Trip free and anti pumping operation.</li> <li>f) Minimum pick up volts of coils</li> <li>g) Contact resistance</li> </ul>

CLAUSE NO.	TECHNICAL SPECIFICATIONS
	<p>h) Functional checking of compressed air plant and all accessories</p> <p>i) Functional checking of control circuits, interlocks, tripping through protective relays</p> <p>j) Insulation resistance of control circuits, motor etc.</p> <p>k) Resistance of closing and tripping coils.</p>
5.04	<p><b>ISOLATORS</b></p> <p>a) Insulation resistance of each pole</p> <p>b) Manual and electrical operation on interlocks</p> <p>c) Insulation resistance of control circuits and motors.</p> <p>d) Ground connections</p> <p>e) Contact resistance</p> <p>f) Proper alignment to minimise the vibration to the extreme possible during operation.</p> <p>g) Measurement of operating torque for isolator and Earth switch</p> <p>h) Resistance of operating and interlocking coils.</p>
5.05	<p><b>CURRENT TRANSFORMERS</b></p> <p>a) Insulation Resistance Test</p> <p>b) Polarity test.</p> <p>c) Ratio identification test-checking of all ratios on all cores by primary injection of current.</p> <p>d) Dielectric test of oil (wherever applicable).</p> <p>e) Magnetizing characteristics test.</p> <p>f) Capacitance and tan delta measurement at minimum 10kV.</p>
5.06	<p><b>CAPACITOR VOLTAGE TRANSFOREMER</b></p> <p>a) Insulation resistance test.</p> <p>b) Polarity test.</p> <p>c) Ratio test.</p> <p>d) Dielectric test of oil (if applicable).</p> <p>e) Capacitance and tan delta measurement at minimum 10kV.</p>
5.07	<p><b>SURGE ARRESTER</b></p> <p>a) Grading leakage current.</p> <p>b) Resistance of ground connection.</p> <p>c) Resistive current drawn at rated voltage after energisation.</p>

Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh	TECHNICAL SPECIFICATION BID DOC. NO: RE-CS-5746-004-9	C-14	PAGE 35
---	--	------	------------

CLAUSE NO.	TECHNICAL SPECIFICATIONS
5.08	<b>PHASING OUT</b>  The phasing out of all supplies in the station system shall be carried out.
5.09	<b>STATION EARTHING</b> <ul style="list-style-type: none"> <li>a) Check soil resistivity</li> <li>b) Check continuity of grid wires</li> <li>c) Check earth resistance of the entire grid as well as various sections of the same.</li> <li>d) Check for weld joint and application of zinc rich paint on galvanised surface.</li> <li>e) Dip test on earth conductor prior to use.</li> </ul>
5.10	<b>CONDUCTOR STRINGING AND POWER CONNECTORS</b> <ul style="list-style-type: none"> <li>a) Physical check for finish</li> <li>b) Electrical clearance check</li> <li>c) Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.</li> <li>d) Sag and tension check on conductors.</li> </ul>
5.11	<b>INSULATOR</b>  Visual examination for finish damage, creepage distance, etc.

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>																		
	<b>ANNEXURE-I</b>																		
a)	<b>EARTHING NOTES FOR SWITCHYARD</b> <ol style="list-style-type: none"> <li>i. <b>GENERAL</b> <p>Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches, equipments and structure by 75 X 12 mm GS flat.</p> </li> <li>ii. Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.</li> <li>iii. Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.</li> </ol>																		
b)	<b>DETAILS OF EARTHING SYSTEM</b> <table> <thead> <tr> <th>Item</th> <th>Size</th> <th>Material</th> </tr> </thead> <tbody> <tr> <td>Main Earthing conductor</td> <td>40mm dia rod</td> <td>Mild steel</td> </tr> <tr> <td>Conductor above ground &amp; earthing leads (for equipment)</td> <td>75X12/50X6 mm</td> <td>Galvanized steel</td> </tr> <tr> <td>Rod Electrode</td> <td>40mm dia, 3000mm</td> <td>Mild steel</td> </tr> <tr> <td>Pipe Electrode</td> <td>40mm dia, 3000mm</td> <td>GS</td> </tr> <tr> <td>G.I. Earthwire</td> <td>7/8 SWG</td> <td>GI</td> </tr> </tbody> </table>	Item	Size	Material	Main Earthing conductor	40mm dia rod	Mild steel	Conductor above ground & earthing leads (for equipment)	75X12/50X6 mm	Galvanized steel	Rod Electrode	40mm dia, 3000mm	Mild steel	Pipe Electrode	40mm dia, 3000mm	GS	G.I. Earthwire	7/8 SWG	GI
Item	Size	Material																	
Main Earthing conductor	40mm dia rod	Mild steel																	
Conductor above ground & earthing leads (for equipment)	75X12/50X6 mm	Galvanized steel																	
Rod Electrode	40mm dia, 3000mm	Mild steel																	
Pipe Electrode	40mm dia, 3000mm	GS																	
G.I. Earthwire	7/8 SWG	GI																	
c)	For Step and Touch Potential the following parameters shall be considered <ol style="list-style-type: none"> <li>i) Current distribution factor – 1 (one)</li> <li>ii) Duration of fault current – 0.5 sec</li> </ol>																		

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
d)	<p>iii) Human body weight – 50kg</p> <p>Grid resistance shall be less than 1(one) ohm.</p> <p><b>EARTHING CONDUCTOR LAYOUT</b></p> <ul style="list-style-type: none"> <li>i. Earthing conductors in outdoor areas shall be buried atleast 600mm below finished grade level unless stated otherwise.</li> <li>ii. Spacing between rod electrodes shall be provided based on the earthmat design calculations.</li> <li>iii. Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.</li> <li>iv. Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, “earth insert” with temporary wooden cover or “earth riser” shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.</li> <li>v. Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.</li> <li>vi. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.</li> <li>vii. In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.</li> </ul>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
f)	<p>viii. Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.</p> <p>ix. Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.</p> <p><b>EQUIPMENT AND STRUCTURE EARTHING</b></p> <p>i. The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.</p> <p>ii. Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.</p> <p>iii. Metallic conduits shall not be used as earth continuity conductor.</p> <p>iv. A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.</p> <p>v. Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.</p> <p>vi. Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running alongwith the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.</p> <p>vii. Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
g)	<p>viii. Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.</p> <p>ix. Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.</p> <p>x. Equipment earthing (Riser &amp; welding of two conductors) shall be done as per standard drawing enclosed in this part.</p> <p><b>JOINTING</b></p> <p>i. Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.</p> <p>ii. Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.</p> <p>iii. Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.</p> <p>iv. Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.</p> <p>v. All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.</p> <p>vi. Bending of large diameter rod/thick conductor shall be done preferably by gas heating.</p> <p>vii. All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.</p>

CLAUSE NO.	 <b>TECHNICAL SPECIFICATIONS</b>
h)	<p><b>POWER CABLE EARTHING</b></p> <p>Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.</p>

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC			
	<b>C-9 EARTHING SYSTEM</b>				
1.0	<b>GENERAL REQUIRMENTS</b> <p>This specification is intended to outline the requirement of earthing (grounding) for Solar array (DC) side and AC Power block side of Solar PV Project. It is not the intent of the specification to specify all details of design and construction since the bidder has full responsibility for engineering and implementation of earthing system meeting the intent of the specification and functional requirement. Any additional equipment, material, services which are not specifically mentioned herein but are required for successful installation, testing and commissioning of earthing system for safe and satisfactory operation of the plant shall be included under scope of the bidder.</p> <p>Earthing requirement for outdoor metering yard/Switchyard has been mentioned elsewhere in the specification and hence shall be excluded from scope of this chapter unless earthing requirement of metering yard/Switchyard is specifically mentioned in this chapter.</p>				
1.1	<b>EARTHING DESIGN REQUIREMENT</b> <p>The object of protective earthing system is to provide as nearly as possible a surface under and around a station which shall be at a uniform potential and as nearly zero or absolute earth potential as possible. The purpose of this is to ensure that, in general, all parts of apparatus other than live parts, shall be at earth potential, as well as to ensure that operators and attendants shall be at earth potential at all times. Also by providing such an earth surface of uniform potential under and surrounding the station, there can exist no difference of potential in a short distance big enough to shock or injure an attendant when short-circuits or other abnormal occurrences take place.</p> <p>Care must be taken for equipment with functional earthing that its service is not disrupted due to undesired disturbances in protective earthing system.</p>				
1.2	<b>CODES AND STANDARD</b> <p>The equipment/product furnished for earthing system shall meet the requirements of all the applicable relevant National/International codes and standards or their latest amendment Codes and Standards. Product</p>				
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9 PAGE 140		

CLAUSE NO.	TECHNICAL SPECIFICATIONS																																																	
	<p>certification has to be CE/UL/BIS/TUV or equivalent. The relevant codes and standard for earthing system are tabulated below.</p> <table border="1"> <tr> <td>IS: 3043</td><td colspan="2">Code of practice for Earthing.</td></tr> <tr> <td>IEEE: 80</td><td colspan="2">IEEE guide for safety in AC substation grounding</td></tr> <tr> <td>IEEE: 837</td><td colspan="2">Standard for qualifying permanent connections used in substation grounding</td></tr> <tr> <td>IS: 2309</td><td colspan="2">Code of Practice for the protection of building and allied structures against lightning.</td></tr> <tr> <td>IS: 802</td><td colspan="2">Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr> <tr> <td>IS: 2629</td><td colspan="2">Recommended practice for hot dip galvanizing of iron &amp; steel</td></tr> <tr> <td>IS: 2633</td><td colspan="2">Method for testing uniformity of coating on zinc coated articles</td></tr> <tr> <td>IS: 513</td><td colspan="2">Cold rolled low carbon steel sheets and strips</td></tr> <tr> <td>IS: 6745</td><td colspan="2">Methods for determination of mass of zinc coating on zinc coated iron &amp; steel articles.</td></tr> <tr> <td>IS 2062</td><td colspan="2">HOT ROLLED MEDIUM AND HIGH TENSILE STRUCTURAL STEEL — SPECIFICATION</td></tr> <tr> <td>IS: 4736</td><td colspan="2">Hot-dip Zinc coating for MS Tubes.</td></tr> <tr> <td>IS: 458</td><td colspan="2">Precast Concrete Pipes (With and Without Reinforcement)</td></tr> <tr> <td>UL-467</td><td colspan="2">Grounding and Bonding Equipment</td></tr> <tr> <td>IEC 62561-7</td><td colspan="2">Requirements for earthing enhancing compounds</td></tr> <tr> <td></td><td colspan="2">CEA regulations for electrical safety-2010</td></tr> <tr> <td></td><td colspan="2">Indian Electricity Rules/ Indian Electricity Act.</td></tr> </table>		IS: 3043	Code of practice for Earthing.		IEEE: 80	IEEE guide for safety in AC substation grounding		IEEE: 837	Standard for qualifying permanent connections used in substation grounding		IS: 2309	Code of Practice for the protection of building and allied structures against lightning.		IS: 802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.		IS: 2629	Recommended practice for hot dip galvanizing of iron & steel		IS: 2633	Method for testing uniformity of coating on zinc coated articles		IS: 513	Cold rolled low carbon steel sheets and strips		IS: 6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.		IS 2062	HOT ROLLED MEDIUM AND HIGH TENSILE STRUCTURAL STEEL — SPECIFICATION		IS: 4736	Hot-dip Zinc coating for MS Tubes.		IS: 458	Precast Concrete Pipes (With and Without Reinforcement)		UL-467	Grounding and Bonding Equipment		IEC 62561-7	Requirements for earthing enhancing compounds			CEA regulations for electrical safety-2010			Indian Electricity Rules/ Indian Electricity Act.	
IS: 3043	Code of practice for Earthing.																																																	
IEEE: 80	IEEE guide for safety in AC substation grounding																																																	
IEEE: 837	Standard for qualifying permanent connections used in substation grounding																																																	
IS: 2309	Code of Practice for the protection of building and allied structures against lightning.																																																	
IS: 802	Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.																																																	
IS: 2629	Recommended practice for hot dip galvanizing of iron & steel																																																	
IS: 2633	Method for testing uniformity of coating on zinc coated articles																																																	
IS: 513	Cold rolled low carbon steel sheets and strips																																																	
IS: 6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.																																																	
IS 2062	HOT ROLLED MEDIUM AND HIGH TENSILE STRUCTURAL STEEL — SPECIFICATION																																																	
IS: 4736	Hot-dip Zinc coating for MS Tubes.																																																	
IS: 458	Precast Concrete Pipes (With and Without Reinforcement)																																																	
UL-467	Grounding and Bonding Equipment																																																	
IEC 62561-7	Requirements for earthing enhancing compounds																																																	
	CEA regulations for electrical safety-2010																																																	
	Indian Electricity Rules/ Indian Electricity Act.																																																	
	<p>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 (codes and standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the above standards/ codes as applicable.</p> <p>The earthing system includes earth electrode, installation of earth electrode in suitable pit size, construction of earth pit with cover for the</p>																																																	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9	PAGE 141																																															

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC	
<p><b>2.0</b></p>	<p>installation, connection of earth electrode with equipotential earth bus and connection of equipment to equipotential earth bus.</p> <p><b>EARTH ELECTRODE</b></p> <p>The earth electrode is in direct contact with the ground provides means for conducting earth current with ground. Earth Electrode material should have good electrical conductivity and mechanical strength and should not corrode in wide variety of soil conditions. For an effective earthing system, following type of vertical earth electrodes can be used.</p> <p>I. MS Rods Hot rolled, Medium or High Tensile Steel Rod as per IS 2062 of length not less than 3000 mm and diameter of 40 mm.</p> <p>II. Copper Bonded Rods High tensile-low carbon steel rod having diameter not less than 14/17 mm of Length 3000 mm to be selected based on earth fault current. The Rod shall comply with requirements of BS 4360 Grade 43A or EN10025:2-004 S275JR, molecularly bonded by 99.99% pure high conductivity copper on outer surface with copper coating thickness 250 micron or more in conformity to UL-467. Its surface shall be clean, free from mechanical defect and any visible oxide layer or foreign material.</p> <p><b>2.1</b></p> <p><b>Earthing Enhancement Compound</b></p> <p>A low resistance earth electrode system is important to provide a low impedance path for the better dissipation of lightning/fault currents, and to protect personnel and equipment by minimizing and equalizing voltage potential differences. Earthing (ground) enhancement materials shall be used to improve the ground electrode resistance. Earth enhancement material shall be a superior conductive material which improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It shall be tested and should conform to the requirements of IEC 62561-7. It shall have the following characteristics:-</p> <p>a) High conductivity, improves earth's absorbing power and humidity retention capability, non-corrosive in nature having low water solubility but highly hygroscopic.</p>		
	<p>DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH</p> <p>TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9</p>	<p>C-9</p>	<p>PAGE 142</p>

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<p>b) Carbon based with min 95% of fixed carbon content premixed with corrosion resistant cement to have set properties. Cement shall not mix separately &amp; shall not have Bentonite.</p> <p>c) Resistivity of less than 0.2 ohms -meter.</p> <p>d) It shall not depend on the continuous presence of water to maintain its conductivity and shall be permanent &amp; maintenance free and in its "set form", maintains constant earth resistance with time.</p> <p>e) It shall not dissolve, decompose or leach out with time and shall be environmental friendly, suitable for soils of different resistivity and any kind of earth electrode.</p> <p>The Earth enhancement material shall be supplied in sealed, moisture proof bags, marked with Manufacturer's name or trade name, quantity etc. The minimum quantity of earth enhancement compound to be used with each earth-pit shall be 25 Kg.</p>		
2.2	<p><b>Earthing conductor</b></p> <p>Earthing conductor is the conductor for buried below the ground at the depth of 600 mm connecting earth pits to make interconnection of earth pit. To interconnect earth pits, following type of conductor can be used. Application of specific conductor and its size has been mentioned in relevant clause:</p> <p>I. Galvanised Steel Flat (GS) Flat GS/GI Flat (Strip) conductor shall comply to IS 2026 with Galvanization of 85 Micron as per IS. Material shall be clean and free from mechanical defects.</p> <p>II. Copper Clad Steel (CCS) Earthing Conductor The Copper Bonded Steel Grounding Conductor shall be made of steel with the coating of 99.99% pure copper complying to ASTM B 869-96 and ASTM B 452-93 standards. Each strand of CCS shall have continuous, uniform coating and the conductor surface shall be smooth and free from mechanical defects.</p> <p>III. MS Rod Hot rolled, Medium or High Tensile Steel Rod as per IS 2062 of length not less than 3000 mm and diameter of 40 mm.</p>		
2.3	<p><b>Earthing Technical and Installation Requirement</b></p> <p>Careful consideration should be given to installing an earthing system that meet or exceed statutory requirements. Contractor shall select certified</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9 PAGE 143

CLAUSE NO.	TECHNICAL SPECIFICATIONS	
	<p>product and ensure good workmanship for installation for satisfactory performance to fulfill the designed parameters all the times. Following care shall be taken while installation of earthing.</p> <ul style="list-style-type: none"> <li>I. Metallic frame/ structure of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed as per requirement mentioned elsewhere in the specification. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable. Metallic column for Inverter/Switchgear shelter/E-house shall be earthed with two distinct connections at minimum two column. All the wall cladding section shall be earthed at minimum two location with flexible copper cable of not less than 50 sq. mm.</li> <li>II. Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground.</li> <li>III. Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.</li> <li>IV. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects.</li> <li>V. Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint/compound.</li> </ul>	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9 PAGE 144

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 एनटीपीसी NTPC
	<p>VI. Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.</p> <p>VII. Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding. Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.</p> <p>VIII. Earthing conductors buried in ground shall be laid minimum 600 mm below grade level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.</p> <p>IX. Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.</p> <p>X. A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same. Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.</p> <p>XI. Earth pit shall be constructed as per IS:3043. Electrodes shall be embedded preferably below permanent moisture level. Minimum spacing between electrodes shall be 600mm.</p> <p>XII. Earth pits shall be treated with earth enhancement compound if resistivity is more than 20 ohm meter.</p> <p>XIII. On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured and recorded. All equipment required for testing shall be furnished by contractor.</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC												
	XIV. Contractor shall obtain all necessary statutory approvals for the earthing system before charging of the plant and electrical equipments.													
3.0	<p><b>TECHNICAL DETAILS FOR AC EARTHING SYSTEM</b></p> <p>This section outlines the requirements of protective and functional earthing system to discharge AC fault current to earth and provide equipotential bonding for Transformer, HT and LT Switchgear Panel and other similar electrical equipments, Transformer neutral and shield.</p> <p>The Contractor shall furnish the detailed design and calculations as per IEEE 80/IS 3043 for Employer's approval for equipment earthing..</p> <p><b>Earthing System requirement for AC Earthing:</b></p> <ol style="list-style-type: none"> <li>1. Conductors above ground level and in built up trenches -Galvanized steel</li> <li>2. Conductors buried in earth -Mild steel</li> <li>3. Earth electrodes - Mild steel rod of diameter 40mm or Copper bonded steel rod of dia not less than 17 mm</li> <li>4. Life Expectancy - 25 years</li> <li>5. Fault Level - Mentioned Elsewhere</li> <li>6. Min. Steel corrosion - As per IS 3043</li> <li>7. Soil Resistivity -Actual as per site condition</li> </ol> <p>The sizes of earthing conductors for various electrical equipment shall be as below:</p> <table border="1"> <thead> <tr> <th>S No.</th> <th>Equipment</th> <th>Earth Conductor Earth</th> <th>Earth conductor above ground level and in buried in built up trenches</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear</td> <td>--</td> <td>65 x 8mm GS flat</td> </tr> <tr> <td>2</td> <td>415 V MCC/</td> <td>--</td> <td>50 x 6mm GS flat</td> </tr> </tbody> </table>	S No.	Equipment	Earth Conductor Earth	Earth conductor above ground level and in buried in built up trenches	1	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	--	65 x 8mm GS flat	2	415 V MCC/	--	50 x 6mm GS flat	
S No.	Equipment	Earth Conductor Earth	Earth conductor above ground level and in buried in built up trenches											
1	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	--	65 x 8mm GS flat											
2	415 V MCC/	--	50 x 6mm GS flat											
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9	PAGE 146											

CLAUSE NO.	TECHNICAL SPECIFICATIONS			<b>एनटीपीसी NTPC</b>
3.2	C o n t r a c t o r s h a l	Distribution boards / Transformers		
		3 LT Motors above 125 KW	--	50 x 6mm GS flat
		4 LT Motors 25 KW to 125 KW	--	25 x 6mm GS flat
		5 LT Motors 1 KW to 25 KW	--	25 x 3mm GS flat
		6 Fractional House power motor	--	8 SWG GS wire
		7 Control panel & control desk	--	25 x 3 mm GS flat
		8 Push button station/Junction Box	--	8 SWG GI wire
		9 Columns, structures, cable trays and bus ducts enclosures	--	50 x 6mm GS flat
		10 Crane, rails, rail tracks & Other non-current carrying metal parts	--	25 x 6mm GS flat
		I ensure there at least two earth pits each dedicated for earthing of each Transformer, HT/LT Switchgear panel, transformer neutral, Battery Charger/UPS/Control Panel etc. shall be provided. Earth electrode shall be located near to the equipment and all earth electrodes shall be interconnected with parallel conductor buried in earth surrounding the equipment.		
3.3	Earthing system of different locations such as Inverter room/Pooling Switchgear/Sub pooling switchgear/Inverter shelter etc. shall be interconnected in single network with buried conductor of the size 65X8 GS Flat laid at 600 mm depth. Contractor shall submit the calculation based on the system of earth conductor and electrode connected in single network. Location and manner of interconnection shall be approved during detail engineering.			
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9		C-9
				PAGE 147

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>															
	<p>3.4 For functional earthing of electronic component such as SCADA, contractor shall provide 1 no. (Min) isolated earth electrode near to the equipment connected with 2 run of copper cable of size not less than 25 sqmm. Contractor shall comply to the recommendation of OEM ( Original Equipment Manufacturer ) for electronic earthing and electrode can be connected with other earth electrode as per recommendation of OEM.</p> <p>3.5 Each inverter duty transformer having shield between HV and LV winding shall be provided with 2 nos. Isolated earth electrode connected with each other for functional earthing of transformer shield. Each electrode shall be connected with transformer shield with separate 25X6 Cu flat.</p> <p><b>4.0 TECHNICAL DETAIL SOLAR ARRAY (DC) EARTHING (if applicable)</b></p> <p>This section outlines the earthing requirement for discharging DC fault current to earth of Solar PV plant and provide equipotential bonding for Module Mounting Structure (MMS), SMB Mounting structure, Module Frames etc.</p> <p>System Requirement for the solar array DC earthing:</p> <table> <tbody> <tr> <td>Conductors buried in earth</td> <td>-GS Flat or CCS</td> </tr> <tr> <td>Conductors above ground level</td> <td>-GS Flat or CCS</td> </tr> <tr> <td>Earth Electrode</td> <td>-40 mm MS Rod or Copper bonded steel rod of dia. not less than 14 mm</td> </tr> <tr> <td>Life Expectancy</td> <td>-25 Years</td> </tr> <tr> <td>System fault level</td> <td>-5 KA for 3 Sec.</td> </tr> <tr> <td>Soil resistivity</td> <td>-Actual as per site conditions</td> </tr> <tr> <td>Min. Steel corrosion</td> <td>-As per IS 3043</td> </tr> </tbody> </table> <p>4.1 Each Module mounting structure (MMS), SPV Module frames, mounting arrangement for String Monitoring Boxes, Metallic Junction Boxes, Metal frames/Panel, Metallic Pipes of the solar array shall be effectively earthed by two separate and distinct connections to earthing system. Earthing system for solar array shall consist interconnected earth pits electrodes connected by 25X6 GS flat (Min.) or Copper Clad Steel (CCS) earthing Conductor of size not less than 120 SQMM laid at the depth of 600 MM below the ground. Minimum size of riser conductor to connect the structures to buried earthing conductor and structure to structure in the solar farm shall be 25X3 GS Flat or CCS of Min. 70 SQ MM size.</p>	Conductors buried in earth	-GS Flat or CCS	Conductors above ground level	-GS Flat or CCS	Earth Electrode	-40 mm MS Rod or Copper bonded steel rod of dia. not less than 14 mm	Life Expectancy	-25 Years	System fault level	-5 KA for 3 Sec.	Soil resistivity	-Actual as per site conditions	Min. Steel corrosion	-As per IS 3043		
Conductors buried in earth	-GS Flat or CCS																
Conductors above ground level	-GS Flat or CCS																
Earth Electrode	-40 mm MS Rod or Copper bonded steel rod of dia. not less than 14 mm																
Life Expectancy	-25 Years																
System fault level	-5 KA for 3 Sec.																
Soil resistivity	-Actual as per site conditions																
Min. Steel corrosion	-As per IS 3043																

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC
4.2	Periphery fencing wherever provided shall be earthed at every 100 meter interval with 25X3 GS flat connected with DC or AC side nearest buried earthing conductor.	
4.3	Earthing conductor for connection to structure and equipment may be kept on the ground below MMS. However, these conductor shall be laid 300 mm below the ground along the pathway and/or crossing the pathway.	
4.4	Equipment and structure in the solar farm shall be earthed in compliance to the IS: 3043 (Code of Practice for Earthing) and Indian Electricity Rules/Acts.	
4.5	The Contractor shall furnish the detailed design and calculations for Owner's approval as per IS 3043 to determine the number of earth pit and size of earth conductor. However the no. of earth pit electrodes for the DC earthing shall be as per Clause. 2.0 of Chapter A-2	
4.6	Buried earth conductor shall be laid all around periphery of solar array farm and at every 300 meter (Min.) across the rows of MMS. GS flat above the ground for structure earthing shall be connected to the nearest buried conductor or electrode. All the earth electrodes shall be interconnected in single network/mesh and no electrode or group of electrodes shall be isolated/islanded. These electrodes shall be uniformly distributed in the solar farm at maximum practical extent and location of earth electrode shall be approved during detail engineering. A continuous earth path is to be maintained throughout the PV array.	
4.7	Connection of DC earthing system and AC earthing system with location and manner of connection shall be approved during detail engineering. Contractor shall submit the design calculation of earthing system of AC and DC side as standalone (no interconnection) system.	
4.8	Connection of riser to the structures shall be bolted or welded type. Portion of galvanized structure which undergoes welding at site shall be coated with two coats of cold galvanizing and anti-corrosion paint afterwards.	
4.9	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection, welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.	
4.10	Each PV Module frame shall be earthed in accordance with module manufacturer guidelines. In case module frame earthing is to be separately provided, it shall be earthed with minimum 2.5 SQMM flexible	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC	
	<p>copper cable with lug at suitable location of module frame. The Number of PV modules in single loop of earthing connection to module frame shall be as per Module manufacturer recommendation. Both ends of the loop of copper cable for earthing shall be connected with nearest earthed structure or earth conductor.</p> <p>4.11 Contractor shall seek owner's approval for connecting solar array earth mesh with any other earth mat/earth grid of the solar PV plant.</p> <p>4.12 Size of earth conductor, nos. of earth pits given in this clause is applicable for solar array earthing only. Relevant method and practice of laying of earthing conductor, earth pits and riser not mentioned herewith but given elsewhere in this specification is applicable to solar array earthing also.</p> <p>4.13 Inverter functional earthing (Negative earthing, Anti PID Earthing) shall be carried out as per guideline of OEM. Contractor shall submit complete detail of such earthing from OEM and implement the earthing accordingly.</p> <p><b>5.0 EARTHING REQUIREMENT FOR EQUIPMENT ON FLOATER</b></p> <p>5.1 Aforementioned requirement of the earthing are applicable earth surfaces. For Floater area, contractor shall lay 25X6 GI Flat all along the periphery of the floater area. This periphery GI Flat shall be connected at suitable location by laying minimum 2 Nos. of 25X6 GI flat equi-spaced (Location to be decided during detail engineering) along East-West and North-South direction making a grid 25X6 GI Flat on the floater.</p> <p>5.2 All the equipment/devices, module metallic frame &amp; structure on the floater shall be connected with 25X6 Flat.</p> <p>5.3 The earthing system of Floater shall be connected with earthing system of ground at each location of Inverter transformer with 2 (two) nos. of 120Sqmm copper earthing cable.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-9	PAGE 150



PURCHASE SPECIFICATION  
ESE LIGHTNING ARRESTOR SYSTEM

REV NO: 00

PAGE : 1 OF 4

**COPYRIGHT AND CONFIDENTIAL**

The information in this document is the property of Bharat Heavy Electricals Limited.  
It must not be used directly or indirectly in anyway detrimental to the interest to the company

**PURCHASE SPECIFICATION FOR**

**SUPPLY OF**

**ESE LIGHTNING ARRESTOR SYSTEM**

00	09-12-2019	VIPINDAS CP	SREENATH M
Revision	Date	Prepared	Checked & Approved



PURCHASE SPECIFICATION  
ESE LIGHTNING ARRESTOR SYSTEM

PS-439-ESE LA

REV NO: 00

PAGE : 2 OF 4

## 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	<b>Supply of Lightning arrestor protection system</b> (comprising of following components) <ul style="list-style-type: none"><li>• Supply of ESE lightning arrestor terminal as per clause A 1.0</li><li>• Supply of 5m LA mounting pole &amp; accessories for array as per clause A 2.0</li><li>• Supply of Down Conductor as per clause A 3.0</li><li>• Supply of Lightning Event Counter as per clause A 4.0</li><li>• Supply of earthing set for LA as per clause A 5.0</li><li>• Installation of ESE lightning arrestor as per clause A 6.0</li></ul>	21 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.



PURCHASE SPECIFICATION  
ESE LIGHTNING ARRESTOR SYSTEM

PS-439-ESE LA

REV NO: 00

PAGE : 3 OF 4

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 using down conductor.
2. The down conductors shall have a minimum size of 50 mm<sup>2</sup> 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. 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. The average soil

## 6.0 Installation of ESE LA

All the ESE type Lightning arresters for PV array, Control room shall be installed on ground. Vendor shall construct the suitable RCC foundations and install the LA mast along with guy



PURCHASE SPECIFICATION  
ESE LIGHTNING ARRESTOR SYSTEM

PS-439-ESE LA

REV NO: 00

PAGE : 4 OF 4

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

CLAUSE NO.	TECHNICAL SPECIFICATIONS				
	<h2 style="text-align: center;"><b>C-10 PLANT ILLUMINATION SYSTEM</b></h2> <p>This chapter covers supply and installation of suitable illumination system along the approach roads to inverter room and inverter room(s), transformer yard and other facilities inside the plant.</p>				
1.0	<h3><b>DESIGN PHILOSOPHY</b></h3> <p>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</p> <p>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.</p>				
2.0	<h3><b>LIGHTING SYSTEM DESCRIPTION for CMCS and inverter room</b></h3> <p>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.</p> <p>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.</p>				
3.0	<h3><b>Lighting Fixture, Lamps &amp; Accessories</b></h3> <ol style="list-style-type: none"> <li>a. All lighting fixtures and accessories shall be designed for continuous operation for its life under atmospheric conditions existing at site.</li> <li>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 &amp; 240 V.</li> <li>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</li> </ol>				
<small>DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH</small>		<small>TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9</small>	<small>C-10</small>		
			<small>PAGE 151</small>		

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC	
	<p>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.</p> <p>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</p> <p>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</p> <p>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</p> <p>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.</p> <p>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.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-10	PAGE 152

CLAUSE NO.	TECHNICAL SPECIFICATIONS																				
4.0	<b>LED Luminaires:</b>																				
4.1	<b>CODES AND STANDARDS</b> <p>All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments &amp; 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 &amp; codes.</p> <table> <tbody> <tr> <td>16101:2012</td><td>General Lighting. LEDs and LED modules Terms and definitions</td></tr> <tr> <td>16102(Part 1):2012</td><td>Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.</td></tr> <tr> <td>16102(Part 2):2012</td><td>Self Ballasted LED Lamps for General lighting Services. Part-2 Performance Requirements.</td></tr> <tr> <td>16103(Part I):2012</td><td>LED modules for General lighting Safety Requirements.</td></tr> <tr> <td>15885(Part 2/Sec. 13) :2012</td><td>Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules</td></tr> <tr> <td>16104:2012</td><td>d.c. or a.c. Supplied Electronic control gear for LED modules - Performance Requirements.</td></tr> <tr> <td>16105:2012</td><td>Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.</td></tr> <tr> <td>16106:2012</td><td>Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products</td></tr> <tr> <td>16107:2012</td><td>Luminarie Performance</td></tr> </tbody> </table>	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	C-10	PAGE 153
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																				



CLAUSE NO.	TECHNICAL SPECIFICATIONS	
	<p>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.</p> <p>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.</p> <p>The beam angle for LED chip for indoor type luminaires shall be 120 degrees. However for highbay &amp; 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%.</p> <p>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 &amp; 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.</p> <p><b>Driver Circuit:</b> 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.</p> <p>LED Drivers may have following control &amp; protections:-</p> <ul style="list-style-type: none"> <li>• Suitable precision current control of LED.</li> <li>• Open Circuit Protection</li> <li>• Short Circuit Protection</li> <li>• Over Temperature Protection</li> <li>• Overload Protection</li> <li>• Surge Protection</li> </ul> <p>Lighting panels shall be powder coated with color shade RAL9002. Lighting panels shall have IP55 degree of protection.</p> <p>Wires of different phase shall normally run in separate conduit.</p> <p>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.</p>	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-10 PAGE 155

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
5.0	<p>Suitable number of 63A, 3ph, 415V AC industrial receptacles shall be provided for welding purposes at one location.</p> <p>Incandescent lamps may be used only with DC Lighting.</p> <p>Electrification of all building shall be carried out as per IS 732-1989, IS 4648-1968 and other relevant standards.</p> <p>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.</p> <p>All luminaries and their accessories and components shall be of type readily replaceable by available Indian makes.</p> <p>Following test reports to be submitted for LED chip/LED luminaires:</p> <ul style="list-style-type: none"> <li>a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.</li> <li>b) LM 80/IS: 16105 report.</li> <li>c) LM 79/IS: 16106 report</li> </ul> <p><b>JUNCTION BOXES, CONDUITS, FITTING &amp; ACCESSORIES</b></p> <p>Junction box for indoor lighting shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type.</p> <p>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.</p> <p>All switches and receptacles upto 16A shall be modular type. These shall be provided with pre-galvanized/galvanized modular switchbox &amp; plate.</p> <p>Conduits, Pipes and Accessories:</p> <p>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.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-10	PAGE 156

CLAUSE NO.	TECHNICAL SPECIFICATIONS	 <b>एनटीपीसी</b> <b>NTPC</b>	
<b>6.0</b> <b>7.0</b> <b>8.0</b>	<p><b>LIGHTING WIRES</b></p> <p>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 &amp; neutral, respectively and white &amp; grey for DC positive &amp; DC negative circuits, respectively. Minimum size of wire shall not be less than 1.5.sq.mm. for copper</p> <p><b>LIGHTING POLES</b></p> <p>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.</p> <p>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 infrastructure.</p> <p>Hot dipped Galvanized with 80 mm thickness hexagonal/Octagonal lighting pole with inbuilt JB shall also be acceptable</p> <p>The luminaries used shall be minimum 32 W with minimum pole height of 2.5 m with 50 m for internal roads.</p> <p><b>EARTHING</b></p> <p>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.</p> <p>Alternately Vendor may offer technically superior and proven product subject to approval of employer.</p>		

CLAUSE NO.	TECHNICAL SPECIFICATIONS																							
9.0	<b>AVERAGE ILLUMINATION LEVEL</b> <table border="1"> <thead> <tr> <th>Location</th><th>Average Illumination Level (Lux)</th><th>Type of Fixture</th></tr> </thead> <tbody> <tr> <td>Control Room</td><td>300</td><td>LED Luminaries</td></tr> <tr> <td>Store Room</td><td>200</td><td>LED Luminaries</td></tr> <tr> <td>Switchgear Room, HT Room</td><td>150</td><td>LED Luminaries</td></tr> <tr> <td>Inverter Room</td><td>150</td><td>LED Luminaries</td></tr> <tr> <td>Street lighting-Roads</td><td>10</td><td>LED Luminaries</td></tr> <tr> <td>Yard/ Substation</td><td>20(general) 50(on strategic equipment)</td><td>LED Luminaries</td></tr> </tbody> </table>			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
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																						
	DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	C-10	PAGE 158																				

# ANNEXURE-13

		<b>PROJECT : Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh</b> <b>PACKAGE : SOLAR</b> <b>CONT. NO. :</b>			<b>INDICATIVE VENDOR LIST</b> <b>Subsystem- Electrical &amp; Mechanical</b>		<b>DOC NO. :</b> <b>REVISION NO. 00</b> <b>PAGE : 1</b>
SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
1.	SPV module	I	Q-001	BHEL Warree Emmvee Vikram Solar Lanco Solar Tata Power Solar Alpex Synergy Photonix HHV Solar	Bangalore Surat Bangalore Parganas Chattisgarh Bangalore Solan Durgapur Satara Bangalore	A A A A A A A A A A	
2.	Power Conditioning Unit (PCU)	I	Q-002	Schneider ABB Bongfiglioli Fecon AEG Hitachi-Hirel Hitachi-Hirel Vacon	Bangalore Bangalore Germany Germany Bangalore Gandhinagar Sananad Bangalore	A	Conditions apply Conditions apply Conditions apply Conditions apply Conditions apply Conditions apply Conditions apply Conditions apply
3.	String Monitoring Box (SMB)	II	Q-003	Trinity Touch Hensel AEG Statcon Weidmuller	Palwal Sriperumbudur Bangalore Pilkhuwa Spain	A	Conditions apply Conditions apply Conditions apply Conditions apply Conditions apply



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 2**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

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
				Nitya Electrocontrols	Noida	A	
				Siemens	Kalwa	A	Conditions apply
				Tricolite	Sahibabad/ Manesar	A	Conditions apply
7.	LV Air Circuit Breaker	*		C&S Electric	Noida	A	*(part of Swgr MQP)
				L&T	Mumbai	A	
				GE	Bangalore	A	
				Siemens	Germany	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 3

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				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 Switchgear Panel			
9.	Wall mounted fixed type indoor / outdoor LT	I	Q-006	Control Devices	Kolkata	A	BOIs preferably with CE/VDE/UL/CSA marked or BIS approved with valid CML no.



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 4**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

	Switchgear non compartmentalized Panel ( Lighting panels / AC / DC Fuse boards etc.) Refer Note-5						
				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	III	Q-007	Southern Electric	Chennai	A	
				Indcoil	Thane	A	
				Pragati	Thane	A	
				Prayog	Pune	A	
				Precise	Mumbai	A	
				Logicstat	Delhi	A	
				Gujarat Plug in	Vadodara	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 5

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				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 (From SMB to PCU)	Refer Note- 2	Q-008	Universal Cable Ltd.	Satna	A	
				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.



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 6

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

							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	
				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	
				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



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 7

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				Indo Alusys	Bhiwadi	A	
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	Khushkhera	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	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 8

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				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	
				Goyoline Fibres(I) Ltd	Daman	A	
				Indo Alusys	Bhiwadi	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	



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 9**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				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	
				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	
16.	DC Cable (Interconnecting SPV Modules, SPV Module to SMB) As per NTPC specification	I	Q-012	Siechem	Pondicherry	A	Upto 35 sq.mm.



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 10

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
---------	------	---------------	----------	-------------------------------------	-------	----------------	---------

				Apar	Khatalwada	A	Conditions apply
17.	Battery ( Ni-Cd)	II	Q-013	M/S HBL-Power System M/S Amcosoft	Hyderabad Bangalore	A A	Up to 990 Ah with conditions 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 Hoppeke	Kolkata Brilon, Germany	A A	
19.	Battery charger	II	Q-015	M/s Amararaja M/s HBL- Power System M/s Chhabhi electrical M/s. Chloride Power M/s Statcon M/s Dubas M/s Saft Nife Power Systems M/s Masstek	Tirupati Hyderabad Jalgaon Kolkatta Hapur Bangalore Singapore Jalgaon	A A A A A A	Up to 220, V 850 A Up to 220 V, 250 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	III		M/s 3M Electro & Communication	Pune	A	Upto 33KV



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 11

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
---------	------	---------------	----------	-------------------------------------	-------	----------------	---------

	(Heat shrinkable type)						
				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	
				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	
				M/s Philips	Noida	A	
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	III		Schneider	Nasik	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 12

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

	receptacles & boxes						
				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 pipes/HDPE pipe/Structural Steel/GI steel rigid conduit/epoxy conduit	III		BIS licensee with valid CML number / ISI marked with valid CML number			
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		Siemens	Mumbai	A	Upto 33kv



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 13

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
---------	------	---------------	----------	-------------------------------------	-------	----------------	---------

		Swgr MQP)					
				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
				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



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 14

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
---------	------	---------------	----------	-------------------------------------	-------	----------------	---------

				Siemens	Goa	A	7SR2X , 7SJ66X series only
30.	Single Rod Air Terminal Type Solar Array Lightning Arrestor	III		Main Contractor approved sources: subject to manufacturer / supplier having valid Type Test Report as per IS 2309 or equivalent Standard			
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	



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**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
------------	------	---------------------	----------	--	-------	-------------------	---------

				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
				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



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

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
------------	------	---------------------	----------	--	-------	-------------------	---------

				Reliable Sponge	Kalunga	A	
				Rukmani	Hoogly	A	Galvanization at Rukmani Fab & Gal- Howrah
				Eros Metal Works	Nagpur	A	Conditions apply
				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
				Patny Systems	Hyderabad	A	
37.	Piping – ERW ( IS 1239)	II		Main Contractor approved sources; with valid BIS license			
38.	Fire Extinguisher	III		BIS approved sources with valid BIS License.			
39.	Circuit Breaker 33KV (outdoor type)	I	Q-027	Siemens	Aurangabad	A	
				ABB	Vadodara	A	
				CGL	Nasik	A	
				BHEL	Hyderabad	A	



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 17**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				GE T&D	Kanchipuram	A	
40.	Isolator 33 kv (outdoor type)	I	Q-028	GR Power	Hyderabad	A	
				Hivelm	Chennai	A	
				S&S Power	Pondicherry	A	
				Switchgear & Structural	Hyderabad	A	
				Siemens Ltd	Hyderabad	A	
41.	PT (Outdoor Type, upto 33Kv)	I	Q-029	Mehru	Bhiwadi	A	
				Vishal Transformer	Meerut	A	
				Heptacare	Meerut	A	
42.	33KV CT (Outdoor Type)	I	Q-030	Mehru	Bhiwadi	A	
				GE T&D	Hosur	A	
				ABB	Vadodara	A	
				CGL	Nasik	A	
				BHEL	Jhansi/Bhopal	A	
				Vishal Transformer	Meerut	A	
				Heptacare	Meerut	A	
43.	Surge Arrestor	I	Q-032	Oblum	Hyderabad	A	
				Lamco	Hyderabad	A	
				Xian	China	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 18

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				CGL	Nasik	A	
44.	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.
45.	Conductor	II		Smita	Ghaziabad	A	
				Gupta Power Infra	Bhubaneswar	A	
				Saravathy	Bangalore	A	
				Galaxy	Sangli	A	
				Hindustan Vid�ut products	Faridabad	A	
				Apar Industries	Vadodara / Silvassa	A	
				Hira Cables	Hirakud	A	
				JSK	Silvassa	A	
				DIAMOND	VADODARA	A	
				HIREN ALUMINIUM	SILVASSA	A	
				LUMINO	KOLKATA	A	
46.	Disc Insulator/Pin Insulator	II		Aditya Birla	Rishra	A	
				IEC	Bhopal	A	
				WSI	Chennai	A	
				BHEL	Bangalore	A	
				Imperial Ceramics	Bikaner	A	Upto 90KN
				SARVANA	CUDDALORE	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 19

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

47.	Bus Post Insulator	II		Aditya Birla IEC WSI MODERN Insulator SARAVANA Global Energy	Halol Bhopal Chennai Abu Road Cuddalore	A A A A A	
48.	Clamps & connectors	III		KLEMMEN ENGG MILIND EMI NOOTAN ENGG TAG CORPORATION ITPL RASHTRAUDYOG PEE VEE ENGG MEGHA Engg EXALT	CHENNAI MUMBAI MUMBAI MUMBAI CHENNAI MUMBAI KOLKATA BANGALORE CHENNAI Mumbai	A A A A A A A A A A	
49.	Insulator hardware, conductor accessories & earthwire accessories	III		RASHTRA UDYOG IAC ITPL EMI Transmission EMTT	KOLKATA KOLKATA MUMBAI MUMBAI Kolkatta	A A A A A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

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
------------	------	---------------------	----------	--	-------	-------------------	---------

50.	Aluminium tube	II		HINDALCO INDALCO CENTURY EXTRUSIONS JINDAL ALUMINUM TUBE ALOM EXTRUSIONS BALCO SUDAL Banco	RENUKUT ALUPURAM KOLKATA BANGALORE KOLKATA KORBA NASIK Vadodara	A A A A A A A	
51.	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
52.	Numerical Relays for Switchyard	(part of C&R MQP)		GE Siemens	UK/Chennai Germany	A A	
				ABB	Sweden/ Bangalore	A	
53	FIBRE OPTIC CABLES	III		BIRLA ERICSSON OPTICAL AKSH FIBER	REWA BHIWADI	A A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 21

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				FINOLEX	PUNE/GOA	A	
				R&M	SWITZERLAND	A	
				HFCL	GOA	A	
54	RELAY TEST KIT	III		OMICRON	USA/AUSTRALIA	A	
				DOBLE	USA	A	
				MEGGER	UK	A	
55	LEAKAGE CURRENT ANALYSER FOR SURGE ARRESTOR	III		DOBLE ENGG	USA	A	
				ISA	ITALY	A	
				TRANSINOR	NORWAY	A	
56	GPS	III		HATHWAY	USA	A	
				SIEMENS	GERMANY	A	
				HOPF	GERMANY	A	
				SERTEL	CHENNAI	A	
				ARBITER	USA	A	
57	SF6 GAS FILLING AND EVACUATING PLANT, GAS RECYCLING & PURIFYING PLANT, GAS LEAKAGE	III		AI QUALITEK	USA	A	
				DILO	GERMANY	A	
				EMT	UK	A	
				ENERVAC	CANADA	A	
				VACCUUM PLANT INDUSTRIES	PUNE	A	
				WIKA	USA	A	



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 22

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

	DETECTOR						
58	Transformer (Oil filled type) Refer Note-8	I		BHEL	Bhopal		up to 400 kV Class
				GE( T&D)	Naini		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
				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)	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
				Hammond Power Solutions	Hyderabad	A	up to 10 MVA, 33 kV Class



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 23

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

				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, Approval 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
				Sudhir Transformers	Bangalore	A	Up to 12.5 MVA, 33KV Class
				Sudhir Power Ltd	Silvassa	A	Up to 12.5 MVA, 33KV Class
59	Dry Type Transformer (refer note-8)	I	Q-036	ABB Raychem Toshiba BHEL Kirloskar Voltamp Hammond Power Solutions	Savli Pune Hyderabad Jhansi Pune Savli Hyderabad	A	up to 8 MVA, 24 kV Class Up to 3.5 MVA, 33 kV Class Up to 2.0 MVA, 33 kV Class Up to 6.3 MVA, 33 kV Class Up to 4.0 MVA, 33 kV Class Up to 3.25 MVA, 33 kV Class Up to 95 KVA, 33 kV Class
				Sudhir Power Ltd	Silvassa	A	Up to 1 MVA, 11 KV Class
60.	132KV Cables	I	Q-037	Iljin Electric KEI Industries Phelps Dodge Universal Cable Ltd.	South Korea Bhiwadi Bangkok Satna	A	



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 24**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

61.	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

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.**



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 25**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

**Note-2-**

**Category of inspection for LT Power Cable:**

<b>TOTAL CONTRACT QUANTITY PER SIZE</b>	<b>CATEGORY OF INSPECTION</b>
For cable total quantity $\leq$ 2.5 KM	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
For cable total quantity above 2.5 km & up to $\leq$ 10 km per size/type	Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years
<b>TOTAL QUANTITY MORE THAN 10 KM PER SIZE/TYPE</b>	Cat-I

**Category of inspection for Control Cable :**

<b>TOTAL CONTRACT QUANTITY PER SIZE</b>	<b>CATEGORY OF INSPECTION</b>
For cable total quantity $\leq$ 2.5 KM	Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for at least 2 years
For cable total quantity above 2.5 km & up to $\leq$ 10 km per size/type	Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for at least 2 years
For cable total quantity above 10 km per size/type	Cat-I

**Category of inspection for HT cables**

<b>TOTAL CONTRACT QUANTITY PER SIZE/TYPE</b>	<b>CATEGORY OF INSPECTION</b>
LESS THAN EQUAL TO 500 M	CAT-III
GREATER THAN 500 M	CAT-I

**Note-3-**

**FOR CABLE TRAYS & CABLE TRAY SUPPORT SYSTEM THE CATEGORY OF INSPECTION SHALL BE AS FOLLOWS**



**PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh**  
**PACKAGE : SOLAR**  
**CONT. NO. :**

**INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical**

**DOC NO. :  
REVISION NO. 00  
PAGE : 26**

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

<b>TOTAL CONTRACT QUANTITY PER SIZE /TYPE</b>		<b>CATEGORY OF INSPECTION</b>
For cable total quantity $\leq$ 2.5 KM		Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for at least 2 years
For cable total quantity above 2.5 km & up to $\leq$ 10 km per size/type		Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for at least 2 years
TOTAL QUANTITY MORE THAN 10 KM PER SIZE/TYPE		Cat-I

**Note-4- Indicative List of acceptable galvanizing sources:**

1. M/s M J Engg,Delhi	8. M/s National Galvanizer, Kolkata	15. M/s Sigma, Mumbai	22. Indian Gratings, Pune
2. M/s Indmark , Pune	9. M/s Unistar Galvanizer, Kolkata	16. M/s Radhakrishnan Shetty, Chennai	23. Encorp Power trans PVT Ltd, Palghar
3. M/s A.V. Engg, Kolkata	10. M/s B.P. Project. Kolkata	17. Karamtara Mumbai	24. Reliable Sponge, Kalunga
4. M/s Inar Profiles, Vishakapatnam	11. M/s Bajaj Pune	18. Poona Galvanizers Pune	25- Rukmani Fab & Gal- Howrah
5. M/s Anand Udyog, Mumbai	12. M/s Electrocare Industries, Mumbai	19. Neha Galvanizer- Kolkata	
6. M/s Techno Engg,Chandigarh	13. M/s B.G. Shirke, Pune	20. Unitech Fabricators & Galvanizers- Hoogly	
7. M/S Steelite Engg, Mumbai	14. M/s Gurpreet Galvanizer, Hyderabad	21. Patny Systems- Mehdak	

**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.

**Note-7:** Approval conditions shall be adhered to.



PROJECT : Development of 25 MW Floating Solar PV  
Project at NTPC Simhadri in Andhra Pradesh  
PACKAGE : SOLAR  
CONT. NO. :

INDICATIVE VENDOR LIST  
Subsystem- Electrical &  
Mechanical

DOC NO. :  
REVISION NO. 00  
PAGE : 27

SL. No.	ITEM	QP / INS CAT.	QP No. -	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE	SC APPL STATUS	REMARKS
------------	------	---------------------	----------	--	-------	-------------------	---------

**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



**PROJECT : Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh**  
**PACKAGE:**  
**SUPPLIER :**  
**CONT. NO.:**

**LIST OF ITEMS  
REQUIRING QUALITY  
PLAN AND SUB- SUPPLIER  
APPROVAL  
SUB SYSTEM: C & I**

**DOC. No. :**  
**Revision No. :**  
**DATE: 28.11.2018**  
**PAGE : 1 OF 7**

SL. NO.	ITEM	QP/IN SPN CAT	QP NO.	PROPOSED SUPPLIER	PLACE	SUB- SUPPLIER APPROVAL STATUS/ CATEGORY	REMARKS
---------	------	---------------	--------	-------------------	-------	---	---------

1	INSTRUMENTATION CABLE(REFER NOTE-1)	I		DELTON CABLES LTD	FARIDABAD	A	PVC, FRLS TYPE
		I		PARAMOUNT COMMUNICATION LTD	KHUSHKHERA	A	PVC, FRLS TYPE
		I		CORDS CABLE INDUSTRIES LTD	BHIWADI/ KAHARANI	A	PVC, FRLS TYPE
		I		KEI INDUSTRIES LTD	BHIWADI	A	PVC, FRLS TYPE
		I		POLY CAB WIRES PVT. LTD	DAMAN	A	PVC, FRLS TYPE
		I		THERMOCABLES	HYDERABAD	A	PVC, FRLS TYPE
		I		ELKAY TELELINKS	FARIDABAD	A	PVC, FRLS TYPE
		I		GUPTA POWER	KHURDHA	A	PVC, FRLS, SHIELDED, MULTI PAIR, TWISTED, TYPE A, B, F&G
		I		NICCO	KOLKATA	A	PVC, FRLS TYPE
		I		UNIVERSAL CABLE	SATNA	A	PVC, FRLS TYPE
		I		CMI	FARIDABAD	A	ONLY FOR F & G TYPE
		I		ADVANCE CABLES PVT LTD	BANGLORE	A	ONLY FOR 0.5 SQMM F&G TYPE CABLES
		I		GEMSCAB INDUSTRIES LTD	BHIWADI	A	ONLY FOR 0.5 SQMM F&G TYPE CABLES
		I		APAR INDUSTRIES LIMITED	VALSAD	A	ONLY FOR 0.5 SQMM F&G TYPE CABLES
		II		SUYOG ELECTRICALS LTD	HALOL	A	ONLY FOR 0.5 SQMM F&G TYPE CABLES
		I		SPECIAL CABLES PVT LTD	RUDRAPUR	A	ONLY FOR 0.5 SQMM F&G TYPE CABLES
		II		T C COMMUNICATION	GHAZIABAD	A	PVC, FRLS TYPE
		II		TEW & C	USA	A	
		II		HABIA CABLES	SWEEDEN	A	
		II		KERPEN CABLES	GERMANY	A	
		II		LAPP CABLES	GERMANY	A	
		II		THERMO ELCRTA BV	NETHERLAND	A	
2	FIRE ALARM PANEL -MICROPROCESSOR BASED & MANUAL CALL POINTS	II		NOTIFIER	USA	A	UL CERTIFICATION OF MODEL NO ALSO PROVIDED WITH COC
				TYCO	USA	A	SIMPLEX BRAND
				AUTRONICA	NORWAY	A	



**PROJECT : Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh**  
**PACKAGE:**  
**SUPPLIER :**  
**CONT. NO.:**

**LIST OF ITEMS  
REQUIRING QUALITY  
PLAN AND SUB- SUPPLIER  
APPROVAL  
SUB SYSTEM: C & I**

**DOC. No. :**  
**Revision No. :**  
**DATE: 28.11.2018**  
**PAGE : 2 OF 7**

SL. NO.	ITEM	QP/IN SPN CAT	QP NO.	PROPOSED SUPPLIER	PLACE	SUB- SUPPLIER APPROVAL STATUS/ CATEGORY	REMARKS
---------	------	---------------	--------	-------------------	-------	---	---------

				SCHRAK	AUSTRIA	A	
				EDWARDS	USA	A	
				TOSHNIWAL INDUSTRIAL PVT LTD	AJMER	A	CONDITONAL AS PER APPROVAL LETTER NETRA/STH/03
				M/S SHIELD FIRE SAFETY AND SECURITY LTD	UK	A	
3	ADDRESSABLE DETECTORS (MULTI SENSOR), INTERFACE UNITS ,HOOTER CUM STROBE & HOOTER	II		NOTIFIER	USA/GURGAON	A	
				TYCO	USA	A	SIMPLEX BRAND
				AUTRONICA	NORWAY	A	
				SCHRAK	AUSTRIA	A	
				EDWARDS	USA	A	
				SHIELD FIRE SAFETY	UK	A	
4	FIBRE OPTIC CABLES (REFER NOTE 2)	II		BIRLA ERICSSON OPTICAL	REWA	A	
				AKSH FIBER	BHIWADI	A	
				FINOLEX	PUNE/GOA	A	
				R&M	SWITZERLAND	A	
				HFCL	GOA	A	
			I	JIANGSU TONGGUANG	CHINA	A	
			II	R&M	SWITZERLAND	A	
			II	MOLEX	UK	A	
			II	CORNING	USA	A	
5	OPERATOR WORK STATION	III		DELL/HP/IBM/LENEVO/COMPAQ /FUJITSU OR OEM APPROVED SOURCES		A	
6	24V INTELLIGENT BATTERY CHARGER /DCDB & BHMS	I		ELTEK	GURGAON	A	MODULES FROM ELTEK
				MASS TECH	JALGAON	A	MODULES FROM ELTEK
				CHHABI	JALGAON	A	MODULES FROM EMERSON



**PROJECT : Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh**  
**PACKAGE:**  
**SUPPLIER :**  
**CONT. NO.:**

**LIST OF ITEMS  
REQUIRING QUALITY  
PLAN AND SUB- SUPPLIER  
APPROVAL  
SUB SYSTEM: C & I**

<b>DOC. No. :</b>
<b>Revision No. :</b>
DATE: 28.11.2018
<b>PAGE : 3 OF 7</b>

SL. NO.	ITEM	QP/IN SPN CAT	QP NO.	PROPOSED SUPPLIER	PLACE	SUB- SUPPLIER APPROVAL STATUS/ CATEGORY	REMARKS

				VERTIV ENERGY PVT LTD	MUMBAI	A	WITH MODULES FROM EMERSON-CHINA
7	PLC BASED SCADA SYSTEM	I		M/S BEIJING K&U ELECTRICAL	BEIJING	A	CQA/9518/LWA/B-437 DTD 01.02.2018
				GE INTELLEGENT PLATEFORMS PVT LTD	BANGALORE	A	NOTESHEET NO. 3428 DTD 12.11.2010
				ABB	BANGALORE	A	
				SCHNEIDER	NASIK	A	
				ROCKWELL	SAHIBABAD	A	
				SIEMENS	NASIK	A	
				HONEYWELL	PUNE	A	APPROVAL AS PER LETTER DATED CW-EN-9661-M03-001 DTD 28.02.2014
				M/S VIRTUAL AUTOMATION	RANGAREDDY	A	CQA/001/151/NKTPP/V-205/VIRTUAL AUTOMATION DTD 29.08.2017
				M/S COTMAC ELECTRONICS PVT LTD	PUNE	A	CQA/001/151/NKTPP/C-352/COTMAC DTD 16.08.2017
				M/S TECH-MASTERS	HYDERABAD	A	CQA/001/151/NKTPP/T-440/TECH MASTER DTD 16.08.2017
				M/S POWERTECH SWITCHGEAR (I) PVT LTD	SONEPAT	A	CQA/001/147/KHARGONE/PLC PANEL DTD 10.07.2017
				M/S UNITY INDUSTRIAL AUTOMATION PVT LTD	DELHI	A	CQA/5505/906/TAPOVAN/U-131/PLC PANEL DTD 27.10.2017
				EMCONS	RANCHI	A	CQA/4410-155E/E-350/EMCONS DTD 31.01.2018
				SCHNEIDER	BANGALORE	A	01/PETF/9548-155/TATA DTD 06.11.2015
				M D INDUSTRIES	VADODARA	A	CQA/5505-902/ M472/PLC PANEL DATED 24.05.2018
8	NI-CD BATTERY FOR PLC SYSTEM (REFER NOTE 5)	I		AMCO SAFT	BANGALORE	A	
				HBL POWER SYSTEM	HYDERABAD	A	
		II		SAFT	FRANCE/ SWEDEN	A	
				HOPPECKE BATTERIEN GMBH & CO KG	GERMANY		
9	BATTERY(LEAD-ACID PLANTE)	II		HOPPECKE BATTERIEN GMBH & CO KG	GERMANY	A	

		INDICATIVE FIELD QUALITY PLAN					Annexure-II							
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh						
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO.:		0	PACKAGE:							
				DATE :			CONTRACT NO.							
				PAGE :			MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments			Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks			
1	2	3			4	5	6	7	8	9	D*			
1	GENERAL REQUIREMENTS													
A	Availability of QA& QC manpower and laboratory				-	A	Physical	Once prior to start of work and thereeo monthly	Tech Specs and Const. Drawings	SR	✓			
B	Sampling for testing of building materials, concrete mix design etc.				As agreed / required	A	Physical	As specified in FQP for various materials	Tech Specs and Const. Drawings	SR/TR	✓			
C	Submission of schedule of tests to be done monthly / quarterly				-	A	Physical	Once prior to start of work and thereeo monthly	Tech Specs and Const. Drawings	SR	✓			
D	Stacking and storage of construction materials and components at site				As per IS:4082	A	Physical	Random	Tech Specs and Const. Drawings and IS: 4082	SR	✓			
2	EXCAVATION AND FILLING IN FOUNDATION WORKS													
	Excavations-													
2.1		Nature, type of soil/rock before and during excavations			As agreed / required	C	Visual	Random in each shift	Tech Specs and Const. Drawings	SR				
2.2		Initial ground level before start of excavations			As agreed / required	C	Measurement	100%	Tech Specs and Const. Drawings	SR	✓			
2.3		Final shape and Dimensions of excavations.			As agreed / required	C	Measurement	100%	Tech Specs and Const. Drawings	SR				
2.4		Final excavation levels			As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	✓			
2.5		Side slope of final excavation			As agreed / required	B	Measurement	Random in each shift	Tech Specs and Const. Drawings	SR				
	Fill/ Backfill -													
2.6	Standard proctor Test	Optimum moisture content and max. dry density before fill			As per IS: 2720, Proctor needle apparatus,etc.	B	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR	✓			
2.70	Moisture content	Moisture content of fill before compaction			As per IS: 2720, balance, oven, rapid moisture meter, etc.	B	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.II), Tech Specs and Const. Drawings	SR/TR	✓			
2.8	Degree Of Compaction Of Fill / Backfill													
i		Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method			As per IS: 2720/compaction test (core cutter), balance, rapid moisture meter etc.	A	Physical	One sample for every 10000 SQM area for each compacted layer.	IS 2720 (Pt. XXIX), Tech Specs and Const. Drawings OR IS 2720 (Pt. XXVIII), Tech Specs and Const. Drawings	SR/TR	✓			

Sl. No	Activity and operation	INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO.:	0	PACKAGE:					
		DATE :		DATE :		CONTRACT NO.					
		PAGE :				MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments			Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3			4	5		6	7	8	9 D* 10
3.0	MATERIALS										
3.1	CEMENT										
		Physical & Chemical Properties		as per IS:4031	A	Testing	At Random	As per relevant IS Codes/ Tech Specification	TR	✓	Each consignment of cement shall be duly correlated with manufacturers TC. One sample from each lot shall be tested for setting time and compressive strength . If cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time.
3.2	Coarse Aggregate	Moisture content		as per IS:2386	B	Physical	Once for each stack of 100 Cu.M. or part thereof	IS : 456 IS : 383/Tech Spec	SR/LB	✓	During monsoon when this has to be done every day before start of concreting
ii		Specific gravity, water absorption		IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS:383/Tech Spec	SR/LB/ TR	✓	
iii		Sieve analysis, flakiness index, elongation index,		IS:2386	B	Physical	One per 100 cum., or part thereof	IS: 2386 Part-I, IS:383/Tech Spec	SR/LB	✓	
iv		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)		IS:2386	A	Physical	Once per source/ on every change of source	IS: 2386 Part-II, IS:383/Tech Spec	SR/LB/ TR	✓	
v		Soundness		IS:2386	A	Physical	-do-	IS: 2386 Part-V, IS:383	SR/LB/ TR	✓	
vi		Crushing value abrasion value and impact value		IS:2386	A	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec	SR/LB/ TR	✓	
3.3	Fine Aggregate										
i		Moisture content, water absorption		balance , oven, rapid moisture meter etc.	B	Physical	To be done every day before start of work	IS: 2386 Part-III IS:383	SR/LB/T R	✓	
ii		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)		IS:2386	A	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383	SR/LB/T R	✓	
iii		All other tests similar to coarse aggregates as mentioned above.						IS-2386, IS-383	SR/LB/T R	✓	except test for flakiness index, elongation index, abrasion value, impact value
3.4	Water										
i		Complete tests as per IS:456		Burette, conical flask, pipette etc.	B	Testing	One for each source.	IS:3025 part 22 and 23 (for test procedure ), IS:456(for acceptance criteria )	SR/LB/T R	✓	

		INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
		DATE :		CONTRACT NO.							
		PAGE :		MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments			Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3			4	5	6	7	8	9	D* 10
3.5	<b>CONCRETE</b>										
		After receiving the recommended mix design from specialist agency, 4 Trial mixes to ascertain the workability and cube strength			A	Physical	One for each mix proportion	NTPC tech specification	SR/LB	✓	
i		Crushing strength (works Tests cubes)			IS:516	A	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, NTPC Tech. Spec.	SR/LB/ TR	✓ Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.
ii		Workability - slump test			IS:1199	B	Physical	At the time of concrete pouring at site every two hrs.	IS:456/NTPC Tech. Spec.	SR/LB/T R	✓
3.5.1	<b>Admixtures for Concrete</b>	Type of admixture			As per IS:9103	B	Review of MTC	Designed mix and IS:9103 For each lot received at site	MTC	✓	Admixture of appd. Brand and tested quality shall be used (each lot of admixture will included with brochure in which the type of admixture and its properties shall be clearly indicated)
3.6	<b>Concrete conveying, placing&amp; compaction</b>										
i		mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix						To be calibrated at the time of starting and subsequently once in three months, and shall conform to IS:4925	Review of calibration chart/ Certificate, IS 4926	✓	
ii		Arrangement for transportation & placement of concrete.			& As required	C	Visual	100%	Before clearance for concreting	Inspection Report	✓
iii		Handling and Transportation of concrete			As required	C	Physical	100%	As per construction/erection methodology (to be approved one week prior to start of	SR	
iv		Placement of concrete			Visual	B	Physical	100%	As per construction/erection methodology and tech.specs / No segregation	SR	✓
v		Compacting			As required	C	Physical	At Random	IS:456	SR	✓
vi		Curing			As required	C	Physical	At Random	Period of curing as per IS 456 (use gunny bags / curing compound)	SR	✓
3.7	<b>TEST/CHECK ON RCC STRUCTURE IN HARDENDED CONDITIONS</b>										
i		Dimensional check on finished structures & Dimensional tolerances			As required	B	Measurement	Approved Drawing	As per IS:456/ tech. Specification.	SR/LB	✓
ii		Water Tightness Test of liquid retaining structure/ tanks			As required	B	Test	100%	IS:3370/ Tech. Specification	SR/LB	✓
3.8	<b>REINFORCEMENT STEEL</b>										
i		Physical and Chemical Properties for each lot as per relevant IS codes			As required/ agreed	A	Review of MTC	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	MTC	✓
ii		Freedom from cracks surface flaws, Lamination.			As agreed / required	C	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR	To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.

		INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
		DATE :		CONTRACT NO.							
		PAGE :		MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
3.9	PLACEMENT OF REINFORCEMENT STEEL										
i	Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required		B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	✓		
ii	Bending of bars, cutting tolerance	As agreed / required		C	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	✓		
iii	Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	As agreed / required		B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR	✓		
3.10	STAGING AND FORMS										
i	Materials and accessories	As agreed / required		C	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR			
ii	Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required		C	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const. Drawings	SR			
iii	Acceptance of formwork before start of concreting			B	Physical / visual	Before start of each concreting	As per provisions and tolerances, Tech Specs and Const. Drawings	SR	✓		
3.11	DAMP PROOF COURSE						Tech Specs and Const. Drawings				
i	Material - Hot bitumen and water proofing materials etc.	As agreed / required		B	Review of MTC	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702	SR	✓		
ii	Acceptance of damp proof course	As agreed / required		B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
3.12	GROUTING										
i	Material	As agreed / required		B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR	✓		
	Type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required		C	Physical	Prior to start of work	Tech Specs and Const. Drawings	SR	✓		
ii	Mixing, placement, application and grout pressure	As agreed / required		C	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
iii	Compressive strength	As agreed / required		C	Physical	Random in each shift	Tech Specs and Const. Drawings	SR	✓		
iv	Acceptance of the grouts	As agreed / required		B	Physical	Each grout section	Tech Specs and Const. Drawings	SR			
3.13	PRE-CAST CONCRETE										
i	Crushing strength	compression strength testing machine	A	Physical	one sample of six cubes per 50m m3 or part thereof	IS:516 & IS: 456	SR/LB	✓	A minimum of three specimen shall be tested for 7 and 28 days compressive strength		
ii	Workmanship and dimensions	Visual	B	Physical	100%	As per IS:456/NTPC Tech. specification.	Register				
iii	Load Test	As required	B	Physical	1% up to 1000 nos. and 0.5% for more than 1000 nos. for each type	IS:456/ As decided by NTPC Site Engr. In charge.	Inspection Report	✓	Applicable members i.e. drains covers .		

		INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
		DATE :		CONTRACT NO.							
		PAGE :		MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
4.00	BRICK MASONARY										
4.1	Test on Bricks										
		Dimensions , shape, compressive strength, water absorption, warpage, efflorescence.		As agreed / required	B	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings	Inspection Report	✓	Efflorescence shall be checked at each source. Warpage test is applicable for facing bricks only as per IS:2691. For clay bricks as per IS 1077, warpage test is not required.
4.2	Masonry construction	Workmanship, verticality and alignment		As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings	SR/LB		
5.00	FINISHING AND ALLIED WORKS										
5.1	PLASTERING - WORKMANSHIP										
i		Curing		As agreed / required	C	Physical	100%	Tech specifications, construction drawings and agreed methodology	SR		
ii		Thickness and finishing of plaster, grooves etc.		As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR/LB		
iii		Trueness of plastering system		As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
6.00	SHEETING AND OTHER WORKS										
6.1	PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONARY SURFACES										
i	Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil EIC	Shade, type from brand and manufacturer as approved by NTPC	As agreed / required	B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		
ii	Surface preparation	As required	As agreed / required	C	Physical /visual	Random in each shift	Tech Specs and Const. Drawings	SR			
iii	Acceptance of painted surfaces	As required	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR			
6.1.1	PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)										
i		Painting Materials and accessories		-	B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	
ii		Surface preparation		As agreed / required	C	Physical /visual	Each Erection Mark	Tech Specs and Const. Drawings,	SR	✓	
iii		Primer Thickness		Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓	
iv		DFT of paint		Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓	
v		Acceptance of painted surfaces		Elcometer	B	visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR		
7.3	WATER PROOFING										
		Methodology for the application of water proofing system		As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings	SR	✓	
7.3.1	Roof / Basement Treatment										
i	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings				
ii	Elastomeric coatings	Material- Primer coat, finishing coat	As required	B	Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings	SR	✓		
iii	Wearing course	Materials - PCC, chicken wire mesh, elastomeric sealant	As required	B	Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings	SR	✓		
iv		Acceptance of water proofing work		As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings			

		INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
				DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
7.4	Fencing and Gates										
i	PVC coated chain link fencing, Welded wire mesh (IS 1566), Reinforced barbed tape galvanized (IS 2629) etc.	Materials	As agreed / required	B	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications / relevant IS Codes	
ii	Acceptance of the installation	As agreed / required	B	Physical / measurements	Each installation		Tech Specs and Const. Drawings	SR			
7.5	FLOOR FINISHES AND ALIED WORKS										
7.5.1	Cement Concrete Flooring										
i	Glass/ PVC strips in joints	As agreed / required	C	Physical	Random in each shift	Tech Specs and Const. Drawings	SR				
ii	Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
7.5.2	Tiles										
i	Ceramic, vitrified, glass mosaic, acid alkali resistant, heavy duty cement concrete	Materials	As agreed / required	B	Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings	SR	✓	MTC shall contain all the parameters specified in the technical specifications / relevant IS Codes	
ii	Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
7.5.3	Kota Stone, Granite and Marble										
i	Quality, texture, thickness, colour for each lot of delivery from approved source	As agreed / required	C	Physical	Each batch of delivery	Tech Specs and Const. Drawings	SR	✓			
ii	Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
8.0	WATER SUPPLY / SANITORY INSTALLATIONS										
8.1	Water supply fittings and fixtures										
i	Materials	GI/ MS pipes and fittings	As agreed / required	B	Review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
ii	Disinfection	Before use	As agreed / required	C	Physical	Each installation	Tech Specs and Const. Drawings	SR			
iii	Hydraulic test	Before use / leakage	As agreed / required	B	Physical	Each installation	Tech specs and const drawings	SR	✓		
iv	Acceptance and working	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings	SR				

		INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
		DATE :		CONTRACT NO.							
		PAGE :		MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments			Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3			4	5	6	7	8	9	D*
8.2	Sand cast iron / cast iron pipes										
i	Material	SCI / CI pipes and fittings / joints	As agreed / required	B	Review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
8.3	Sanitary fittings and fixtures										
i	Material	Sanitary items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc.,	As agreed / required	B	Physical	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
ii		Acceptance of installations of all sanitary items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
8.4	RCC Pipes										
i	Material	RCC pipes	As agreed / required	B	Review of MTC	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings /IS 458	SR	✓		
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
8.5	Water Storage Tanks										
i	Material	Over head / loft type	As agreed / required	B	Physical	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
ii		Acceptance and leakage	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings	SR			
9.0	SPECIAL ITEMS										
9.1	Earthing Mat (Grounding System)										
i	Material	Earthing mat	As agreed / required	B	Physical	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/MTC	✓		
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings			NTPC approved electrodes shall be used	
iii		D P test	DP test Kit	B	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	✓		
iv		Earth test	Earthing test kit	A	Physical	100%	Tech Specs and Const. Drawings,	SR	✓		

		INDICATIVE FIELD QUALITY PLAN				Annexure-II					
		ITEM : CIVIL WORK		QP NO. :	1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :	0	PACKAGE:					
		PAGE :		DATE :	CONTRACT NO.						
		PAGE :		MAIN CONTRACTOR							
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	
10.00	ROAD WORKS									10	
10.1	Construction of Sub-Grade and earthen/hard shoulders										
i	Standard proctor Test to determine optimum moisture content and max. dry density	As per IS: 2720, Proctor needle apparatus,etc.	A	Physical	One in every 2000 cum for each type and source of fill materials	As per Technical Specifications/ BOQ /IRC/MORTH	SR/TR	✓			
ii	Moisture content of fill before compaction	As per IS: 2720, balance, oven etc.	B	Physical	One in every 2000 cum for each type and source of fill materials		SR/TR				
iii	Dry density by core cutter method --- OR --- Dry density in place by sand displacement method	As per IS: 2720/compaction test (core cutter), balance etc.	A	Physical	One in every 500 SQM area for each compacted layer.		SR/TR	✓			
10.2	Granular Sub Base (GSB)										
i	Gradation	As required / agreed	B	Physical	One test per 200 cum of aggregate	SR	✓				
ii	Atterberg Limit	As per IS: 2720	B	Physical	One test per 200 cum of aggregate	SR	✓				
iii	Moisture content prior to compaction	As per IS: 2720	B	Physical	One test per 250 SQM of aggregate	SR	✓				
iv	Density of compacted layer	As per IS: 2720	A	Physical	One test per 500 SQM of aggregate	SR / TR	✓				
v	Deleterious constituents	As required / agreed	B	Physical	As required	SR	✓				
vi	CBR	As per IS: 2720	B	Physical	As required	SR / TR	✓				
10.3	Water Bound Macadam (Non-Bituminous)										
i	Aggregate Impact value	Aggregate Impact value Test Apparatus	A	Physical	One test per 200 cum of Test aggregate	SR	✓				
ii	Grading	Set of IS Sieves	B	Physical	One test per 100 cum of aggregate	SR					
iii	Flakiness index and elongation index	Flakiness test gauge	B	Physical	One test per 200cum of aggregate	SR					
iv	Atterberg Limits of binding material	Atterberg limits determination	A	Physical	One test per 25 cum of binding material	SR	✓				
v	Atterberg Limits of portion of aggregate passing 425 micron sieve	Atterberg limits determination	A	Physical	One test per 100cum of aggregate	SR	✓				

		INDICATIVE FIELD QUALITY PLAN					Annexure-II										
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh									
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :	0	PACKAGE:											
		PAGE :		DATE :		CONTRACT NO.											
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks						
1	2	3		4	5	6	7	8	9	D*	10						
10.4	Bituminous Surfacing - Open graded premix carpet and Seal coat																
i	Quality of binder	Penetrometer with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable		As per Technical Specifications/ BOQ /IRC/MORTH	SR	✓								
ii	Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact Value Test apparatus	A	Physical	One test per 50 cum of aggregate			SR	✓								
iii	Flakiness Index and elongation index of aggregates	Flakiness test gauge	B	Physical	One test per 50 cum of aggregate			SR									
iv	Stripping value of aggregate (Immersion tray test)	As required / agreed	B	Physical	Initially one set or 3 representative specimen per source, and on every change of source			SR									
v	Water absorption test		A	Physical	One test per 50 cum of aggregate			SR	✓								
vi	Water sensitivity of mix	As required / agreed	A	Physical	Initially one set or 3 representative specimen per source, and on every change of source			SR	✓								
vii	Grading of aggregates	Set of Sieves	B	Physical	One test per 25 cum of aggregates			SR									
viii	Soundness ( Magnesium and Sodium Sulphate)	As required as per IS:2386	A	Physical	Once per source by each method and on every change of source			SR	✓								
ix	Polished stone value	As required as per BS:812(Part 114)	B	Physical	As required			SR									
x	Temperature of binder at application	Thermometer	B	Physical	At regular close intervals			SR									
xi	Binder content	Bitumen extractor	A	Physical	One test per 500 cum& not less than two tests per day			SR	✓								
xii	Rate of spread of materials	As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests per day			SR									

	 <b>NTPC</b>	INDICATIVE FIELD QUALITY PLAN					Annexure-II				
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :		0	PACKAGE:				
				DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments			Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3			4	5	6	7	8	9	D*
xiii		Percentage of fractured faces		Bitumen extractor	A	Physical	When gravel is used one test per 50cum of aggregates		SR	✓	
10.5	Tack Coat/ Prime coat/ fog coat										
i		Quality of binder		Penetrometer with Standard needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable		SR	✓	
ii		Temperature of binder at application		Thermometer	B	Physical	At regular close intervals		SR		
iii		Rate of spread of binder		As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests		SR		
10.6	Alignment, Level, Surface regularity and rectification										
		Horizontal alignment, Surface levels and Surface regularity		As required / agreed	B	Physical	As per section 900 of MORTH specification	As per Technical Specifications/ BOQ/ Referred Standards and construction	SR		
		Rectification		As required / agreed	B	Physical	Each rectification	As per Technical Specifications/ BOQ/	SR	✓	
11.00	False Ceiling										
i		Materials ( gypsum glass, glass fibre membrane, fibre board acoustical tiles etc)		As agreed / required	B	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR	✓	Compare MTC with technical specification and requirement
ii		Installation finishing and acceptance		As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR		
12.0	GEOTECHNICAL INVESTIGATION WORK										
i		Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc.		As required / agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	✓	
ii		Execution of Geotechnical Investigation - locations, type etc. as per scheme		As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes	SR	✓	
iii		Collection of disturbed and undisturbed samples , their packing and storage		As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes	SR		
iv		Conducting field tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc.		As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes	SR		
v		Submission of Field Bore logs in approved format		As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes	SR	✓	
vi		Submission of laboratory test schedule and selection of samples for laboratory testing		As required / agreed	A	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes	SR	✓	
vii		Submission of Final Geotechnical investigation report along with recommendations		As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes	-	✓	
13.00	STRUCTURAL STEEL MATERIAL (For Site Fabrication)										
i	Procured by contractor	Structural steel procured from NTPC approved sources- Mechanical (YS, UTS, Elg, UT if specified),and Chemical properties (CE as per IS)			A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062	SR	✓	Correlated MTC shall be verified.
13.1	PRE-WELDING REQUIREMENTS										

	 <b>INDICATIVE FIELD QUALITY PLAN</b>	Annexure-II									
		ITEM : CIVIL WORK		QP NO. :	1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :	0	PACKAGE:					
				DATE :							
				PAGE :							
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D* 10	
i		Welding Procedure Specification *	(WPS*)	-	A	Review	Each Welding Process	Technical Specification and Construction Drawings, ASME-IX/ AWS D 1.1	WPS	✓	*To be approved by CQA
ii		PQR and Welder's Qualification		-	A	Physical	Each welder	PQR/ WQR, AWS-D1.1/ASME-IX, Technical Specification and Construction Drawings	TR	✓	
iii		Welding consumables		-	B	Physical	Random in each shift	Approved WPS, Latest NTPC	SR	✓	
<b>13.2 FIT-UP</b>											
i		Marking and Cutting		Tape, ruler etc.	B	Visual & Measurement	Each plate/ Section	Technical Specification and Construction Drawings/ Approved cutting plan	SR		
ii		Match markings for trial assembled components		-	B	Physical	Each fit-up	Technical Specification and Construction Drawings	SR		
iii		Weld Fit Up- Edge Preparation/ Gap/ Alignment		Tape, ruler etc.	B	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215	SR	✓	If required suitable stiffeners shall be provided to prevent deflection.
<b>13.3 PRE HEATING (wherever applicable)</b>											
i		Pre-Heating Temperature		Thermal chalk	B	Measurement	Each pre-heating	Technical Specification and Construction Drawings	SR	✓	
ii		Post Weld Heat Treatment (PWHT), if required	Thermo couple with time temperature	A	Time & Temperature	Each PWHT	Technical Specification and Construction Drawings, Approved WPS	SR	✓		

		INDICATIVE FIELD QUALITY PLAN				Annexure-II					
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO.:		0	PACKAGE:				
				DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
<b>13.4 WELDING REQUIREMENTS</b>											
i	Sequence of welding	-	B	Physical	Random in each shift	Technical Specification and Construction Drawings, Agreed scheme	SR				
ii	Removal/ grinding of temporary	-	B	Measurement	All cleats/ attachments	Technical Specification and Construction Drawings	SR				
iii	Completeness after welding- Dimensions/ distortion	Weld gauge	B	Visual	Each structure component	Technical Specification and Construction Drawings, IS 822	SR	✓			
iv	Completeness of welding (each butt & fillet weld)		B	Visual	Each structure component	Technical Specification and Construction Drawings, Approved Drg.	SR	✓			
<b>13.5 NON DESTRUCTIVE AND DESTRUCTIVE TESTING</b>											
<b>13.5.1 FILLET WELDS</b>											
i	size and visual examination	As required/ agreed	B	Visual/ Measurement	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	SR		As per requirement of NTPC Engineer		
ii	Dye Penetration Test	As required/ agreed	B	Physical	5% of Weld length with min. 300mm at each location	As per technical specifications and construction drawings, IS 822, AWS D 1.1	SR				
<b>13.5.2 BUTT WELDS</b>											
i	Visual examination	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and	SR		As per requirement of NTPC Engineer		
ii	DPT	As required/ agreed	B	Physical	100% on all butt welds after back gouging on root run and 10% on final weld	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR		All butt welds to be back gouged before DPT		
iii	Radiography Test	As required/ agreed	A	Physical	10%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	✓	Wherever RT is not feasible UT to be carried out. In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.		
<b>13.6 FOUNDATION CHECKS</b>											
i	Dimensions and levels- Shape, lines (including diagonal checks)	Theodolite, Tape etc.	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	✓			
ii	Foundation Bolts and Embedment's- Verticality, Levels, pitch distance	Theodolite, Tape, Piano wires etc.	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	✓			
<b>13.7 PAINTING SYSTEM</b>											
i	Paining Materials and accessories	-	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	Mfr.'s T.C. shall be correlated with the consignment received.		
ii	Submission of painting methodology	-	B	For Review of painting system	Before start of painting work	Tech Specs and Const. Drawings					
iii	Surface preparation	As agreed / required	B	Physical/visual	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓			
iv	Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓			
v	DFT of paint	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓			
vi	Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR				

	 <b>NTPC</b>	INDICATIVE FIELD QUALITY PLAN					Annexure-II							
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh						
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO. :	0	PACKAGE:								
		DATE :		CONTRACT NO.										
		PAGE :		MAIN CONTRACTOR										
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks				
1	2	3		4	5	6	7	8	9	D* 10				
13.8	PRE-ASSEMBLY CHECKS													
i	Punch Erection marks and match marks			-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		Markings for -				
ii	Pre-assembly as per match mark			-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings						
iii	Camber, sweep and total length after trial assembly of structure.			Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	✓				
iv	Control assembly check at shop			Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings						
V	Completion of primer & intermediate coat of paint				B	Visual / Physical	Random	Tech Specs and Const. Drawings	SR					
13.9	ERCTION CHECKS													
i	Alignment, slopes, level, tolerances of erected member			Theodolite, Tape, plumb, piano wires etc.	B	Measurement	Each structural member	Tech Specs and Const. Drawings	SR	✓				
ii	Tightening of bolts/ Torque including foundation bolts with lock nuts			Wrench/ Torque wrench if specified	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	✓				
iii	Completion of all erection fillet & butt welds				B	Visual	Each structural member	Tech Specs and Const. Drawings	SR	✓				
iv	Acceptance of erected structure			Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	SR	✓				
13.10	PERMANENT BOLTS AND NUTS AND WASHERS													
i	Material- Permanent mild steel Bolts, mild steel Nuts, High strength structural Bolts, Washers-Dimensions, properties, Class, storage along with MTC			Screw gauge, Vernier, Tape etc.	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓				
ii	Contact surfaces before bolting			-	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR					
iii	Inspection of the assembled bolts			-	B	Physical	Randomly in each shift for assembled bolts	Tech Specs and Const. Drawings, IS 4000	SR					
iv	Tensioning			As agreed / required	B	Physical	Randomly during snug tight test and after full tensioning.	Tech Specs and Const. Drawings, IS 4000	SR	✓				
v	Acceptance of installed bolts			-	B	Physical	Each bolt	Tech Specs and Const. Drawings	SR					
<b>Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR = Site Register , TR= Test Report, MfrTC = Manufacturer's Test Certificate</b>														
<b>Categorization Witnessing &amp; Accepting (As per NTPC QA&amp;I System)</b>														
<b>Format No.: QS-01-QAI-P-09/F2-R1</b>										Engg. Div./QA&I				

 <b>PROJECT:</b> Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh <b>PACKAGE:</b> SOLAR <b>MAIN SUPPLIER:</b> <b>CONTRACT NO.:</b>	<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL</b>				<b>NTPC DOC NO</b>			
	<b>SUB SYSTEM: CIVIL WORKS</b>				<b>REV. NO.</b>	0		
					<b>DATE</b>	28.11.2018		
	<b>SR. NO.</b>	<b>ITEM</b>	<b>QAP / INSP. CAT</b>	<b>QAP NO.</b>	<b>PROPOSED SUB SUPPLIER</b>	<b>PLACE OF MANUFACTURING</b>	<b>APPROVAL STATUS / CATEGORY</b>	<b>REMARKS</b>
1.	<b>CEMENT</b>	III	-		BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
2.	<b>CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS WATER PROOFING COMPOUNDS GROUTS</b>	III	-		SIKA INDIA LTD	-	A	
					CICO TECHNOLOGIES LTD	-	A	
					FOSROC CHEMICALS (I) PVT LTD	-	A	
					BASF	-	A	
3.	<b>PAINT AND PAINTING SYSTEM</b>	III	-		BERGER	-	A	
					SHALIMAR PAINTS	-	A	
					JENSON AND NICHOLSON	-	A	
					KANSAI NEROLAC	-	A	
					AKZO NOBEL	-	A	
					ASIAN PAINTS	-	A	
4.	<b>GI PIPES</b>	III	-		BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
5.	<b>BITUMEN ASPHALT</b>	III	-		ALL GOVERNMENT REFINERIES	-		
6.	<b>PLASTIC/ PVC PIPES</b>	III	-		BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
7.	<b>BITUMEN IMPREGNATED FIBER BOARD JOINT FILLER , BITUMEN SEALING COMPOUND</b>	III	-		BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
8.	<b>CERAMIC / VITRIFIED TILES</b>	III	-		BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	

 <b>PROJECT:</b> Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh <b>PACKAGE:</b> SOLAR <b>MAIN SUPPLIER:</b> <b>CONTRACT NO.:</b>	<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL</b>				<b>NTPC DOC NO</b>		
	<b>SUB SYSTEM: CIVIL WORKS</b>				<b>REV. NO.</b>	0	
					<b>DATE</b>	28.11.2018	
	<b>SR. NO.</b>	<b>ITEM</b>	<b>QAP / INSP. CAT</b>	<b>QAP NO.</b>	<b>PROPOSED SUB SUPPLIER</b>	<b>PLACE OF MANUFACTURING</b>	<b>APPROVAL STATUS / CATEGORY</b>
9.	<b>PARTICLE BOARDS, PLYWOOD, MDF</b>	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
10.	<b>HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING</b>	III	-	STP	-	A	
				IWL INDIA LTD	-	A	
				LLOYDS	-	A	
				CICO TECHNOLOGIES LTD	-	A	
				FOSROC CHEMICALS (I) PVT LTD	-	A	
11.	<b>POLYTHENE WATER STORAGE TANKS</b>	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
12.	<b>MINERAL WOOL FOR THERMAL INSULATION</b>	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.	<b>CI PIPES</b>	III	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE			
14.	<b>MODULE MOUNTING STRUCTURES (MMS)</b>	III		MAIN CONTRACTOR'S APPROVED SOURCES			

 <b>PROJECT:</b> Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh <b>PACKAGE:</b> SOLAR <b>MAIN SUPPLIER:</b> <b>CONTRACT NO.:</b>	<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL</b>				<b>NTPC DOC NO</b>			
	<b>SUB SYSTEM: CIVIL WORKS</b>				<b>REV. NO.</b>	0		
					<b>DATE</b>	28.11.2018		
	<b>SR. NO.</b>	<b>ITEM</b>	<b>QAP / INSP. CAT</b>	<b>QAP NO.</b>	<b>PROPOSED SUB SUPPLIER</b>	<b>PLACE OF MANUFACTURING</b>	<b>APPROVAL STATUS / CATEGORY</b>	<b>REMARKS</b>
15.	<b>GALAVANISED STEEL STRUCTURES FOR TRANSMISSION LINE</b>	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.	<b>GALVANISED STEEL STRUCTURE (LATTICE &amp; PIPE )</b>	I			GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
					RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
					L&T	PONDICHERRY	A	
					L&T	PITAMPUR	A	
					R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
					VIJAY TRANSMISSION P. LTD	RAIPUR	A	
					UNIQUE STRUCTURES & TOWERS LTD.	RAIPUR	A	
					VATCO ELEC-POWER PVT. LTD.	NAVIMUMBIAI	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	

 <b>PROJECT:</b> Development of 25 MW Floating Solar PV Project at NTPC Simhadri in Andhra Pradesh <b>PACKAGE:</b> SOLAR <b>MAIN SUPPLIER:</b> <b>CONTRACT NO.:</b>	<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL</b>				<b>NTPC DOC NO</b>			
	<b>SUB SYSTEM: CIVIL WORKS</b>				<b>REV. NO.</b>	0		
					<b>DATE</b>	28.11.2018		
	<b>SR. NO.</b>	<b>ITEM</b>	<b>QAP / INSPN. CAT</b>	<b>QAP NO.</b>	<b>PROPOSED SUB SUPPLIER</b>	<b>PLACE OF MANUFACTURING</b>	<b>APPROVAL STATUS / CATEGORY</b>	<b>REMARKS</b>
					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	<b>FOUNDATION BOLT</b>	<b>III</b>			MAIN CONTRACTOR'S APPROVED SOURCES			
<b>LEGENDS:</b> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> </ol>								
<b>NOTE 1:</b> 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. <b>NOTE 2:</b> Clearance from NTPC Engineering required wherever the Proveness / Sub-QR criteria mentioned against that particular BOIs or Sub-Suppliers in the Technical specifications.								


**PURCHASE SPECIFICATION:  
AUXILIARY TRANSFORMER**

PS-439-AUX

Rev No: 00

PAGE : 1 OF 7

**Specification of auxiliary transformer 30 KVA and 20kVA, \*\*\*V/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 container (C5 complied) housing, having degree of protection of IP-23.
3	Type of cooling	AN
4	Governing Standard	As per relevant IS/IEC
5	Rating in KVA	<p>30 KVA &amp; 20 KVA as mentioned in specification</p> <p>a. For CMCS power requirement, <b>30 KVA</b> type Auxiliary Transformer (<b>Dry type</b>) for tapping power from LV side of nearest PCU for connecting to ACDB (providing LT supply of 3 phase, 415 V).</p> <p>b. <b>20 KVA</b> type Auxiliary Transformer (<b>Dry type</b>) for tapping power from LV side of PCU (other four platforms) and for connecting to ACDB (providing LT supply of 3 phase, 415 V).</p>
6	No. of phases	3
7	Frequency	50 Hz, +/- 3%
8	HV winding	***kV, 3-Ph, with <b>Delta</b> connection ( <b>560-690V, will be informed during detail Engineering</b> )
9	LV windings	433V, 3-Ph, with <b>Star</b> 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°.
17	Cable entry on HV side	Bottom entry of cables. <b>Cable supply in bidder scope.</b>
18	Cable entry on LV side	Bottom entry of cables. <b>Cable supply in bidder scope.</b>
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%.



**PURCHASE SPECIFICATION:  
AUXILIARY TRANSFORMER**

PS-439-AUX

Rev No: 00

PAGE : 2 OF 7

	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°C, 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°C, UPF	As per IS 1180 and CBIP
	30	Regulation at full load, 75 °C	< 2 % for UPF For 0.8 PF lagging, to be indicated by bidder.
	31	Harmonics	Shall be designed to suppress harmonics especially 3 <sup>rd</sup> & 5 <sup>th</sup> .
	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.



**PURCHASE SPECIFICATION:  
AUXILIARY TRANSFORMER**

PS-439-AUX

Rev No: 00

PAGE : 3 OF 7

	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 <b>RAL 5012</b> . 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	SI.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**

SI.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).



**PURCHASE SPECIFICATION:  
AUXILIARY TRANSFORMER**

PS-439-AUX

Rev No: 00

PAGE : 6 OF 7

(h) Cable boxes shall have removable top cover (for transformer above 100 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**



**PURCHASE SPECIFICATION:  
AUXILIARY TRANSFORMER**

PS-439-AUX

Rev No: 00

PAGE : 7 OF 7

	6.1	<p>Following documents shall be submitted to BHEL at the time of delivery of the consignment:</p> <ul style="list-style-type: none"><li>(1) As built drawings of transformer</li><li>(2) Routine test reports on transformer</li><li>(3) Type test reports on transformer</li><li>(4) Test certificate for transformer oil</li><li>(5) Operations and maintenance manual of transformer</li></ul>
--	-----	---

	<b>PURCHASE SPECIFICATION</b> <b>LT SWITCHGEAR</b>	PS-439-LT SWITCHGEAR
		REV NO: 00
		PAGE : 1 OF 16

## 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.



# PURCHASE SPECIFICATION

## LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 2 OF 16

### 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/IS139 47	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 50°C ambient:	As Per Requirement
------	--	--------------------



**PURCHASE SPECIFICATION**  
**LT SWITCHGEAR**

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 3 OF 16

(vii)	Temperature Rise allowed above ambient	40 <sup>0</sup> C for plain joints 55 <sup>0</sup> C 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 incomm 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/ $\sqrt{3}$ / 110/ $\sqrt{3}$ V 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



**PURCHASE SPECIFICATION**  
**LT SWITCHGEAR**

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 4 OF 16

(ii)	Rupturing capacity	80kA (RMS) for AC circuits
<b>G. CONTACTORS</b>		
(i)	Type	Air break electro magnetic
(ii)	Utilising Category	AC3 of IS/IEC 60947 for nonreversible AC4 of IS/IEC 60947 for reversible drives
<b>H. SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS</b>		
(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.



## PURCHASE SPECIFICATION

### LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 5 OF 16

- 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-



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 6 OF 16

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



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 7 OF 16

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 mm<sup>2</sup> (min.) for control circuit wiring and 2.5 mm<sup>2</sup> (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.



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 8 OF 16

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

- 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.
- 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).



# PURCHASE SPECIFICATION

## LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 9 OF 16

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



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 10 OF 16

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.



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 11 OF 16

- 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.



## PURCHASE SPECIFICATION

### LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 12 OF 16

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.



## PURCHASE SPECIFICATION

### LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 13 OF 16

- 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.



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 14 OF 16

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



## PURCHASE SPECIFICATION LT SWITCHGEAR

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 15 OF 16

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.



**PURCHASE SPECIFICATION  
LT SWITCHGEAR**

PS-439-LT SWITCHGEAR

REV NO: 00

PAGE : 16 OF 16

**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**

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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.



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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.



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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.

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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.

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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.

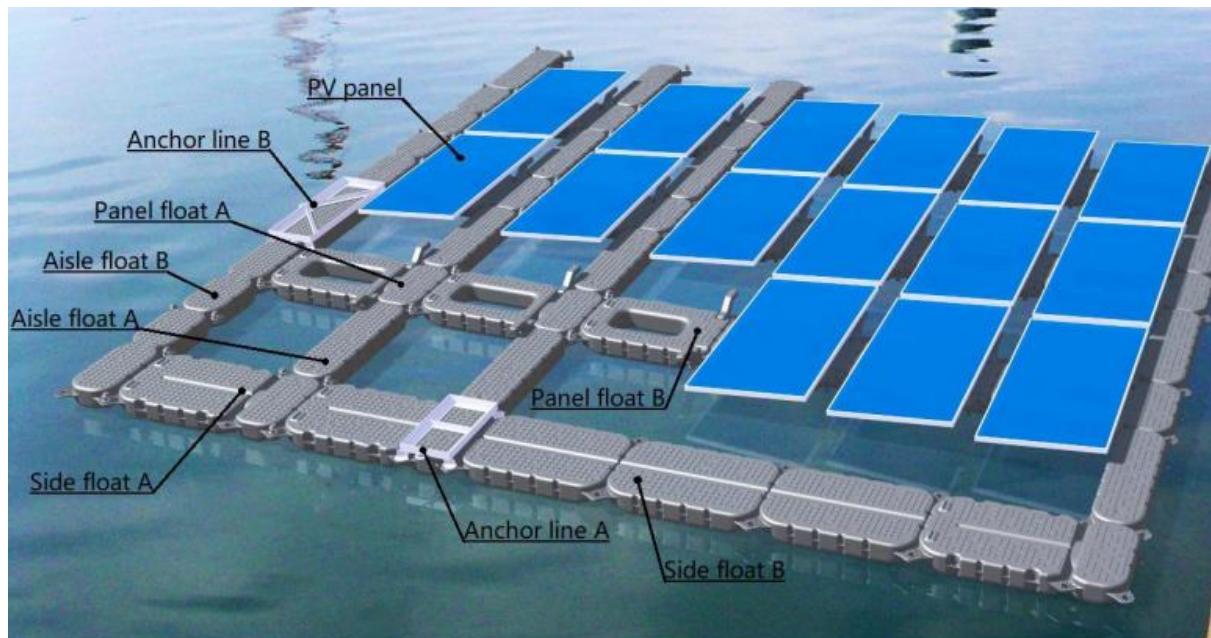


Image 1 : Source: Prabh Dayal Om Parkash Infra Ltd

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

## 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	Φ 75×120	Pcs
9		Nuts	PE	Φ 78×38	Pcs
10		anchorline A	Q235b+HD G	950×520×150	Set
11		anchorline B	Q235b+HD G	1400×580×150	Set

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL)and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**.Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

### 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 2000m<sup>2</sup> for assembly near the site.

Please follow the steps below for installation

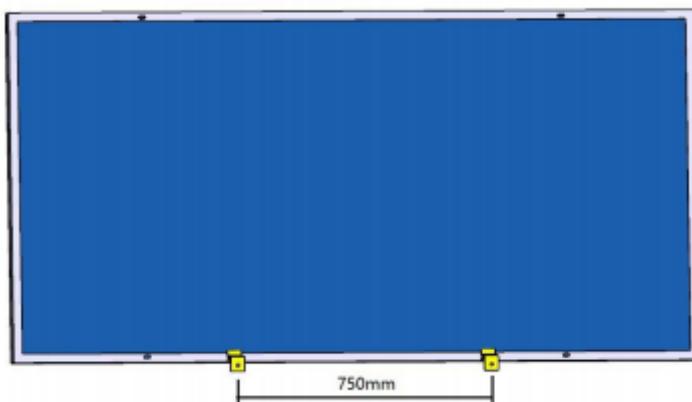
**Step 1) Place the photovoltaic module on a flat surface**

step 1



**Step 2) Install two clamp (with SS screw) at specific position keeping distance of 750mm on the back face of the panel**

step 2



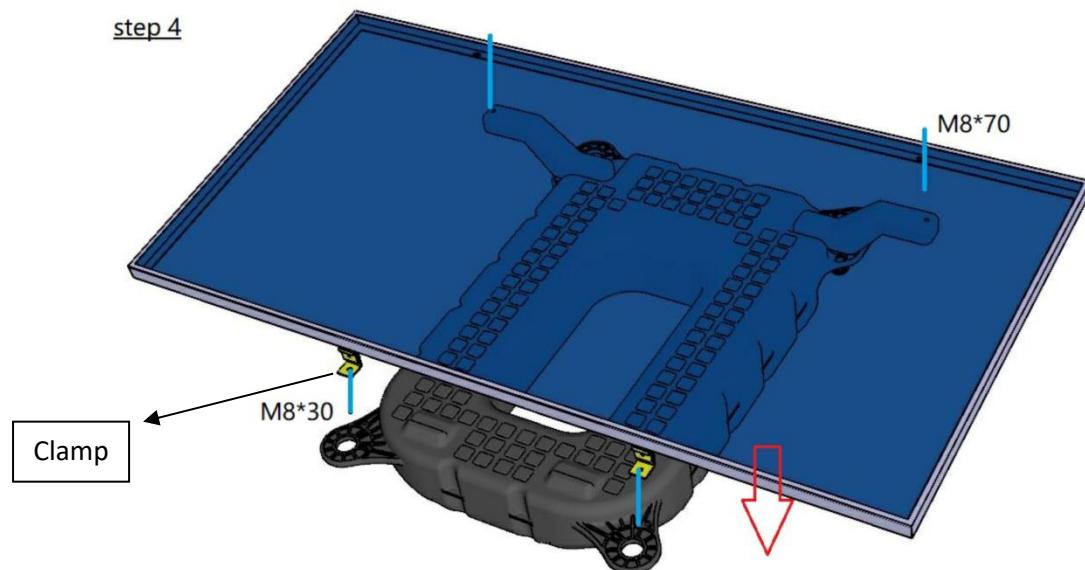
The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

**Step 3) Connect a Support float on panel float B on each side and Fasten Nuts under lugs**

Refer to the image below

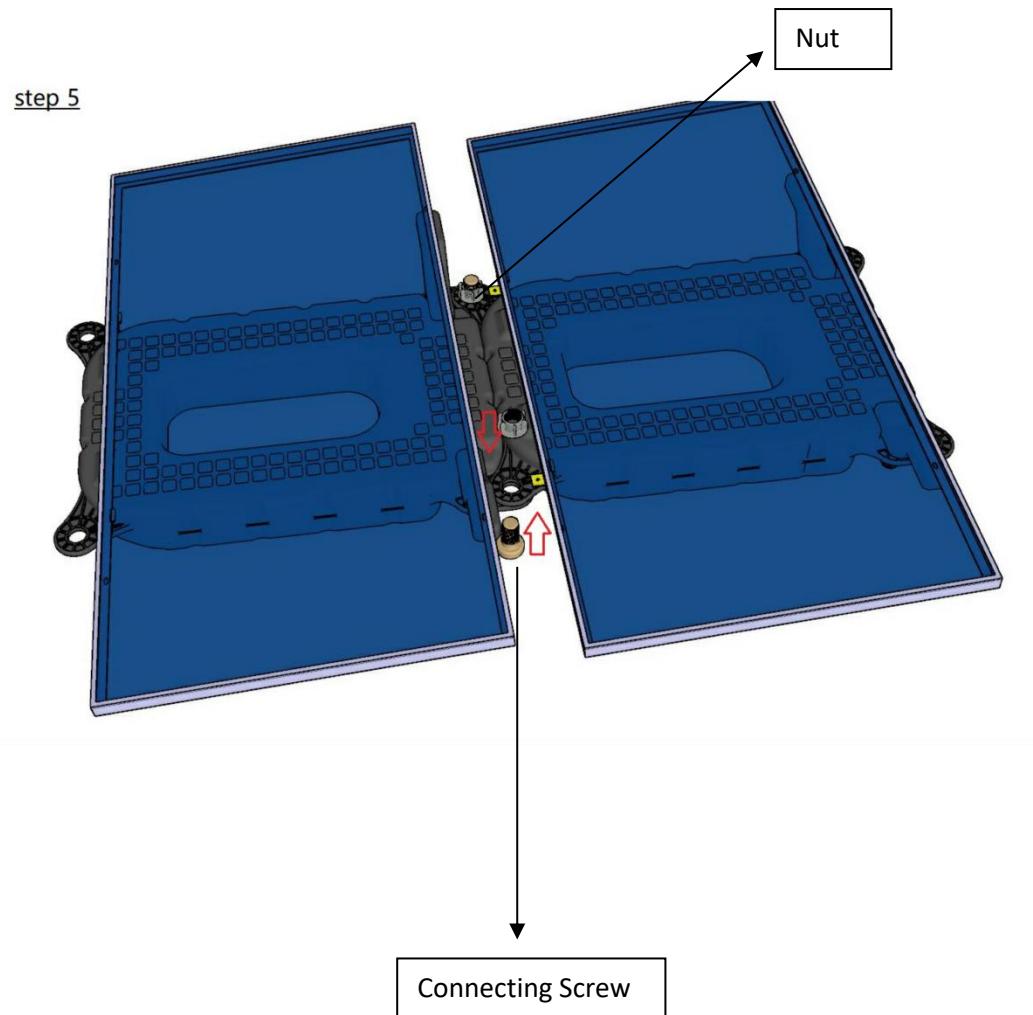


**Step 4) Lift the photovoltaic module and place it on panel float B such that they perfectly align together on all fours points, next screw the module with stainless steel screw M8**



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

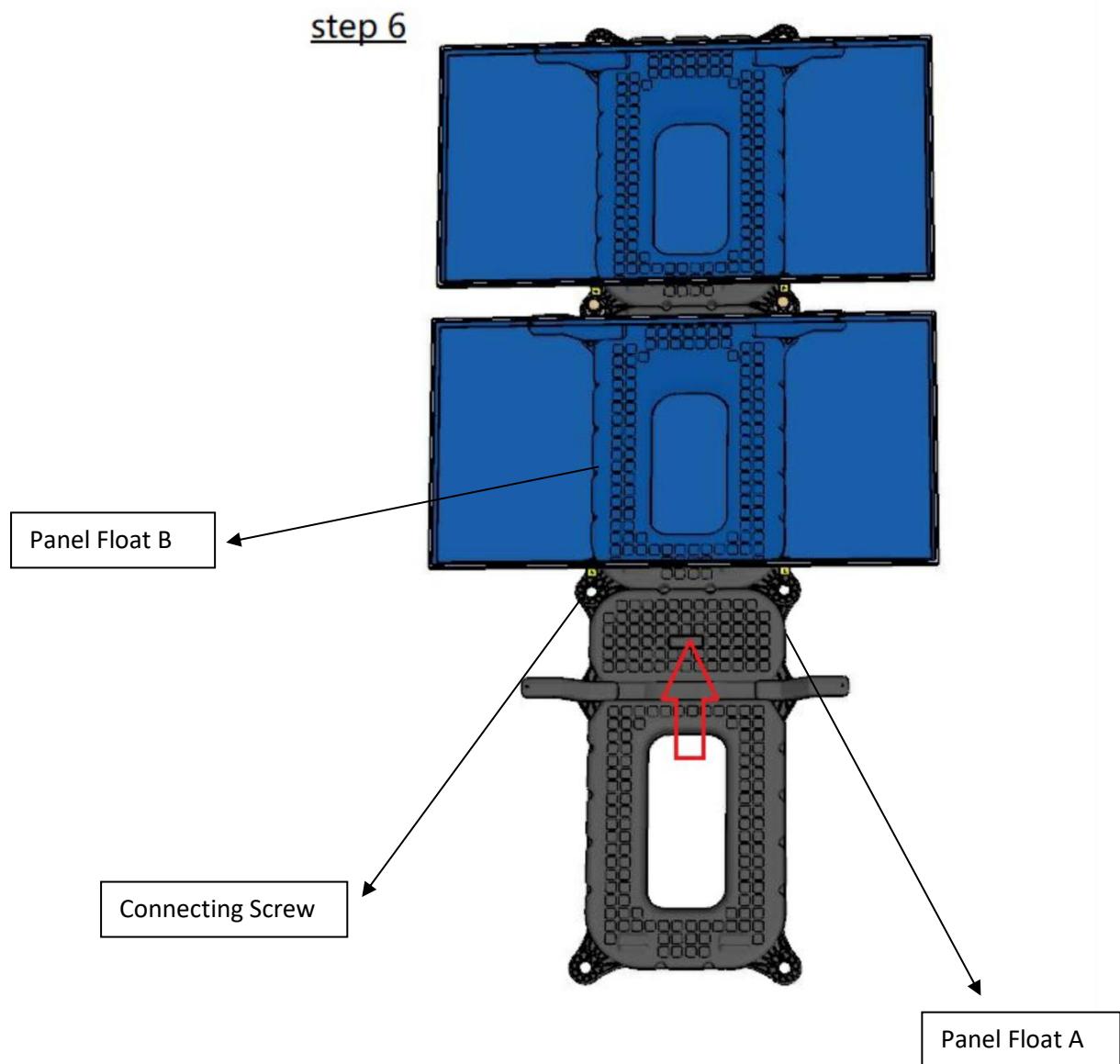
**Step 5) Repeat the process to mount another module on panel float B and then using the connecting screw and nuts, join two panel float B on land**



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

**Step 6) Now, follow step 1-3 and mount a photovoltaic module on panel float A**

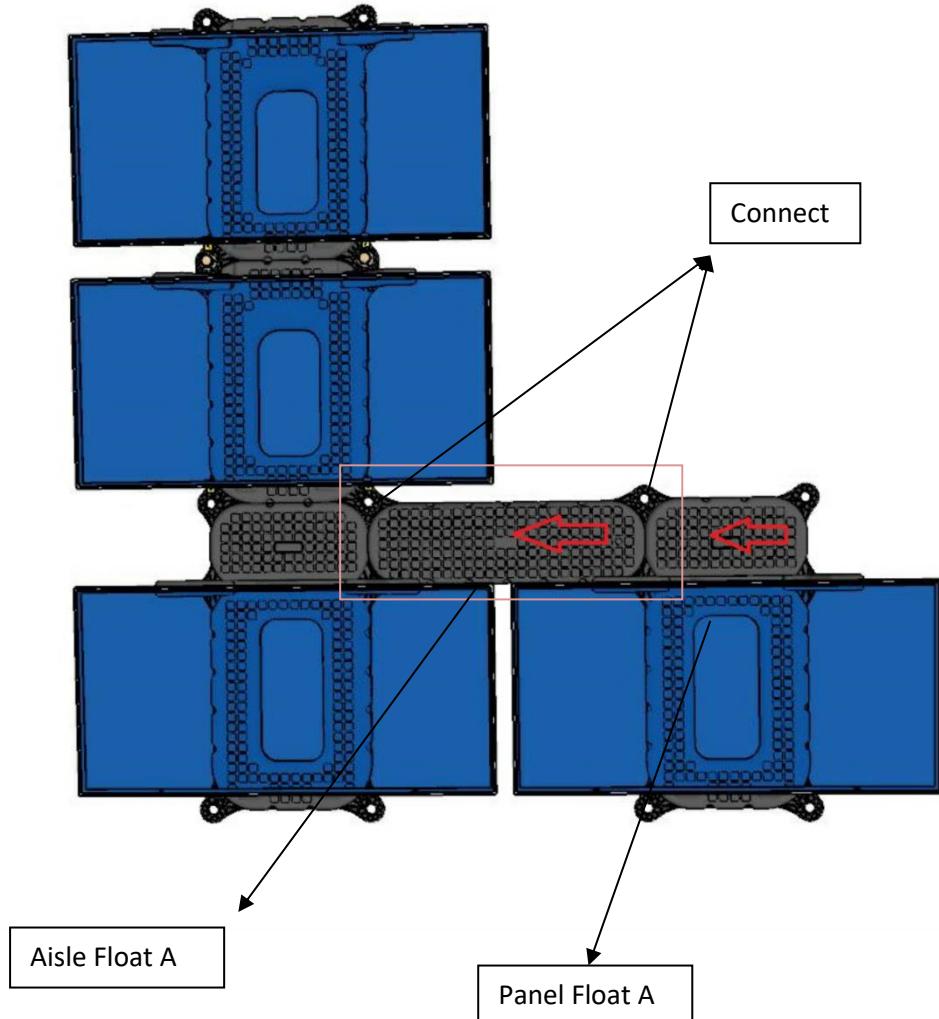
**After mounting a module on panel float A, connect panel float A to panel float B as below**



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

**Step 7) After connecting Panel Float A with Panel Float B, Connect an Aisle Float A between two Panel Float A**

step 7

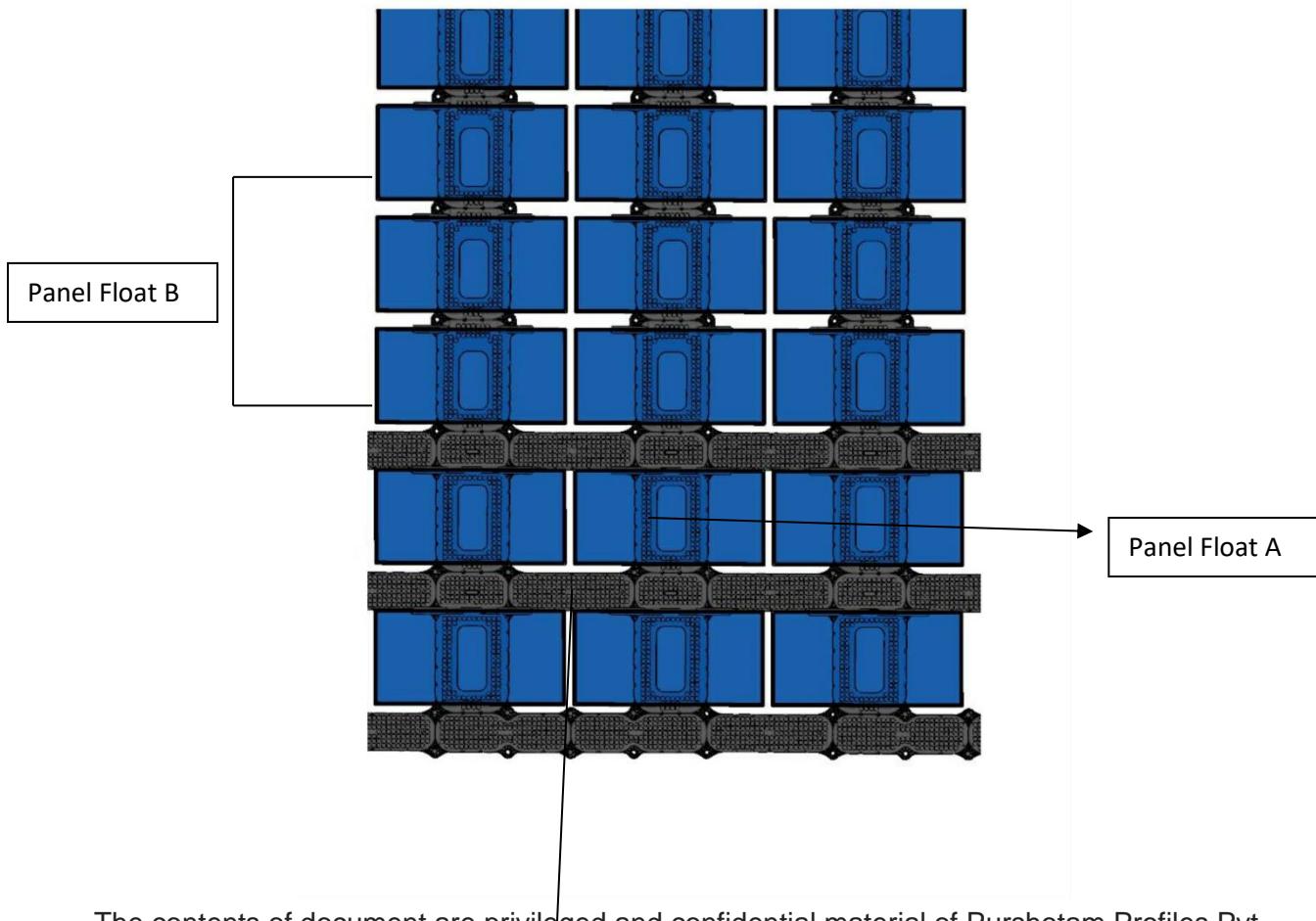


The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

**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.

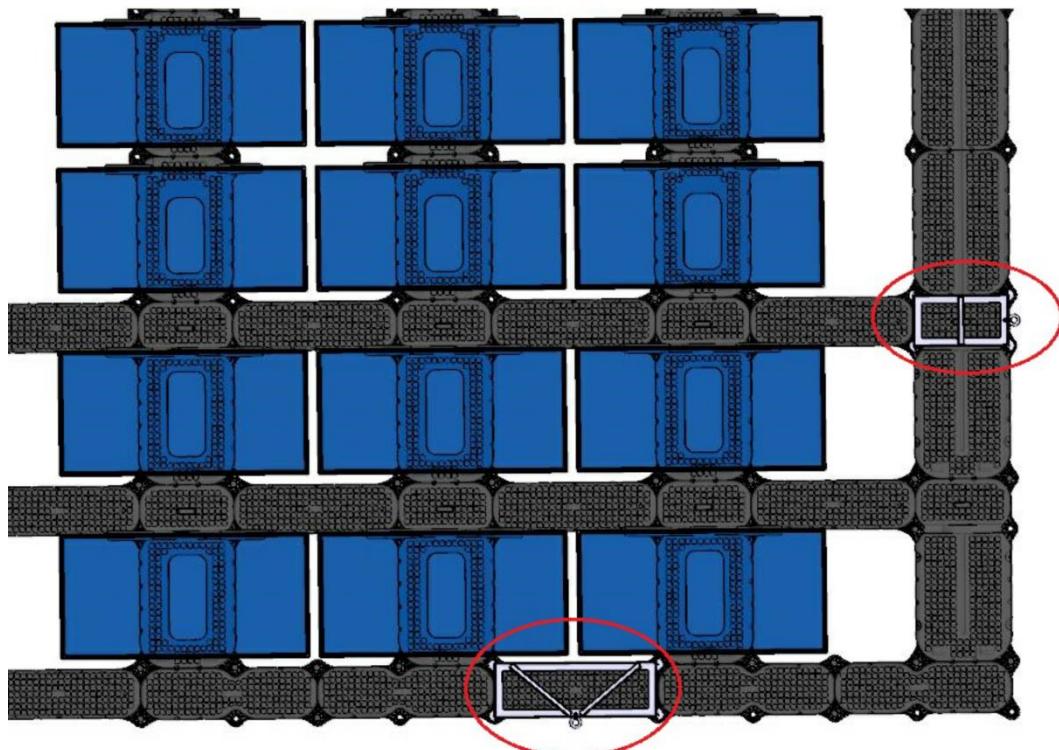
step 8



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee(s). These are meant for use by BHEL & NTPC only for RFQ NO : TGPBOS0045 | Aisle Float A | 9 .Please note that the designs and specifications are proprietary information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

**Step 9) Final step is installation of anchor line nuts as per drawing, We need to push float array into water gradually.**

step 9



The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

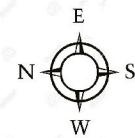


The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

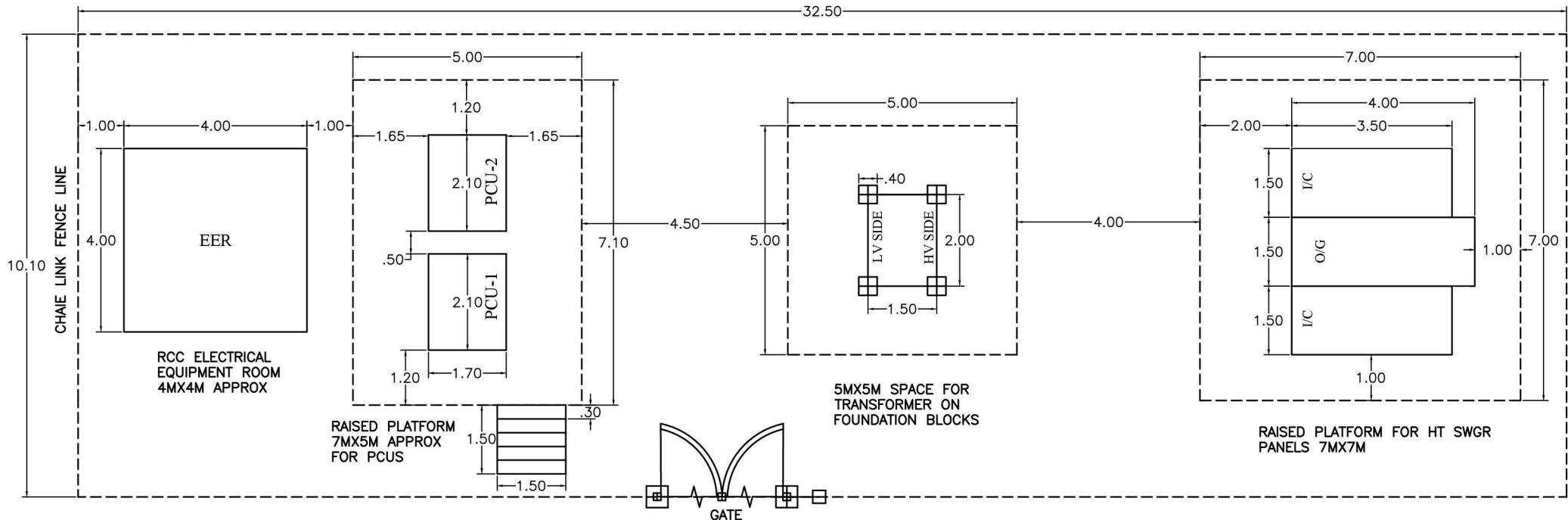


The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project

The contents of document are privileged and confidential material of Purshotam Profiles Pvt Limited (PPPL) and should not be disclosed to, used by or copied in any manner by anyone other than the intended addressee/(s). These are meant for use by BHEL & NTPC only for **RFQ NO : TGPBOS0045 Dated 15.10.2019**. Please note that the designs and specifications are proprietary and privileged information of PDOPIL and PPPL. These cannot be shared with any third party and cannot be used for anything else other than this project



**DETAILS OF INVERTER CUM TRANSFORMER PLATFORM YARD  
25 MW FSPV NTPC SIMHADRI**



SL.NO	ITEM	DIMENSION IN M	APPROX WEIGHT KG
1	PCU 2.5MW	2.1X1.7	6000
2	TRANSFORMER 5MVA	5X5	12000
3	HT SWGR PANELS	2X1.5X3.5+1X4X1.5 OR 1X3.5X1.5	2500X3 OR 2500X1

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<b>D-2 GENERAL CIVIL WORKS</b>		
1.0	<p><b>GENERAL</b></p> <p>This chapter covers the Specific technical and functional requirements.</p> <p>The design calculations and drawings for RCC structure/Room, 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.</p> <p>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.</p>		
2.0	<p><b>CMCS, INVERTER ROOMS, SECURITY ROOM:</b></p> <p>The following structures shall be designed and provided by the bidder:</p> <p>(I) <b>CMCS Building:</b> For the operation and maintenance of SPV Plant one Central Monitoring and Control Station (CMCS) with 11 KV switchgear room shall be provided. The CMCS building shall consist of the following:</p> <ol style="list-style-type: none"> <li>1. Air conditioned SCADA Room</li> <li>2. Inverter, battery room, ACDB and 11 KV Switchgear Room</li> </ol> <p>Inverter(s), battery room, ACDB and 11 KV Switchgear room shall be based on manufacturer recommendation, easy passage of O&amp;M persons and cable trench layout required. The CMCS shall be RCC framed structure with bricks/concrete blocks masonry walls.</p> <p>The minimum size &amp; requirements of the CMCS Building &amp; all items shall be as per tender drawing.</p> <p>(II) <b>Inverter Rooms:</b> Inverter rooms consist of PCU's, LT panels, batteries, etc. shall be provided based on manufacturer recommendation, easy passage of O&amp;M persons and cable trench layout required. The Inverter Room shall be RCC framed structure with bricks/concrete blocks masonry walls and containerized solutions.</p> <p>The battery and its associated equipment shall be suitably segregated inside the Inverter room with proper ventilation arrangement.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2 PAGE 4

CLAUSE NO.	TECHNICAL SPECIFICATIONS						
	<p>The equipment inside the inverter room shall be placed so as to provide sufficient space for their maintenance.</p> <p>The layout, design and drawings for all RCC structure, etc. and foundation system shall be approved from NTPC before start of works.</p> <p>The buildings and allied works shall be designed to meet NATIONAL BUILDING CODE (SP: 07 2016) requirements.</p> <p>Finish floor level of all building shall be minimum 450 mm above from Finish graded level.</p>						
2.1	<p><b>Specification for RCC Building for CMCS and Inverter room.</b></p> <p>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:</p>						
2.1.1	<p><b>Floor Finishes</b></p> <table border="1"> <tr> <td>Switchgear/Inverter rooms</td><td>: Cement concrete flooring with ironite hardener.</td></tr> <tr> <td>SCADA room</td><td>: Heavy duty vitrified ceramic tiles</td></tr> <tr> <td>Battery room</td><td>: Acid Alkali resistance tile flooring or acid alkali resistant epoxy coating over concrete flooring with ironite hardener</td></tr> </table> <p>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.</p> <p>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.</p> <p>Finish floor level of all building shall be minimum 600 mm above from Finish graded level.</p>	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
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						
2.1.2	<p><b>False Ceiling</b></p> <p>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</p>						
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH							
TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9							
D-2							
PAGE 5							

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC
2.1.3	<p>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.</p> <p><b>Roof Finishes</b></p> <p>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.</p> <p>Bidder can also provide Roof of the building as Cast-in-situ RCC slab conforming to Indian code.</p> <p>The roof of the building shall be water proof with Polymeric membrane type waterproofing as per DSR. The roof shall be designed for minimum superimposed load to 150 kg/m2.</p> <p>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 450 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.</p> <p>The bidder shall also provide rain water harvesting system consisting of ground water recharge pits for CMCS building roof.</p>	
2.1.4	<p><b>View point</b></p> <p>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</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC
2.1.5	<p>landing staircase shall be provided for access to roof of the RCC CMCS building.</p> <p><b>Windows, Doors, Ventilators and Rolling Shutters</b></p> <p>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.</p> <p>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.</p> <p>The Bidder can also propose uPVC extruded casement/ sliding windows and doors with complete fitting and accessories as per items mentioned in DSR 2016.</p> <p>All external door of CMCS shall be provided with Collapsible metal grille with locking system.</p> <p>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 450 mm over door openings except for main entrance door to the control room where the projection shall be 1500 mm.</p> <p>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</p>	
2.1.6	<p><b>Glazing</b></p> <p>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.</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS																		
2.1.7	<p>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.</p> <p>The glass to be used should be from reputed brand / manufacturer and as approved by NTPC. The glass should be free from distortion and thermal stress.</p> <p><b>Paintings of wall and ceilings</b></p> <table border="1"> <tbody> <tr> <td><b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings</td><td>-Acrylic Emulsion -Acrylic Distemper</td></tr> <tr> <td><b>External faces of walls:</b></td><td>-Exterior emulsion paint</td></tr> <tr> <td>Walls of battery room</td><td>-Acid alkali resistant paint, an exposed wall above Dado -2100 mm high Dado of acid alkali resistant tiling.</td></tr> <tr> <td>All Ceiling</td><td>-Acrylic Distemper</td></tr> </tbody> </table> <p>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.</p> <p>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.</p> <p>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 painting shall be similar to PEB painting colors.</p> <p>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.</p>	<b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings	-Acrylic Emulsion -Acrylic Distemper	<b>External faces of walls:</b>	-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	<p><b>Paintings of wall and ceilings</b></p> <table border="1"> <tbody> <tr> <td><b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings</td><td>-Acrylic Emulsion -Acrylic Distemper</td></tr> <tr> <td><b>External faces of walls:</b></td><td>-Exterior emulsion paint</td></tr> <tr> <td>Walls of battery room</td><td>-Acid alkali resistant paint, an exposed wall above Dado -2100 mm high Dado of acid alkali resistant tiling.</td></tr> <tr> <td>All Ceiling</td><td>-Acrylic Distemper</td></tr> </tbody> </table> <p>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.</p> <p>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.</p> <p>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 painting shall be similar to PEB painting colors.</p> <p>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.</p>		<b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings	-Acrylic Emulsion -Acrylic Distemper	<b>External faces of walls:</b>	-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
<b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings	-Acrylic Emulsion -Acrylic Distemper																		
<b>External faces of walls:</b>	-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																		
<b>Internal wall surfaces:</b> SCADA room All other rooms in plant buildings	-Acrylic Emulsion -Acrylic Distemper																		
<b>External faces of walls:</b>	-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																		
2.1.8	<b>Plumbing and sanitary</b>																		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2 PAGE 8																

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC
	<p>Wash basin provision for hand wash shall also be provided in <b>battery room</b>.</p> <p>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.</p> <p>The bidder shall design &amp; provide packaged sewerage treatment plant/septic with soak pit for CMCS 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.</p> <p><b>2.2 Specification for PEB room</b> Deleted.</p> <p><b>2.3 Water Supply</b> 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.</p> <p>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.</p> <p><b>2.4 Plastering</b> 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.</p>	

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
2.5	<p><b>Masonry Work</b></p> <p>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/mm<sup>2</sup> 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.</p> <p>The cement mortar for all kind of masonry work shall be in the ratio 1 cement and 6 sand by weight.</p> <p>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.</p> <p>Bricks of class designation 50 and 35 may be permitted to have slight distorted &amp; 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.</p> <p>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.</p> <p>Use of fly ash brick for masonry shall be subjected to approval of NTPC.</p> <p>Suitable damp proof course shall be provided the proportion of cement, sand &amp; 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.</p>		
2.6	<p><b>Reinforced Concrete Structure, Allied Works and Foundation</b></p> <p>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.</p>	D-2	PAGE 10

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC	
	<p>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.</p> <p>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</p> <p>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 Coated re-bars of grade minimum Fe-500 and shall conform to IS: 1786. Ductile detailing in accordance with IS: 13920 shall be adopted for superstructure and substructure of all RCC buildings / structures</p> <p>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.</p> <p>M 30 - All RCC structural elements above and below ground level, precast concrete, MMS foundation, cable trench, oil pit, Grade Slab, Paving, culverts &amp; road.</p> <p>M-20 (Equivalent nominal Mix of 1:1.5:3)* - Fencing work</p> <p>M-15 (Equivalent Nominal Mix of 1:2:4) - Base slab of drains.</p> <p>M-10 (Equivalent Nominal Mix of 1:3:6) - Plain Concrete Cement.</p> <p>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.</p> <p>In case Geotechnical investigations requires any special kind of cement or higher grade of concrete, the same shall be provided.</p> <p>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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 11

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC
2.7	<p>All loads shall be considered in line with IS: 875. Seismic loads for design shall be in accordance with IS: 1893 and relevant Standards.</p> <p>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.</p> <p>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.</p> <p><b>A. Structural Steel</b></p> <p>All structural steel design shall be carried out as per IS 800. Structural steel shall conform IS 2062/IS 1079 or equivalent, 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.</p> <p><b>B. Structural Steel/Steel Sheet Painting</b></p> <p>All non-hot dip galvanised structural steel (excluding Module Mounting &amp; SCB structure)/ Outdoor metal containers/ Enclosure/ Rolling shutter items shall be provided with paint designed for a minimum maintenance-free life of fifteen (15) years (high durability) as per <b>ISO 12944 and IS 800</b>. For finishing coat suitable colour pigment shall be added. All paints including primer shall be of the reputed brand/manufacturer and as approved by the Engineer-In-charge. The method of application shall be as per the recommendations of the manufacturer. For corrosive category of refer appendix-D1</p>	
2.8	<p><b>Grouting</b></p> <p>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/mm<sup>2</sup> at 28 days.</p>	
3.0	<p><b>TRANSFORMER YARD CIVIL WORKS</b></p> <p>Transformer and equipment's foundations shall be founded on piles/isolated spread footings depending on the final geotechnical investigation report. Metering yard equipment's structures shall be designed as per IS: 801 and IS: 800.</p>	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9
		D-2
		PAGE 12

CLAUSE NO.	TECHNICAL SPECIFICATIONS	एनटीपीसी NTPC	
4.0	<p>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.</p> <p>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 the oil volume of the transformer connected to it, without backflow. The Gravel-filled level under transformer shall be in accordance with FGL outside pit and transformer bottom level.</p> <p>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. The portion of the fence covering towards rail track shall be made of a removable type for movement of the transformer during erection /removal. In addition, a small gate, 1.2 m wide shall be provided for an entry. The transformer yard fencing work shall conform to CEIG requirements.</p> <p>Transformer track rails shall conform to IS 3443. The requirement of a fire barrier wall between transformers shall be as per Electricity Rules and IS 1646 recommendations</p> <p><b>PIPE /CABLE RACKS &amp; TRENCHES</b></p> <p>Trenches shall be constructed in reinforced cement concrete of M-30 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.</p> <p><u>Outdoor Cable Trenches:</u> 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.</p> <p><u>Indoor Cable Trenches:</u> 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 (600-1200 mm in length except at ends &amp; 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.</p>		
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH		TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2
		PAGE 13	

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	<p><b>Trench Drainage:</b> The trench bed shall have a slope of approx. 1/500 along the run &amp; 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.</p> <p><b>5.0 ROAD AND PATHWAY</b></p> <p><b>5.1 Road</b></p> <p>The approach road to the Floating Solar Power Plant facilities shall originate from the nearest existing Plant road. Approach road shall be 3.0 meter wide with 0.5 meter 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.</p> <p>The minimum road section shall be as follows:</p> <ol style="list-style-type: none"> <li>1) Topping: Wearing course of premix carpet 20 mm thick.</li> <li>2) WBM, compacted 75 mm thick (Grade-III).</li> <li>3) WBM, compacted 100 mm thick (Grade-II).</li> <li>4) Granular Sub-base, compacted 150mm thick granular sub-base (Gr-I). (WBM 100 mm thickness can be modified to 75 mm for WBM with corresponding increase of 25 mm in subbase thickness.) Bidders can also propose Wet Mix Macadam (WMM) in place of Water Bound Macadam (WBM) for approach road base construction.)</li> <li>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.</li> </ol> <p>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.</p> <p><b>6.0 DRAINAGE SYSTEM</b></p> <p>Surface drainage/Garland Drain 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</p>	D-2	PAGE 14

CLAUSE NO.	TECHNICAL SPECIFICATIONS					
	<p>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 &amp; maintains the existing drainage pattern as far as possible is desired. A network of open drains shall be designed &amp; 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 40mm thick for stone slab.</p> <p>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.</p> <p><b>7.0 ELECTRIFICATION OF BUILDING</b></p> <p>Electrification of all building shall be carried out as per IS 732-1989, IS: 4648-1968 and other relevant standards.</p> <p><b>8.0 LIST OF APPLICABLE INDIAN STANDARDS:</b></p> <p>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.</p> <p>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.</p> <p>A brief list of Indian Standards applicable to these works is as below:</p> <p>General</p> <table border="1"> <tr> <td>IS: 875-I</td><td>Code of Practice for Design Dead Loads for Building and Structures</td></tr> <tr> <td>IS: 875-II</td><td>Code of Practice for Design Imposed Loads for Building and Structures</td></tr> </table>	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-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					
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 15			

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	IS: 875-III	Code of practice for design loads (other than earthquake) for buildings and structures.	
<b>Foundations</b>			
	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	
<b>Concrete Structures</b>			
	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	
<b>Steel Structures</b>			
	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	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 16

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	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	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 17

CLAUSE NO.	TECHNICAL SPECIFICATIONS		
	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	
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 18

CLAUSE NO.	TECHNICAL SPECIFICATIONS				
	IRC: 73   Geometric design of roads				
<b>APPENDIX-D1</b>					
<b>GENERAL DESIGN DATA</b>					
<p>A. <b>VICINITY MAP:</b> Refer Tender drawing No: 5746-004-POC-A-001</p> <p>B. <b>WIND:</b> Basic wind speed shall as per Cl. 2.0 of Chapter A-2.</p> <p>C. <b>SEISMIC</b> shall be as per IS: 1893 (Part-1)</p> <p>D. <b>Corrosive category: C5</b></p>					
DEVELOPMENT OF 25 MW FLOATING SOLAR PV PROJECT AT NTPC SIMHADRI IN ANDHRA PRADESH	TECHNICAL SPECIFICATION BID DOC. NO:RE-CS-5746-004-9	D-2	PAGE 19		



## ANNEXURE A

## PROFORMA OF BANK 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. 5 .....(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 .....<sup>7</sup> 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 .....<sup>7</sup> 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.....



# Guidelines for Reverse Auction - 2016

Issued on 26.09.2016

(Applicable for all NITs issued on or after 26.11.2016)

(AA:SSP:RA:03)

**Sourcing Strategy & Policy**  
**Corporate Operations Management**  
**BHEL, New Delhi**

(Note: Abridged version for the information of the bidders)

## 1.0 Scope

This document describes the guidelines to be followed by each Unit/ Division/ Region for conducting reverse auction for procurement of material/ services/ works. These guidelines will be applicable for all purchases/ contracts to be awarded under extant policy and the Reverse Auction shall follow the philosophy of English Reverse (No ties).

English Reverse (No ties) is a type of auction where the starting price and bid decrement are announced before start of online reverse auction. The interested bidders can thereupon start bidding in an iterative process wherein the lowest bidder at any given moment can be displaced by an even lower bid of a competing bidder, within a given time frame. The bidding is with reference to the current lowest bid in the reverse auction. All bidders will see the current lowest quoted price and their rank. The term 'No ties' is used since more than one bidder cannot give an identical price, at a given instant, during the reverse auction. In other words, there shall never be a tie in the bids.

## 2.0 Intent of Reverse Auction (RA)

To derive maximum benefit in cost savings through competitive bidding.

## 3.0 Terms in NIT

Wherever it is felt that procurement may be done through Reverse Auction, the bids shall be invited in two parts/ three parts or single part bid (Price Bid) where Techno-Commercial MoU already exists. Wherever, the evaluation is done for individual line item, separate envelope sealed price bid for each line item shall be taken.

Decision to go for RA would be taken after evaluation of techno-commercial bids. The NIT would contain following **clause**:

*"BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on [www.bhel.com](http://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](http://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](http://www.bhel.com))."*

As a reminder to the bidders, system will flash following message (in RED Color) during the course of 'online sealed bid':

*"Bidders to submit online sealed bid less than or equal to their envelope sealed bid already submitted to BHEL"*

## **6.0 Business rules for RA**

Business rules (annexure-I) are attached.

## **7.0 Role of Service Provider**

- Acknowledge the receipt of mandate from BHEL.
- Contact the bidders, provide business rules and train them, as required.
- Get the process compliance form signed by all the participating bidders before RA event.
- Conduct the event as per the contract and business rules.
- Submit the login reports, results, history sheet and authorized final bid from the bidders.
- To obtain price breakup including that of line items (wherever required) from successful bidder and submit the same to BHEL.

## **8.0 Receipt of Techno-Commercial Bids & Evaluation**

Suppliers are required to submit their best price bid in a separate sealed cover along with techno-commercial bid. After evaluation of Techno-Commercial Bids:

- a) In case BHEL decides not to conduct RA, the envelope sealed price bids of all techno-commercially qualified bidders, along with price impact, if any, should be opened and processed as per extant Policy.
- b) In case BHEL decides to conduct RA, business rules of RA will be sent to service provider.

## **12.0 Reverse Auction Process**

12.1 Reverse auction process is deemed to have been started upon receipt of 'Online Sealed Bids' from the bidders within the prescribed time frame as per Business Rules. After receipt of 'online sealed bids', start price & bid decrement will be decided by BHEL and the same shall be communicated to the service provider, to start the bidding process. Only those bidders who have submitted the 'online sealed bid' within the scheduled time shall be eligible to participate further in RA process. However, the H1 bidder (whose quote is highest in online sealed bid) will not be allowed to participate in further RA process provided minimum three bidders are left after removal of H1 bidder.

In case of tie for H1 bid (identical online sealed bids), 15 minutes additional time shall be provided and all the participating bidders shall be informed by mail/ message on bidding screen to enable bidders submit revised online sealed bids so as to break the tie.

12.2 All bidders who had given online sealed bid will see their rank and L1 price and their ranking L1, L2 etc. would be based on their last quoted price irrespective of quote received in RA or online sealed bid.

### **13.0 Failure of RA**

RA shall be treated as failed in the following scenarios:

- a) In case no bidder accepts the start price.
- b) In cases where the number of online sealed bids are less than four before removal of highest bidder.
- c) In cases of tie among H1 bidders, even after extension of submission of online sealed bids once by 15 minutes.

Wherever, the evaluation is done for individual line items, RA shall be treated as failed only for those line item(s) for which any of the above a), b) or c) satisfies.

### **14.0 Treatment of RA failed scenarios:**

In cases of failure of RA, sealed envelope price bids (of item(s) for which RA has failed) of all the techno-commercially qualified bidders shall be opened and the tender shall be processed accordingly. However, the envelope sealed bid(s) of techno-commercially acceptable bidder(s) who had agreed to participate in the RA and had failed to submit the online sealed bid shall not be opened.

### **15.0 Processing of case after RA**

15.1 After declaring L1 upon completion of RA, the envelope sealed price bid of L1 bidder shall also be opened for placement of order on lower of the two bids (RA closing price & envelope sealed price) and file is to be processed as per extant policy provisions. Action as per NIT terms is to be taken if online sealed bid is higher than the envelope sealed bid.

15.2 Relative position of bidders (for usage in cases of predefined splitting the quantities) shall also include bidders who have given 'online sealed bids' but have not given further bids in auction. In case of splitting requirement, H1 bidder may also be considered for counter offer if the pre-stated (NIT) numbers of suppliers do not accept the counter offer.

15.3 In case H1 bidder happen to be MSE and was removed from further bidding but is within  $L1 + 15\%$  band, then this bid shall also be considered and to be processed in line with 'Public Procurement Policy for Micro & Small Enterprises (MSEs) order, 2012'.

15.4 For providing preference to Domestically manufactured Electronic Products, in accordance with Department of Electronics and Information Technology (DeitY) Gazette Notification No. 33(3)/2013-IPHW dated 23.12.2013 and its related notifications issued from time to time, H1 bidder removed from further bidding may be considered for counter offer to meet domestic bidder requirement for the item(s) under procurement.

## **17.0 Processing of cases where RA is not done**

In case BHEL decides not to go for Reverse Auction for the tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL's standard practice.

## **18.0 Others**

18.2 In case of enquiry through e-Procurement, the sealed electronic price bid (e-bid) is to be treated as sealed envelope price bid.

18.3 BHEL will inform bidders the details of service provider who will provide business rules, all necessary training and assistance before commencement of online bidding on internet.

18.4 Bidders are advised to read the 'Business Rules' indicating details of RA event carefully, provided by the Service provider, before reverse auction event.

## Business Rules for Reverse Auction

This has reference to tender no {tender number....date...}. BHEL shall finalise the Rates for the supply of {item name} through Reverse Auction mode. BHEL has made arrangement with M/s. {Service provider}, who shall be BHEL's authorized service provider for the same. Bidders should go through the instructions given below and submit acceptance of the same.

The technical & commercial terms are as per (a) BHEL Tender Enq. No. {...} dated {...}, (b) Bidders' technical & commercial bid (in case of two part bid) and (c) subsequent correspondences between BHEL and the bidders, if any.

### 1. Procedure of Reverse Auctioning

- i. **Online Sealed Bid:** This duration of online sealed bid will be {...} minutes. All bidders to submit their online sealed bids during this period.
- ii. **Online Reverse Auction:** The 'opening price' i.e. start price for RA and 'bid decrement' will be decided by BHEL.
- iii. If BHEL decides the lowest online sealed bid as the starting price, then the lowest bidder in online sealed bid shall be shown as current L1 automatically by the system and no acceptance of that price is required. System shall have the provision to indicate this bid as current L1.
- iv. Bidders by offering a minimum bid decrement or the multiples thereof can displace a standing lowest bid and become "L1" and this continues as an iterative process.
- v. After the completion of the online reverse auction, the Closing Price (CP) shall be available for further processing.

### 2. Schedule for Reverse Auction:

The Reverse Auction is tentatively scheduled on {date}; and the duration of online sealed bid will be {...} minutes. All bidders to submit their online sealed bids during this period.

#### - Online Sealed Bid:-

- {Start Time:}
- {Close Time: }

#### - Online Reverse Auction:-

- {Start Time:}
- {Close Time: }

### 3. Auction extension time:

If a bidder places a bid in the last {...} minutes of closing of the Reverse Auction and if that bid gets accepted, then the auction's duration shall get extended automatically for another {...} minutes, for the entire auction (i.e. for all the items in the auction), from the time that bid comes in. Please note

that the auto-extension will take place only if a bid comes in those last (...) minutes and if that bid gets accepted as the lowest bid. If the bid does not get accepted as the lowest bid, the auto-extension will not take place even if that bid might have come in the last (...) minutes. In case, there is no bid in the last (...) minutes of closing of Reverse Auction, the auction shall get closed automatically without any extension. However, bidders are advised not to wait till the last minute or last few seconds to enter their bid during the auto-extension period to avoid complications related with internet connectivity, network problems, system crash down, power failure, etc.

The above process will continue till completion of Reverse Auction. Complaints/ Grievances, if any, regarding denial of service or any related issue should be given in writing thru e-mail/ fax to M/s. {Service provider} with a copy to BHEL within 15 minutes prior to initial closing time of Online Reverse Auction.

- 4. Bid price:** The Bidder has to quote the ..... Price inclusive of Packing & Forwarding charges, all the routine & type tests as per tender scope, ED + cess, CST against C-form, Freight (bidder to provide original Freight paid receipt), insurance charges, etc. including loading (if indicated by BHEL due to deviations in technical/ commercial terms) for the Items specified. Details are as shown in Excel Sheet for calculation of total cost to BHEL (To be specified by Unit as per NIT conditions).
- 5. Bidding currency and unit of measurement:** Bidding will be conducted in *Indian Rupees per Unit* of the material as per the specifications (...) In case of foreign currency bids, exchange rate (TT selling rate of State Bank of India) as on scheduled date of tender opening (Part-I bid) shall be considered for conversion in Indian Rupees. If the relevant day happens to be a Bank holiday, then the forex rate as on the previous bank (SBI) working day shall be taken.
- 6. Validity of bids:** Price shall be valid for (...) days from the date of reverse auction. These shall not be subjected to any change whatsoever.
- 7. Lowest bid of a bidder:** In case the bidder submits more than one bid, the lowest bid at the end of Online Reverse Auction will be considered as the bidder's final offer to execute the work.
- 8.** Bidders shall be assigned a **Unique User Name & Password** by M/s. {Service provider}. Bidders are advised to change the Password and edit the information in the Registration Page after the receipt of initial Password from M/s. {Service provider} to ensure confidentiality. All bids made from the Login ID given to the bidders will be deemed to have been made by the bidders/ bidders' company.
- 9. Post auction procedure:** BHEL will proceed with the Lowest Bid in the Reverse Auction for further processing.
- 10.** Any commercial/ technical loading shall be intimated to bidders prior to RA. The excel sheet provided in this regard shall cover all these aspects. Commercial/ technical loading if any, shall be added by the respective bidder in its price during online sealed bid & Online Reverse Auction. Modalities of loading & de-loading

shall be separately intimated to the bidders. The responsibility for correctness of total cost to BHEL shall lie with the bidders.

11. Computerized reverse auction shall be conducted by BHEL (through M/s. *{Service Provider}*), on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice. Internet connectivity shall have to be ensured by bidders themselves.

During the RA process if a bidder is not able to bid and requests for extension of time by FAX/ email/ phone then time extension of additional 15 minutes will be given by the service provider provided such requests come before 5 minutes of auction closing time. However, only one such request per bidder can be entertained.

Despite this extension if bidder fails to upload his prices due to extreme case of failure of Internet connectivity, (due to any reason whatsoever may be) it is the bidders' responsibility/ decision to send fax communication immediately to M/s. *{Service provider}*, furnishing the price the bidder wants to bid online with a request to the service provider to upload the faxed price online so that the service provider will upload that price online on behalf of the Bidder. It shall be noted clearly that the concerned bidder communicating this price to service provider has to solely ensure that the fax message is received by the service provider in a readable/ legible form and also the Bidder should simultaneously check up with service provider about the clear receipt of the price faxed. It shall also be clearly understood that the bidder shall be at liberty to send such fax communications of prices to be uploaded by the service provider only within the closure of Bid time and under no circumstance it shall be allowed beyond the closure of Bid time /reverse auction. It shall also be noted that the service provider should be given a reasonable required time by the bidders, to upload such prices online and if such required time is not available at the disposal of the Service provider at the time of receipt of the fax message from the bidders, the service provider will not be uploading the prices and either BHEL or the service provider are not responsible for this unforeseen circumstances. In order to ward-off such contingent situation bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the reverse auction successfully. Failure of power or loss of connectivity at the premises of bidders during the Reverse auction cannot be the cause for not participating in the reverse auction. On account of this, the time for the auction cannot be extended and neither BHEL nor M/s. *{Service provider}* is responsible for such eventualities.

12. Proxy bids: Proxy bidding feature is a pro-bidder feature to safeguard the bidder's interest of any internet failure or to avoid last minute rush. The proxy feature allows bidders to place an automated bid in the system directly in an auction and bid without having to enter a new amount each time a competing bidder submits a new offer. The bid amount that a bidder enters is the minimum that the bidder is willing to offer. Here the software bids on behalf of the bidder. This obviates the need for the bidder participating in the bidding process until the proxy bid amount

is decrementally reached by other bidders. When proxy bid amount is reached, the bidder (who has submitted the proxy bid) has an option to start participating in the bidding process. The proxy amount is the minimum amount that the bidder is willing to offer. During the course of bidding, the bidder cannot delete or change the amount of a proxy bid. Bids are submitted in decrements (decreasing bid amounts). The application automates proxy bidding by processing proxy bids automatically, according to the decrement that then auction originator originally established when creating the auction, submitting offers to the next bid decrement each time a competing bidder bids, regardless of the fact whether the competing bids are submitted as proxy or standard bids. However, it may please be noted that if a manual bid and proxy bid are submitted at the same instant manual bid will be recognized as the L1 at that instant. In case of more than one proxy bid, the system shall bid till it crosses the threshold value of 'each lowest proxy bid' and thereafter allow the competition to decide the final L1 price. Proxy bids are fed into the system directly by the respective bidders. As such this information is privy only to the respective bidder(s).

- ~~REVERSE AUCTION~~ 13. Bidders are advised to get fully trained and clear all their doubts such as refreshing of screen, quantity being auctioned, tender value being auctioned etc from M/s. {Service provider}.
14. M/s. {Service provider}, shall arrange to demonstrate/ train the bidder or bidder's nominated person(s), without any cost to bidders. M/s. {Service provider}, shall also explain the bidders, all the business rules related to the Reverse Auction. Bidders are required to submit their acceptance to the terms/ conditions/ modalities before participating in the Reverse Auction in the process compliance form as enclosed. Without this, the bidder will not be eligible to participate in the event.
15. Successful bidder shall be required to submit the final prices (L1) in prescribed format (Annexure-VI) for price breakup including that of line items, if required, quoted during the Online Reverse Auction, duly signed and stamped as token of acceptance without any new condition (other than those already agreed to before start of auction), after the completion of auction to M/s. {Service provider} besides BHEL within two working days of Auction without fail.
16. Any variation between the final bid value and that in the confirmatory signed price breakup document will be considered as tampering the tender process and will invite action by BHEL as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).
17. Bidders' bid will be taken as an offer to execute the work/ supplies of the item as per enquiry no. {...} dt. {...}. Bids once made by the bidder, cannot be cancelled/ withdrawn and bidder shall be bound to execute the work as mentioned above at bidder's final bid price. Should bidder back out and not execute the contract as per the rates quoted, BHEL shall take action as per extant guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)).

**18.** Bidders shall be able to view the following on their screen along with the necessary fields during Online Reverse Auction:

- a. Leading (Running Lowest) Bid in the Auction (only total price of package).
- b. Bid Placed by the bidder.
- c. Start Price.
- d. Decrement value.
- e. Rank of their own bid during bidding as well as at the close of auction.

**19.** BHEL's decision on award of contract shall be final and binding on all the Bidders.

**20.** BHEL reserves the right to extend, reschedule or cancel the Reverse Auction process at any time, before ordering, without assigning any reason, with intimation to bidders.

**21.** BHEL shall not have any liability to bidders for any interruption or delay in access to the site irrespective of the cause. In such cases, the decision of BHEL shall be binding on the bidders.

**22.** Other terms and conditions shall be as per bidder's techno-commercial offers and other correspondences, if any, till date.

**23.** If there is any clash between this business document and the FAQ available, if any, in the website of M/s. {Service provider}, the terms & conditions given in this business document will supercede the information contained in the FAQs. Any changes made by BHEL/ service provider (due to unforeseen contingencies) after the first posting shall be deemed to have been accepted if the bidder continues to access the portal after that time.

**24.** Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action as per extant BHEL guidelines for suspension of business dealings (as available on [www.bhel.com](http://www.bhel.com)), shall be initiated by BHEL.

ABRIDGED

# ANNEXURE - 22

HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA) DOC.1	
<b>Job Task:</b> Erection of materials and over all site work	<b>Equipment #:</b> Hydra/Crane, Welding M/c,
<b>Project/Location:</b> 25 MW Floating Solar Project, NTPC, SIMHADRI	<b>Analysis done by:</b> Roney Das, QUEST <b>Reviewed by:</b> BHEL EDN, Safety Dept
<b>PPE required:</b> Safety helmet, vest, shoes, hand gloves, etc. (IS standard)	<b>Date Initiated:</b>
<b>Emergency Plan:</b> Yes	<b>Revised date:</b>
<b>Tools used:</b> Crane, Chain pulleys, Sling, D-shackle, Bow shackle, Gas cutting set, Welding set.	<b>Chemicals used:</b> NO

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Structural materials and Equipment shifting and Lifting</b>	<p>1. Pinching of leg/hands of workmen while handling Structural members.</p> <p>2. Swinging of load.</p> <p>3. Poor weather condition.</p> <p>4. Overloading of crane.</p> <p>5. Unauthorized operation of crane by helper.</p> <p>6. Failure of lifting tools and tackles due to use of damaged / under capacity tools and tackles.</p>	<p>1. Serious injuries.</p> <p>2. Property damage.</p> <p>3. Chances of Fatality</p>	<p>1. Pre work cautioning &amp; proper Permit must be followed before starting the work.</p> <p>2. Ensure that workmen keep their body parts away from pinching points.</p> <p>3. Ensure proper stacking of Structural members.</p> <p>4. While fit up work structural member must be secured safely.</p> <p>5. Qualified operator, rigger and signalman should be assigned.</p> <p>6. Ensure use of tag lines at both ends to control the load.</p> <p>7. Use crane/Hydra within the capacity and do not over load.</p> <p>7a. Safe working load should be displayed on all matl handling eqpt.</p> <p>8. Avoid work in poor visibility / poor weather condition / Raining and in heavy wind.</p> <p>9. Affected area to be cordoned off and caution sign to be posted to avoid unauthorized entry.</p> <p>10. Ensure to use of certified and tested lifting tools and tackles with proper capacity, color code &amp; identification number.</p>	<p>Safety shoes, Safety Helmet, Safety goggles, Safety vest, Hand gloves.</p>

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Erections of structural materials with the help of crane&amp; rigging activity. (as applicable to CMCS building)</b>	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. Serious injuries. 2. Property Damage.	1. Ensure qualified Crane operator and competent Signal man/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 cordoned off & caution sign to be posted to avoid unauthorized entry. 10. 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
<b>Erection/Dismantling Of Scaffolding (Only for CMCS area)</b>	1. Dropped objects 2. Slips, trips and falls 3. Striking against 4. Collapse and fall of scaffold structure	1. Serious injuries. 2. 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 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. Only essential personnel are allowed access to scaffold	Safety shoes, Safety Helmet, Safety goggles, Safety vest, Hand gloves, Full body harness

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Gas cutting and Welding work</b>	1. Fire and Explosion 2. Welding fumes 3. Fall of gas cylinders while transporting	1. Injury from cylinder fall 2. Burn injuries due to fire, spatters. 3. Eye injury to nearby workers 4. Property damage due to cylinder blast	1. Ensure flash back arrester /NRV on cylinder and torch side. 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. Ensure appropriate safety goggles to all workers. 8. Provide suitable face shield for welders. 9. Use gas cylinders trolley for internal shifting of gas cylinders. 10. Ensure Fixing of the valve caps while shifting/storing the gas cylinders. 11. O2 and LPG Gas cylinders shall be stored separately chained and secured. 12. Ensure safe storage of diesel fuel if any.	Safety shoes, safety helmet, gloves, goggles. Face shield.
<b>Electrical work</b>	1. Electrical Shock 2. Fire	1. Injury 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
<b>Removal Of Lifting Arrangement</b>	1. Fall of materials/objects from height.	1. Injuries 2. Property damage.	1. Trained and Authorized person only allow to perform the job. 2. All tools & tackles should be tightened by rope to prevent fall from height. 3. Safe lowering procedure should be ensured. 4. The area must be cordoned off. 5. Life line must be provided for anchoring safety harness.	Full body harness, Safety shoes, safety helmet, gloves, goggles
<b>Excavation Work by JCB/manually</b>	1. Fall of person 2. Soil collapse	1. Serious injuries.	1. Install cordon/warning tape 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	Safety shoes, safety helmet, goggles, hand gloves, vest.
<b>Civil work</b>	1. Slippery approach. 2. While work at height, fall hazard. 3. Electrical hazard for electric line/equipment's. 4. Sharp edges of construction materials. 5. Chemical component of cement.	1. Slip trip fall injuries 2. Property damage. 3. Eye injuries, skin irritation	1. Preparation of proper approach with proper slope, steps, hand railing/ ropes. 2. Barricading /cordonning the area. 3. Display safety posters 4. Inspection of all hand tools before use. 5. Ensure proper working platform	Safety shoes, safety helmet, goggles, gloves, full body harness, nose masks.

Job activities/Work	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Work on Water body (NTPC reservoir)</b>	<ol style="list-style-type: none"> <li>1. Trip slip and fall hazard on floats</li> <li>2. Chance of fall into water</li> <li>3. Electrical hazard.</li> <li>4. Effect of extreme weather condition such as Sun burn and heat stress.</li> </ol>	<ol style="list-style-type: none"> <li>1. Physical fall shock - chance of injury or fatality.</li> <li>2. Fall from the work area in to the water resulting in suffocation or drowning.</li> <li>3. Chance of sun burn or sun stroke</li> </ol>	<ol style="list-style-type: none"> <li>1. Before start of work check all documents (such as work permit, TPI certificates of all tools and tackles and test certificates of life saving boat)</li> <li>2. Ensure all work men working in or very near to water to wear Life jackets</li> <li>3. Ensure availability of rescue boat in water with spare life jackets and floatation air tubes</li> <li>4. Make a proper approach into the water body with proper slope or steps if required</li> <li>5. In case of emergency, rescue team consisting of expert swimmers and above rescue boat to be always prepared.</li> <li>6. In case of underwater work such as diving related work, an expert for checking diving equipment prior to commencement of work. Also person shall be present for observing and monitoring diving activity during dive sessions.</li> <li>7. Arrangement to be in place to summon Ambulance on Call to site for emergency shifting of any injured person to the nearest hospital.</li> <li>8. Ensure drinking water to avoid de-hydration</li> <li>9. Ensure Wireless / mobile/ walky-talky arrangement between site to control room/office</li> <li>10. Ensure non-contamination of water body during the activities</li> </ol>	<p>Safety shoes, safety helmet, goggles, hand gloves, Reflective life jackets.</p> <p>Certified and compliant Diving gear to be used by divers if required</p> <p>One dedicated Rescue boat with life jackets</p>

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) Doc 2		
<b>Job Task:</b> Vegetation clearance at PV plant area		<b>Equipment #:</b> Hydra/Crane/JCB
<b>Project/Location:</b> 25 MW Floating Solar Project, NTPC, SIMHADRI	<b>Analysis done by:</b> Roney Das, QUEST	<b>Reviewed by:</b> BHEL
<b>PPE required:</b> Safety helmet, vest, shoes, hand gloves, goggles etc.	<b>Date Initiated:</b>	<b>Revised date:</b>
<b>Emergency Plan:</b> Yes		
<b>Tools used:</b> Hand operated Power saws, Cutting tools	<b>Chemicals used:</b> No	

Sequence of Job Steps	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Entry to Vegetation/ Undergrowth area (Area Survey)</b>	1. Common Natural Hazard : A) Snake Bite, Insect bites like mosquito, Honey bee sting etc B) Falling branches, trees C) Fall, trip	1. Injuries 2. Fatality 3. Property damage	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 person 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 antidote, insect repellent cream) shall be available near the site	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
<b>Cutting and shifting of trees with the help of sawing machine, crane &amp; rigging activity.</b>	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. Serious injuries 3. Fatality 4. Property damage	1. Check Submit all TPI certificates and check for proper working of cutting machines 2. Ensure presence of qualified Signaller/Rigger. 3. Ensure that workmen keep their hands / leg away from pinching points. Proper communication & co-ordination with coworker. 4. Ensure proper supervision. 5. Ensure to use certified and tested lifting tools and tackles with proper capacity. 6. Safe working load should be displayed on all matl handling eqpt. 7. While lifting ensure no one comes under suspended load. 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 entry. 10. Only authorized operator with valid license to operate the crane. 11. Daily Inspection checklist of crane/JCB/Cutting machine shall be ensured by users. 12. Stationary type Machinery shall be located in leveled platform and the same shall be ensured by the site engineer. 13. Ensure that soil bearing capacity is adequate to bear the load of machinery 14. Keep cutting tools sharp and in good condition. 15. Avoid work with oily hands. 16. 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,

Sequence of Job Steps	Potential Hazards	Risk/Hazard Effect	Safety Precautions	PPE
<b>Housekeeping</b>	<ol style="list-style-type: none"> <li>1. Chances of fire during friction</li> <li>2. Slip Trip Fall</li> </ol>	<ol style="list-style-type: none"> <li>1. Injuries</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean area properly</li> <li>2. Not to dump bushes and trees in work area</li> <li>3. Carry out stacking in designated area in orderly manner for further disposal.</li> <li>4. Be aware of Fire fighting equipment locations</li> </ol>	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	

<u>UNPRICED PRICE-BID (25 MW NTPC SIMHADRI)</u>							
<b>BOQ for (BOS) of 25MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Simhadri</b>							
SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
<b>List of Supply items</b>							
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)	1	Sets	1,574,815.55	1,574,816		Nodal
2	Supply of M/s. Multi contact make MC4 connectors for string connection	2000	Pairs	83.89	167,782		Nodal
3	Supply of M/s. Multi contact make Y Connectors	1900	Pairs	374.28	711,137		Nodal
4	Supply of HDPE DWC pipe for routing of 6sqmm cables through pathways	5	Kms	47,866.73	239,334		Nodal
5	Supply of 2.5sqmm lug and M4 size screw of SS-304 grade for earth cable connection on PV module frames.	218220	Nos	11.97	2,611,370		Nodal
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	10	Kms	23,933.37	239,334		Nodal
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	5	Kms	47,866.73	239,334		Nodal
8	Supply of SCB earthing cable (25 sq.mm CU) with necessary lugs and hardware	500	M	478.67	239,334		Nodal
9	Supply of SCB support structure (Aluminium) and SS304 hardware suitable for mounting SCBs on HDPE floating pontoons	90	Nos	15,955.58	1,436,002		Nodal
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter	60	Kms	15,955.58	957,335		Nodal
11	Supply of Hume pipes(NP2 or better) for 36 no.s of DC cables and earthing cables for crossing over the bund at 5 locations near inverter platforms	5	Sets	472,444.66	2,362,223		Nodal
12	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	596.38	8,945,761		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	200	Sets	2,362.22	472,445		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	180	Sets	2,362.22	425,200		Nodal
15	Supply of UPS systems (5 KVA), with 1 hour backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	1	Sets	159,555.78	159,556		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)	4	Sets	119,666.84	478,667		EDN
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformer for CMCS	1	Sets	116,475.72	116,476		EDN
18	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 20 KVA Dry Type Auxiliary Transformers for EERs	4	Sets	77,650.48	310,602		EDN
19	Supply of ACDB inside EER (RCC building) for electrical equipment	5	Sets	275,592.72	1,377,964		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
20	Supply of 33KV outdoor switchyard equipment as per specification and SLD- 1. Metering CTs. 2. Metering PTs 3. LAs 4. three no.s of ABT meter with outdoor cubicle ( locable type) 5. ACSR conductor 6. Isolator with earth switch 7. Earthing systems 8. Necessary support structures with foundations. (All Structure surface protection suitable for surviving harsh environmental conditions- C5 corrosive category).	3	Sets	3,988,894.50	11,966,684		EDN
21	Supply of Structural steel support columns (HDG) with column foundations along Canal bed and under road bridge for crossover of HT cables from pooling stations to termination yard. Distance of canal to be covered is about 400 meters upto opposite side. Aluminium /FRP Cable trays, trapezoidal clamps, steel anchor bolts for securing by grouting to bridge RCC columns are covered in scope of supply.	400	M	7,977.79	3,191,116		Nodal
22	Supply of Structural steel support columns (HDG)/ Cable Trestle with Aluminium /FRP Cable Tray and foundation along cable laying route adjacent to RCC Cable trench of NTPC for IDCT Cables. (Refer Google Map with proposed HT Cable route from PCUs upto Outdoor yard approx. 4.2 km away). For 3 Runs of trefoils with center to center spacing of 200MM. Vendor can consider 1 tier/2 tier tray arrangement.	300	M	7,977.79	2,393,337		Nodal
23	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70	Nos	1,595.56	111,689		Nodal
24	Supply of indoor cable termination kit for 33KV(E), 1CX240 sq.mm	70	Nos	12,764.46	893,512		Nodal
25	Supply of outdoor cable termination kit for 33KV(E), 1CX240 sq.mm	24	Nos	14,360.02	344,640		Nodal
26	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	42	Nos	11,168.90	469,094		Nodal
27	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	6	Nos	11,168.90	67,013		Nodal
28	Supply of earthing electrodes with chemical compound, earthing strips/flats, earthing cable for all electrical equipment i.e. unarmored copper cables, termination hardware, brick masonry earth chamber with inspection lids for solar array and main control room	150	Sets	3,988.89	598,334		Nodal
29	Supply of module washing system- Battery/diesel/petrol operated hand held/portable pump motor set system with pressure nozzle for cleaning SPV modules	5	Sets	14,360.02	71,800		EDN
30	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS, Wireless receiver mounted on top of building etc to SCADA panel	5	Sets	3,829.34	19,147		Nodal
31	Supply of items for LED based outdoor lighting system covering Inverter platforms	20	Nos	19,944.47	398,889		Nodal
32	Supply of weather monitoring system (WMS)	1	Sets	558,445.23	558,445		Nodal
33	Supply of safety related items including fire alarm systems for building, fire extinguishers, sand buckets, safety gadgets etc	1	Sets	957,334.68	957,335		EDN
34	Supply of ESE type lightning arrester including 5 meter pole, counter, earthing materials, earthing strip etc. (20 sets on water and 1 set on main control room)	21	Sets	63,822.31	1,340,269		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
35	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	7	Kms	83,766.78	586,367		Nodal
36	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1	Kms	319,111.56	319,112		Nodal
37	Supply of air conditioners for main control building SCADA room- Capacity 1.5 Ton/5 star	2	Nos	55,844.52	111,689		Nodal
38	Supply of life jackets as per IS 6685.(IROS approved makes)	40	Nos	1,595.56	63,822		Nodal
39	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	612,428.27	612,428		Nodal
40	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)	1	Sets	957,334.68	957,335		Nodal
41	Supply of spare items	1	Sets	1,276,446.24	1,276,446		Nodal
42	Supply of Water supply system with bore well having submersible pump set, starter with protections (both of reputed make). Bore well shall be with casing and filters for bore well, piping with valves etc. upto water storage tank on top of CMCS building. Bore well shall be located adjacent to CMCS	1	AU	797,778.90	797,779		Nodal
43	Supply of Emergency lamps and associated cabling with conduits for CMCS (to be connected with UPS)	1	Set	19,944.47	19,944		Nodal
<b>Total price for Supply</b>					<b>51,190,895</b>		
	<b>List of Works (I&amp;C activities)</b>						
1	<b>I&amp;C:</b> 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 109110 Nos.  All tools, tackles and Infrastructure like boats required for Installation of Floater 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= 2.5MWAC Block consisting of approx. 10920SPV modules)	10	AU	2,453,367.17	24,533,672		EDN
2	<b>I&amp;C:</b> Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	1,211,676.17	12,116,762		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
3	<b>I&amp;C:</b> Interconnection of SPV modules, installation of 90 Nos of SCBs, laying/ termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works. (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	104,432.45	1,044,324		EDN
4	<b>I&amp;C:</b> Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays (For SCB to PCU cabling).Also laying of Hume pipes with road concreting and preparation of bund after laying. (On the pathway array, at the entrance of embankment to Hume pipes, at the exit of Hume pipes and at the input side of PCU at inverter platform.) (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	31,911.16	319,112		EDN
5	<b>I&amp;C:</b> Earthing of 3030 nos of modules and 2.5 nos of SCBs using combination of earthing cables of adequate size and earthing strips. SCB-SPD earthing cables shall be connected to array earthing grid. (1 AU= 1 earth pit)	36	AU	118,861.08	4,278,999		Nodal
6	<b>I&amp;C:</b> Installation of 20 Nos of ESE type LA on separate floating platform and 1 No on main control room. LAs on pond shall be placed as per tentative layout. The earth pits for LA shall be suitably placed on the ground near embankment. 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 21 LAs)	1	AU	891,831.45	891,831		Nodal
7	<b>I&amp;C:</b> 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= 2.5MWAC Block)	10	AU	638,223.12	6,382,231		EDN
8	<b>I&amp;C:</b> Erection of 33kV transformer yard - Erection of 5.3MVA inverter transformers, cable trays, drain pipes and stone jelly spreading. (1 AU= 5MWAC Block)	5	AU	1,276,446.24	6,382,231		EDN
9	<b>I&amp;C:</b> Erection of 33kV HT power cables from transformer to HT panels and to Local pooling stations (1 AU= 25MWAC Block)	1	AU	638,223.12	638,223		EDN

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
10	<p><b>I&amp;C:</b> Laying of 33kV HT power cables from Local pooling stations to 33kV evacuation point. Also laying of SCADA communication (OFC) cable from plant CMCS to switch yard panel room. Conducting of detailed route survey is in Vendor scope. Based on the route study, Cables shall be laid suitably (underground in trenches and over cable trays with required steel structural supports (Corrosion resistance treated) and Civil foundations and Steel reinforcements while crossing the Canal and bridge section of the route.). Some of the reference photos are attached for vendor reference.</p> <p>3 trefoils of HT cables laid from the PV plant shall be terminated on the 2 or 4 pole structures and further laid through available trenches and terminated at Panels in nearby panel room of customer. (1AU = laying of 1 KM)</p>	4.2	AU	360,899.98	1,515,780		EDN
11	<p><b>I&amp;C:</b> Erection of Auxiliary transformers, ACDB, UPS/ battery bank, SCADA panels etc. in EER (Electrical Equipment Room) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables. (1 AU= 5MWAC Block)</p>	5	AU	79,777.89	398,889		EDN
12	<p><b>I&amp;C:</b> Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment (WMS) of the power plant at the data logger/ PLC panel / HMI computer control desk at CMCS, Metering end at termination point etc (1 AU= for 25MWAC Block).</p>	1	AU	438,778.40	438,778		EDN
13	<p><b>I&amp;C:</b> Earthing system for Inverter platforms (including CMCS and EERs) 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 5MWAC Block)</p>	5	AU	223,378.09	1,116,890		Nodal
14	<p><b>I&amp;C:</b> Preparation of foundation and installation of 33KV switchyard CT, PT, isolator with earth switch, LA, ABT meter etc. (1 AU= for 1 feeder)</p>	3	AU	132,963.15	398,889		
15	<p><b>I&amp;C:</b> 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)</p>	20	AU	63,822.00	1,276,440		Nodal
16	<p><b>I&amp;C:</b> Emergency lighting system including cable laying, cable terminations at CMCS. (1 AU= for 1 LED fixture)</p>	4	AU	63,822.31	255,289		Nodal
17	<p><b>I&amp;C:</b> 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 25MWAC Block)</p>	1	AU	877,556.79	877,557		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal		
18	<b>I&amp;C:</b> 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 25MWAC Block)	1	AU	1,914,669.36	1,914,669		Nodal		
19	<b>I&amp;C:</b> Installation of Water supply system for CMCS. (1 AU= for 25MWAC Block)	1	AU	797,778.90	797,779		Nodal		
20	SPV module washing (1AU=25 MW Block module wash once per month)	3	AU	106,370.00	319,110		Nodal		
21	Deputation of Safety supervisor for duration of I&C ( 1 AU = 1 Month )	6	AU	30,315.00	181,890		Nodal		
22	Provision of emergency vehicle/Ambulance on standby for duration of I&C ( 1 AU = 1 Month )	6	AU	38,293.00	229,758		Nodal		
<b>Total I&amp;C Works</b>					<b>66,309,105</b>				
<b>TOTAL AMOUNT for (Supply + I&amp;C works) excluding GST</b>					<b>117,500,000</b>				
<b>TOTAL AMOUNT (Excl.GST) in (INR) = Eleven Crore seventy five lakh rupees only</b>									
QUOTE PERCENTAGE (%) ABOVE/Below (+/-) (OR) AT PAR TO TOTAL AMOUNT						XXXXXXXXXXXXXXXXXXXX			
QUOTED PERCENTAGE (%) IN WORDS ABOVE/Below (OR) AT PAR TO TOTAL AMOUNT						XXXXXXXXXXXXXXXXXXXX			
<b>GST (As applicable) To be mandatorily indicated</b>									
<b>NOTE:</b>		1.CONTRACTOR SHOULD QUOTE PERCENTAGE (%) ABOVE/Below (OR) AT PAR TO TOTAL AMOUNT 2. QUOTED PERCENTAGE (%) IS APPLICABLE ON ALL ITEM RATES UNIFORMLY.							

<u>PRICE-BID (25 MW NTPC SIMHADRI)</u>							
<b>BOQ for (BOS) of 25MW (AC) Floating Solar Photovoltaic Grid-connected Power plant for NTPC at Simhadri</b>							
SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
<b>List of Supply items</b>							
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)	1	Sets	1,574,815.55	1,574,816		Nodal
2	Supply of M/s. Multi contact make MC4 connectors for string connection	2000	Pairs	83.89	167,782		Nodal
3	Supply of M/s. Multi contact make Y Connectors	1900	Pairs	374.28	711,137		Nodal
4	Supply of HDPE DWC pipe for routing of 6sqmm cables through pathways	5	Kms	47,866.73	239,334		Nodal
5	Supply of 2.5sqmm lug and M4 size screw of SS-304 grade for earth cable connection on PV module frames.	218220	Nos	11.97	2,611,370		Nodal
6	Supply of 25*3 MM GS/CCS earthing strip for internal earth grid formation	10	Kms	23,933.37	239,334		Nodal
7	Supply of 25*6 MM GS/CCS earthing strip for peripheral earth grid formation	5	Kms	47,866.73	239,334		Nodal
8	Supply of SCB earthing cable (25 sq.mm CU) with necessary lugs and hardware	500	M	478.67	239,334		Nodal
9	Supply of SCB support structure (Aluminium) and SS304 hardware suitable for mounting SCBs on HDPE floating pontoons	90	Nos	15,955.58	1,436,002		Nodal
10	Supply of 2.5 sq.mm earthing copper cable (Yellow Green PVC sheathed) for inter	60	Kms	15,955.58	957,335		Nodal
11	Supply of Hume pipes(NP2 or better) for 36 no.s of DC cables and earthing cables for crossing over the bund at 5 locations near inverter platforms	5	Sets	472,444.66	2,362,223		Nodal
12	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	596.38	8,945,761		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	200	Sets	2,362.22	472,445		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	180	Sets	2,362.22	425,200		Nodal
15	Supply of UPS systems (5 KVA), with 1 hour backup, UPSDB and Ni-Cd type battery bank (Comprising of 2 x100% redundancy for Battery and Charger)	1	Sets	159,555.78	159,556		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)	4	Sets	119,666.84	478,667		EDN
17	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 30 KVA Dry Type Auxiliary Transformer for CMCS	1	Sets	116,475.72	116,476		EDN
18	Supply Auxiliary transformers along with all necessary connections and materials like cables, cable lugs and cable glands 20 KVA Dry Type Auxiliary Transformers for EERs	4	Sets	77,650.48	310,602		EDN
19	Supply of ACDB inside EER (RCC building) for electrical equipment	5	Sets	275,592.72	1,377,964		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
20	Supply of 33KV outdoor switchyard equipment as per specification and SLD- 1. Metering CTs. 2. Metering PTs 3. LAs 4. three no.s of ABT meter with outdoor cubicle ( locable type) 5. ACSR conductor 6. Isolator with earth switch 7. Earthing systems 8. Necessary support structures with foundations. (All Structure surface protection suitable for surviving harsh environmental conditions- C5 corrosive category).	3	Sets	3,988,894.50	11,966,684		EDN
21	Supply of Structural steel support columns (HDG) with column foundations along Canal bed and under road bridge for crossover of HT cables from pooling stations to termination yard. Distance of canal to be covered is about 400 meters upto opposite side. Aluminium /FRP Cable trays, trapezoidal clamps, steel anchor bolts for securing by grouting to bridge RCC columns are covered in scope of supply.	400	M	7,977.79	3,191,116		Nodal
22	Supply of Structural steel support columns (HDG)/ Cable Trestle with Aluminium /FRP Cable Tray and foundation along cable laying route adjacent to RCC Cable trench of NTPC for IDCT Cables. (Refer Google Map with proposed HT Cable route from PCUs upto Outdoor yard approx. 4.2 km away). For 3 Runs of trefoils with center to center spacing of 200MM. Vendor can consider 1 tier/2 tier tray arrangement.	300	M	7,977.79	2,393,337		Nodal
23	Supply of double compression weatherproof metallic cable gland for 33KV(E), 1CX240 sq.mm cable	70	Nos	1,595.56	111,689		Nodal
24	Supply of indoor cable termination kit for 33KV(E), 1CX240 sq.mm	70	Nos	12,764.46	893,512		Nodal
25	Supply of outdoor cable termination kit for 33KV(E), 1CX240 sq.mm	24	Nos	14,360.02	344,640		Nodal
26	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	42	Nos	11,168.90	469,094		Nodal
27	Supply of straight through joint kits for 33KV(E), 1CX240 sq.mm cable	6	Nos	11,168.90	67,013		Nodal
28	Supply of earthing electrodes with chemical compound, earthing strips/flats, earthing cable for all electrical equipment i.e. unarmored copper cables, termination hardware, brick masonry earth chamber with inspection lids for solar array and main control room	150	Sets	3,988.89	598,334		Nodal
29	Supply of module washing system- Battery/diesel/petrol operated hand held/portable pump motor set system with pressure nozzle for cleaning SPV modules	5	Sets	14,360.02	71,800		EDN
30	Supply of control and instrumentation cable for connecting PCU, HT panel, UPS, fire alarm system, inverter transformer, WMS, Wireless receiver mounted on top of building etc to SCADA panel	5	Sets	3,829.34	19,147		Nodal
31	Supply of items for LED based outdoor lighting system covering Inverter platforms	20	Nos	19,944.47	398,889		Nodal
32	Supply of weather monitoring system (WMS)	1	Sets	558,445.23	558,445		Nodal
33	Supply of safety related items including fire alarm systems for building, fire extinguishers, sand buckets, safety gadgets etc	1	Sets	957,334.68	957,335		EDN
34	Supply of ESE type lightning arrester including 5 meter pole, counter, earthing materials, earthing strip etc. (20 sets on water and 1 set on main control room)	21	Sets	63,822.31	1,340,269		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
35	Supply of 70 Sqmm bare aluminum conductor for ESE LA earthing with Lugs and clamps	7	Kms	83,766.78	586,367		Nodal
36	Supply of 1Cx70 sqmm PVC sheathed copper cable for earthing interconnections	1	Kms	319,111.56	319,112		Nodal
37	Supply of air conditioners for main control building SCADA room- Capacity 1.5 Ton/5 star	2	Nos	55,844.52	111,689		Nodal
38	Supply of life jackets as per IS 6685.(IROS approved makes)	40	Nos	1,595.56	63,822		Nodal
39	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	612,428.27	612,428		Nodal
40	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)	1	Sets	957,334.68	957,335		Nodal
41	Supply of spare items	1	Sets	1,276,446.24	1,276,446		Nodal
42	Supply of Water supply system with bore well having submersible pump set, starter with protections (both of reputed make). Bore well shall be with casing and filters for bore well, piping with valves etc. upto water storage tank on top of CMCS building. Bore well shall be located adjacent to CMCS	1	AU	797,778.90	797,779		Nodal
43	Supply of Emergency lamps and associated cabling with conduits for CMCS (to be connected with UPS)	1	Set	19,944.47	19,944		Nodal
<b>Total price for Supply</b>					<b>51,190,895</b>		
	<b>List of Works (I&amp;C activities)</b>						
1	<b>I&amp;C:</b> 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 109110 Nos.  All tools, tackles and Infrastructure like boats required for Installation of Floater 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= 2.5MWAC Block consisting of approx. 10920SPV modules)	10	AU	2,453,367.17	24,533,672		EDN
2	<b>I&amp;C:</b> Connection of anchoring ropes/chains/Buoys to each floating island as per drawing (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	1,211,676.17	12,116,762		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
3	<b>I&amp;C:</b> Interconnection of SPV modules, installation of 90 Nos of SCBs, laying/ termination/ ferruling of solar array 1Cx6sqmm cable including related conduit works. (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	104,432.45	1,044,324		EDN
4	<b>I&amp;C:</b> Laying and termination of 1Cx400sqmm DC power cable from SCB to PCU through covered cable trays (For SCB to PCU cabling).Also laying of Hume pipes with road concreting and preparation of bund after laying. (On the pathway array, at the entrance of embankment to Hume pipes, at the exit of Hume pipes and at the input side of PCU at inverter platform.) (1 AU= 2.5MWAC Block consisting of approx. 10920 SPV modules)	10	AU	31,911.16	319,112		EDN
5	<b>I&amp;C:</b> Earthing of 3030 nos of modules and 2.5 nos of SCBs using combination of earthing cables of adequate size and earthing strips. SCB-SPD earthing cables shall be connected to array earthing grid. (1 AU= 1 earth pit)	36	AU	118,861.08	4,278,999		Nodal
6	<b>I&amp;C:</b> Installation of 20 Nos of ESE type LA on separate floating platform and 1 No on main control room. LAs on pond shall be placed as per tentative layout. The earth pits for LA shall be suitably placed on the ground near embankment. 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 21 LAs)	1	AU	891,831.45	891,831		Nodal
7	<b>I&amp;C:</b> 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= 2.5MWAC Block)	10	AU	638,223.12	6,382,231		EDN
8	<b>I&amp;C:</b> Erection of 33kV transformer yard - Erection of 5.3MVA inverter transformers, cable trays, drain pipes and stone jelly spreading. (1 AU= 5MWAC Block)	5	AU	1,276,446.24	6,382,231		EDN
9	<b>I&amp;C:</b> Erection of 33kV HT power cables from transformer to HT panels and to Local pooling stations (1 AU= 25MWAC Block)	1	AU	638,223.12	638,223		EDN

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal
10	<p><b>I&amp;C:</b> Laying of 33kV HT power cables from Local pooling stations to 33kV evacuation point. Also laying of SCADA communication (OFC) cable from plant CMCS to switch yard panel room. Conducting of detailed route survey is in Vendor scope. Based on the route study, Cables shall be laid suitably (underground in trenches and over cable trays with required steel structural supports (Corrosion resistance treated) and Civil foundations and Steel reinforcements while crossing the Canal and bridge section of the route.). Some of the reference photos are attached for vendor reference.</p> <p>3 trefoils of HT cables laid from the PV plant shall be terminated on the 2 or 4 pole structures and further laid through available trenches and terminated at Panels in nearby panel room of customer. (1AU = laying of 1 KM)</p>	4.2	AU	360,899.98	1,515,780		EDN
11	<p><b>I&amp;C:</b> Erection of Auxiliary transformers, ACDB, UPS/ battery bank, SCADA panels etc. in EER (Electrical Equipment Room) near to the inverter platform, including grouting of panels, Supply and fixing of cable trays, routing/terminations of cables. (1 AU= 5MWAC Block)</p>	5	AU	79,777.89	398,889		EDN
12	<p><b>I&amp;C:</b> Installation and commissioning of SCADA and telemetry system by integrating the data cables from all the electrical and weather monitoring system equipment (WMS) of the power plant at the data logger/ PLC panel / HMI computer control desk at CMCS, Metering end at termination point etc (1 AU= for 25MWAC Block).</p>	1	AU	438,778.40	438,778		EDN
13	<p><b>I&amp;C:</b> Earthing system for Inverter platforms (including CMCS and EERs) 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 5MWAC Block)</p>	5	AU	223,378.09	1,116,890		Nodal
14	<p><b>I&amp;C:</b> Preparation of foundation and installation of 33KV switchyard CT, PT, isolator with earth switch, LA, ABT meter etc. (1 AU= for 1 feeder)</p>	3	AU	132,963.15	398,889		
15	<p><b>I&amp;C:</b> 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)</p>	20	AU	63,822.00	1,276,440		Nodal
16	<p><b>I&amp;C:</b> Emergency lighting system including cable laying, cable terminations at CMCS. (1 AU= for 1 LED fixture)</p>	4	AU	63,822.31	255,289		Nodal
17	<p><b>I&amp;C:</b> 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 25MWAC Block)</p>	1	AU	877,556.79	877,557		Nodal

SL NO	DESCRIPTION OF THE WORK (With Unit of Measurement)	Qty	Unit	Unit Rate-Rs (Excluding GST)	Total Amount (INR)	% GST	Item billed to EDN/Nodal		
18	<b>I&amp;C:</b> 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 25MWAC Block)	1	AU	1,914,669.36	1,914,669		Nodal		
19	<b>I&amp;C:</b> Installation of Water supply system for CMCS. (1 AU= for 25MWAC Block)	1	AU	797,778.90	797,779		Nodal		
20	SPV module washing (1AU=25 MW Block module wash once per month)	3	AU	106,370.00	319,110		Nodal		
21	Deputation of Safety supervisor for duration of I&C ( 1 AU = 1 Month )	6	AU	30,315.00	181,890		Nodal		
22	Provision of emergency vehicle/Ambulance on standby for duration of I&C ( 1 AU = 1 Month )	6	AU	38,293.00	229,758		Nodal		
<b>Total I&amp;C Works</b>					<b>66,309,105</b>				
<b>TOTAL AMOUNT for (Supply + I&amp;C works) excluding GST</b>					<b>117,500,000</b>				
<b>TOTAL AMOUNT (Excl.GST) in (INR) = Eleven Crore seventy five lakh rupees only</b>									
QUOTE PERCENTAGE (%) ABOVE/Below (+/-) (OR) AT PAR TO TOTAL AMOUNT									
QUOTED PERCENTAGE (%) IN WORDS ABOVE/Below (OR) AT PAR TO TOTAL AMOUNT									
<b>GST (As applicable) To be mandatorily indicated</b>									
<b>NOTE:</b>		1.CONTRACTOR SHOULD QUOTE PERCENTAGE (%) ABOVE/Below (OR) AT PAR TO TOTAL AMOUNT 2. QUOTED PERCENTAGE (%) IS APPLICABLE ON ALL ITEM RATES UNIFORMLY.							