

REQUEST FOR QUOTATION



BHARAT HEAVY ELECTRICALS LIMITED
Electronics Division
PB No. 2606, Mysore Road Bangalore - 560026
INDIA

RFQ NUMBER:
ANKBOS0014

RFQ DATE :
06.DEC.2017

Due Date
27.DEC.2017
Time: 13:00 HRS

VENUE :
NEW ENGG. BLDG

PURCHASE FILE COPY

(for all correspondence)
Purchase Executive : Ankita Reja
Phone : 26989637
Fax :
E-mail: ankitareja@bheledn.co.in

Offers shall be submitted through our e-procurement portal <https://bheleps.buyjunction.in>

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	PS0679074511 Supply of BOS items for 6.34MWp SPV plan as per spec PS-439-1176	1	ST	1	
2	PS0679074520 Installation and commissioning of 6.34MW as per spec PS-439-1176	1	AU	1	
3	PS0679074538 Operation & Maintenance of 6.34MWp SPV p Installation and commissioning support as per BHEL spec PS-439-1176.	20	AU	20	

Total Number of Items - 3

Please note that the tender will be opened in the presence of the bidders or his authorised representatives (maximum two per organisation) who choose to be present with authorisation letters. Refer annexure for the terms and conditions.

Please specify Terms of delivery, Excise duty, sales tax, Ex-BHEL, Ex-works surcharge, Insurance,P&F, Freight and other taxes very clearly .
For evaluation,exchange rate(TT selling rate of SBI) as on scheduled date of tender opening (Part-I bid incase of two part bid) shall be considered.
The offers of the bidders who are on the banned list as also the offer of the bidders, who engage the services of the banned firms, shall be rejected.The list of banned firms is available on BHEL web site www.bhel.com

- i). This is only RFQ not an order.
- ii). In all correspondence quote RFQ No. & due date.
- iii). In Quotation BHEL material code / RFQ Sl. No. should be mentioned clearly.
- v). Quotation should remain valid for a minimum period of 90 days from due date.
- vi). In case of non-receipt of Quotation or regret letter for 3 consecutive RFQs you are liable to be removed from our vendors list.
- vii). All Prices should be written in words and numbers.
- viii). Excise Chapter Heading should be mentioned for all items where VAT is applicable .

For and On behalf of BHEL.

SPECIAL COMMERCIAL CONDITIONS OF CONTRACT (SCC) - for foreign vendors				
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017				
Sl. No.	Terms	BHEL Term	Confirmation	Deviation/Remarks
1	Pre-Qualification Criteria (PQC)	(A) Vendor should have executed at least one contract of indoor/outdoor electrical installation of 33KV minimum in power plants or sub-stations in India with scope including both supply and erection for total value, not less than Rs. 1.5 Crores within last 3 years from date of tender opening. As evidence for this, vendor shall submit (a) certification from clients for completion of supply and erection (b) copies of purchase orders from the clients.	Complied	
		(B) Vendor should have achieved annual average financial turnover of Rs. 5 Crores in last three financial years (2014-15, 15-16 and 16-17). Vendor shall submit the audited balance sheets for all the 3 years. In case, for FY 2016-17, audited balance sheet is not available, unaudited balance sheet is acceptable.	Complied	
2	Bidding	(a) Bid has to be submitted as Two Part – Techno Commercial Bid (Part-1) & Price Bid (Part-II). Bids shall be submitted through e-Procurement portal https://bheleps.buyjunction.in of M/s. Mjunction Services Limited.	Complied	
		(b) SCC & Annexure A1 to be submitted along with technical bid (Part-I) & Annexure A2 to be submitted along with Price bid (Part-II).	Complied	
		(c) Clause-wise compliance to BHEL Purchase specification along with all documents as called in Technical specification to be submitted along with technical bid(Part-1).	Complied	
3	Price basis:	Firm i.e., from the date of PO to completion of supply if I&C is not applicable. If I&C is in supplier's scope, then the prices shall remain firm till commissioning & handing-over of the complete system. (PVC clause not acceptable).	Complied	
4	Terms of Delivery:	Clf Seaport/ Clf Airport/ FCA Airport (Indicate name of Seaport/Airport)	Complied	
5	Delivery Period:	(a) Supply : 6 (Six) weeks from the date of Drawing approval. GTP/Drawing Submission : 1 (One) week from the date of Purchase Order.	Acceptable / Not acceptable	
		(b) I&C support : 2(Two) weeks after receipt of material at site.	Acceptable / Not acceptable	
		(c) O&M : 5 years commencing from commissioning date.	Acceptable / Not acceptable	
6	Payment Term:	(a) Supply : 1) 80% of the basic value (excluding I&C charges) will be paid with 45 days credit, against Sight draft, from the date of AWB/BOL on submission of complete set of documents as in PO. 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any). 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank. (b) I&C : 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis. (c) O&M : 100% O&M charges shall be done in quarterly basis against report certified by BHEL. Note : In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.	Acceptable / Not acceptable	
		(b) For any deviation in payment term, the offer will be liable for loading as per Clause G of ITB.	Acceptable / Not acceptable	
7	Evaluation of L1 vendor	Over all L1 of the entire package including Supply + I&C + O&M on "FOR" basis to site will only be considered.	Complied	
8	Warranty :	Warranty for Supply : 18 months from supply or 12 months from I&C, whichever is earlier.	Acceptable / Not acceptable	
9	Pre Shipment Inspection	(a) Pre Shipment Inspection will be carried out by BHEL/Customer for which test report shall be sent one week in advance.	Acceptable / Not acceptable	
		(b) Pre Shipment Inspection charges , if any, shall be considered while evaluating your offer to arrive at "Total Cost to BHEL".The charges for the same shall be informed to you before Price Bid Opening/Reverse Auction.	Acceptable / Not acceptable	
10	Penalty	(a) Supply : Penalty of 0.5% per week at the basic price of the good for undelivered quantity of supply portion, subject to a maximum of 10%. For Supply, Pre Shipment Inspection Call Letter Date (Receipt of test report) will be treated as delivery for purpose of penalty.	Acceptable / Not acceptable	
		(b) For any deviation in penalty term, the offer will be liable for loading as per Clause No. G, Point No.(b) of ITB.	Acceptable / Not acceptable	
11	PBG	PBG shall be furnished in the BHEL, prescribed format.	Acceptable / Not acceptable	
12	Validity:	Quotation should remain valid for a period of 90 days from the due date.	Acceptable / Not acceptable	
13	Bank charges (If applicable):	(a) All Bank charges to seller's account	Acceptable / Not acceptable	
		(b) Deviation will be liable for loading as per CLG of ITB	Acceptable / Not acceptable	
14	Reverse Auction:	BHEL reserves the right to conduct Reverse auction.Procedure for the same will be informed by BHEL .	Acceptable / Not acceptable	
15	DUN No.	Please mention Dun & Bradstreet No.(DUN No.)		
16	Consignment Details	Weight and Dimension of consignment with packing.	Furnished / To be furnished	
17	Despatch Documents:	Despatch documents include Air Waybill/Bill of Lading, Invoice, Packing list, PSI letter copy and Warranty certificate.	Acceptable / Not acceptable	
		One copy of Invoice, Packing list and Air Way Bill /Bill of Lading shall be faxed/emailed immediately after despatch. Also one copy of packing list to be kept inside each box for easy identification of material at site.		
18	Other terms & conditions	For any other Terms and Conditions, kindly refer to the following: A: ITB (document ref :SCPV: BOS: ITB - Rev 02) B: GCC (document ref: SCPV: BOS: GCC - Rev 02)	Acceptable / Not acceptable	
19	Documents Submission	All the documents pertaining to I&C & O&M as per Annexure-C to be submitted.	Enclosed/Not Enclosed	
20	BOS %	The percentage of Supply, I&C and O&M values shall be in the range indicated below(approximately,with overall tallying to 100%) : (a) Supply : 40-46% (b) I&C :27-33% (c) O&M :22-28%	Complied	

Annexure-A1

TECHNICAL BID ENCLOSURE FOR COMPLIANCE OF QUOTE : UNPRICED BID (Foreign Vendors)							
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017							
Sl No.	Material Code	DESCRIPTION	Quantity	Unit	Quoted	HSN/SAC CODES	Currency
1	PS0679074511	Supply of BOS items for 6.34MWp SPV plant	1	ST	YES/NO		
2	PS0679074520	Installation and Commissioning of 6.34MWp SPV plant	1	AU	YES/NO		
3	PS0679074538	Operation and Maintenance of 6.34MWp SPV plant	20	AU	YES/NO		

Note:

The above format is to be used for Unpriced bid.

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ANNEXURE A2

PRICE BID (Foreign Vendors)							
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017							
Sl No.	Material Code	DESCRIPTION	Quantity	Unit	UNIT RATE	Total value (Rate X Quantity)	Currency
1	PS0679074511	Supply of BOS items for 6.34MWp SPV plant	1	ST			
2	PS0679074520	Installation and Commissioning of 6.34MWp SPV plant	1	AU			
3	PS0679074538	Operation and Maintenance of 6.34MWp SPV plant	20	AU			

Note:

The above format is to be used for Priced bid.

AUTHORISED SIGNATORY WITH SEAL

SPECIAL COMMERCIAL CONDITIONS OF CONTRACT (SCC) - for indigenous vendors				
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017				
SI No.	Terms	BHEL Term	Confirmation	Deviation / Remarks
1	Pre-Qualification Criteria (PQC)	(A) Vendor should have executed at least one contract of indoor/outdoor electrical installation of 33KV minimum in power plants or sub-stations in India with scope including both supply and erection for total value, not less than Rs. 1.5 Crores within last 3 years from date of tender opening. As evidence for this, vendor shall submit (a) certification from clients for completion of supply and erection (b) copies of purchase orders from the clients.	Complied	
		(B) Vendor should have achieved annual average financial turnover of Rs. 5 Crores in last three financial years (2014-15, 15-16 and 16-17). Vendor shall submit the audited balance sheets for all the 3 years. In case, for FY 2016-17, audited balance sheet is not available, unaudited balance sheet is acceptable.	Complied	
2	Bidding	(a) Bid has to be submitted as Two Part – Techno Commercial Bid (Part-1) & Price Bid (Part-II). Bids shall be submitted through e-Procurement portal https://bheleps.buyjunction.in of M/s. Mjunction Services Limited.	Complied	
		(b) SCC & Annexure B1 to be submitted along with Technical bid (Part-I) & Annexure B2 to be submitted along with Price bid (Part-II).	Complied	
		(c) Clause-wise compliance to BHEL Purchase specification along with all documents as called in Technical specification to be submitted along with technical bid(Part-1).	Complied	
3	Price Basis	Firm i.e., from the date of PO to completion of supply if I&C is not applicable. If I&C is in supplier's scope, then the prices shall remain firm till commissioning & handing-over of the complete system.(PVC clause not acceptable).	Complied	
4	Terms of Delivery	Free On Road Basis to Project site : 5.04MW(AC) HPPCL SPV Project, Berra Dol, Bilaspur District, HP.	Complied	
5	Delivery Period	(a) Supply : 6 (Six) weeks from the date of Drawing approval. GTP/Drawing Submission : 1 (One) week from the date of Purchase Order.	Acceptable / Not acceptable	
		(b) I&C suport : 2(Two) weeks after receipt of material at site.	Acceptable / Not acceptable	
		(c) O&M : 5 years commencing from commissioning date.	Acceptable / Not acceptable	
6	Payment Term	(a) Supply : 1) 80% of basic Supply value + 100% of taxes, duties and freight charges will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later. 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any). 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank. (b) I&C/Supervision : 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis. (c) O&M : 100% O&M charges shall be done in quarterly basis against report certified by BHEL. Note : In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.	Acceptable / Not acceptable	
		(b) For any deviation in payment term, the offer will be liable for loading as per Clause G of ITB.	Acceptable / Not acceptable	
7	GST	(a) Kindly provide the tax structure (CGST, SGST, IGST) with current rate applicable.	CGST:% SGST:% IGST:%	
		(b) Kindly furnish your GST No.	GST no.....	
8	Evaluation of L1 vendor	Over all L1 of the entire package including Supply + I&C + O&M on "FOR" basis to site will only be considered.	Complied	
9	Warranty	Warranty for Supply : 18 months from supply or 12 months from I&C, whichever is earlier.	Acceptable / Not acceptable	

10	Pre Shipment Inspection	(a) Pre Shipment Inspection will be carried out by BHEL/Customer for which test report shall be sent atleast one week in advance.	Acceptable / Not acceptable	
		(b) Pre Shipment Inspection charges , if any, shall be considered while evaluating your offer to arrive at "Total Cost to BHEL".The charges for the same shall be informed to you before Price Bid Opening/Reverse Auction.	Acceptable / Not acceptable	
11	Penalty	(a) Supply: Penalty of 0.5% per week at the basic price of the good for undelivered quantity of supply portion, subject to a maximum of 10%. For Supply, Pre Shipment Inspection Call Letter Date (Receipt of test report) will be treated as delivery for purpose of penalty.	Acceptable / Not acceptable	
		(b) For any deviation in penalty term, the offer will be liable for loading as per Clause No. G, Point No.(b) of ITB.	Acceptable / Not acceptable	
12	Road Permit	Road permit if applicable will be given by BHEL before Dispatch of ordered Items.However, vendor shall give request for road permit 24 hours in advance.	Complied	
13	PBG	PBG shall be furnished in the BHEL prescribed format.	Acceptable / Not acceptable	
14	Despatch Documents	Complete set of despatch documents in 3 sets shall be forwarded to BHEL directly. Despatch documents include Invoice, Lorry receipt (L/R), Packing list, PSI letter Copy, Proof of delivery such as MRC (Material Receipt Certificate)/ original acknowledged LR, Insurance intimation letter and Warranty certificate. One set of Invoice, Packing list and L/R shall be emailed immediately after despatch to BHEL-EDN, Bangalore.	Complied	
15	Reverse Auction	BHEL reserves the right to conduct Reverse auction.Procedure for the same will be informed by BHEL .	Acceptable / Not acceptable	
16	Other terms & conditions	For any other Terms and Conditions, kindly refer to the following: A: ITB (document ref :SCPV: BOS: ITB - Rev 02) B: GCC (document ref: SCPV: BOS: GCC - Rev 02)	Acceptable / Not acceptable	
17	Validity	Quotation should remain valid for a period of 90 days from the due date.	Acceptable / Not acceptable	
18	Shipment	Kindly indicate the state from where the shipment will take place.	State/Place	
19	Documents Submission	All the documents pertaining to I&C & O&M as per Annexure-C to be submitted.	Enclosed/Not Enclosed	
20	BOS %	The percentage of Supply, I&C and O&M values shall be in the range indicated below(approximately,with overall tallying to 100%) : (a) Supply : 40-46% (b) I&C :27-33% (c) O&M :22-28%	Complied	

AUTHORISED SIGNATORY WITH SEAL

TECHNICAL BID ENCLOSURE FOR COMPLIANCE OF QUOTE : UNPRICED BID (Indigenous Vendors)								
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017								
Sl No.	Material Code	DESCRIPTION	QUOTED	QTY	UNIT	HSN/SAC CODES	BREAK UP OF TAX STRUCTURE (CGST/SGST/IGST etc) WITH CURRENT RATES	Remarks
1	PS0679074511	Supply of BOS items for 6.34MWp SPV plant	YES/NO	1	ST			Taxes Extra
2	PS0679074520	Installation and Commissioning of 6.34MWp SPV plant	YES/NO	1	AU			Taxes Extra
3	PS0679074538	Operation and Maintenance of 6.34MWp SPV plant	YES/NO	20	AU			Taxes Extra
4	**Freight Charge including GST on Freight Charges		YES/NO	Lumpsum				**Freight Charges: NIL/Extra

Note:

1. The quoted prices shall be on "FOR" basis to project site.
2. Please indicate taxes clearly applicable as on date.
3. The above format only shall be used for compliance.No changes are acceptable.
4. Taxes will be considered extra. Please quote only the basic rates for Sl No. 1-3.
5. **Indicate whether freight charges are NIL or will be charged extra.In absence of clarity, freight charges shall be considered free of cost from vendor.(If the offer contains the freight value at actuals, it will be considered as free of cost).
6. Insurance will be in BHEL scope.
7. SUCCESSFUL VENDOR SHALL SUBMIT THE BILLING BREAK UP FOR SUPPLY & I&C FOR APPROVAL AND IMPLEMENTATION.

PRICED BID (Indigenous Vendors)								
RFQ No. ANKBOS0014 Dtd.06.12.2017 Due Date (Tech Bid): 27.12.2017								
Sl No.	Material Code	DESCRIPTION	QTY	UNIT	Unit Rate (Rs.)	Total Value (Rs.) (Rate X Qty)	BREAK UP OF TAX STRUCTURE (CGST/SGST/IGST etc) WITH CURRENT RATES	Remarks
1	PS0679074511	Supply of BOS items for 6.34MWp SPV plant	1	ST				Taxes Extra
	Unit rate in words :							
2	PS0679074520	Installation and Commissioning of 6.34MWp SPV plant	1	AU				Taxes Extra
	Unit rate in words :							
3	PS0679074538	Operation and Maintenance of 6.34MWp SPV plant	20	AU				Taxes Extra
	Unit rate in words :							
4	**Freight Charge including GST on Freight Charges		Lumpsum					**Freight Charges: NIL/Extra
	Freight charge in words :							

Note:

1. The quoted prices shall be on "FOR" basis to project site.
2. Please indicate taxes clearly applicable as on date.
3. The above format only shall be used for compliance.No changes are acceptable.
4. Taxes will be considered extra. Please quote only the basic rates for Sl No. 1-3.
5. **Indicate whether freight charges are NIL or will be charged extra.In absence of clarity, freight charges shall be considered free of cost from vendor.(If the offer contains the freight value at actuals, it will be considered as free of cost).
6. Insurance will be in BHEL scope.
7. SUCCESSFUL VENDOR SHALL SUBMIT THE BILLING BREAK UP FOR SUPPLY & I&C FOR APPROVAL AND IMPLEMENTATION.

List of Documents to be submitted by Vendors/Subcontractors for SPV Contracts.		Confirmation on submission	Deviation / Remarks
IR Documents (Type - A): For all Civil & I&C & O&M			
Sl No.	Documents		
1	Wage Sheet (Form 17)	YES / NO	
2	Attendance Register (w.r.t Sl No.1)	YES / NO	
3	Workman Policy & Additional Insurance (Automotive Liability, Group Servis Insuarncce Policy et	YES / NO	
4	PF Challan	YES / NO	
5	ESI (Employee State Insurance)	YES / NO	
6	ECR (Electronic Challan Receipt)	YES / NO	
7	Bank Statement for PF deposit	YES / NO	
8	RCS (Remittance Confirmation Slip)	YES / NO	
Quality Documents (Type - B): For all MMS Civil Works			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	NA	
2	Field Content, Slump Test	NA	
3	Gradation of Aggregate (10mm, 20mm)	NA	
4	Fine Aggregate Test (for Sand)	NA	
5	Cube Test Registered	NA	
6	Material Test Certificate for Steel & Cement	NA	
7	Consumption Register for Steel & Invoice	NA	
8	Pour Card for Concreting purpose	NA	
9	Royalty Reports (10mm, 20mm, Sand)	NA	
10	Sand Soundess Test Reports	NA	
11	Slump Test Register	NA	
12	Sieve Analysis, Flakiness Index, Elongation Index - Register to be maintained	NA	
13	Moisture Content Coarse and Fine Aggregate - Register to be maintained	NA	
14	Water Test Report for Concrete	NA	
15	Design Mix Report for Concrete	NA	
Quality Documents (Type - B): For all Civil related Works			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	YES / NO	
2	Field Content, Slump Test	YES / NO	
3	Gradation of Aggregate (10mm, 20mm)	YES / NO	
4	Fine Aggregate Test (for Sand)	YES / NO	
5	Cube Test Registered	YES / NO	
6	Material Test Certificate for Steel & Cement	YES / NO	
7	Consumption Register for Steel & Invoice	YES / NO	
8	Pour Card for Concreting purpose	YES / NO	
9	Royalty Reports (10mm, 20mm, Sand)	YES / NO	
10	Sand Soundess Test Reports	YES / NO	
11	Warpage of Bricks Test Reports	YES / NO	
12	Core Cutting (Compaction Test) - Roads & Pathways	YES / NO	
13	Slump Test Register	YES / NO	
14	Sieve Analysis, Flakiness Index, Elongation Index - Register to be maintained	YES / NO	
15	Moisture Content Coarse and Fine Aggregate - Register to be maintained*	YES / NO	
16	Brick Test Reports	YES / NO	
17	Plastering profile and thickness	YES / NO	
18	Compaction test beneath floor of all buildings. - Reports	YES / NO	
19	Test Certificates for Paint, Glan, Glazing, etc.	YES / NO	
20	Test Certificates Aluminium Section for doors and windows (Anodisation Certificates also)	YES / NO	
21	BBS for Buildings	YES / NO	
22	Water Test Report for Concrete	YES / NO	
23	Design Mix Report for Concrete	YES / NO	
Quality Documents: for Electrical & Mechanical Installation Works (BOS)			
Sl No.	Documents		
1	FQA (Field Quality Assuarance)	YES / NO	
2	Inspection Reports	YES / NO	
3	Guarantee Certificates	YES / NO	
4	Factory Acceptance Test Reports	YES / NO	
5	Commissioning Reports	YES / NO	

NOTE:

* This list of documents is indicative and intended towards all Solar Projects.

* Apart from the above, any other document required by the Customer and which are mandatory for Billing by BHEL to the Customer, the same needs to be provided by the respective vendors.



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भारत हेवी इलेक्ट्रिकल्स लिमिटेड

Bharat Heavy Electricals Ltd.,
(A Government of India undertaking)
Electronics Division

PB 2606 , Mysore Road Bangalore , 560026 INDIA

SCPV: BOS: ITB - Rev 02

INSTRUCTIONS TO BIDDERS (ITB)

Bidders are requested to read the instructions carefully and submit their quotations covering all the points:

A. GENERAL INSTRUCTIONS:

1. Any Purchase Order resulting from this enquiry shall be governed by the Instructions to Bidders (document reference: SCPV: BOS: ITB – Rev 01), General Conditions of Contract (document reference: SCPV: BOS: GCC - Rev 01) and Special Conditions of Contract (document reference: SCPV: BOS: SCC: I - Rev 01/ SCPV: BOS: SCC: F - Rev 01), if any, of the enquiry.
2. Any deviations from or additions to the “General Conditions of Contract” or “Special Conditions of Contract” require BHEL’s express written consent. The general terms of business or sale of the bidder shall not apply to this tender.
3. Bidders (also includes the term suppliers / contractors wherever used in this document) are instructed to quote their most competitive price and best delivery, etc. in the offer. Prices should be indicated in both figures & words. **(Please also refer clause 11 under section B)**
4. Regret letter (either through post or by mail) indicating reasons for not quoting must be submitted without fail, in case of non-participation in this tender. If a bidder fails to respond against 3 consecutive tenders for the same item, he will be liable for removal as a registered vendor of BHEL.
5. Procurement directly from the manufacturers shall be preferred. However, if the OEM / Principal insist on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacturer / supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer / supplier or the manufacturer / supplier could bid directly but not both. In case bids are received from the manufacturer / supplier and his agent, bid received from the agent shall be ignored.
6. Consultant / firm (and any of its affiliates) shall not be eligible to participate in the tender/s for the related goods for the same project if they were engaged for consultancy services for the same project.
7. If an Indian representative / associate / liaison office quotes on behalf of a foreign based bidder, such representative shall furnish compulsorily the following documents:
 - a. Authorization letter to quote and negotiate on behalf of such foreign-based bidder.
 - b. Undertaking from such foreign based bidder that such contract will be honored and executed according to agreed scope of supply and commercial terms and conditions.
 - c. Undertaking shall be furnished by the Indian representative stating that the co-ordination and smooth execution of the contract and settlement of shortages / damages / replacement / repair of imported scope till system is commissioned and handed over to customer will be the sole responsibility of the Indian representative / associates / agent / liaison office.
8. In case of imported scope of supply, customs clearance & customs duty payment will be to BHEL account after the consignment is received at Indian Airport / Seaport. Bidders must provide all original documents required for completing the customs clearance along with the shipment. Warehousing charges due to incomplete or missing documentation will be recovered from the supplier’s bill. All offers for imported scope of supply must be made from any of the gateway ports (within the country) indicated. **(Refer Annexure I)**
9. The offers of the bidders who are on the banned list and also the offers of the bidders, who engage the services of the banned firms, shall be rejected. The list of the banned firms is available on BHEL website: **www.bhel.com**.

10. Business dealings with bidders will be suspended if they are found to have indulged in any malpractices / misconduct which are contrary to business ethics like bribery, corruption, fraud, pilferage, cartel formation, submission of fake/false/forged documents, poor quality, certificates, information to BHEL or if they tamper with tendering procedure affecting the ordering process or fail to execute a contract, or rejection of 3 consecutive supplies or if their firms / works are under strike / lockout for a long period.

B. GUIDELINES FOR PREPARATION OF OFFER:

1. Quotation shall be submitted in Single Part Bid, Two Part Bid or Three Part Bid, as called for in the tender:
 - **SINGLE PART BID:** Technical and Commercial Bid with prices along with price summary & filled in BHEL Standard Commercial terms and conditions in a single sealed envelope.
 - **TWO PART BID:** Unpriced offer i.e. "Techno-commercial Bid" with filled in BHEL Standard Commercial terms and conditions in a sealed envelope **along with the copy of the "Price Bid" without the prices** should be enclosed in one cover and the cover must be super scribed "**Techno-commercial offer** and Priced offer i.e. "Price Bid" containing price summary in a separate sealed envelope and must be super scribed "**Price Bid**". Both these envelopes shall be enclosed in a single sealed envelope super scribed with enquiry number, due date of tender and any other details as called for in the tender document.
 - **THREE PART BID:** Pre-qualification Bid (Part-I), Techno Commercial Bid with filled in BHEL Standard Commercial terms and conditions (Part-II), and Price Bid (Part-III). All three envelopes shall be enclosed in a single sealed envelope super scribed with enquiry number due date of tender and any other details as called for in the tender document.

If any of the offers (Part I, Part II or Part III) are not submitted before the due date and time of submission at the venue/place specified or if any part of the offer is incomplete the entire offer of the bidder is liable for rejection.

2. Supplier shall ensure to super scribe each envelope with RFQ number, RFQ Date, RFQ Due date and time, Item Description and Project clearly & boldly. Also mention on the envelope whether it is "Techno Commercial Bid" or "Price Bid" or "Pre-Qualification Bid". Please ensure complete address, department name and purchase executive name is mentioned on the envelope (before dropping in the tender box or handing over) so that the tender is available in time for bid opening.
3. BHEL standard Commercial Terms and Conditions shall be duly filled, signed & stamped and must accompany Technical-Commercial offer without fail and should be submitted in original only. Photocopy will not be accepted. All documents submitted along with the offer shall be signed and stamped in each page by authorized representative of the bidder.
4. Any of the terms and conditions not acceptable to supplier, shall be explicitly mentioned in the Techno-Commercial Bid. If no deviations are brought out in the offer it will be treated as if all terms and conditions of this enquiry are accepted by the supplier without any deviation.
5. Deviation to this specification / item description, if any, shall be brought out clearly indicating "DEVIATION TO BHEL SPECIFICATION" without fail, as a part of Techno-Commercial Bid. If no deviations are brought out in the offer it will be treated as if the entire specification of this enquiry is accepted without deviation.
6. Suppliers shall submit one set of original catalogue, datasheets, bill of materials, dimensional drawings, mounting details and / or any other relevant documents called in purchase specification as part of Technical Bid.
7. "Price Bid" shall be complete in all respects containing price break-up of all components along with all applicable taxes and duties, packing & forwarding charges (if applicable), freight charges (if applicable) etc. Once submitted no modification / addition / deletion will be allowed in the "Price Bid." Bidders are advised to thoroughly check the unit price, total price to avoid any discrepancy.
8. In addition, bidder shall also quote for erection & commissioning charges (I&C charges), documentation charges, service charges, testing charges (type & routine), training charges, service tax, etc. wherever applicable. The price summary must indicate all the elements clearly.
9. Vendors should indicate "lump sum" charges (including To & Fro Fare, Boarding, Lodging, Local Conveyance etc.) for Supervision of Erection, Commissioning and handing over to customer. The quotation shall clearly indicate scope of work, likely duration of commissioning, pre-commissioning checklist and service tax (if any).
10. Wherever bidders require PAC (Project Authority Certificate) for import of raw materials, components required for Mega

Power Projects, Export Projects, MNRE Concession or other similar projects wherein supplies are eligible for customs duty /Excise duty benefits, lists and quantities of such items and their values (CIF) has to be mentioned in the offer. Prices must be quoted taking into account of such benefits.

11. All quotations shall be free from corrections /overwriting. Corrections if any should be authenticated with signature and seal. Any typographical error, totalling mistakes, currency mistake, multiplication mistake, summing mistakes etc. observed in the price bids will be evaluated as per **Annexure VI** "Guidelines for dealing with Discrepancy in Words & Figures – quoted in price bid". BHEL decision will be final.

C. GUIDELINES FOR OFFER SUBMISSION:

1. Offers / Quotations must be dropped in tender box before 13.00 Hrs. on or before due date mentioned in RFQ. The offers are to be dropped in the proper slot of the Tender Box kept in our reception area with caption "CE, SC&PV, DEFENCE." Tenders are opened on 3 days in a week (Monday/Wednesday/Friday). Tender must be deposited in the slot corresponding to the day (Monday - Box no.4/Wednesday - Box no. 6 /Friday - Box no.8) while depositing the offer. **(This clause will not be applicable for e-tenders).**
2. E-Mail / Internet / EDI offers received in time shall be considered only when such offers are complete in all respects. In case of offers received through E-mail, please send the offer to the email IDs within time of submission of tender.
3. In cases where tender documents are bulky, or due to some reasons tender documents are required to be submitted by hand or through posts/couriers, the offers are to be handed over to purchase officers.
4. Tenders will be opened on due date, time and venue as indicated in the RFQ in the presence of bidders at the venue indicated in the RFQ. In case of e-procurement, bidders can see tender results till seven days after due date and time.
5. Vendor will be solely responsible:
 - a. For submission of offers before due date and time. Offers submitted after due date and time will be treated as "Late offers" and will be rejected.
 - b. For submission of offers in the correct compartment of the tender box based on the day of due date (Monday/Wednesday/Friday). Please check before dropping your offer in the correct tender box.
 - c. For depositing offers in proper sealed condition in the tender box. If the bidder drops the tender in the wrong tender box or if the tender document is handed over to the wrong person BHEL will not be responsible for any such delays.
 - d. For offers received through email/courier etc., suppliers are fully responsible for lack of secrecy on information and ensuring timely receipt of such offers in the tender box before due date & time.
 - e. In case of e-tender, all required documents should be uploaded before due date and time. Availability of power, internet connections, etc. will be the sole responsibility of the vendor. Wherever assistance is needed for submission of e-tenders, help line numbers and executives of service provider of BHEL may be contacted.
Service provider: M-junction
Website address: <https://bheleps.buyjunction.in/>
Helpline no.: 033-66106426/6217/6013/6046/6176 (9:30 am to 5:30 pm)
9163348283/9163348284/9163348285/9163348286/8584008116 (5:30 pm to 8:30 pm)

Purchase Executive / BHEL will not be responsible for any of the activities relating to submission of offer.

D. PROCESSING OFFERS RECEIVED:

1. Any discount / revised offer submitted by the supplier on its own shall be accepted provided it is received on or before the due date and time of offer submission (i.e. Part-I bid). The discount shall be applied on pro-rata basis to all items unless specified otherwise by the bidder.
2. Changes in offers or Revised offers given after Part-I bid opening shall not be considered as a part of the original offer unless such changes / revisions are requested by BHEL.
3. In case there is no change in the technical scope and / or specifications and / or commercial terms & conditions by BHEL, the supplier will not be allowed to change any of their bids after Technical bids are opened (after the due date and time of tender opening of Part-1 Bid).

4. In case of changes in scope and/ or technical specifications and/ or commercial terms & conditions by BHEL and it accounts for price implications from vendors, all techno-commercially acceptable bidders shall be asked by BHEL (after freezing the scope, technical specifications and commercial terms & conditions) to submit the impact of such changes on their price bid. Impact price will be applicable only for changes in technical specification / commercial conditions by BHEL. The impact price must be submitted on or before the cut-off date specified by BHEL and the original price bid and the price impact bid will be opened together at the time of price bid opening. Impact price means only for those items which have been impacted by addition / deletion / changes in the technical specifications or commercial conditions. The impact may be +/- incremental value of the currency in which originally quoted. The impact price bid to be submitted on the cut-off date, time & venue as specified by BHEL. The impact price bid shall be opened along with original price bid.
5. Un-opened bids (including price bids) will be returned to the respective bidders after release of PO and receipt of order acknowledgement from the successful bidder.
6. After receipt of Purchase Order, supplier should submit required documents like drawings, bill of materials, datasheets, catalogues, quality plan, test procedure, type test report , O & M Manuals and / or any other relevant documents as per Specification / Purchase Order, as and when required by BHEL / Customer.
7. Any deviation to the terms and conditions not mentioned in the quotation by supplier in response to this enquiry will not be considered, if put forth subsequently or after issue of Purchase Order, unless clarification is sought for by BHEL EDN and agreed upon in the Purchase Order.
8. Evaluation shall be on the basis of delivered cost (i.e. "Total Cost to BHEL"). As per RFQ terms.
"Total Cost to BHEL" shall include total basic cost, packing & forwarding charges, taxes and duties, inspection charges, freight charges, test charges, insurance, service tax for services, any other cost indicated by vendor for execution of the contract and loading factors (for non-compliance to BHEL Standard Commercial Terms & Conditions). Benefits arising out of Nil Import Duty on Mega Projects, Physical Imports or such 100% exemptions & MNRE Exemptions (statutory benefits), customer reimbursements of statutory duties (like Excise Duty, CST, VAT) will also be taken into account at the time of tender evaluation. (Wherever applicable and as indicated in SCC document of tender)
9. For evaluation of offers in foreign currency, the exchange rate (TT selling rate of SBI) shall be taken as under:

Single part bids:	Date of tender opening
Two/three part bids:	Date of Part-I bid opening
Reverse Auction:	Date of Part-I bid opening

In case of Performance Bank Guarantee (PBG) also, exchange rate will be considered as mentioned above for converting foreign currency to Indian currency and vice versa.

If the relevant day happens to be a bank holiday, then the exchange rate as on the previous working day of the bank (SBI) shall be taken.
10. Ranking (L-1, L-2 etc.) shall be done only for the techno-commercially acceptable offers and on the basis or evaluation of Total Cost to BHEL.

E. INFORMATION ON PAYMENT TERMS:

1. All payments will be through Electronic Fund transfer (EFT). Vendor has to furnish necessary details as per BHEL standard format (**Refer Annexure IV**) for receiving all payments through NEFT. (Applicable for Indian vendors only)
2. Statutory deductions, if any, will be made and the deduction certificate shall be issued. In case vendor does not provide PAN details, the TDS deduction shall be at the maximum percentage stipulated as per the provisions of Income Tax Act. (Applicable for Indian vendors only). Foreign vendors shall submit relevant details of their bankers like Swift Code, Banker's Name & Address etc.
3. Vendors must submit bills & invoices along with required supporting documents in time. Incomplete documentation / delayed submission of invoice / documents will result in corresponding delay in payment.

F. STANDARD PAYMENT TERMS OF BHEL-EDN**Purchase Orders for indigenous procurement****(a) SUPPLY WITH I&C/SUPERVISION:****Supply:**

- 1) 80% of basic Supply value + 100% of taxes, duties and freight charges will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later.
- 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any).
- 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank.

I&C/Supervision: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis.

O&M: 100% O&M charges are payable as per RFQ terms against report certified by BHEL.

(b) SUPPLY ONLY:

- 1) 100% of Basic value with taxes, duties and freight will be paid with 45 days credit from the receipt of material at site or 15 days credit from the date of submission of complete set of documentation whichever is later)+ submission of PBG valid for Warranty Period+ 3 months Claim Period from BHEL Consortium Bank ,if applicable.

Purchase orders for import procurement:**(c) SUPPLY WITH I&C/SUPERVISION:****Supply:**

- 1) 80% of the basic value (excluding I&C charges) will be paid with 45 days credit, against Sight draft, from the date of AWB/BOL on submission of complete set of documents as in PO.
- 2) 10% of basic supply value will be paid on completion of I&C against submission of supplementary invoice along with proof of completion of I&C along with I&C charges (if any).
- 3) Balance 10% (retention money) against submission of supplementary invoice along with PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank.

I&C: 100% on completion of I&C/Supervision and certification line item wise on pro-rata basis.

(d) SUPPLY ONLY:

- 1) 100% of PO value will be paid against Sight draft with 45 days Credit from the date of dispatch or 15 days credit from the date of submission of complete set of documents whichever is later)+ submission of PBG valid for Warranty Period+3 months Claim Period from BHEL Consortium Bank ,if applicable.

Note for (a), (b), (c) and (d): In exceptional cases, if vendor fails to submit PBG after supplies, vendors can also accept for the final 10% payment, payable after the warranty period + 3 months of claim period against supplementary invoice subject to the completion of commissioning (if applicable) as PBG is linked to Warranty period.

G. LOADING FACTORS FOR PAYMENT TERMS & DELAYED DELIVERY:

Loading factors as detailed below will be added to the quoted price (basic) to evaluate the lowest quote for non-compliance of BHEL standard commercial term.

SI No	Deviation on	Nature of Deviation / Offered Terms	Loading %
1.	Payment Terms	For Purchase within India :-	
		1) Credit period less than 45 days	15
		* For Foreign Purchase :-	
		1) Payment through At Sight Letter of Credit	10
		2) Payment through Letter of Credit with usance credit of 45 days	5
		3) Sight Draft with credit period less than 45 days	5
2.	Penalty for Delayed Delivery	1) Non – Acceptance	10
		2) Partial Acceptance (X%)	(10 – X)

*** All bank charges shall be to seller's account. If bank charges of BHEL banker are to BHEL's account then additional loading of 2% on the quoted basic value is applicable.**

Offer/s with payment terms other than the standard payment terms indicated at Clause No. F or Deviated Payment Terms with loading indicated at Clause No. G above are liable for rejection.

NOTES:

- ADVANCE PAYMENT/LC: Quotations with "Advance payment/Inland LC" shall be rejected.
- Basic value of Purchase Order mentioned above will include all components of the purchase order and will exclude only taxes, duties, freight and I&C charges (wherever applicable).
- Wherever the Purchase Order is split into import portion and indigenous portion of supply the retention money will be 10% (as applicable) of both purchase order values put together.
- Non-Compliance of Warranty terms. Offers not complying with Warranty terms as per RFQ Terms is liable for rejection.
- SALE IN TRANSIT/ LOCAL VAT: Sale in transit under section 6(2) of CST is allowed if movement of goods is interstate. In case intra state movement of goods, benefit of sale in transit is not available.
- In case of intrastate movement i.e. supply within same state and VAT is applicable, the vendor shall furnish the respective BHEL's nodal agency TIN no. and address in their invoice. (Refer **Annexure IX**)

H. BANK GUARANTEE (BG) / PERFORMANCE BANK GUARANTEE (PBG):

- Bank guarantee (BG) / Performance bank guarantee (PBG) will be applicable as called in the tender documents. Such PBG shall be valid for a period of Warranty Period + claim period of 3 months for a value equal to 10 % of the basic value of the purchase order. No deviation for the duration of PBG / BG will be permitted.
 - PBG shall be from any of the BHEL consortium of bankers (**refer Annexure V**).
 - PBGs from nationalized banks are also acceptable.

- c. PBG should be sent directly by the bank to the dealing executive mentioned in the purchase order located at the address mentioned in the purchase order. PBG should be in the format indicated. **(Refer Annexure III)**. No deviation to these formats will be allowed.
- d. Confirmation from any of the BHEL consortium of banks or any of the Indian Public Sector Banks is essential for the acceptance of PBGs issued by foreign banks (located outside India).
- e. Expired BGs / PBGs will be returned only after expiry of the claim period or on completion of the contractual obligation.
- f. In case vendor does not accept for submission of PBG, the vendor is liable for rejection on commercial grounds.

I. DOCUMENTS (TRIPLICATE COPIES) REQUIRED AT THE TIME OF DISPATCH FOR PROCESSING OF BILL:

1. FOR INDIGENOUS SCOPE OF SUPPLY:

For Supply: Invoice in Triplicate, Lorry receipt (LR) copy, Packing List, PSI Call Letter Copy, Proof of delivery such as MRC (Material Receipt Certificate)/ original acknowledged LR, Insurance intimation Letter and Warranty Certificate. Note that document pertaining to Proof of delivery shall clearly mention number of boxes/panels etc which shall be in line with the Packing list.

For I&C: Supplementary Invoice in Triplicate with copy of I&C Certificate (Proof of Completion of I&C).

For PBG: Supplementary Invoice in Triplicate with copy of PBG. However, PBG should reach concerned Purchase Officer directly from the Bank.

2. FOR IMPORTED SCOPE OF SUPPLY:

For Supply: Invoice in Triplicate, Air Way Bill/Bill of Lading, Packing List, PSI Call Letter Copy, and Warranty Certificate.

For I&C: Supplementary Invoice in Triplicate with copy of I&C Certificate (Proof of Completion of I&C).

For PBG: Supplementary Invoice in Triplicate with copy of PBG. Both PBG & supplementary invoice should reach concerned Purchase Officer directly from the Bank.

J. PROVISIONS APPLICABLE FOR MSE VENDORS (MICRO AND SMALL ENTERPRISES)

Vendors who qualify as MSE vendors are requested to submit applicable certificates (as specified by the Ministry of Micro, Small and Medium Enterprises) at the time of vendor registration. Vendors have to submit any of the following documents along with the tender documents in the Part I / Technical bid cover to avail the applicable benefits.

- a. Valid NSIC certificate or
- b. Entrepreneur's Memorandum part II (EM II) certificate (deemed valid for 2 years).
- c. EM II certificate with CA certificate **(in the prescribed format given in Annexure VIII)** applicable for the year certifying that the investment in plant and machinery of the vendor is within permissible limits as per the MSME Act 2006 for relevant status where the deemed validity is over.
- d. Documents submitted for establishing the credentials of MSE vendors must be valid as on the date of part I / technical bid opening for the vendors to be eligible for the benefits applicable for MSE vendors. Documents submitted after the Part I / Technical bid opening date will not be considered for this tender.

PURCHASE PREFERENCE FOR MSE VENDORS:

- e. MSE vendors quoting within a price band of L1 + 15% shall be allowed to supply up to 20% of the requirement against this tender provided.
 - 1. The MSE vendor matches the L1 price.
 - 2. L1 price is from a non MSE vendor.
 - 3. L1 price will be offered to the nearest vendor nearest to L1 in terms of price ranking (L2 - nearest to L1). In case of non-acceptance by the MSE vendor (L2) next ranking MSE vendor will be offered who is within the L1 + 15% band (if L3 is also within 15% band).
 - 4. 20% of the 20% (i.e. 4% of the total enquired quantity) will be earmarked for SC/ST owned MSE firms provided conditions as mentioned in (1) and (2) are fulfilled.
 - 5. In case no vendor under SC / ST category firms are meeting the conditions mentioned in (1) and (2) or have not participated in the tender, in such cases the 4% quantity will be distributed among the other eligible MSE vendors who have participated in the tender.

6. Serial no. 1 to 5 will not be applicable wherever it is not possible to split the tendered quantity / items on account of customer contract requirement, or the items tendered are systems. Such information that tendered quantity will not be split will be indicated in the SCC.

K. INTEGRITY COMMITMENT IN THE TENDER PROCESS, AND EXECUTION OF CONTRACTS:

1. Commitment by BHEL:

BHEL commits to take all measures necessary to prevent corruption in connection with the Tender process and execution of the Contract. BHEL will, during the tender process, treat all bidder / suppliers in a transparent and fair manner, and with equity.

2. Commitment by Bidder(s)/ Contractor(s):

- a. The Bidder(s)/ Contractor(s) commit(s) to take all measures to prevent corruption and will not directly or indirectly try to influence any decision or benefit which he is not legally entitled to.
- b. The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding or any actions to restrict competition.
- c. The Bidder(s)/ Contractor(s) will not commit any offence under the relevant Acts. 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 BHEL as part of business relationship.
- d. 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 and shall adhere to the relevant guidelines issued from time to time by Government of India/ BHEL.

If the Bidder(s) / Contractor(s), before award or during execution of the Contract commit(s) a transgression of the above or in any other manner such as to put his reliability or credibility in question, BHEL is entitled to disqualify the Bidder(s) / Contractor (s) from the tender process or terminate the contract and/ or take suitable action as deemed fit.

L. 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 intranet.

PURCHASE EXECUTIVE



ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್
भारत हेवी इलेक्ट्रिकल्स लिमिटेड

Bharat Heavy Electricals Ltd.,
(A Government of India undertaking)
Electronics Division

PB 2606 , Mysore Road Bangalore , 560026 INDIA

SCPV: BOS: GCC - Rev 02

GENERAL COMMERCIAL CONDITIONS FOR CONTRACT (GCC)

These 'General Commercial Conditions for Contract for Purchase' hereinafter referred to as GCC apply to all enquiries, tenders, requests for quotations, orders, contracts and agreements concerning the supply of goods and the rendering of related services (hereinafter referred to as "deliveries") to Bharat Heavy Electricals Limited and any of its units, regions or divisions (hereinafter referred to as "BHEL" or the Purchaser) or its projects / customers.

Any deviations from or additions to these GCC require BHEL's express written consent. The general terms of business or sale of the vendor shall not apply to BHEL. Acceptance, receipt of shipments or services or effecting payment shall not mean that the general terms of business or sale of the vendor have been accepted.

Orders, agreements and amendments thereto shall be binding if made or confirmed by BHEL in writing. Only the Purchasing department of BHEL is authorized to issue the Purchase Order or any amendment thereof.

Definitions: Throughout these conditions and in the specifications, the following terms shall have the meanings assigned to them, unless the subject matter or the context requires otherwise.

- 'The Purchaser' means Bharat Heavy Electricals Limited, Electronics division, Mysore road, Bangalore 560 026, a Unit of Bharat Heavy Electricals Limited (A Govt. of India Undertaking) incorporated under the Companies Act having its registered office at BHEL House, Siri Fort, New Delhi-110049, India and shall be deemed to include its successors and assigns. It may also be referred to as BHEL.
- 'The vendor' means the person, firm, company or organization on whom the Purchase Order is placed and shall be deemed to include the vendor's successors, representative heirs, executors and administrator as the case may be. It may also be referred to as Seller, Contractor or Supplier.
- 'Contract' shall mean and include the Purchase Order incorporating various agreements, viz. tender/ RFQ, offer, letter of intent / acceptance / award, the General Conditions of Contract and Special Conditions of Contract for Purchase, Specifications, Inspection / Quality Plan, Schedule of Prices and Quantities, Drawings, if any enclosed or to be provided by BHEL or his authorized nominee and the samples or patterns if any to be provided under the provisions of the contract.
- 'Parties to the Contract' shall mean the 'The Vendor' and the Purchaser as named in the main body of the Purchase Order.
- "Bidder" shall mean duly established reputed organisation, manufacturer etc. having requisite financial and technical capability and experience of participating in the bid invited by the purchaser for the tender.
- Bid- The term "bid" or "bidding" can also relate to the documented Offer submitted in response to a request for quotation (RFQ) /Tender.

Interpretation:

In the contract, except where the context requires otherwise:

- words indicating one gender include all genders;
- words indicating the singular also include the plural and words indicating the plural also include the singular;
- provisions including the word "agree", "agreed" or "agreement" require the agreement to be recorded in writing, and
- "Written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record.

Applicable Conditions:

1. **Price Basis:** All prices shall be firm until the purchase order is executed / completed in all respects. No price variations / escalation shall be permitted unless otherwise such variations / escalations are provided for and agreed by BHEL in writing in the purchase order.
2. **Validity:** The offer will be valid for a period of 90 days from the date of technical bid opening date. Validity beyond 90 days, if required, will be specified in the SCC (special conditions of contract).
3. **Taxes & Duties:** Taxes as mentioned in the Contract Price or Price Schedule shall be paid to the Contractor subject to the Contractor complying with all the statutory requirements and furnishing the relevant documents including error free invoices containing detailed break-up of the taxes. Any duties, levies or taxes not mentioned in Contract Price or Price Schedule but applicable as per any statute(s) shall be deemed to be included in the Contract price and shall be to the account of the Contractor.
The Contractor shall bear and pay all the costs, liabilities, levies, interest, penalties in respect of non-compliances of any legal requirements as per various statutory provisions. The contractor shall keep the owner indemnified at all times from any tax liability, interest, penalties or assessments that may be imposed by the statutory authorities for non-compliances or non-observation of any statutory requirements by the Contractor.
4. **Ordering and confirmation of Order:** Vendor shall send the order acceptance on their company letter head within two weeks from the date of Purchase Order or such other period as specified / agreed by BHEL. BHEL reserves the right to revoke the order placed if the order confirmation differs from the original order placed. The acceptance of goods/services/supplies by BHEL as well as payments made in this regard shall not imply acceptance of any deviations.
The purchase order will be deemed to have been accepted if no communication to the contrary is received within two weeks (or the time limit as specified / agreed by BHEL) from the date of the purchase order.
5. **Documentation:** After receipt of Purchase Order, vendor should submit required documents like drawings, bill of materials, datasheets, catalogues, quality plan, test procedure, type test report , O & M Manuals and/or any other relevant documents as per Specification/Purchase Order, as and when required by BHEL/Customer.
At any stage within the contract period, the vendor shall notify of any error, fault or other defect found in BHEL's documents /specifications or any other items for reference. If and to the extent that (taking account of cost and time) any vendor exercising due care would have discovered the error, fault or other defect when examining the documents/specifications before submitting the tender, the time for completion shall not be extended. However if errors, omissions, ambiguities, inconsistencies, inadequacies or other defects are found in the vendor's documents, they shall be corrected at his cost, notwithstanding any consent or approval.
6. **TERMS OF DELIVERY:**
FOR IMPORTED PURCHASE:
Price offered shall be for goods packed and delivered CIF Seaport/ International Airport (FCA) including packing, forwarding, Handling, Ancillary charges like processing of Sight Draft, negotiation charges of bank, Export declaration, Certificate of origin etc.
Packing shall be Air/Sea worthy, best suitable for trans-shipment and to take care of transit damages. If containerized, no. of containers & size of container shall be mentioned. Packing weight (gross & net) Packing dimensions shall be given prior to shipment to ascertain whether the consignment can be carried on standard cargo in contract or as ODC.
Wooden packing material for all the foreign consignments should be treated as per ISPM-15 & Fumigation / Phytosanitary certificate to be submitted to the freight forwarders/ BHEL along with the invoice, B/L, packing list etc.
Vendors shall indicate the name of International Airport/Seaport. The consignment shall be handed over to BHEL approved freight forwarder as mentioned in PO.

FOR INDIGENOUS PURCHASE:

Equipment shall be delivered on “FOR SITE” basis, inclusive of freight, packing, insurance & forwarding charges.

Packing shall be Road / Rail / Air / Sea worthy, best suitable for transshipment and to take care of transit damages. Smaller consignments can be dispatched through Courier services/ RPP with the prior approval of the purchasing Executive.

Deviation for the delivery term is liable for rejection.

7. Penalty:

For delay in delivery: In the event of delay in agreed contractual delivery as per Purchase Order, penalty @ 0.5 % (half percent) per week or part thereof but limited to a max of 10% (ten percent) value of undelivered portion (basic material cost) will be applicable. Delivery will commence from the date of document approval by customer / BHEL or date of issue of manufacturing clearance, whichever is later. The date for which Inspection call is issued by vendor along with test certificates / test reports / Certificate of Conformance / calibration reports, as proof of completion of manufacturing will be treated as date of deemed delivery for penalty calculation. In the absence of furnishing such document indicated above as proof of completion of manufacturing along with inspection call, actual date of inspection will be considered as date of deemed delivery and BHEL will not be responsible for delay in actual date of inspection.

Penalty for delayed delivery, if applicable, shall be deducted at the time of first payment. If penalty is applicable for duration of less than a week, penalty @ 0.5% (half percent) of the basic material value will be deducted.

8. **Contract variations (Increase or decrease in the scope of supply):** BHEL may vary the contracted scope as per requirements at site. If vendor is of the opinion that the variation has an effect on the agreed price or delivery period, BHEL shall be informed of this immediately in writing along with technical details. Where unit rates are available in the Contract, the same shall be applied to such additional work. Vendor shall not perform additional work before BHEL has issued written instructions / amendment to the Purchase Order to that effect. The work which the vendor should have or could have anticipated in terms of delivering the service(s) and functionality (i.e.) as described in this agreement, or which is considered to be the result of an attributable error on the vendor's part, shall not be considered additional work.
9. **Reverse Auction:** BHEL reserves the right to go for Reverse Auction (RA) (Guidelines as available on www.bhel.com) instead of opening the sealed envelope price bid, submitted by the bidder. This will be decided after techno-commercial evaluation. Bidders to give their acceptance with the offer for participation in RA. Non-acceptance to participate in RA may result in non- consideration of their bids, in case BHEL decides to go for RA.

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

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

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

10. **Pre Shipment Inspection:** Prior written notice of at least one week shall be given along with internal test certificates / COC and applicable test certificates. Materials will be inspected by BHEL-EDN-QS/CQS or BHEL nominated Third Party Inspection Agency (TPIA) or BHEL authorized Inspection Agency or Customer / Consultant or jointly by BHEL & Customer / consultant. All tests have to be conducted as applicable in line with approved Quality plan or QA Checklist or Purchase specification and original reports shall be furnished to BHEL-EDN, Bangalore for verification / acceptance for issue of dispatch clearance. All costs related to inspections & re-inspections shall be borne by vendor. Whether the Contract provides for tests on the premises of the vendor or any of his Sub-contractor/s, vendor shall be responsible to provide such assistance, labour, materials, electricity, fuels, stores, apparatus, instruments as may be required and as may be reasonably demanded to carry out such tests efficiently. Cost of any type test or such other special tests shall be borne by BHEL only if specifically agreed to in the purchase order.
11. **Transit Insurance:** Transit insurance coverage between vendor's works and project site shall be to the account of BHEL, unless specifically agreed otherwise. However, vendor shall send intimation directly to insurance agency through fax/courier/e-mail, immediately on dispatch of goods for covering insurance. A copy of such intimation sent by vendor to insurance agency shall be given to BHEL along with dispatch documents. Dispatch documents will be treated as incomplete without such intimation copy. BHEL shall not be responsible for sending intimations to insurance agency on behalf of the vendor.
12. **Packaging and dispatch:** The Seller shall package the goods safely and carefully and pack them suitably in all respects considering the peculiarity of the material for normal safe transport by Sea / Air / Rail / Road to its destination suitably protected against loss, damage, corrosion in transit and the effect of tropical salt laden atmosphere. The packages shall be provided with fixtures / hooks and sling marks as may be required for easy and safe handling. If any consignment needs special handling instruction, the same shall be clearly marked with standard symbols / instructions. Hazardous material should be notified as such and their packing, transportation and other protection must conform to relevant regulations. The packing, shipping, storage and processing of the goods must comply with the prevailing legislation and regulations concerning safety, the environment and working conditions. Any Imported/Physical Exports items packed with raw / solid wood packing material should be treated as per ISPM – 15 (fumigation) and accompanied by Phytosanitary / Fumigation certificate. If safety information sheets (MSDS – Material Safety Data Sheet) exist for an item or the packaging, vendor must provide this information without fail along with the consignment. Each package must be marked with Consignee name, Purchase order number, Package number, Gross weight and net weight, dimensions (L x B x H) and Seller's name. Packing list of goods inside each package with PO item number and quantity must also be fixed securely outside the box to indicate the contents of each box. Total number of packages in the consignment must also be indicated. Separate packing & identification of items should be as follows.
 1. Main Scope - All items must be tagged with part no. & item description.
 2. Commissioning spares - All items must be tagged with part no. & item description.
 3. Mandatory spares - All items must be tagged with part no. & item description.
13. **Assignment of Rights & Obligations; Subcontracting:** Vendor is not permitted to subcontract the delivery or any part thereof to third party or to assign the rights and obligations resulting from this agreement in whole or in part to third parties without prior written permission from BHEL. Any permission or approval given by the BHEL shall, however, not absolve the vendor of the responsibility of his obligations under the Contract.
14. **Progress report:** Vendor shall render such report as to the progress of work and in such form as may be called for by the concerned purchase officer from time to time. The submission and acceptance of such reports shall not prejudice the rights of BHEL in any manner.

15. **Non-disclosure and Information Obligations: Vendor** shall provide with all necessary information pertaining to the goods as it could be of importance to BHEL. Vendor shall not reveal confidential information that may be divulged by BHEL to Vendor's employees not involved with the tender/ contract & its execution and delivery or to third parties, unless BHEL has agreed to this in writing beforehand. Vendor shall not be entitled to use the BHEL name in advertisements and other commercial publications without prior written permission from BHEL.
16. **Cancellation / Termination of contract:** BHEL shall have the right to completely or partially terminate the agreement by means of written notice to that effect. Termination of the Contract, for whatever reason, shall be without prejudice to the rights of the parties accrued under the Contract up to the time of termination.
BHEL shall have the right to cancel/foreclose the Order/ Contract, wholly or in part, in case it is constrained to do so, on account of any decline, diminution, curtailment or stoppage of the business.
17. **Risk Purchase Clause:** In case of failure of supplier, BHEL at its discretion may make purchase of the materials / services NOT supplied / rendered in time at the RISK & COST of the supplier. Under such situation, the supplier who fails to supply the goods in time shall be wholly liable to make good to BHEL any loss due to risk purchase.
In case of items demanding services at site like erection and commissioning, vendor should send his servicemen /representatives within 7 days from the service call. In case a vendor fails to attend to the service call, BHEL at its discretion may also make arrangements to attend such service by other parties at the **RISK & COST** of the supplier. Under such situation the supplier who fails to attend the service shall be wholly liable to make good to BHEL any loss due to risk purchase / service including additional handling charges due to the change.
18. **Shortages:** In the event of shortage on receipt of goods and/or on opening of packages at site, all such shortages shall be made good within a reasonable time that BHEL may allow from such intimation and free of cost.
Transit Damages: In the event of receipt of goods in damaged condition or having found them so upon opening of packages at site, Supplier shall make good of all such damages within a reasonable time from such intimation by BHEL.
19. **Remedial work:** Notwithstanding any previous test or certification, BHEL may instruct the vendor to remove and replace materials/goods or remove and re-execute works/services which are not in accordance with the purchase order. Similarly BHEL may ask the vendor to supply materials or to execute any services which are urgently required for any safety reasons, whether arising out of or because of an accident, unforeseeable event or otherwise. In such an event, Vendor shall provide such services within a reasonable time as specified by BHEL.
20. **Indemnity Clause:** Vendor shall comply with all applicable safety regulations and take care for the safety of all persons involved. Vendor is fully responsible for the safety of its personnel or that of his subcontractor's men / property, during execution of the Purchase Order and related services. All statutory payments including PF, ESI or other related charges have to be borne by the vendor. Vendor is fully responsible for ensuring that all legal compliances are followed in course of such employment.
21. **Product Information, Drawings and Documents:** Drawings, technical documents or other technical information received by Vendor from BHEL or vice versa shall not, without the consent of the other party, be used for any other purpose than that for which they were provided. They may not, without the consent of the Disclosing party, otherwise be used or copied, reproduced, transmitted or communicated to third parties. All information and data contained in general product documentation, whether in electronic or any other form, are binding only to the extent that they are by reference expressly included in the contract.
Vendor, as per agreed date/s but not later than the date of delivery, provide free of charge information and drawings which are necessary to permit and enable BHEL to erect, commission, operate and maintain the product. Such information and drawings shall be supplied in as many numbers of copies as may be agreed upon.
All intellectual properties, including designs, drawings and product information etc. exchanged during the

formation and execution of the Contract shall continue to be the property of the disclosing party.

22. **Intellectual Property Rights, Licenses:** If any Patent, design, Trade mark or any other intellectual property rights apply to the delivery (goods / related service) or accompanying documentation shall be the exclusive property of the Vendor and BHEL shall be entitled to the legal use thereof free of charge by means of a non-exclusive, worldwide, perpetual license. All intellectual property rights that arise during the execution of the Purchase Order/ contract for delivery by vendor and/or by its employees or third parties involved by the vendor for performance of the agreement shall belong to BHEL. Vendor shall perform everything necessary to obtain or establish the above mentioned rights. The Vendor guarantees that the delivery does not infringe on any of the intellectual property rights of third parties. The Vendor shall do everything necessary to obtain or establish the alternate acceptable arrangement pending resolution of any (alleged) claims by third parties. The Vendor shall indemnify BHEL against any (alleged) claims by third parties in this regard and shall reimburse BHEL for any damages suffered as a result thereof.

23. **Force Majeure:** Notwithstanding anything contained in the purchase order or any other document relevant thereto, neither party shall be liable for any failure or delay in performance to the extent said failures or delays are caused by the "Act of God" and occurring without its fault or negligence, provided that, force majeure will apply only if the failure to perform could not be avoided by the exercise of due care and vendor doing everything reasonably possible to resume its performance.
A party affected by an event of force majeure which may include fire, tempest, floods, earthquake, riot, war, damage by aircraft etc., shall give the other party written notice, with full details as soon as possible and in any event not later than seven (7) calendar days of the occurrence of the cause relied upon. If force majeure applies, dates by which performance obligations are scheduled to be met will be extended for a period of time equal to the time lost due to any delay so caused.

Notwithstanding above provisions, in an event of Force Majeure, BHEL reserves for itself the right to cancel the order/ contract, wholly or partly, in order to meet the overall project schedule and make alternative arrangements for completion of deliveries and other schedules.

24. **Guarantee / Warranty:** Wherever required, and so provided in the specifications / Purchaser Order, the Seller shall guarantee that the stores supplied shall comply with the specifications laid down, for materials, workmanship and performance. The guarantee / warranty period as described shall apply afresh to replaced, repaired or re-executed parts of a delivery. If the vendor fails to take proper corrective action to repair/replace defects satisfactorily within a reasonable period, Purchaser shall be free to take corrective action as may be deemed necessary at vendor's risk and cost after giving notice to the vendor, including arranging supply of goods from elsewhere at the sole risk and cost of the vendor. Unless otherwise specifically provided in the Purchase Order, Vendor's liability shall be co terminus with the expiration of the applicable guarantee / warranty period.

25. **Limitation of Liability:** Vendor's liability towards this contract is limited to a maximum of 100% of the contract value and consequential damages are excluded. However the limits of liability will have no effect in cases of criminal negligence or wilful misconduct.
The total liability of Vendor for all claims arising out of or relating to the performance or breach of the Contract or use of any Products or Services or any order shall not exceed the total Contract price.

26. **Liability during guarantee / warranty:** Vendor shall arrange replacement / repair of all the defective materials / services under its obligation under the guarantee / warranty period. The rejected goods shall be taken away by vendor and replaced / repaired. In the event of the vendor's failure to comply, BHEL may take appropriate action including disposal of rejections and replenishment by any other sources at the cost and risk of the vendor.
In case, defects attributable to vendor are detected during first time commissioning or use, vendor shall be responsible for replacement / repair of the goods as required by BHEL at vendor's cost. In all such cases expiry of guarantee / warranty will not be applicable.

27. **Liability after guarantee / warranty period:** At the end of the guarantee / warranty, the Vendor's liability ceases except for latent defects (latent defects are defects / performance issues noticed after the

guarantee / warranty has expired). The Contractor's liability for latent defects warranty for the plant and equipment including spares shall be limited to a period of six months from the end of the guarantee / as specified in RFQ.

28. **Compliance with Laws:** Vendor shall, in performing the contract, comply with all applicable laws. The vendor shall make all remittances, give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the laws in relation to the execution and completion of the contract and for remedying of any defects; and the Contractor shall indemnify and hold BHEL harmless against and from the consequences of any failure to do so.
29. **Settlement of Disputes:** Except as otherwise specifically provided in the Purchase Order, decision of BHEL shall be binding on the vendor with respect to all questions relating to the interpretation or meaning of the terms and conditions and instructions herein before mentioned and as to the completion of supplies/work/services, other questions, claim, right, matter or things whatsoever in any way arising out of or relating to the contract, instructions, orders or these conditions or otherwise concerning the supply or the execution or failure to execute the order, whether arising during the schedule of supply/work or after the completion or abandonment thereof. Any disputes or differences among the parties shall to the extent possible be settled amicably between the parties thereto, failing which the disputed issues shall be settled through arbitration. Vendor shall continue to perform the contract, pending settlement of dispute(s).
30. **Arbitration Clause:** 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 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 by either party to the sole arbitration of an Arbitrator appointed by the Executive Director/ General Manager of the purchasing unit/ region/ division of BHEL. Vendor shall have no objection even if the Arbitrator so appointed is an employee of BHEL or has ever dealt/ had to deal with any matter relating to this Contract.
 Subject as aforesaid the provisions of the Arbitration and Conciliation Act, 1996 of India 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 proceedings under this clause. It is a term of contract that the party initiating 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 venue for the arbitration shall be Bangalore, India. The award of the arbitrator shall be a speaking award and shall be final, conclusive and binding on all parties to this contract.
 The cost of arbitration shall be borne equally by the parties. Notwithstanding the existence of any dispute or difference or any reference for the arbitration, the vendor shall proceed with and continue without hindrance the performance of the work under the contract with due diligence and expedition in a professional manner.
31. **Applicable Laws and Jurisdiction of Courts:** Prevailing Indian laws both substantive and procedural, including modifications thereto, shall govern the Contract. Subject to the conditions as aforesaid, the competent courts in BANGALORE alone shall have jurisdiction to consider over any matters touching upon this contract.
32. **General Terms:** That any non-exercise, forbearance or omission of any of the powers conferred on BHEL and /or any of its authorities will not in any manner constitute waiver of the conditions hereto contained in these presents.
 That the headings used in this agreement are for convenience of reference only.
 That all notices etc., to be given under the Purchase order shall be in writing, type script or printed and if sent by registered post or by courier service to the address given in this document shall be deemed to have been served on the date when in the ordinary course, they would have been delivered to the addressee.
33. Vendors shall provide their state wise list of GSTIN number as per Govt of India Statute.

34. If the vendor is below the threshold limit, viz Rs.20. lacs as per existing provisions, then a declaration to be provided to that effect along with copy of accounts, failing which the supplier will be treated as an Unregistered dealer (URD) for which tax is payable on reverse charge (RCM) by BHEL.
35. If the vendor is above the threshold limit & is yet not registered, GST is payable by BHEL on reverse charge basis.
36. All supply items are linked to HSN code (Harmonised System Nomenclature). This goods list is mapped with HSN code which is released by Govt of India & available in public domain. All registered suppliers submitting the quote shall mandatorily mention HSN code relevant for the goods quoted.
37. Under GST, Govt of India has linked every service to a service accounting code called SAC. The list of services and the corresponding service accounting code (SAC) is released by Govt of India & available in public domain. All registered suppliers submitting the quote shall mandatorily mention SAC code relevant for the service quoted.
38. The rate of tax applicable for 35 services is also released by Government and rate for any service not falling in the list of 35 services is 18%.
39. Invoice should contain all particulars as per invoice Rules and should include the GST registration number (GSTIN), service accounting code (SAC) apart from all other details mentioned.
40. Invoice should contain all particulars as per invoice Rules and should include the GST registration number (GSTIN), HSN code apart from all other details mentioned.
41. In case GST is payable on reverse charge (RCM) invoice should mention that tax is payable on reverse charge
42. For a registered supplier, the supplier uploaded sales data for the month will be available to recipient on 11th of the subsequent month & details can be verified by BHEL. Credit availment can be confirmed based on this verified data
43. If the Supplier is not registered, then tax is payable on Reverse charge & will be to the account of the supplier
44. All services in the course of business or furtherance of business are eligible to credit subject to other compliances listed herein.
45. If service is eligible for credit, then the credit can be availed only if the invoice is as per the prescribed format, the supplier has uploaded the invoice in the GSTN portal, paid the taxes & uploaded the return, and matches with our inward data, failing which any availment of credit attracts interest.
46. Even in case of services where credit is not eligible,
 - (i) either the supplier should have registered (if above threshold limit) & comply with all above statutory provisions relating to invoice, tax remittance, return filing etc. This can be verified by BHEL from the GSTN portal OR
 - (ii) if not registered BHEL shall be liable to pay applicable taxes on reverse charge
47. For any deficiency in services, where a recovery is made / adjusted in supplier bills, the supplier has to raise a credit note on BHEL & upload in GSTN portal. All above rules applicable for invoice also apply for credit note.
48. All notifications and rules as per central board of excise and customs will be applicable.

ANNEXURE - I
LIST OF INTERNATIONAL GATEWAY AIRPORTS

SCHEDULE NO	COUNTRY	CURRENCY CODE	AIRPORT
D01	UK	GBP	LONDON (HEATHROW)
D02	UK	GBP	NEW CASTLE
D03	UK	GBP	OXFORD. CHETLAM
D04	UK	GBP	BRISTOL. WELLINGBOROUGH
D05	UK	GBP	BIRMINGHAM
D06	UK	GBP	EAST MIDLANDS
D07	UK	GBP	MANCHESTER
D08	UK	GBP	LEEDS
D09	UK	GBP	GLASGOW
D10	FRANCE	EURO	PARIS (ROISSY) & LYON
D11	SWEDEN	EURO	STOCKHOLM
D12	SWEDEN	EURO	GOTHENBERG & MALMO
D13	ITALY	EURO	ROMA, MILAN
D14	ITALY	EURO	TURIN, BOLOGNA, FLORENCE
D15	NETHERLANDS	EURO	AMSTERDAM, ROTTERDAM
D16	AUSTRIA	EURO	VIENNA, LINZ, GRAZ
D17	BELGIUM	EURO	ANTWERP, BRUSSELS
D18	DENMARK	DKK	COPENHAGEN
D19	JAPAN	JPY	TOKYO, OSAKA
D20	SINGAPORE	SGD	SINGAPORE
D21	CANADA	CAD	TORONTO
D22	CANADA	CAD	MONTREAL
D23	USA	USD	NEW YORK, BOSTON
D24	USA	USD	CHICAGO
D25	USA	USD	SAN FRANCISCO, LOS ANGELES
D26	USA	USD	ALANTA, HOUSTON
D27	GERMANY	EURO	MUNICH, KOLN, DUSSELDORF, HANNOVER, HAMBURG, STUTTGART, DAMSTADT, MANIHIEM, NURUMBERG
D28	GERMANY	EURO	FRANKFURT
D29	GERMANY	EURO	BERLIN
D30	SWITZERLAND	SFR	BASLE, ZURICH, GENEVA
D31	SPAIN	EURO	BARCELONA
D32	AUSTRALIA	AUD	SYDNEY
D33	AUSTRALIA	AUD	MELBOURNE
D34	AUSTRALIA	AUD	PERTH
D35	CZECH	EURO	PRAGUE
D36	HONG KONG	HKD	HONG KONG
D37	NEW ZELAND	NZD	AUCKLAND
D38	RUSSIA	USD	MOSCOW
D39	SOUTH KOREA	USD	KIMPO INTERNATIONAL, INCHEON
D40	FINLAND	EURO	HELSINKI
D41	ROMANIA	EURO	BUCHAREST
D42	NORWAY	EURO	OSLO
D43	IRELAND	EURO	DUBLIN
D44	ISRAEL	USD	TEL AVIV
D45	UAE	USD	DUBAI
D46	OMAN	USD	MUSCAT
D47	EGYPT	USD	CAIRO
D48	TAIWAN	USD	TAIPEI
D49	UKRAINE	USD	KIEV
D50	CHINA	USD	SHANGHAI, SHENZHEN
D51	PHILIPINES	USD	MANILA
D52	MALAYSIA	USD	KUALALUMPUR, PE NANG
D53	CYPRUS	USD	LARNACA
D54	SOUTH AFRICA	USD	JOHANNESBERG, DURBAN
D55	SLOVAKIA	EURO	BARTISLOVA
D56	SAUDI ARABIA	SAR	RIYADH
D57	TURKEY	EURO	ISTANBUL
D58	THAILAND	USD	BANGKOK
D59	BRAZIL	USD	SAO PAULO, RIO DE JANEIRO

ANNEXURE - II
REQUEST FOR C FORM

NAME OF VENDOR :

VENDOR CODE ALLOTTED BY BHEL :

E mail id for c form correspondence :

BHEL PO NO	INVOICE NO	INVOICE DATE	INVOICE AMOUNT	SUPPLY FROM - STATE	SUPPLY TO - STATE	CST TIN NUMBER (SUPPLIER)	INVOICE AMOUNT EXCLUDING FREIGHT	C FORM QTR	YEAR	SUPPLY TO BHEL EDN / SITE
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Please note that one 'C' form will be issued for a quarter.

Any modification and cancellation of c form is not possible from our end since it is generated online therefore include all invoices pertaining to quarter in your request
Also check the data are correct in all respect

General Instruction:

1. C form request should be given only in this file.
2. Amount should be 100% of Invoice value but should Not include freight, Insurance etc.
3. PO No. should be numeric, starting with 4 and has 10 digits
4. For every quarter separate file to be provided
5. All Invoices pertaining to the relevant quarter to be included.
6. No corrections will be entertained once c-form is issued.

ANNEXURE-III

BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited ¹ (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at _____ through its Unit at.....(name of the Unit) having awarded to (Name of the Vendor / Contractor / Supplier) having its registered office at _____ ² hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No.....dated³ valued at Rs.....⁴ (Rupees -----)/FC.....(in words.....) for⁵ (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to% (.... Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we,, (hereinafter referred to as the Bank), having registered/Head office at and inter alia a branch at being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ----- (Rupees -----) without any demur, immediately on a demand from the Employer, .

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 Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto 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 thereunder and the contractors/supplier shall have no claim against us for making such payment.

We thebank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We BANK further agree with the Employer 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 Contract or to extend time of performance by the said Contractor/Supplier 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 Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier 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 Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

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

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the⁷ we shall be discharged from all liabilities under this guarantee thereafter.

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.....⁸
- b) This Guarantee shall be valid up to⁹
- c) Unless the Bank is served a written claim or demand on or before¹⁰ 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)

Dated.....

Place of Issue.....

¹ NAME AND ADDRESS OF EMPLOYER I.e Bharat Heavy Electricals Limited

² NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.

³ DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE

⁴ PROJECT/SUPPLY DETAILS

⁵ BG AMOUNT IN FIGURES AND WORDS

⁶ VALIDITY DATE

⁷ DATE OF EXPIRY OF CLAIM PERIOD

⁸ BG AMOUNT IN FIGURES AND WORDS.

⁹ VALIDITY DATE

¹⁰ DATE OF EXPIRY OF CLAIM PERIOD

Note:

1. In Case of Bank Guarantees submitted by Foreign Vendors-

- a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
- b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**
 - b.1** In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
 - b.2** In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.
 - b.3** The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.
 - b.4** The BG should clearly specify that the demand or other document can be presented in electronic form.

ANNEXURE - IV

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 _____
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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: _____ (.....)

Place: _____ 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 Query, please call : 080-26998xxx / 2674xxxx or fax no. 080-2674xxxx

ANNEXURE-V
BHEL MEMBER BANKS (LIST OF CONSORTIUM BANKS)

BANK GUARANTEE (BG) SHALL BE ISSUED FROM THE FOLLOWING BANKS ONLY:

	Nationalised Banks		Nationalised Banks
1	Allahabad Bank	19	Vijaya Bank
2	Andhra Bank		Public Sector Banks
3	Bank of Baroda	20	IDBI
4	Canara Bank		Foreign Banks
5	Corporation Bank	21	CITI Bank N.A
6	Central Bank	22	Deutsche Bank AG
7	Indian Bank	23	The Hongkong and Shanghai Banking Corporation Ltd. (HSBC)
8	Indian Overseas Bank	24	Standard Chartered Bank
9	Oriental Bank of Commerce		
10	Punjab National Bank	26	J P Morgan
11	Punjab & Sindh Bank		Private Banks
12	State Bank of India	27	Axis Bank
13	State Bank of Hyderabad	28	The Federal Bank Limited
14	Syndicate Bank	29	HDFC Bank
15	State Bank of Travancore	30	Kotak Mahindra Bank Ltd
16	UCO Bank	31	ICICI Bank
17	Union Bank of India	32	IndusInd Bank
18	United Bank of India	33	Yes Bank

Note:

- All BGs must be issued from BHEL consortium banks listed above.
- BHEL may accept BG from other Nationalised Banks also which are not listed above.
- BG will not be accepted from Scheduled Banks and Co-operative Banks.
- In case BG is issued from a bank located outside Indian territory and is issued in foreign currency, the BG must be routed through and confirmed by any one of the above mentioned consortium banks or any of the Indian Public Sector Banks.
- This list is subject to changes. Hence vendors are requested to check this list every time before issuing BGs.

ANNEXURE - VI

DISCREPANCY IN WORDS & FIGURES – QUOTED IN PRICE BID

Following guidelines will be followed in case of discrepancy in words & figures-quoted in price bid:

- (a) 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 the purchaser there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price corrected accordingly.
- (b) 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; and
- (c) 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 to (a) and (b) above.
- (d) If there is such discrepancy in an offer, the same shall be conveyed to the bidder with target date upto which the bidder has to send his acceptance on the above lines and if the bidder does not agree to the decision of the purchaser, the bid is liable to be ignored.

ANNEXURE - VII

BENEFITS FOR MSE SUPPLIERS AS PER MSMED ACT 2006 AND PUBLIC PROCUREMENT POLICY 2012

MSE suppliers can avail the intended benefits only if they submit along with the offer, attested copies of either EM II certificate having deemed validity (five years from the date of issue of Acknowledgement in EM II).

Or

Valid NSIC certificate or EM II certificate along with attested copy of CA certificate (Format enclosed: ANNEXURE VIII) where deemed validity of EM II certificate of five years has expired) applicable for the relevant financial year (latest audited).

Date to be reckoned for determining the deemed validity will be the date of bid opening (Part 1 in case of two part bid).

Non-submission of such documents will lead to consideration of their bid at par with other bidders.

No benefit shall be applicable for this enquiry if any deficiency in the above required documents are not submitted before price bid opening. If the tender is to be submitted through e-procurement portal, then the above required documents are to be uploaded on the portal. Documents should be notarized or attested by a Gazette officer.

ANNEXURE - VIII
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 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.

The above investment of Rs. Lacs in 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/yy) 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 - IX

In case of intrastate movement i.e. supply within same state and VAT is applicable, the vendor shall furnish the respective BHEL™s nodal agency TIN no. and address in their invoice.

List of Statewise Nodal Officers with Contact Details

Region	State	Nodal Unit responsible for all other units except those in column 4	Contact Details- Landline No.	E-mail	TIN No.	CST No.
1	2	3		7	8	9
Norther States	Jammu & Kashmir	PSNR	0120-2510488/2416452	rahulb@bhelsnr.co.in / a.chadha@bhelsnr.co.in	01291101313	
	Himachal Pradesh	PSNR			02011000622	
	Punjab	PSNR			03451148722	
	Haryana	PSNR			06962606884	
	Rajasthan	PSNR			08232903345	
	Uttar Pradesh	PSNR	0120-2416536	rahulb@bhelsnr.co.in / smittal@bhelsnr.co.in	09365800914	
	Uttarakhand	Hardwar	01334-285449	alok@bhelhwr.co.in	05001757277 Dated 30th Sep 2005	5000030 Dated 13/03/1965
	Delhi	TBG	0120-6748429	skiindal@bhel.in	07472001760	07472001760
Western States	Madhya Pradesh	Bhopal	0755-2503231	meeta@bhelbpl.co.in	23573600001 (HEL/05/01/0001/S dated 15/11/1979 under MPCT)	HEL/05/01/0004/C dated 15/11/1979
	Chattisgarh	PSWR	0712-3048609	m Gupta@bhelswr.co.in	22173202974	
	Gujarat	PSWR	0265-2370321	bhavin@bhelswr.co.in	24190101571	
	Maharashtra	ROD Mumbai	022-22126061/22187850	mahajani@bhel.in	27060300130V	27060300130C
	Daman & Diu	EDN	080-26998724 / 26998830	theerthagiri@bheledn.co.in	25000009902	
Southern States	Orissa	PSSR	044-28286773	sparida@bhelssr.co.in / lakshmi@bhelssr.co.in	21031301916	
	Tamil Nadu	Trichy	0431-2577757/ 2577229	msrao@bheltry.co.in / bharaths@bheltry.co.in	33243560005	239383 dt.11.6.91
	Kerala	PSSR	044-28286773	lakshmi@bhelssr.co.in	32072043622	
	Karnataka	EDN	080-26998724 / 26998830	theerthagiri@bheledn.co.in	29180069268	00850081
	Telangana	HPEP RC, Puram	040-23185406/ 040-23182238	chand@bhelhyd.co.in / sbsv@bhelhyd.co.in	36360151179	
	Andhra Pradesh	HPVP, Vizag	0891-6681298	sarmaass@bhvpvl.com	37418632431	
	Puducherry	PSSR				
Eastern States	West Bengal	PSER	033-23216130-3238	amitavac@bhelsper.co.in	19200936019	19200936213
	Bihar	PSER	0612-2231275	rakesh@bhelsper.co.in	10010994046	10010994046
	Jharkhand	PSER	06549-266351(Sh. Parmanand Swaroop)/06534-292179 (Sh. K.K. Ajeet)	pswaroop@bhelsper.co.in (Bokaro) kk.ajit@bhelsper.co.in (Koderma/Abhijeet/North Karanpura) manishk.jain@bhelsper.co.in (Chandrapura)/ kpsubbu@bhelsper.co.in	20352205642 (Bokaro) 20082005255 (Maithon) 20512405410 (Koderma) 20122200394 (Chandrapura) 20620905730(Adhunik) 20650507026(Abhijeet) 20452110016 (North Karanpura)	TG-729(C)
	Mizoram	PSER	033-23216130-3249	anindya@bhelsper.co.in	15501465017	
	Arunachal Pradesh	PSER	033-23216130-3249	anindya@bhelsper.co.in	12020122182	Not Applied
	Assam	PSER	033-23216130-3249	anindya@bhelsper.co.in	18790101415	18179903204
	Tripura	PSER	03821-265209	mkmahato@bhelsper.co.in	16060947071	16060947273
	Sikkim	PSER				
	Meghalaya	PSER				
	Manipur	PSER				
	Nagaland	PSER				

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Technical specification for Design, Supply, Installation & Commissioning, and O&M of 6340KWp Solar PV ground mounted system at Berra Dol, Tehsil Sri Naina Devi ji, District Bilaspur, Himachal Pradesh
--

Revision details:	Prepared	Approved:	Date:
	Ram Kumar	M Sreenath	09.11.2017

	Technical specification for Design, supply, installation and commissioning, O&M of 6340KW _p Solar PV ground mounted system at Berra Dol, Tehsil Sri Naina Devi ji, District Bilaspur, Himachal Pradesh	PS-439-1176
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	5.31	Installation and supporting commissioning of BHEL SCADA integration systems ,HT switch gear panel etc.
	5.32	LAN Network at site with WI Fi routers at 5 locations in plant
	5.33	Metering panel containing 0.2 S Class, Bi Directional ABT-TOD Main, Standby and check meters as per HPSEBL requirement and with built in clock for GPS synchronization, Optical port, with 4 nos. Machine clients, 20 nos. Web client License along with MRI and laptop
	5.34	UPS system- 5KVA for control room (1 No.), 1KVA for SCADA rooms at transformer locations (2Nos.). All UPS shall have battery of capacity considering 4 hours back
	5.35	Plant lighting system
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	Date of commencement of operations and maintenance
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1.0 Introduction

1.1 Project outline of 6.34MWp (DC) solar photovoltaic power plant

- (a) Bharat Heavy Electricals Limited (BHEL), Electronics Division, Bangalore is setting up a 6.34MWp (DC) solar photovoltaic (SPV) power plant for HPPCL (Himachal Pradesh Power Corporation Limited). At Berra Dol, Tehsil Sri Naina Devi ji, District Bilaspur (Himachal Pradesh).
- (b) Solar PV modules employed at the plant generates DC electricity that in turn shall be inverted to AC in the range (370-460V) using string inverters that is further stepped up to 33KV. This system is ground mounted where solar PV system with string inverters and AC combiner boxes (ACCB) shall be installed. AC outputs from ACCBs are combined at a LT power distribution board (LTPDB) in the transformer yard. The combined LT is further stepped up to 33kV using oil-filled transformers. VCB panels and Metering panel shall be installed at main control room.
- (c) The output of the Plant has to be connected from the 33 kV out goer of the HT panel at Control room by underground 33 kV cable feeder up to a 2-pole arrangement near Zero point along the approach road leading up to PV Plant. The termination from the HT cables on the 2-pole structure to Utility grid overhead line also has to be completed by the vendor and the plant charging from Grid to be completed.
- (d) The plant shall have other infrastructural support systems such as Water washing system for module cleaning, plant illumination system, fire alarm system, boundary fencing, approach roads, pathways, drainage system, CCTV, Intercom etc.

1.2 Scope of this tender specification

Vendor scope includes supply, installation, testing, commissioning of certain identified activities of the solar photovoltaic power plant.

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

Also, the scope includes operations and maintenance, for a period of 05 years, of the complete Solar PV plant (including solar array, DC+AC sides and, all infrastructures therein) up to and inclusive of 33kV side of 3.15MVA 415/33kV Inverter transformers.

Vendor shall have capability for design of systems such as foundations for inverter transformers, earth mat grid for control room panels/transformer yards, peripheral lighting system, module cleaning system, outdoor cable trench layout for HT/LT/OFC cables etc. as envisaged under this specification. In case they do not have design/drafting capability, after receiving purchase order from BHEL, the vendor shall tie up with competent design consultants in which case vendor shall submit the credentials of the proposed consultants to BHEL.

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Subsequent to approval by BHEL, vendor shall award the work on the consultants. All drawings/ design documents shall be originated by the consultants, endorsed by the vendor clearly stating the name of the project, names of clients (BHEL/HPPCL), drawing/document number, revision number, number of sheets etc. Details of drawings/ design documents to be submitted are brought out under **section 5.1** and 8.0 of this specification.

Civil related works shall be tested as per BHEL/HPPCL-approved FQP that will be issued during course of project execution. All third party testing shall be carried out only at NABL accredited laboratories (or) Government laboratories.

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

1.3 Location / approach particulars of the power plant

5.04MW (AC)/6.34MW_p Solar Photovoltaic Power Plant,
Village: Berra Dol, Tehsil Sri Naina Devi ji, District Bilaspur, Himachal Pradesh

1.4 Enclosures to this tender specification (Tender purpose only)

1	Overall map of project site
2	Provisional single line diagram (AC) of overall Solar PV power plant
3	Typical site layout with solar array, control rooms, switchyards
4	Typical layout of control room
5	Indicative soil report
6	Indicative drawing of Module Mounting Structure
7	Request for Quotation with instructions, terms and conditions, formats for filling-up etc.
8	Major BOS items as listed shall be supplied from OEMs complying to Pre-qualification criteria of HPPCL and BHEL. Refer PQC in respect of BOS items wherever specified.

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3.0 Scope of work

3.1 Vendor scope – breakup of supply, I&C, O&M

The table below indicates the scope of work for the vendor, as briefly outlined. Vendor shall submit the offer (in two part bids) as per this list and quantity.

#	Scope of work (as briefly outlined)	Qty
1	Supply of MC4 connectors, PVC conduits, cable ties, HDPE conduits, ferrules etc as per clause 5.6 – 5.12	1 set
2	Supply of LT/HT power/control/Instrumentation cables, cable installation accessories such as cable trays/ cable ties/ casing / capping/ glands/ lugs/ trefoil clamps etc, LT/DC/HT/control cable termination hardware, HT termination kits, LT/DC/HT straight through jointing kits, HDPE DWC conduit pipes, hard PVC conduit pipes etc as per clauses 5.12-5.16, 5.18-5.20	1 set
3	Supply of HT Cable 33kV , 3CX95 sq.mm, Al, XLPE, armoured as per IS: 7098 (for all 33kV connections within plant including Aux transformer HV side)	approx. 750 M
4	Supply of HT Cable 33KV, 3C x 185 sq.mm, Al, XLPE, armoured as per IS: 7098, to be connected from Out goer panel to 2pole structure of power evacuation point	approx. 200 mtrs
5	Supply of ACCB, LTPDB, ACDB panel, HT Metering panel, Distribution boards of all types, UPS Panels, FCBC/battery banks with all related accessories/ hardware etc as per clauses 5.23 to 5.25.	1 set
6	Supply of items of earthing system for solar array field, control room panels, switchyard equipment etc including GI flats, MS rods (for earth mat) etc and all related miscellaneous hardware etc as per clauses 5.29-5.30	1 set
7	Supply of lightning arrestors for the complete solar power plant as per clauses 5.31.	1 set
8	Supply of items of module cleaning system such as submersible pumps of rated HP, GI pipes with fittings, valves etc, as per clause 5.32.	1 set
9	Supply of items for plant lighting system such as street light poles, bend pipes, luminaires, lamps, junction boxes, cable conduits, foundation items and all related accessories, hardware etc as per clause 5.28.	1 set
10	Supply and installation of Intercom system as per clause 5.48	1 set
11	Supply of miscellaneous items such as cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, checkered plates, air conditioners, tool kits, measuring instruments, office furniture, items for remote connectivity of SCADA, etc as per clauses 5.16, 5.17, 5.36-5.42.	1 set
12	Supply of safety related items including fire alarm systems for buildings, fire extinguishers, sand buckets, safety gadgets etc as per clauses 5.33-5.34.	1 set
13	Supply of CCTV system as per clause 5.35.	1 set
14	Supply of spare items as per clause 5.47.	1 set
15	Supply of Weather Monitoring system as per clause 5.26.	1 set

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16	Supply of Pre-Engineered Buildings for 1 No. Control room, 2 Nos. Security rooms and 2 Nos. RTU rooms as per Annexure-1.	1 Set
17	I&C: Interconnection of SPV modules, installation of string inverters including power cable terminations as per clauses 5.6 to 5.12 1 AU = Work proportionate to approx. 6.34 MW	1 AU
18	I&C: Cable trenches & laying of cables for LT AC/DC power cables, HT (33kV) cables, data communication / control / SCADA / OFC cables as per clause 5.13-5.15, 5.19-5.20. Note: 1 AU = 25% of total work as certified by BHEL site in-charge.	1 AU
19	I&C: Erection of indoor and outdoor electrical panels (LT DB boards of all types, VCB panels, UPS with battery, FCBC/ battery bank, SCADA panels, Metering panel, etc.) on covered platforms/sheds at the Transformer yard locations in the PV yard rooms including grouting of panels, laying/fixing of cable trays, routing/terminations of cables at the electrical panels and up to LV side of transformers in the switchyard as per clauses 5.17-5.20. 1 AU = Work proportionate to one inverter room.	1 AU
20	I&C: Erection of 33kV transformer yards (attached to LT panels platforms) with necessary land leveling within switchyard, laying of underground earth mat grid, foundation/ erection of transformers, underground cable trenches, laying/termination of 33kV/ LT / data / control / SCADA cables between yard and the control room panels, Stone Aggregate, fencing and gate for switchyard, drains/ drain pipes etc. as per clause 5.21. Note: 1 AU = Work proportionate to one control room & 2nos transformer yard.	1 AU
21	I&C: Erection of indoor electrical panels (VCB panels, AC/DC DB boards/panels, UPS system, FCBC/ battery banks, SCADA panels etc.) in the main control room including grouting of panels, laying/fixing of cable trays, routing/terminations of LT/HT power/control cables to the electrical panels and to 33kV side of 3.15 MVA transformers in the switchyards etc. as per clauses 5.17-5.20.	1 AU
22	I&C: Installation and commissioning of SCADA system by integrating the data cables from all the electrical and weather monitoring equipment's of the power plant at the data logger/ PLC panel / HMI computer control desk at main control room etc. as per clause 5.26-27.	1 AU
23	I&C: Earthing system for solar array field including laying of underground earth mat grids and interconnection to the module mounting structures, I&C of lightning protection system (lightning arrestors) with earthing provisions and separate electronic earthing for SCADA & String inverters per clause 5.29, 5.31	1 AU
24	I&C: Earthing system for inverter rooms, main control room and 33kV transformer yards including laying of underground earth mat grids, earth chambers with lids, laying/termination of earthing strips from all electrical equipment to earth mat grid, writing earthing values on chamber etc. as per clause 5.30.	1 AU
25	I&C of plant lighting system including outdoor cable laying, cable terminations at poles/lights as well as DB boards of inverter rooms / main control room etc. as per clause 5.28.	1 AU

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26	I&C of Water washing system for module cleaning system including trenches for pipelines, laying of pipelines from Sump to water tanks in solar array field, erection of pumps, valves etc as per clause 5.32.	1 AU
27	I&C of miscellaneous and safety items such as, cable tags, cable markers, hoarding board, sign boards, danger boards, display boards, electrical insulation mat, chequered plates, air conditioners, office furniture, fire extinguishers, fire alarm system, weather monitoring system, items for remote connectivity of SCADA, identification markings using painting etc as per clauses 5.16, 5.17, 5.36-5.42.	1 AU
28	Installation of Pre-Engineered Buildings including civil works for 1 No. Control room, 2 Nos. Security rooms and 2 Nos. RTU rooms as per clause Annexure.	1 AU
29	I&C of CCTV system and Intercom system as per clause 5.35.	1 AU
30	I&C: Pre-commissioning inspections/ checks/tests, MRT tests, coordination/liaison with state /central departments/CEIG etc. for necessary approvals/clearances for commissioning, synchronization with grid/ plant commissioning as per clause 5.46	1 AU
31	Operations and Maintenance per month as per clause 7.0.	60 Months

BHEL scope

For clarity to the vendor, other items and activities within BHEL scope of AC part (up to and inclusive of 33kV 2pole connection to grid) of solar PV plant end of the project are listed below:

1	Supply of PV Modules	~18240 Nos
2	Supply of Module Mounting structures 2X5 type	~912 ST
3	Supply of string inverters	101 Nos
4	Supply of Inverter transformers	2 Nos
5	Supply of indoor type 33KV VCB panels	1 Set
	Supply of 1CX6 sqmm, 1.8 KV, copper conductor, Unarmoured, XLPO insulation as per EN50618 standard	~100 KM
	Supply of LT cable, 4C x 16, Cu, XLPE, armored as per IS: 7098 (from String inverter to ACCB)	approx. 7 KMS
	Supply of LT cable, 1Cx 400sqmm Al, XLPE, armored as per IS 7098 (ACCB to LTPDB, LTPDB to LT side of transformer)	approx. 5.5 KMS
6	Supply of SCADA and RTU panels	1 Set
7	Supply of RS485 cables for string inverter to SCADA panel	~ 5 KM
8	Supply of Ethernet cables for SCADA panel to PC (SCADA System)	As required
9	Supply of OFC cables along with termination kits. Also, termination of the cables at both ends (SCADA panels of inverter rooms, SCADA panels of main control room)	~ 600 M

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10	Supply of GPS time synchronization (master clock) to interface with ABT meter.	1 No.
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4.0 Instructions to vendors on bid submission

4.1	Offer shall be submitted in two-parts (Two part-bid). Both parts shall be in separate sealed envelopes as per instructions in tender. The individual envelopes shall be enclosed in a common bigger envelope with markings (address etc.) on the envelope as per instructions provided in tender.
4.2	First-part shall be techno-commercial bid. Following details shall be furnished: 1. Technical offer with covering letter expressing acceptance to BHEL tender specification. 2. Separate list of clause-wise in case of deviations, if any. 3. Filled-up enclosures as per BHEL formats (meant for first-part) provided in tender.
4.3	Second-part shall be price bid with filled up enclosures as per BHEL formats provided in tender.
4.4	In addition to the above instructions, tender document provides detailed instructions for bid submission. Vendor shall submit the bid based on instructions in tender document.

5.0 Technical specification for design, supply, installation and commissioning

#	BHEL specification
5.1	Design and drafting Vendor shall either have in-house design expertise (or) shall outsource consultancy in case of inadequacy of internal expertise. Vendor shall carry out electrical / mechanical / civil design computations wherever applicable. Typical design areas are as listed below. (1) Computation of cable drop, power loss, rating etc. for LT aux power cables (2) Selection basis/computations for data and control cables (3) Earth mat calculations for main control room, & transformer yards (4) RCC foundation design calculations for 3.15MVA transformers and auxiliary transformer (5) Lightning arrestors – area coverage calculation and lightning protection layout (6) Illumination lux calculations and layout design for plant lighting poles (7) Layout design for String Inverters and ACCBs (8) Cross section/ layout design for underground trenches or Cable Trestle and Tray arrangement (for laying LT / HT/ control/ OFC cables) (9) Layout design for 33kV transformer yard including LTPDB of canopy type construction. (10) Battery bank sizing calculations for UPS, FCBC (11) Layout design of LAN and Wi-Fi Network at Project site (12) Structure Earthing layout, separate string inverter earthing layout, Transformer yard earthing layout, control room earthing layout etc. The above list is indicative and not exhaustive. Wherever BHEL/HPPCL finds applicability, vendor shall carry out design and submit documents viz. GA drawings / datasheets / GTP / MQP/ type test reports etc for BHEL/HPPCL approval. Note: Design and drafting is not a separate billing item. These activities shall be treated as integral part of the related supply and I&C items of the tender.

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5.2	Electrical power / water for construction, drinking water (1) Construction Power shall be made available at site by HPPCL on commercial charge rate. (2) Vendor shall on their own organize to provide necessary Electrical Panel with Safety devices and required cables to tap this power from the HPPCL provided point and draw it to locations where power is required for work. However, in case HPPCL power supply fails, vendor shall put in place back up power supply arrangement of DG set required for construction activities
5.4	Construction of open yards/ covered sheds for safe storage of all items except PV Modules and MMS (1) Vendor shall, at a suitable location at the site, as decided based on discussions with BHEL site engineer, construct temporary yards/sheds for safe storage of vendor supplied items. (a) Open storage yard (without roof) with fencing all around and a gate. This shall be for storage of items supplied by the vendor such as UPS panels, earthing materials, Plant lighting poles/ bend pipes etc. (b) Covered shed with a lockable door for storage of light-weight items such as control cables (in drums), spare parts, tools, measuring instruments, other lighter construction materials. (c) Separate storage yard shall be used for civil construction items such as cement bags. (2) Area of storage yards/cabins shall be selected based on sizes of storage items. Vendor shall submit drawings/ sketches/ dimensions etc to obtain approval from BHEL. (3) Wherever applicable, suitable raised platforms / arrangements shall be provided to ensure that the items are not affected by water at the ground level during rain, storm, flood etc. (4) Storage yards shall have clearance (within the yard) for movement of concerned transportation vehicles/ equipment's such as forklifts, hydra, trucks etc as applicable.
5.5	Unloading, safe storage and movement of supply items received at site: A. Items supplied by vendor (1) Vendor shall organize all necessary resources such as labour, machinery and tools (cranes, hydra, forklifts, transportation trucks/ trolleys, lifting accessories etc) for unloading the items (supplied by the vendor) received at site and subsequent movement to storage yards. (2) Similar arrangements shall also be made by vendor for movement of the stored items from storage yards to the exact construction locations within the project site. (3) Vendor 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. (4) Registers shall be maintained for the yard to keep track of incoming / outgoing items. (5) Safety of supplied items shall be in vendor scope. Accordingly, suitable watch and ward shall be deployed on round-the-clock basis. B. All other items (supplies from BHEL and other vendors) (1) Receipt, unloading, storage, security guards shall be in scope of BHEL/ other vendors. (2) However, movement of these items from their respective storage locations to the points of construction is in scope of vendor. Accordingly, vendor shall organize all necessary resources such as labour, machinery and tools (Crane, forklifts, transportation trucks/ trolleys, lifting accessories etc) for this purpose.
5.6	Series interconnection of SPV modules to form strings Supply of SPV modules is in BHEL scope. Type of module: L24270 (~320Wp) as per BHEL drawing enclosed with tender. Vendor shall interconnect the SPV modules as follows:

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	(a) Each module is fitted integrally with a junction box having positive and negative polarity cables (4 sq-mm). (b) Positive cable of one module shall be connected to the negative cable of adjacent module. The cables have MC4 type of connectors. One polarity cable has male type connector, while the other has female type connector. (c) This way, 20 modules shall be connected in series. Each set of connections is called as a series string. Thus, a total of 912 strings shall be connected to achieve 912x 20x ~320Wp = ~6.34 MWp (DC). (d) After placing the purchase order on vendor, BHEL will provide layout drawings that will describe the exact way in which the series strings are formed. Vendor shall implement the interconnection as per these drawings. No. of strings are tentative may vary based on site conditions. Note: All the MMS are of 10 module type. Two structures shall be interconnected to form a string. As the distance between structure to structure is high, both structures shall be interconnected using 6-sqmm cable with MC4 connectors on both ends.
5.7	Installation of string Inverter including supply/erection of mounting structures (1) Supply of string Inverters (SI), 101 nos, is in BHEL scope. These are 10-in/ 1- out type. This way, on input side of SI, there are 9/8 series strings connected in parallel based on DC SLD. (2) SI shall be mounted on the Module Mounting structures. Provision will be provided in the Module mounting structure to mount the SI. However, necessary hardware and accessories required for mounting the SI shall be in the vendor scope of supply. Structures for mounting the String inverters and their separate Fuse box/Connection box if any are in vendor scope of supply. (3) Typical drawing (for tender purpose only) is enclosed along with this specification. Vendor shall design the fixture based on the actual SI drawing/datasheet that shall be provided by BHEL after placement of purchase order. Vendor shall submit the drawing/BoM of complete mounting fixture for BHEL/HPPCL approval during detailed engineering. (4) Supply of hardware for mounting the SI on the mounting structures is in vendor scope. (6) Vendor shall install the SI on the module mounting structures. (7) All necessary labour, tools, machinery etc for erection work shall be in vendor scope.
5.8	Interconnection of SPV module strings to 1Cx6 cable (1) Vendor shall connect each series string of 20 SPV modules to String Inverter using 1Cx6 cable (1.8 KV, copper conductor, Un armoured, XLPO insulation as per EN50618 standard). Supply of cable shall be in BHEL scope. (2) SPV module is provided with positive and negative cables (1Cx4 sq.mm.) having male and female parts of MC4 type connectors. (3) Vendor shall supply plug connectors of MC4 out door type, each set having a pair of male and female parts, to join both the 1Cx6 cables. (4) MC4 out door connectors (IP65) shall have rating of 1000VDC (IEC), rated current of 30A, Type approved by TUV Rheinland for product safety. (5) Approved make: Multicontact, Bizlink, Sunlont or other reputed equivalent subject to BHEL/HPPCL approval during detailed engineering. (6) Total quantity of MC4 connector sets required = 3,000 sets (each set having a male and a female part) that include 2736 sets to complete installation, 264 sets as mandatory spares. Vendor shall ensure that there shall not be any shortage during execution time. (7) Two sets of tool kits (with box enclosure) shall be supplied. This shall include crimping plier MC4, open end spanner set MC4, stripping plier MC4, socket wrench insert to tighten, socket wrench insert to secure, inserts.

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5.9	Ferruling for 1Cx6 cable 1) For 1Cx6 sq.mm DC solar array cable, vendor shall provide UV resistant ferrules printed with source/destination identification of cable. Printing details shall be submitted for BHEL/HPPCL approval during detailed engineering. Printing shall be of appropriate size to ensure readability. 2) Supply of ferrule shall be in vendor scope. Make shall be reputed brand and approval shall be obtained from BHEL/HPPCL prior to procurement for make, type, color, size/ dimension. 3) Ferrules shall be provided on both the termination ends: module end, String Inverter end.
5.10	Routing of 1Cx6 cable below the SPV modules (1) 1Cx6 sq-mm cables connecting the SPV module strings to String Inverter shall be suitably routed below the SPV modules and along the horizontal C-lip purlin member of MMS structure through hard PVC conduits and suitable PVC fittings. Also, the cables and conduits shall be fastened to the purlin using UV resistant cable ties. To allow MMS tilting, sufficient slack length shall be allowed in 6 sq.mm cable runs in between each MMS such that cables will not get pulled while each successive MMS is being tilted. (2) Cable ties shall be in vendor scope of supply. (3) Cable ties, nylon polyamide 6.6 UV stabilized black, UL94 flammability rating V2, operating temperature up to 85 deg C, shall be used to arrest any possibility of movement or sagging. Cable ties shall be of make: 3M, Phoenix contact, Weidmuller, Hellermannntyton, Panduit or other reputed equivalent subject to BHEL/HPPCL. Width of the cable ties shall be a minimum of 4.5 mm. Length shall be so appropriate as to ensure that the bunched cables are held firmly to the mounting structure. During detailed engineering, BHEL/HPPCL approval shall be obtained for the selected brand and sizes of cable tie. (4) Spacing between two adjacent cable ties shall be so appropriate as to ensure that there is no loose hanging of cables.
5.11	Routing of 1Cx6 cable in pipes underground between the rows of solar array (1) Where 1Cx6 cables run between two rows of structure (or) where the cables cross over the pathway separation between two adjacent solar array blocks, HDPE double walled corrugated (DWC) pipe shall be provided to route the cables underground from one row/block to the other. In such a case, the pipe shall also be laid vertically to cover the distance from purlin to the ground on either ends. Vertical arrangement shall be firmly tied to the MMS structure using suitable cable ties. (2) HDPE DWC pipe together with necessary HDPE couplers/joints (T-joints, elbows, bends etc) shall be within scope of vendor supply. Vendor shall submit the bill of materials and the drawing showing the details of routing for BHEL/HPPCL approval during detailed engineering. (3) Specification of HDPE DWC pipe: As per IEC 61386 part 1-4; ID shall be selected to accommodate the number of 1Cx6 cables to be guided. ID shall be such that only a maximum of 60% of the ID space is occupied by the cables. Make, part number, sizes/ dimensions shall be submitted for BHEL/HPPCL approval during detailed engineering. (4) Cables with HDPE pipe (and couplers/joints etc) shall be directly buried underground as per IS: 1255. a. Trench depth = 750 mm minimum b. Trench width = As per conduit size and number of conduits c. Bottom layer shall be sand as per IS: 383 with 75mm minimum thick. d. HDPE conduit with cables shall be laid over the sand layer. e. Another layer of sand as per IS: 383 with 75 mm minimum thick. f. Single layer of brick as protective cover g. Trench shall, then, be filled with refill soil and compacted

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	(5) Total length of HDPE DWC pipe and quantity of couplers/joints shall be as required. (6) Bending radii for cables shall be as per IS: 1255. (7) At road crossings, cables shall be routed through GI pipe of appropriate size that shall be in vendor scope of supply and technical details/ brand etc. shall be submitted for BHEL/ HPPCL approval during detailed engineering. (8) All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant (single component thermoplastic insulating compound) to ensure water proof tightness. Make, item description, part number etc. shall be submitted for BHEL/HPPCL approval during detailed engineering.
5.12	Termination of 1C x 6sq mm cu (DC side), 4 C x 16sqmm cu (AC side) cables at string inverters & ACCB boxes (1) 1Cx6 cables of positive and negative polarities originating from SPV module strings shall be terminated at the DC input side of string inverters (SI) using MC4 connectors that are in BHEL scope of supply at cable end and string inverter end. For AC side connection at string inverters and ACCB boxes, AC power cable of 1.1 KV, 1R, 4Cx16 sq.mm Cu, armored, overall FRLS cable, PVC outer sheathed conforming to IS 7098 (from SI to ACCB), together with nickel plated brass double compression cable glands, Al cable lugs, SS304 bolts/ nuts/ plain and spring washers shall be in vendor scope of supply. Termination shall be carried out using appropriate tools and torque setting as per BHEL/HPPCL approval.
5.13	Supply and installation of AC combiner boxes (1) AC combiner boxes(ACCB), qty. 12 no's, 9 Incomer and 1 out goer combining the 3-phase AC outputs of the string inverters shall be in vendor scope of supply and installation. (2) ACCB shall be 3-phase, 50Hz, 415VAC, 1.1kV system voltage, outdoor, with canopy, IP55, neoprene gasket for doors/ frame joints, CRCA sheets 2mm (frame)/ 1.6mm (door)/ 3mm (removable gland plate bottom side), painting seven tank process, color RAL 7032, base frame with section 75mm min/ black painted, panel lifting hooks, Al bus bars as per SLD, RYB colour coded heat-shrinkable sleeves for bus bars, Al earth bus, accessible live parts shrouded with FRP/polycarbonate sheets, MCCBs for i/c feeders, 25mm min phase to phase clearance, LED indicators for RYB at o/g, colour coded Cu-cable AC/DC wiring (1.5/2.5 mm² as applicable) etc. For the incoming and outgoing power cables, nickel plated brass double compression glands, Al cable lugs, SS304 plain/ spring washers shall be provided. (3) Extra feeders (including two spare feeders) shall be provided to meet the various auxiliary supply requirements for WMS, module washing pumps, data loggers etc. (4) MCCB of 100 A shall be L&T/C&S/Siemens/ABB/ Schneider or reputed equivalent subject to BHEL approval. (5) Indicator lamps shall be L&T/ C&S or reputed equivalent subject to BHEL approval (6) Vendor shall submit the detailed GA, SLD, BOM, MQP etc of ACCBs for BHEL/HPPCL approval during detailed engineering. (7) Spare shall be supplied as follows: (a) MCCB: 5 Nos each type (b) LED indicators: 3 Nos each type

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	(8) Vendor shall install the ACCB boxes using 1:2:4 concrete pedestals of appropriate size. This shall be a two-column structure with two independent pedestals. The structure shall be made of GI ISA / cold-formed angles of minimum 3mm thick as per IS: 2062, IS: 811, IS: 808 as applicable. (9) Minimum ground clearance shall be 500mm. (10) All galvanizing shall be minimum 80 microns and as per IS: 4759, IS: 2629, IS: 2633 (11) Vendor shall submit GA of the mounting structure along with stability calculations (STAAD.pro etc) for BHEL/HPPCL approval during detailed engineering. (12) All structure/pedestal items including hardware shall be in vendor scope of supply. Note: Refer SLD for equipment specifications.
5.14	Underground cable trenches, Supply and laying of 1Cx400, RS485 and OFC cables in solar array field 1.1 KV, 2R, 1Cx400 sqmm, Aluminium conductor, XLPE, armored, overall FRLS cable, PVC outer sheathed conforming to IS 7098 (from ACCB to LTPDB), Data cable RS485 (from SI to SI for looping) and OFC cable from RTU to Control room SCADA panel shall be laid underground by way of direct burying as per IS:1255 or wherever feasible through Trestles and cable tray arrangement. Supply of the cables shall be in Vendor scope. Typical trench details/dimensions are below only for tender purpose. During detailed engineering, cable trench layouts and cross section drawings as per IS: 1255 shall be submitted for BHEL/HPPCL approval. (a) Total trench depth = 750 mm minimum for LT cables and 1000 mm for HT Cables (b) Trench width = As per number of cables laid. (c) Trench shall have layers one over the other as below (from bottom to top): 1. Bottom layer shall be sand of IS: 383 with 75mm minimum thick. 2. 1Cx500 cable shall be laid over the sand layer. 3. Another layer of sand of 75 mm minimum thick. 4. Single layer of brick as protective cover 5. Layer of sand of IS:383 with 75mm minimum thick 6. RS485 and OFC cable (armoured) shall be laid in HDPE duct. Supply of HDPE pipe for RS 485 cable and OFC cables in Vendor scope 7. Layer of sand of IS:383 with 75mm minimum thick 8. Single layer of brick as protective cover 9. Trench shall, then, be filled with refill soil and compacted Data communication (RS 485) cables shall be laid between String Inverter to form daisy chain loop (Not more than 15 SI in one loop or 1000mtr length) and from the end SI of each loop, optical fiber cable shall be laid to the SCADA panel in the control room. Bending radii for cables shall be as per IS: 1255. At road crossings, cables shall be routed through GI pipe of appropriate size that shall be in vendor scope of supply and technical details / brand etc shall be submitted for BHEL/HPPCL approval. Vendor shall take utmost care in laying the cables in order to prevent damages on outer sheath and inner insulation. In case cables found to be damaged/ cut after the laying in trenches, vendor shall remove the damaged portion and join.

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5.15	Supply and installation of LTPDB combiner boxes (1) LTPDB, Four panels, 1600 kVA each, 2 nos per 33kV transformer yard, combining the 3-phase AC outputs from the six ACCBs boxes shall be in vendor scope of supply and installation. (2) LTPDB 3-in/ 1-out shall be 3-phase, 50Hz, 415VAC, 1.1kV system voltage, outdoor, with canopy, cubicle design, compartmentalized (Breaker/ control box/ CTPT chamber etc), floor mounted, free standing IP55, neoprene gasket for doors/ frame joints, CRCA sheets 2mm (main frame)/ 1.6mm (door)/ 3mm (removable gland plate bottom side), painting seven tank process, color RAL 7032, MS base channel 75x40x6 min/ black painted, panel lifting hooks, Al bus bars as per SLD, RYB color coded heat-shrinkable sleeves for bus bars, Al earth bus, accessible live parts shrouded with FRP/polycarbonate sheets, 800A MCCBs as per SLD for I/C feeders, 2500A EDO ACB as per SLD and with microprocessor based controls and motor operated for o/g feeders, SPDs, 25mm min phase to phase clearance, LED indicators for RYB at o/g, digital MFM cl:0.5 with RS485 port at o/g, color coded Cu-cable AC/DC wiring (1.5/2.5 mm² as applicable), panel illumination lamp, space heater, thermostat etc. For the incoming and outgoing power cables, nickel plated brass double compression glands, Al cable lugs, SS304 plain/ spring washers shall be provided. (3) An auxiliary supply feeder, 32A MCB shall be provided with changeover switch for auxiliary supply purpose. (4) Two no's of CTs of 2500/1A, CL:0.5,5VA shall be supplied - one for metering purpose and another for future purpose (5) Digital MFM shall be EM6300 of Schneider (6) MCCB, ACB shall be ABB/ Schneider (7) Earth fault relay with CBCT from L&T/ C&S/ ABB/ Siemens/ Schneider or reputed equivalent subject to BHEL approval (8) MCB: L&T/ C&S/ ABB/ Siemens/ Schneider or reputed equivalent subject to BHEL approval (9) Indicator lamps shall be L&T/ C&S or reputed equivalent subject to BHEL approval (10) Vendor shall submit the detailed GA, SLD, BOM, MQP etc. of LTPDBs for BHEL/HPPCL approval during detailed engineering. (11) Spares shall be supplied as follows: (a) MCCB: 1 No each type (b) SPD: 2 Nos each type (c) LED indicators: 3 Nos each type Vendor shall install the LTPDB panels of canopy type construction in 33kV switchyard using RCC foundation for which design/ GA shall be submitted for BHEL/HPPCL approval during detailed engineering. Note: Refer SLD for equipment specifications.
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5.16	Supply & laying of 1Cx400/ RS485 cables and terminations at Transformer LT/SCADA (1) 4 Runs of 1Cx400 cables (Al conductor, XLPE, armored, overall FRLS cable, PVC outer sheathed conforming to IS 7098: Vendor scope of supply) and RS 485 (unarmored, Vendor scope of supply) running from LTPDB shall be routed into the respective Transformers and laid on the cable trays therein. Supply and laying of cable trays within the Switchyard shall be in vendor scope of supply. Vendor shall route/lay/dress the cables neatly on the trays. Cable ties shall be in vendor scope of supply. RS 485 Cable shall be laid inside the HDPE pipe. The minimum clearance of 300 mm between AC cable and Rs 485 cable shall be maintained (2) Vendor shall carry out drilling of holes in cable gland plates, holes for entry of RS 485 cables into SCADA panels. Gas cutting method is strictly not allowed. Vendor shall organize hole-saw cutters of appropriate size for this purpose. All necessary drilling machines / tools etc. shall be made available at site. (3) Prior to termination, each cable shall be checked for continuity and megger. In case any cable found defective, vendor shall implement suitable corrective action such as cable jointing, replacement/relaying of cable etc as applicable. (4) Vendor shall carry out glanding of the cables following which the glands shall be fitted to the respective holes of gland plates. (5) Vendor shall carry out the 1Cx400 cable terminations that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightening using torque wrench etc. Glands (metallic, double compression), bimetallic cable lugs (Cu/Al), SS304 bolts/nuts/plain washers/spring washers shall be in vendor scope of supply. (6) Vendor shall carry out the RS485 cable terminations at SCADA end that include tasks such as unsleeving, crimping, connecting to the tinned copper bus bars, tightness using torque wrench etc. Shield of the cables shall be properly earthed at SCADA end. Cable glands (metallic, single compression), cable lugs (appropriate type/size), SS304 bolts/nuts/plain washers and Zinc/epoxy coated spring washers etc as applicable shall be in vendor scope of supply. (7) Vendor 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. (8) Vendor shall submit details of cable glands/lugs/ties/hardware (Make, part number, size, quantity etc) for BHEL/HPPCL approval. Glands shall be of COMET make or other reputed equivalents subject to BHEL/HPPCL approval. Cable lugs shall be of Dowell/ 3D/ Braco or other reputed equivalents subject to BHEL/HPPCL approval. (9) All tools/accessories such as crimping tools etc required to carry out the termination shall be within scope of vendor.
5.17	Identification marking of cables using cable tags 1) Cable tags shall be provided on 4C X 16 sq mm Cu AC cables at both ends (SI end, ACCB end) just before entering the equipment enclosure. 2) Similarly, for RS485 cables at SI end and SCADA end. 3) Cable tags shall be of rectangular shape. 4) 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. 5) Vendor shall submit the technical details of cable tags, ID numbering scheme for BHEL/ HPPCL approval during detailed engineering.
5.18	Supply & Installation of electrical panels within main control room Panel installation within main control room: (a) 33kV VCB panels: 1 set (2 incomers + 1 Outgoer + 1 Aux outgoer)- HT/VCB panel in BHEL scope of supply.

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	(b) ACDB main panel: 1 set (c) Distribution boards (wall mounted): DCDB, UPS DB, CR DB (room utilities), LDB (plant lighting), PDB (power DB): 1 No each + any extra boards as required (d) SCADA panel: 2 Nos (e) HMI SCADA control desk with PCs and accessories: 1 set (f) UPS with battery bank (for SCADA/emergency loads etc.) – 1 No (g) FCBC battery charger – 1 No (h) Battery bank – 1 No (i) Panels shall be moved to the respective positions and placed over the cable trenches in control room, in the exact sequence and locations as per vendor drawings approved by BHEL/HPPCL. (j) VCB panels shall be placed on cable trench of main control rooms, with cable entry openings to match cable trench on bottom side. (k) 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 vendor scope of supply.
5.18	Supply & Installation of cable trays, cable laying/dressing etc in main control room A. Installation of cable trays (1) Vendor shall supply and install cable trays, fittings and accessories within control room for laying 33kV HT, DC/AC LT, control, communication cables etc as per “Cable installation methodology” section of this specification. Cables trays shall be ladder type with horizontal corner bend pieces. 750mm minimum width, 3mm minimum thickness and appropriate height. Drawings/ make/ part number of these shall be submitted for BHEL/HPPCL approval. (2) Vendor shall place and fit these cable trays over steel support structure (angles, sections etc) that are provided in the cable trenches of main control rooms by Vendor (3) Cable trays shall be in three vertical layer arrangements: bottom for 33kV cables, middle for LTAC/DC cables and top for control/data/ communication cables. (4) Suitable cut outs, wherever applicable, shall be made in the cable trays to provide path for the cable to reach the panel. (5) Adjacent cable trays shall be interconnected using suitable hardware items. Cable trays shall be double earthed to the earth mat grid of the room. B. Cable routing, laying, dressing (1) Cables entering into the main control rooms from outside (solar array/ transformer yards) shall be bunched appropriately LT/HT/control category wise. The multiple bunches shall be routed through PVC conduit pipes (strong and durable) of appropriate type, diameter and length that shall be fixed below the plinth beam of room. (2) Such PVC conduit pipes shall be in vendor scope of supply. Vendor shall make appropriate assessment of size of PVC pipe considering 50% max allowed filling of the pipe by the cables. Layout drawings of PVC pipes shall be submitted for BHEL/HPPCL approval during detailed engineering. (3) Cables (HT, LT, communication, control etc) shall be laid on cable trays in separate tiers with appropriate spacing as per IS: 1255. (4) Control/ data/ instrumentation cables that run from inverter to marshalling box of inverter transformers shall be routed through HDPE DWC conduit pipes of appropriate size.

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	(5) Cables shall be dressed using appropriate cable ties at appropriate intervals to ensure firmness of their position over the trays. (6) Trefoil clamps shall be used wherever single core cables are used for three phase system. These clamps shall be at appropriate intervals to ensure firmness of bunching of cables. (7) All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using appropriate sealant to ensure water proof tightness. (8) All cable accessories such as cable conduits/pipes, ties, trefoil clamps, sealants etc for the above purpose shall be in vendor scope of supply. (9) All the supply and installation works as mentioned above shall be as per “Cable installation methodology” section of this specification and as per drawings approved by BHEL/HPPCL during detailed engineering.
5.19	Supply, laying, termination of LT/HT/aux supply cables (1) For all electrical panels viz PCUs/ VCB panels, UPS/ battery charger/ battery bank /DB boards and inverter transformers laying and termination of LT/HT/Aux power cables shall be in vendor scope. (2) For all electrical panels viz VCB panels/ ACDB panel/ UPS/ FCBC battery charger/ Battery bank / DB boards / aux transformer of main control room, laying and termination of LT/HT/Aux power cables within the room shall be in vendor scope. (3) All cables required for plant operation shall be in vendor scope of supply. (4) All aux cables shall be in vendor scope of supply. Sizing shall be as per design calculations. Vendor shall submit make/ GTP etc for BHEL/ HPPCL approval during detailed engineering. (a) ACDB panel of main control room to SDB boards of LT panels in Transformer yard rooms: 3.5 core, 1.1kV, Al, XLPE, armoured, PVC FRLS as per IS: 7098. /IEC 60189,IS694/IS1554,IS/IEC69947. (b) All other aux power cables: Cu/Al, PVC, armoured, PVC FRLS, IS: 694, 1554. Refer section “Auxiliary AC/DC power supply system” of this specification. (c) Lengths of all above cables shall be assessed by vendor based on indicative layouts of main control room enclosed with the tender. (5) Cable glands, cable lugs, 33kV HT cable termination kits (indoor/ outdoor types as applicable), bolts, nuts, washers etc shall be in vendor scope of supply. For power terminations of LTPDB AC side and Inverter transformer LV side, bimetallic (Cu/Al) lugs shall be provided by the vendor. Other lugs shall be Cu or Al as applicable. (6) Make of cable lugs: Dowell/ 3D / Braco or any other reputed equivalent subject to approval of BHEL/HPPCL.

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	(7) Glands shall be nickel plated brass double compression for PCU/ transformer power cables. For marshalling box of transformer/ UPS/ SCADA/ DB boards, single compression nickel plated brass glands shall be provided by vendor. Make shall be COMET or reputed equivalent subject to approval of BHEL/ HPPCL. (8) HT termination kits (indoor/ outdoor as applicable) shall be 3M/ Raychem or reputed brand subject to BHEL/HPPCL approval. HT termination shall be carried out by certified jointers. Credentials / certification of experience from 3M/ Raychem etc for the proposed jointers shall be submitted for BHEL/ HPPCL approval during detailed engineering. (9) Vendor shall make appropriate holes in the gland plates of PCUs, HT VCB panels, UPS panel, Distribution boards etc for fixing the cable glands. Gas cutting is strictly prohibited. Hole-saw cutters of appropriate sizes with suitable drilling machines shall be made available at site for this purpose. (10) Terminations with M10 and above shall be tightened using torque wrench. Torque setting shall be as per size, property class of bolt. BHEL approval shall be obtained for the settings prior to tightening. (11) All resources such as labour, machinery, tools and accessories to carry out the above electrical works shall be in vendor scope. (12) All applicable/relevant clauses under “General specification of LT cables” and “Cable installation methodology” sections of this specification shall be adopted for all aspects of these cables such as technical specifications (ratings, sizes, calculations etc), cable selection, tests on cables, cable installation, cable accessories etc.
5.20	Supply, laying and installation of Control / data / instrumentation / OFC cables / WIFI routers, Intercom cables, CCTV data and communication cables (1) Vendor shall supply the following SCADA related data communication cables - String Inverter to SCADA panels in respective HT Yard room/ control rooms (Ethernet/LAN cables) - Protection relays of VCB/C&R panels to SCADA in inverter/control rooms (Ethernet/LAN) - MFM meters of LTPDB, VCB/ACDB/FCBC/C&R panels to SCADA (RS485, 2Px0.5) - C&R panels, ABT meters of main control room (RS485, 2Px0.5) - LAN cables within SCADA network - OFC cable from String inverters to SCADA panel in main control room 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 vendor scope of supply. Cable laying and cable terminations shall be in vendor scope. All necessary resources such as labour, tools and accessories required to carry out laying and termination works etc shall be in vendor scope. (2) All the other cables such as (i) control cables from inverter transformer marshaling 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 marshaling boxes to SCADA panels (4-20mA signals, WTI/OTI values), (v) control cables from metering CTs/ PTs of 33kV VCB out goer panel to ABT metering panel shall be in vendor scope of supply. (a) Control and instrumentation cables: - Control cable shall be 1.1 KV, PVC Insulated, Armoured, FRLS PVC sheathed, Copper conductor cables. Cable specification shall be 12C/16C/3C of 2.5 sq-mm minimum, copper conductor.

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	• All the cable installation accessories such as cable trays, cable conduits, cable glands, cable lugs, bolts, nuts, washers etc shall be in vendor scope of supply. • Cable laying and cable terminations shall be in vendor scope. Make shall be reputed brands subject to BHEL/HPPCL approval. • Design calculations for cable selection together with GTP/datasheet particulars, make etc shall be submitted for BHEL/HPPCL approval. Similarly, No of cores, length requirements shall be appropriately assessed by the vendor. • All necessary resources such as labour, tools and accessories required to carry out laying and termination works etc shall be within scope of vendor. (b) Vendor shall lay OFC cables underground in the conduit from end string inverter in each loop to main control room SCADA panel and RTU panel at each transformer location to main control room. Supply and Termination of the OFC cable at both the ends shall be in BHEL scope. Supply of HDPE conduit shall be in vendor scope of supply. (3) Vendor shall supply, lay and terminate the RS485 cables to SCADA from (a) MFM meters of LTPDB (b) MFM meters of VCB panels, (c) MFM meters of ACDB panel, (d) MFM meters of C&R panel, (e) 4 nos. ABT meters for 33kV side and (f) Fire alarm panels, (g) Weather monitoring station. (4) Vendor shall lay and terminate the Ethernet cables to SCADA from (a) SI (b) numerical relays of VCB panels, (c) numerical relays of C&R panels. These cables shall be laid between the panels of respective inverter/ main control rooms. (5) All applicable/relevant clauses under “General specification of LT cables” and “Cable installation methodology” sections of this specification shall be adopted for all aspects of these cables such as technical specifications (ratings, sizes, calculations etc), cable selection, tests on cables, cable installation, cable accessories etc.
5.21	Erection of 33kV transformer yards – 2 nos (1) Two of the four LTPDB is attached to each transformer yards. (2) Vendor shall design and construct RCC foundations for the two transformers as per relevant clauses of “General civil works” section of this specification, geotechnical investigation report (soil report), the transformer weight / dimensions etc. In addition, following points shall be taken into account. - Approximate total weight of 3.15MVA inverter transformer ~9,000 Kg - Approximate total weight of auxiliary transformer ~ 500 Kg - Soil report will be submitted to vendor prior to price bid opening. - Foundation structure shall include appropriate layers of PCC, sand, boulders, RCC portions etc as per design requirements. - Foundation depth shall be as per design requirements. - Foundation pedestal height above the finished ground level 500 mm minimum. (3) Individual oil pits for the transformer, interconnectivity between the pits, oil collection pit, transformer track rails, stone gravels / fencing / gates of transformer yards, finishing works such as plastering/ painting etc shall be as per relevant clauses of the “General civil works” section of this specification and as per relevant IS standards / CBIP/ CEIG requirements etc. (4) Hardware arrangements (transformer track rails, angles, steel bolts, plates, nuts, washers etc), which will be part of foundation pedestal, shall be as per transformer GA drawing. GA drawing of inverter transformer shall be provided by BHEL during detailed engineering. (5) Vendor shall erect the transformers on RCC foundation as per transformer GA details. Vendor scope of I&C of transformers shall include:

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	a) Movement of transformers and its accessory parts such as radiators, cable boxes, hardware etc from storage yard and placement on foundation pedestal. b) Assembly of transformer parts. c) Cable laying and terminations at LV/HV/Marshalling boxes of transformers. For this required material like cable tray, support structure, hardware etc is in vendor scope of supply. d) 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 (>60 kV) and PPM (< 15ppm) values. e) Testing of transformers as per “pre-commissioning checks” section of this section. (6) After installation of transformers at the transformer yards, vendor 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, vendor 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. 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 of appropriate size shall be in vendor scope of supply. (7) Fencing and gate shall be provided for transformer yard as per section “General civil works” of this specification. All supply items shall be in vendor scope. (8) Vendor shall provide applicable earthing connections to transformers, fencing / gates etc in the yard as per relevant clauses under the “Earthing system” section of this specification. (9) 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 vendor. (10) Vendor shall submit (a) GA drawings / design calculations of transformer foundations/ oil pits, (b) GA/layout/scheme of transformer yard (with appropriate overall size/ dimensions), (c) GA/BoM of fence, (e) GA/BoM of gate etc for BHEL/HPPCL approval, (f) GA for location/layout of aux transformer.
5.22	Underground cable trenches and laying of HT/LT/Control/Instrumentation/OFC cables Applicable/relevant clauses under “Cable installation methodology” section of this specification shall be adopted for burying the cables underground. Accordingly, following cables shall be laid underground by way of direct burying using appropriate layers of sand (75mm each layer), brick layers, refill soil etc to appropriate excavation depth below the ground level (750mm) as per relevant Indian standards (IS:1255), Indian Electricity rule, CEIG/CBIP norms etc related to cable installation practices and procedures: 1) AC aux supply cable from aux transformer to ACDB panel in main control room. 2) AC aux supply cables from DB boards of the main control room to (i) the plant lighting poles, and (ii) booster pumps. 3) AC aux supply / Instrumentation / data communication cables, as applicable, from weather monitoring station data logger to SCADA room in main control room. 4) AC aux supply / Control / instrumentation cables from inverter transformers to HT panels. 5) HT cables (33kV), AC aux supply cables, data communication / control / instrumentation/ SCADA cables from 33kV transformer yards to the related panels in the main control room.

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	6) HT Cable (33KV) evacuation cable from the Control room (HT Out goer panel to be laid up to 4 pole structure with all accessories and Isolator arrangement for injecting power into 33 KV Grid line of HP state Utility grid. Scope is including termination of 33 KV output from the 4 Pole structure to Utility 33 kV Overhead conductor line – complete. 7) Any other cables such as CCTV, Intercom etc. (other than the above) to meet the underground cable laying requirements. Vendor shall avoid jointing of cut pieces of LT/HT cables to form the required length between two termination ends. However, in case of unavoidable situations due to longer routes, vendor shall join the cut pieces using LT/HT straight through joints of appropriate size. Jointing shall be carried out by certified jointers for which approval shall be obtained from BHEL. Cable trench layouts and cross section drawings shall be submitted to BHEL/HPPCL for approval during detailed engineering.
5.23	Auxiliary Transformer (63KVA) – Customer scope of supply, cable supply and cable termination in vendor scope.
5.24	Auxiliary AC/DC power supply system Vendor shall establish an auxiliary AC supply system for (a) various utility power consumption purposes such as control room lamps, ceiling fans, exhaust fans, booster pumps, plant lighting, air-conditioner, other electric appliances, VCB panels, transformers etc and also, for (b) powering the battery chargers that in-turn charge the battery banks for 110V DC supply. Vendor shall submit detailed SLD diagram of Aux AC/DC system with MCB types/ratings for incoming/ outgoing feeders etc for BHEL/HPPCL approval during detailed engineering. The system shall comprise of following items: (a) An auxiliary transformer/Station transformer (1 No) 63kVA, 33kV/415V,3-ph,50Hz Outdoor type along with LT panel shall be provided by HPPCL. All necessary cable supply, cable terminations, cable installation and cable interconnections with VCB panel (on HV side) and with ACDB panel (on LV side) shall be in vendor scope. Both the HV (33kV) and LV cables shall be in vendor scope of supply. (b) ACDB floor-mounted panel, 1 No (fed by 3ph, 4-wire 433V auxiliary transformer supply) that distributes the AC power to various utility applications in main control room shall be supplied, installed and commissioned in main control room by the vendor. The panel shall have incoming feeder supply from aux transformer and outgoing feeders for main control room utility and individually for each inverter room. Incoming as well as each outgoing feeder shall have a separate MFM meter with RS485 communication feature for SCADA connections. (c) Battery bank, Float-cum-boost charger, UPS in main control room: Vendor shall supply, install and commission 1 No each of Battery bank, Dual Float-cum-boost charger, UPS in main control room.

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	1. Battery bank shall be VRLA/MF stationery, sealed type, 110V DC, at 8 hours rate of discharge, IS 1651-1979, performance as per IS:8702, nominal cell voltage 2V, 55 cells, plastic resin/ ABS/ PP container, epoxy coated exhaust fans to remove the gas emissions, suitable battery rack/stand with painted steel sections. Exact Ah sizing shall be finalized during detailed engineering for which calculations shall be submitted for BHEL/HPPCL approval. Minimum rating of the battery shall be 110V, 100Ah for Control room 2. Float-cum-boost-charger with boost current (25A): Battery charger as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Trickle mode i.e. Trickle charging the associated DC Batteries while supplying the DC loads. The chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 50°C. Battery chargers shall have a selector switch for selecting the battery charging mode i.e. whether Trickle or Boost charging. During automatic boost charging, the Battery chargers shall operate on constant current mode. Charger 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. LED indications with alarm annunciation on the panel for Mains ON, Float charger AC ON, Float charger DC ON, Boost charger AC ON, Boost charger DC ON, AC Mains Fail, Float charger DC fail, Boost charger DC fail, DC earth fault, SCR fuse fail, Filter fuse fail, Blocking diode fail, Battery under-voltage, Battery over-voltage, Charger DC overload. LED indications for various parameters: 3-ph AC input voltage, boost/float/trickle currents, charge/discharge currents, DC output voltage/current, Battery leakage current etc. Selector switches for Float Auto/Manual, Boost Auto/Manual, Float/Boost/ Auto boost selector switches. Also, Voltmeter / Ammeter selector switches as applicable. Charger shall have constructional features as per “LT switchgear panels” of this specification. Feeders as below: (i) Incoming feeder – 3ph from ACDB panel in control room (ii) Outgoing feeders min 6 feeders - To HT Panel - To SCADA Panel - To DCDB - At least three spare feeders - 3. UPS panel, 5kVA with VRLA battery backup 1hour for each control room and inverter room - Incoming feeder – from Battery charger panel - Outgoing feeder – To UPSDB board - At least one spare feeder
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	- Make shall be Hitachi, Consul Neowatt or reputed equivalent subject to BHEL/HPPCL approval - Constructional features of the panel shall be as per clause “LT switchgear panels” ii. Following DB boards (wall mounted, 1 No each) for application in main control room shall be in vendor scope of supply, installation and commissioning: 1. DCDB for 110V DC supply to 33kV VCB breaker panels 2. UPS DB for 230V AC UPS supply to SCADA, ABT metering panel, weather monitoring system, fire alarm system, emergency loads such as Intercom 3. CRDB (Control room DB) 230/415V for room utilities including SCADA, Operator room air conditioners 4. LDB (Lighting DB) 230V/415V for outdoor plant lighting system 5. PDB (Power DB) 230V/415V for submersible/ booster pumps, CCTV system, Intercom 6. Nitrogen fire protection system for transformers iii. Following DB boards (wall mounted, 1 No each) for each of the LT Panel cum SCADA rooms in Transformer yards shall be in vendor scope of supply, installation and commissioning: 1. SDB (supply DB) with incomer feeder from ACDB of main control room, outgoing feeders for Nitrogen Fire protection system for transformers, Exhaust fans, UPS/BC/Battery panel etc 2. TYPDB (Transformer yard Panel room DB) 230/415V for room utilities 3. DCDB for SCADA 4. LDB (lighting DB) for outdoor plant lighting system Note: AC/DC DB boards shall be designed considering availability of space/ footprint requirements. iv. 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 vendor. v. Detailed constructional specification of the panels viz: ACDB panel, UPS/FCBC, DB panels/boards etc shall be as per separate clause “LT switchgear panels”. Where standard product is proposed for wall-mounted board, approval for the reputed brand such as Legrand, Siemens, Schneider etc shall be obtained from BHEL/HPPCL. vi. DB boards shall be provided with incoming/ outgoing ACB/ MCCB/ MCB as applicable (based on rating requirements) with spare feeders as shall be approved by BHEL/HPPCL. vii. Design, supply and installation of all the above items including all necessary cable terminations/ installation shall be in vendor scope. viii. Vendor shall submit the design calculations (battery, FCBC, UPS sizing etc), GA drawings, GTP particulars, Bill of materials, Make, Model / Part number etc for all the above items as per relevant IS/IEC standards for BHEL/HPPCL approval during detailed engineering.
5.25	LT switchgear panels

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	The LT switchgear panels (ACDB, DCDB etc wherever applicable) shall be designed as per the relevant IS codes and as per the approved design for the panel. All the parts of the panels must be rated as per the relevant rated voltage level. All the panels must have multifunction meters (MFM) flushed with the surface of the panels. However, the outgoing feeder can have Tri vector meter (TVM) for the energy accounting. The ACDB panels in main control room shall be rated for the maximum output of the Aux transformer feeding the system. The short circuit withstand rating (1 sec) at rated voltage of the switchgear shall be relevant to the existing electrical system short circuit ratings. (1) LT switchgear panels (Construction) (i) Single front / compartmentalized, modular design, degree of protection IP55 with provision of extension on both sides. (ii) Incomer feeders: mains incomer - Electrically operated draw out type Air Circuit Breakers (ACBs)/ Vacuum Circuit breakers (VCBs), as applicable. (iii) Outgoing feeders: Moulded Case Circuit Breakers (MCCBs)/ electrically operated draw out type Air Circuit Breakers (ACBs) / Vacuum Circuit Breakers (VCBs), as applicable. (iv) The colour finish shade of switchgear enclosure for interior shall be glossy white & for exterior it shall be light grey, semi glossy shade 631 of IS: 5. if a different exterior shade is desired by the Employer, the same shall be intimated to the supplier. (v) The LT switchgear panel shall be fabricated out of CRCA sheet steel; 2 mm thick for the outer shall all-round. The internal walls and separators shall be of 1.6 mm thick CRGO sheet steel (vi) The gland plates shall be 3 mm thick (2) Control Circuit a) Air Circuit Breaker spring charge motor – 230 V AC, 1 phase b) Moulded Case Circuit Breakers – 230 V AC, 1 phase c) Space heater, sockets, etc. – 230 V AC, 1 phase d) Control supply for breaker closing / tripping - 110V DC e) Indications, annunciation – 110V DC (3) Bus Bar & Cable Cavity (a) The material for main bus bars and tap off bus bars shall be electrolytic grade aluminum with properly color coded HR PVC sleeved insulation. (b) Bus bars shall be suitable for short circuit rating and current suitable for all connected load. (c) Cable entry for incoming and outgoing cables shall be from Bottom. (d) A suitable gland plate shall be supplied for termination of power, control and instrumentation cables. (e) Whenever feeders are housed in multi-tier configuration, these tiers shall be segregated by sheet metal barriers. (f) Earthing: Earthing bus bar shall be terminated at both ends of the switchgear to suit the connections to outside earthing conductor. All components inside the module are required to be earthed individually and are to be looped and
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	connected to the horizontal earth bus. All the non-current carrying parts of the panels, e.g., enclosure, must be connected to earth as per the regulations. (4) Terminals (a) CT circuit - Isolating link type terminals with shorting facility (b) PT circuit – clip on type terminals (c) Spare contacts shall be wired up to terminal block. 10% spare terminals shall be provided for each module (5) Specific requirements (a) All ACBs/ MCBs, as applicable, shall be 4 pole, electrically operated, draw-out type, with closing coil, spring charge motor, trip coil, TNC switch for close and trip, manual closing and tripping push buttons, door I/L, test and service position micro switches, emergency P.B., safety shutters, etc. The circuit breaker shall be provided with anti-pumping feature. (b) ACBs/ VCBs, as applicable, shall be complete with microprocessor release and shall be provided with over current, short circuit and earth fault protections. (c) Minimum 10% spare feeders of each rating shall be provided in the switchgear. (d) All current transformers shall have 5/1A secondary and all meters shall be suitable for 5/1A operation. (e) All indicating lamps shall be of LED cluster type. ACB feeders shall be provided with ON, OFF, AUTOTRIP, SPRING CHARGED, TEST, SERVICE, TRIP CIRCUIT HEALTHY indications (f) All indicating instruments, including MFM, shall be flush mounting, Digital type and of standard size. (g) Window annunciator with hooter and accept, test, reset button shall be provided. (h) Necessary auxiliary relays for contact multiplication shall be provided in the panel. (i) The maximum temperature of the bus bars, droppers and contacts at continuous current rating under site reference ambient temperature of 50° C shall not exceed 105° C. (j) Instrumentation: Switchgear instrumentation shall be provided as follows: 1. Mains Incomer – Voltmeter with selector switch 2. Ammeter with selector switch 3. Power Factor meter 4. Frequency meter 5. TVM + MD meter 6. Potential indicating lamps 7. Outgoing Feeders 8. Ammeter with selector switch on all feeders (6) General Technical Specifications (LT Switch gear Panel) (a) The panel shall be self-supporting, free standing, floor mounted, modular type with construction having degree of protection of IP 54 as per IS 2147. (b) The panel shall be fabricated from 14 SWG CRCA sheet steel for frame & load bearing surfaces. Partitions may be fabricated from 16 SWG CRCA if no components are mounted on them. (c) The panel shall be painted with 2 coats of primer after pre-treatment and 2 coats of Polyurethane / epoxy paint with shade as decided by the Owner
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	(d) Stiffeners shall be provided at corners & between modules to make panel rugged. The stiffeners will necessarily be required for relay compartments or doors where heavy components are mounted. (e) The openable covers will be provided with lift off type hinges, quarter turn door locks and flexible copper wire for earth connection. (f) The panel shall be dust and vermin proof. Synthetic or neoprene gaskets shall be provided at all openings. (g) The panel shall be of dead front construction suitable for front operated and back maintained functioning. (h) Panel shall be provided with fluorescent lamp of 20W capacity operated by door operated limit switch. Panel shall also have space heaters and thermostat arrangement. (i) Panel shall be provided with 3 pin switch socket combined unit of 5 Amp capacity. (j) Lifting hooks shall be provided at the top of the panel. (k) The hardware components used in the panel shall be hot dipped galvanized. (l) The control components shall be fixed on mounting plate by drilling & tapping. (m) Al anodized legend plates shall be provided for all the components. For components mounted on front face, legend plate from inside shall also be provided. (n) Pre-treatment by 7 tank process shall be done before painting / powder coating the panel. (o) Panel shall have provision of drawing pocket. (p) The panel shall be designed to ensure maximum safety during operation inspection, connection of cables and maintenance. Inside panel, checking and removal of components shall be possible without disturbing other units. (q) Cable entries will be from bottom. The opening of cable entry shall be covered by 3 mm thick gland plates. (r) The panel shall be provided with all necessary components / devices and instruments as per the recommended schematic diagram and functional requirements. (s) The components such as protective relays, auxiliary relays, push buttons, switches, instruments shall be flush mounted on the front side of a panel. (t) The control wiring shall be done with PVC insulated flexible copper wire. For CT secondary circuits 2.5 sq.mm wire shall be used. For control wiring 1.5 sq.mm wire will be used. (u) Earthing bus bar of suitable cross section shall be provided throughout the length of panel. (v) The panel shall be fully wired all the terminals shall be brought out for cable connections. 10% spare terminals shall be provided on each terminal block. Separate terminal block shall be provided for different voltages. All wire shall have P.V.C. ferrules as per wiring diagram. (w) Proper shrouding to incoming and outgoing terminals shall be provided to ensure safety during operation, inspection and maintenance. (x) Indicating lamps shall be with multiple LEDs & shall be suitable for the voltage specified. (y) All the components in the panel shall be properly labeled. The labels shall be made of non-rusting metal or engraved PVC material properly fixed by screws. (z) The panel layout shall be made in such a way that it will always facilitate easy removal and reconnection of control cables without disturbing other wiring. (aa) Centre lines of control switches, push buttons and indicating lamps shall be matched so as to give neat appearance. Similarly top lines of indicating instruments and relays shall also be matched. (bb) The panel shall be provided with electrolytic grade Al bus bar of suitable cross section so as to maintain max current density of 0.8 AMP/ Sq.mm.
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	(cc) Bus bars shall be provided with color coded heat shrinkable insulating sleeves. (dd) Bus bars shall be supported by high quality epoxy insulators provided at specified distances so as to withstand to the given fault level. (ee)The bus bar chambers shall be provided with suitable ventilation arrangements so as to limit the maximum temperature of 85°C while carrying rated current. (ff) Proper clearance of minimum 25 mm shall be maintained between phase bus bars and between bus bars. (gg) The panel shall be inspected at manufactures works before dispatch to site at the discretion of Employer. (hh) All routine tests shall be carried out on the panel in presence of Employer or their representative or its representative. These tests shall include following: (i) Verification of components ratings and operation. (ii) High voltage measurement test. (iii) Insulation Resistance measurement. (iv) Control testing																											
5.26	Supply and installation of Weather monitoring system As part of weather monitoring system (WMS), vendor shall supply, install and commission the following measuring instruments with all necessary software and hardware such as data logger, power supply/ control/ data/ communication cables etc required to integrate with SCADA. Scope of vendor shall also include supply and erection of all the mounting arrangements including all necessary civil works/ foundations etc. Communication cables shall be laid and terminated at both SCADA station at main control room and data logger at weather monitoring station end. Similarly, power supply cables shall be laid between WMS and DB boards in main control room. Exact location of the weather monitoring station (on the top of (or) in the vicinity of main control room) shall be decided during detailed engineering. Vendor shall submit all necessary GTP/ GA drawings of instruments and installation arrangement, installation manual, make/ model number/ part number etc for BHEL/HPPCL approval during detailed engineering. Pyranometer (2 Nos) Vendor shall provide 2 Nos pyranometers for measuring the incidental solar radiation at horizontal and inclined plane of array. Specification of the Pyranometer shall be as follows: <table><tr><td>1</td><td>Spectral response</td><td>0.31 to 2.8 micron</td></tr><tr><td>2</td><td>Sensitivity</td><td>Min 7 micro-volt / W/ m2</td></tr><tr><td>3</td><td>Time response (95%)</td><td>Max 15s</td></tr><tr><td>4</td><td>Nonlinearity</td><td>+/- 0.5%</td></tr><tr><td>5</td><td>Temperature response</td><td>+/- 2%</td></tr><tr><td>6</td><td>Tilt error</td><td>< +/- 0.5%</td></tr><tr><td>7</td><td>Zero off-set thermal radiation</td><td>+/- 7 W/m2</td></tr><tr><td>8</td><td>Zero off-set temperature change</td><td>+/- 2 W/m2</td></tr><tr><td>9</td><td>Operating temperature range</td><td>0 deg to +80 deg</td></tr></table>	1	Spectral response	0.31 to 2.8 micron	2	Sensitivity	Min 7 micro-volt / W/ m2	3	Time response (95%)	Max 15s	4	Nonlinearity	+/- 0.5%	5	Temperature response	+/- 2%	6	Tilt error	< +/- 0.5%	7	Zero off-set thermal radiation	+/- 7 W/m2	8	Zero off-set temperature change	+/- 2 W/m2	9	Operating temperature range	0 deg to +80 deg
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	10	Uncertainty (95% confidence level)	Hourly- Max 3%, Daily-Max 2%				
	11	Non stability	Max +/-0.8%				
	12	Resolution	Min +/- 1W/m2				
	13	Input power for instrument and peripherals	230V AC (if required)				
Each instrument shall be supplied with necessary cables. Calibration certificate with calibration traceability to World Radiation Reference (WRR) or World Radiation Centre (WRC) shall be furnished along with the equipment. The signal cable length shall not exceed 20m. Vendor shall provide Instrument manual in hard and soft form. Thermometers Vendor shall provide two thermometers (one for ambient temperature measurement with shielding case and other for module temperature measurement). The thermometers shall be RTD/ semiconductor type measuring instrument. Instrument shall have arrange of 0 oC to 80 oC.The instrument shall have valid calibration certificate. Anemometer Vendor shall provide Ultrasonic type anemometer (wind speed and direction) (1 set) <table><tr><td>1) Velocity range with accuracy limit</td><td>+/- 0.11 m/s up to 10.1 m/s +/- 1.1% of true when more than 10.1 m/s</td></tr><tr><td>2) Wind direction range with accuracy limit</td><td>0 to 360 deg with accuracy +/- 4 deg.</td></tr></table>				1) Velocity range with accuracy limit	+/- 0.11 m/s up to 10.1 m/s +/- 1.1% of true when more than 10.1 m/s	2) Wind direction range with accuracy limit	0 to 360 deg with accuracy +/- 4 deg.
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2) Wind direction range with accuracy limit	0 to 360 deg with accuracy +/- 4 deg.						
5.27	Installation and commissioning of SCADA integration systems (1) SCADA system, supply of which shall be in BHEL scope, comprises of data station panels and PC based control desks with software to collect, store, process and report the data parameters of power plant and also to control the operations of the power plant by integrating the various equipment's at the segments as follows: (a) String Inverters (101 Nos) in solar array field (b) Weather monitoring equipment: Pyranometers for solar irradiation (2 Nos) one no. horizontal and one no. with inclined facility, thermometer for ambient temperature (1 No), thermometer for module surface temperature (2 No), anemometer for wind speed and direction. (c) Inverter transformers (2 Nos): Alarm/Trip signals, WTI/OTI temperature values, Oil level (d) 33kV VCB breaker panels (as per SLD, 4 panels): status of VCB breakers, status of protection relays of transformers, oil / winding temperatures, AC parameters at every 5MW level of the plant. (e) LTPDB multifunction meters (4 Nos): AC auxiliary utility consumption parameters (f) ABT metering panels: at 33kV side, Three (Main/ Check/ Standby) ABT meters, LT level ABT meters in Auxiliary load panel (Station load) (g) Fire alarm system (all inverter/ main control rooms): status signals (h) Nitrogen fire fighting system in Transformers (2) BHEL scope of SCADA: (a) Data station panels with necessary data loggers / PLCs and other accessories such as power supply etc. to integrate the data signals as listed below. This includes main panel at main control room and intermediate (linking) panels at each inverter room.						

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	(b) Desktop PCs (HMI control desks) provided with necessary software packages and remote monitoring features. (c) Supply of SCADA related data / LAN cables as brought out in other clauses of this specification. (3) Vendor scope of supply and installation of SCADA system: (a) Vendor shall install the BHEL supplied SCADA system in the air-conditioned SCADA room in main control room. Vendor shall also install SCADA panels in each of the two Transformer yard LT panel rooms. (b) Control / instrumentation cables as mentioned in other clauses of this specification. (c) Cable laying/ terminations of all SCADA cables at respective panels / equipment's shall be in vendor scope of supply. BHEL will provide the necessary cabling schedule during detailed engineering. (d) Vendor shall supply, install and commission necessary provisions/ equipments (Modem/ Router/ WiFi etc, broadband connection (BSNL etc)) to enable remote monitoring of SCADA from offices of BHEL/ HPPCL. Also, periodic payments (rental and usage charges) towards broadband connections shall be borne by the vendor until completion of 10 years of O&M. (e) Vendor shall supply following furniture sets at SCADA room and office room of main control room at SPV plant end: ▪ PC table: 2 Nos ▪ Printer table: 1 No ▪ Executive table complete with draws/ side racks:3 Set ▪ Chair, industry standard, revolving type, with wheels, arm rest, provisions for adjustment of height (hydraulic/ gas lift):8 Nos ▪ Storage almirah: 2 No ▪ Filing cabinet: 2 No (4) Data signals for SCADA integration are described as below: Following is the list of signals from the five major segments of the power plant as above. 4.1 String Inverters in solar array field – 101 Nos (a) RS485 Modbus (RTU) cables among string inverters of solar photovoltaic array field. (b) OFC cable from the end String Inverter of each daisy chain of string inverters upto the respective RTU panel in the Transformer Yard LT panel room and to the main RTU panel in the Control room Vendor shall draw appropriate number of such RS485 Modbus communication cables between String Inverters and OFC cables from solar array field to SCADA room, based on the daisy-chain grouping of string inverter outputs. 4.2 Weather monitoring equipment – 6 Nos Analog signals from the weather monitoring equipment viz. pyranometer (2 Nos), anemometer (1 No) and ambient temperature sensor (1 No), Module temperature sensor (1No). 4.3 LT and HT equipment's (Transformers, VCB panels, ACDB panel, LTPDBs, ABT metering panels etc) a) 3.15 MVA inverter transformers - Analog and Digital signals.
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	b) HT Panels: VCB On/Off status, open/command signals: potential free NO contact, Digital. c) Numerical relays of VCB panels d) HT VCB panels: multifunction meters: RS485 data e) ACDB panel multifunction meters: RS485 data f) Aux transformer (1 No): OTI value, WTI value, Buchholz alarm, low oil level alarm, PRD alarm, OTI alarm, WTI alarm: potential free NO contact, Digital. g) LTPDB : Multifunction meters, Relays: RS485 data h) ABT meter at 33kV side 3 meters + 1 Aux meter i) Fire alarm system: Status signals
5.28	Plant Lighting System Vendor shall supply, install and commission plant lighting system (for areas listed below) that includes all necessary items such as luminaires, LED lamps, GI poles, bend pipes, junction boxes with MCBs/TBs/ glands/ provisions for earthing, conduit pipes for aux supply cables above ground level up to junction box for street light poles, conduit pipes for cables above ground level up to luminaire for wall mounted lighting, casing/capping wherever applicable, GI earth wires, aux supply cables (multicore, 1.1kV, Al/Cu, PVC, armoured, PVC FRLS as per IS:1554, appropriate sizing) up to junction box, cables (1.1kV, Al/Cu, PVC, unarmoured, unsheathed, as per IS: 694, appropriate sizing) from junction box to luminaires, cable glands, cable lugs, termination hardware etc. Scope also includes civil foundation works for street lighting poles. Cables shall be laid underground as per IS: 1255/IS732 with reference the section “cable installation methodology” of this specification. Cables shall be terminated at both the lighting end and LDB board end. Spacing between poles/lamps shall satisfy the lux requirements of the respective areas. AC supply shall be from the LDB distribution boards from the main control room. Vendor shall submit lux calculations, lighting layout, single line diagram for aux supply from LDB boards, GA drawings of lighting poles/ wall-mounted/ column-mounted/ fence-mounted systems, GA drawings of civil foundation for street light poles, bill of materials with make/ GTPs/ model number/ part number/ rating/ applicable IS standards/ quantity etc for BHEL/HPPCL approval during detailed engineering. For all the items, reputed brand shall be procured after approval from BHEL/HPPCL. Cable schedule shall also be submitted. Vendor shall also supply 15-20W (230V) LED lamps for emergency purpose as well as General lighting purpose as per the general lighting requirements furnished in the table. Areas of plant lighting systems for vendor scope: Accordingly the no. of LEDs shall be designed as per IS 3646 and calculations submitted for approval and accordingly implemented. General technical requirements: (1) All LED luminaires shall be supplied with proper diffuser to avoid direct visibility of LED with proposer thermal management for longer life. (2) The lighting level shall take into account appropriate light output ratio of luminaires, coefficient of utilization maintenance factor (of 0.7 or less) to take into account deterioration with time and dust deposition.



1. Average illumination levels-

Location	Average Illumination Level (Lux)	Type of Fixture
Control Room	300	LED Luminaries
Store Room	200	Industrial trough type, LED
Switchgear Room, HT Breaker Room	150	Industrial trough type, LED
Inverter Room	150	Industrial trough type, LED
Street lighting-Roads	10	Industrial trough type, LED
Switchyard and Substation	20 (general) 50 (on strategic equipment)	HPSV flood light/ LED
Security Room Lighting	50	LED

(3) LED luminaires shall meet the following parameters

1	Input voltage	170-260V
2	Input frequency	50 +/- 1 Hz
3	Power factor	0.95 minimum
4	Power efficiency	>96%
5	LED efficacy	>130 lumens per watt
6	Dispersion angle	Minimum 120 deg
7	Usage hours	Dusk to dawn
8	Total harmonic distortion	<15%
9	Working temperature	-5 deg to +50 deg C
10	Working humidity	10% - 90% RH (preferably hermetically sealed unit)
11	Index of protection level	Minimum IP65
12	Lamp casing	Powder coated metal/ Aluminium
13	Life	> 50,000 Hrs
14	LED type	Power LEDs from reputed make
15	Colour temperature	2800 deg K / 3000 deg K
16	Colour rendering	>75
17	Junction temperature	< 60 deg C
18	Electrical connector	Lead wire with 2m long (or) as required by customer at site
19	Expected life of components	Passive electronic components life greater than > 1,00,000 hrs
20	Moisture protection in case of casing damage	IP 65 (preferably totally encapsulated)

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	(4) Control gear specification EN 61347-2-13: Particular requirements for DC/AC supplied electronic control gear for LED module EN 62384: DC/AC supplied electronic control gear for LED modules (5) Luminaire EMC specification EN 61000-3-2: Electromagnetic compatibility (EMC). Limits for harmonic current emissions (Equipment input current < 16 A per phase) EN 61000-3-3: Limitation of voltage fluctuation and flicker in low voltage supply systems for equipment with rated current < = 16 A (6) Additional information for LED luminaire The LED luminaire housing, heat sink, pole mounting bracket, individual LED reflectors and front heat resistant tempered glass should be provided. The LED luminaire housing should be made of non-corrosive high pressure die cast aluminum and the housing should be power coated grey, so as to ensure good weather ability. Each individual LED source should be provided with asymmetrical distribution high reflectance aluminized reflector, which should ensure that the light distribution of the luminaire is suitable for road lighting applications (wide beam distribution) and should ensure high pole to pole spacing. The luminaire should be provided with in built power unit and electronic driver. The luminaire should be should be so constructed to ensure that the gear and LED modules are replaceable, if required. The luminaire should be suitable for both standard street light poles with a typical pole diameter of 50 mm – 60 mm and should be suitable for both side entry and bottom entry (post top). The lux levels should be such that all the areas are well illuminated along with the arrangements for emergency lighting in accordance with the internationally accepted codes/ standards by providing the adequate no. of distribution boxes along with MCBs and the capacity of UPS/battery sufficient to maintain the supply for at least 12 hours (7) Junction Boxes, Conduits, Fitting & Accessories Junction boxes for street lighting poles, lighting mast, wall-mounted, fence-mounted as applicable shall be deep drawn or fabricated type made of min 1.6 mm thick CRCA Sheet. The box shall be hot dip galvanized. The degree of protection shall be IP55. All switches and receptacles up to 16A shall be modular type. These shall be provided with pre-galvanized/ galvanized modular switchbox & plate. Conduits, Pipes and Accessories Galvanized heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be offered. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.
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	Rigid steel conduits shall be heavy duty type, hot dip galvanized conforming to IS: 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Flexible conduit shall be water proof and rust proof made of heat resistant lead coated steel. Pull out boxes shall be provided at suitable interval in a conduit run. Boxes shall be suitable for mounting on Walls, Columns, Structures etc. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP55 degree of protection and those used indoor shall be suitable for IP52 degree of protection. Pull out box & its cover shall be hot dip galvanized. (8) Lighting Poles 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 maximum height of pole shall be 8 mtrs. The poles shall be hot-dip galvanized as per relevant IS: 2629/ IS: 2633/ IS: 4759. 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. Street light poles shall have loop-in/ loop-out arrangement for cable entry and light fixture / wiring protected with suitably rated MCB. Lighting fixtures shall generally be controlled from switchboxes of each area and not directly from lighting panel. (9) Earthing Lighting poles etc shall be earthed by two separate and distinct connections with earthing system. Distribution boards, junction boxes, lighting fixtures 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 armors shall be connected to earthing system at one end.
5.29	Earthing for solar array structures and String inverters The solar array MMS structures, String inverters (individual string inverters are earthed by separate earth rods and all inverter earthing to be formed separate earth grid) and various electrical equipments installed by the vendor shall be provided with appropriate earthing for protection against faults as guided by IEC 60364. The earthing system shall be designed with consideration of the soil resistivity of the project site. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed. The permissible system fault power level also shall be kept in consideration while designing the earthing system. Each array structure of solar PV yard, string monitoring boxes, other electrical equipments of module cleaning system viz pumps/ switchboards etc and all other metallic bodies shall be grounded properly as per IS 3043-1987 and Indian electricity act / IE Rules. The earthing electrodes for solar array shall be of 3m minimum long, 40 mm minimum diameter, perforated GI pipe, chemical compound filled, double walled. Each electrode shall be connected to the solar array earth mat grid. For each electrode, earth chamber shall be constructed using brick

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	masonry. Electrodes shall be of reputed brand such as Ashlok, Balaji Metacast Industries or any other equivalent subject to BHEL/ HPPCL approval during detailed engineering. At least 20 nos. Earth electrodes shall be provided for the PV array. Earth chamber shall have features as follows: (a) Square sized with 450 x 450mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc. (b) Brick wall thickness all around = 230mm minimum (c) Depth of chamber = 500 mm minimum below FGL. (d) Projection of chamber above FGL = 150mm minimum (e) Top of electrode shall have minimum clearance of 100 mm below cover plate. (f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint. (g) Cover plate shall have suitable lifting hooks and padlocking arrangement. (h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant civil works clauses of this specification. Supply and installation of all materials shall be in vendor scope. Earth mat grid shall have following dimensions: (1) Earth mat grid shall be buried 600mm minimum below ground level. Where it crosses trenches, pipes, ducts, channels etc, it shall be at least 300mm below them. Back filling soil to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Backfilled surface shall be well compacted. (2) Outer grid shall be with GI flat 65x8 mm minimum (3) Inner branches (along the solar array rows) with GI flat 25x3mm minimum (4) Inner branches shall be welded to outer grid (5) Electrode shall be bolted to a horizontal GI flat 25x6 that in turn bolted (M10 minimum) to two GI flat 25x6 raisers on either side of horizontal flat. Raisers shall be connected to outer grid of earth mat by way of welding. (6) Number of electrodes for solar array shall be decided based on earth mat design to obtain interconnected grid earth resistance less than 1 Ohm. (7) Earth mat design/ calculations as per IS: 3043 and IEEE 80, Indian Electricity Rules along with layout drawing for complete solar array shall be submitted for BHEL/HPPCL approval during detailed engineering. Earthing of MMS structures shall be as follows: (a) Solar array MMS structure shall be connected to Inner branch of earth mat using GI flat 25x3 mm minimum; Bolting on structure (M8 minimum), Welding on earth mat end. (b) Adjacent structures shall be connected to one another using GI flat 25x3 mm minimum. Both ends shall be bolted (M8 minimum). Earthing of String Inverters (SI) shall be as follows: (a) Body of SI structure shall be earthed using GI flat 50x3 mm minimum; Welding/Bolting on SI structure end (M10 minimum) and welding on inner branch of earth mat grid. (b) SI's earth point shall be earthed using 1Cx16 flexible copper (unarmoured) green cable. Both ends of cable shall be suitably lugged and connected using matching hardware. (c) The String Inverters shall have separate grid of Earth electrodes for potential earthing. No. of electrodes shall be calculated and executed. Calculations shall be provided by the vendor as per soil resistivity data made available.
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	General points: (a) All items related to earthing viz electrodes, GI flats, hardware etc shall be in vendor scope of supply. (b) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated. (c) Welding for GI flats shall be using electric arc welding. Both the flats shall be overlapped for the full width where they are in perpendicular direction in same plane. Where the connection is along same line, both flats shall be overlapped for a minimum of 50mm. L-bend with weld length of 50mm minimum shall be adopted wherever overlap length to be ensured. (d) Resistance of welded joint shall not be more than that of GI flat. (e) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection. (f) While laying earthing electrodes, adding/mixing of chemical compound and water around the electrode in the dug hole shall be as per instructions of OEM. (g) Other applicable standards: - IS: 2629: Recommended practice for hot dip galvanizing of iron and steel - IS: 2633: Method for testing uniformity of coating on zinc coated articles - IS: 6745: Methods for determination of mass of zinc coating on zinc coated iron and steel articles. - IS: 513: Cold rolled low carbon steel sheets and strips - IS: 3063: Fasteners single coil rectangular section spring washers In compliance to Rule 11 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
5.30	Earthing system for main control room, 33kV transformer yards (1) Vendor shall supply, install and commission appropriate earthing for protection against faults as guided by IEC 60364 for the main control room, 33kV transformer yards and Transformer yard LT panel rooms. (2) Earthing system shall be designed with consideration of the soil resistivity of the project site. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed. Permissible system fault power level also shall be kept in consideration while designing the earthing system. (3) Design calculations and layout of the earth mat grid with electrodes, to achieve earth mat grid resistance value of less than 1.0 Ohm for the individual rooms, shall be submitted for BHEL/HPPCL approval during detailed engineering. (4) Earthing electrodes shall be of 3m minimum long, 40 mm minimum diameter, perforated GI pipe, chemical compound filled, double walled. Bore holes of appropriate diameter shall be made on the earth for insertion of such chemical earthing electrodes with filling of mix of chemical compound and water around. Number of earth electrodes per room, spacing between them, GI flat layout etc shall be based on design calculation. Make of electrode shall be Ashlok, Balaji Metacast or any other reputed equivalent subject to BHEL/HPPCL approval. (5) Inverter rooms and main control room shall be provided with separate earth mat grids: (a) GI flats 65x8 minimum shall be laid underground cutting across the room from one end to the other and extending outward from both sides. These flats shall be at bottom level of internal cable trench.

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	(b) GI flats 65x8 minimum shall be laid underground around the room and interconnected to the above cutting-across flats. The interconnection shall be by way of welding with full width overlapping. (6) Earthing connections to electrical panels within the inverter room/ main control room: Flats GI 65x8 minimum shall be provided for double earthing of PCUs, 33kV VCB panels, SCADA, UPS/ FCBC/ Battery banks, C&R panel, ABT metering panels, cable trays. However, if design calls for copper flats for PCUs & transformer shield/neutral Cu flats 50x6 minimum shall be provided. For all DB boards and any other metallic bodies within the inverter room, earthing shall be by way GI flats or PVC insulated copper cables of appropriate size. GI/Cu flats shall be bolted on panel end and overlap welded to earth mat grid running internally. In case of cables, both ends shall be bolted for which the earth mat grid shall be drilled with matching holes. (7) Earthing of inverter transformers in the transformer yards of inverter rooms/ Aux transformer near main control room: (a) Flats GI 65x8 minimum shall be provided for interconnecting various parts of the inverter transformer (for body earthing) viz tank, conservator, disconnecting chambers, cable boxes, marshaling box, radiators etc. (b) Such interconnected local grid shall be double earthed to the main earth mat grid running underground through GI flats 65x8 minimum. (c) Flats shall be bolted on transformer side and overlap welded to earth mat grid. Two earth pits shall be located close to each transformer for body earthing. (d) Shield earthing of inverter transformers shall be separate and connected to two earth pits using 50x6 copper conductor. (e) Neutral of aux transformer shall be connected to two earth pits using CuI flat 65x8 minimum. (f) For both shield earthing and neutral earthing, heat-shrinkable insulation sleeve shall be provided around the earthing conductor. (8) Transformer yard fencing shall be earthed at two different locations using GI flats 65x8 minimum. Gate shall be looped to the fencing mesh by way of GI wire of suitable size. (9) Earth mat grid shall be buried underground up to a depth of 600mm minimum from FGL. Back filling soil to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm. Backfilled surface shall be well compacted. (10) Earth chambers shall be constructed around electrodes as per relevant IS standards. a) Square sized with 450 x 450mm minimum inner opening. Exact size shall be chosen to ensure ease of maintenance operation using spanners etc. b) Brick wall thickness all around = 230mm minimum c) Depth of chamber = 500 mm minimum below FGL. d) Projection of chamber by 150mm minimum above FGL (for outside transformer yard) and, by 100mm minimum above stone jelly level (inside transformer yard). e) Top of electrode shall have minimum clearance of 100 mm below cover plate. f) Cover plate, cast iron of 5mm minimum thickness, square shaped to fit the opening of chamber, painted with red oxide and two coatings of black paint. g) Cover plate shall have suitable lifting hooks and padlocking arrangement. h) Both the outer and inner walls of the brick wall shall be plastered and painted as per relevant civil works clauses of this specification. i) Supply and installation of all materials shall be in vendor scope.
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	(11) Earth electrode shall be bolted to a horizontal GI flat 65x8 minimum that in turn bolted (M10 minimum) to two GI flat 65x8 minimum raisers on either side of horizontal flat. Raisers shall be connected to earth mat grid by way of overlap welding. (12) Interconnection of earth mat grids of individual Transformer yard LT panel rooms, main control room and solar array: • Vendor shall interconnect each of the two LT panel room earth mat grids to solar array earth mat grid at least at two nearest locations. • Vendor shall also interconnect the main control room earth mat grid to solar array earth mat grid at least at two nearest locations. General points: (a) All items related to earthing viz electrodes, GI flats, hardware etc shall be in vendor scope of supply. (b) GI bolts, nuts, plain washers shall be used. Spring washers shall be zinc/epoxy coated. (c) Welding for GI flats shall be using electric arc welding. Both the flats shall be overlapped for the full width where they are in perpendicular direction in same plane. Where the connection is along same line, both flats shall be overlapped for a minimum of 50mm. L-bend with weld length of 50mm minimum shall be adopted wherever overlap length to be ensured. (d) Resistance of welded joint shall not be more than that of GI flat. (e) Welds shall be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection. (f) While laying earthing electrodes, adding/mixing of chemical compound and water around the electrode in the dug hole shall be as per instructions of OEM. (g) Other applicable standards: - IS: 2629: Recommended practice for hot dip galvanizing of iron and steel - IS: 2633: Method for testing uniformity of coating on zinc coated articles - IS: 6745: Methods for determination of mass of zinc coating on zinc coated iron and steel articles. - IS: 513: Cold rolled low carbon steel sheets and strips - IS: 3063: Fasteners single coil rectangular section spring washers										
5.31	Lightning arrestor (ESE) system/ Surge arrester for protection of solar array/ control room Supply, installation and commissioning of lightning arrestor (ESE) system for protection Coverage of solar array, inverter, ACCBs, LTPDBs, Switch yard and the main control room shall be in vendor scope. Surge arresters shall be provided at line terminal end. STANDARDS: The Surge Arresters shall conform to: <table border="1"> <tr> <td>IEC 99-4 Part-4</td><td>Surge Arresters without gap for AC System</td></tr> <tr> <td>IS: 3070 (Part-III)</td><td>Specification for Lightning Arresters for alternating current System</td></tr> <tr> <td>IS: 2629</td><td>Recommended practice for hot dip galvanizing of iron and steel.</td></tr> <tr> <td>IS: 2633</td><td>Method for testing uniformity of coating on Zinc coated articles.</td></tr> <tr> <td>IS: 5621</td><td>Specification for large hollow porcelain for use in electrical installation</td></tr> </table>	IEC 99-4 Part-4	Surge Arresters without gap for AC System	IS: 3070 (Part-III)	Specification for Lightning Arresters for alternating current System	IS: 2629	Recommended practice for hot dip galvanizing of iron and steel.	IS: 2633	Method for testing uniformity of coating on Zinc coated articles.	IS: 5621	Specification for large hollow porcelain for use in electrical installation
IEC 99-4 Part-4	Surge Arresters without gap for AC System										
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	IS: 2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
	Indian Electricity Rules-1956	
1.	The Station Type Surge Arresters shall be fitted with pressure relief devices and arc diverting ports and shall be tested as per the requirements of IEC specification for minimum prospective symmetrical fault current as specified Annexure XV.	
2.	The grading ring on each complete Arrester for proper stress distribution shall be provided if required for attaining all the relevant technical parameters.	
3.	Each individual unit of Surge Arrester shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for the entire life time of the Arrester and under the service conditions as specified. The Bidder shall furnish sectional view of the Arrester, showing details of sealing employed.	
4.	The Surge Arresters shall be suitable for hot line washing.	
5.	All the necessary flanges, bolts, nuts, clamps etc., required for assembly of complete Arrester with accessories are included in Bidder's scope of supply.	
6.	The porcelain housing of LA shall be well vitrified and Nonporous and shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths.	
The porcelain petticoat shall be of self-cleaning type (Aerofoil design).		
All ferrous parts exposed to atmosphere shall be hot dip galvanized as per IS: 2629 amended up to date. Tinned copper/brass lugs shall be used for internal wiring. Screws used for electrical connections shall be either made of brass or nickel plated.		
Ground terminal pads and name plate brackets shall be hot dip galvanized.		

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	All necessary accessories and earthing connection leads shall be in the Vendor's scope of supply Terminal connector conforming to IS: 5561 shall be supplied along with the arrester. The grounding terminal shall be suitable for accommodating Purchaser's grounding connection to earth mat. A. Lightning arrestor (ESE) with mast, counter and test link 1) Solar array shall be protected from direct lightning stroke with Early Streamer Emission (ESE) air terminal as per NF C 17-102 (latest revision). Vendor scope of lightning protection coverage shall also include inverter, switchyard and control room. 2) Location and layout of ESE terminal (mounted on masts of appropriate size/height) shall be in such a manner that it does not cast shadow on the PV Modules during 08:30 AM to 04:30 PM. Quantity and locations of ESE air terminals (masts) shall be decided during detailed engineering. Make shall be ABB or other reputed equivalent subject to approval of BHEL/HPPCL approval. Design calculations for protection coverage, drawing showing layout with arrester locations/ protection coverage/ bill of materials for the complete system shall be submitted for BHEL/HPPCL approval. 3) ESE air terminal shall be type tested in any national/international approved lab for advance triggering time (ΔT). Lightning Impulse current test and type test report shall be submitted for BHEL/HPPCL for approval. Each ESE air terminal shall be provided with separate earthing termination and test link for equipotential bonding of lightning protection system as per OEM guidelines/ NFC 17 - 102. Each ESE air terminal shall be equipped with lightning stroke counter to be fixed at suitable height in serial on the down conductor. 5) Mast of ESE air terminal shall be erected on isolated RCC foundation. Suitable guy wires shall be used to support the mast of ESE terminal against the wind. Drawing of foundation with design load calculations shall be submitted for BHEL/HPPCL approval. B. Down Conductors 1) Down conductors shall be as straight as practicable and shall follow a direct path to earth electrode. 2) Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be inaccessible to interference. Other than the direct connection to the earth electrode, no other connections shall be made below a test point. 3) All joints in the down conductors shall be welded type. 4) Lightning conductors shall not pass through or run inside GI Conduits. 5) Testing link shall be made of galvanized steel of size 25x6 mm. 6) Pulser system for lightning shall not be accepted. C. Earth chambers for lightning arrestors: 1) Two earth chambers shall be provided for each lightning arrester. 2) Each down conductor shall be connected to individual earth pit as per required Standards.
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3) Earth chamber shall be of brick masonry enclosure with cast iron cover plate (minimum 5mm thick) and having locking arrangement.

4) Earth electrode shall be of chemical earthing type of Ashlok or Balaji metacast or any other equivalent. These electrodes shall be the same type as those used for solar array earthing.

D. General points:

1.1. 1) The lightning conductor must ensure Type Two protection level

1.2. Lightning & Over Voltage Protection

Complete PV plant array area, all the inverter stations and the control rooms shall

be protected from lightning. The protection system will be based on early streamer emission lightning conductor air terminals. The air terminals shall provide an umbrella protection against direct lightning strike covering a radial distance of maximum 107m. The air terminal will be capable of handling multiple strikes of lightning current and should be maintenance free after installation.

The SPV Power Plant should be provided with Lightning and over voltage protection connected to proper earth mats. The main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other subsystem components. The source of over voltage can be lightning or other atmospheric disturbance.

The vendor shall ensure adequate lightning and over voltage protection to provide and acceptable degree of protection as per IS for the array yard/Shed.

The lightning Masts / Conductors shall be made as per applicable Indian Standard/International Standard in order to protect the entire Array Yard/ Shed from Lightning stroke.

Necessary concrete foundation for holding the lightning conductor, in position, to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

The lightning masts / conductor shall be earthed through flats and connected to the Earth mats as per applicable Indian Standards with earth pits. Each Lightning Conductor shall be fitted with individual earth pit as per required Standards including accessories, and

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	providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as per required provisions of IS. (Design calculations and detailed explanations in 4 sets) shall be provided for approval of BHEL/HPPCL within 15 days of order. Lightning arrester provided within PV yard shall be located in a way that there is no shading effect on PV panel during operating hours.
5.32	Water washing system for SPV modules (Module cleaning system) A suitable arrangement of water shall be supplied and installed to cater the day-to-day requirement of drinking water and washing needs of Solar Photovoltaic plant during entire O&M period. Water shall be provided from HPPCL source to the plant. The vendor shall plan the water requirements for cleaning the photovoltaic modules at least once in every week or as per the soiling conditions prevailing at site, in order to operate the plant at its guaranteed plant performance. The system shall include the storage water tanks, pumps, laying of GI/ HDPE/ UPVC pipes, flexible pipes, taps/ valves, pressure gauges etc. Vendor has to submit the drawing/ plan for the proposed module cleaning system. All the pipes thus laid must be buried in ground at least 150mm below FGL. Road crossings and drain crossings, the pipes must be passed through GI pipes/Hume pipes as applicable. The system shall essentially include the following minimum components: Storage Tanks of Sintex type (Weather resistant, BIS approved) placed on suitable civil foundations. Capacity : Minimum 6000 litres for PV array applications and 500 litres for Control room personnel use. Surface pump (Booster pump of approx 5 HP) with stand by unit, Pump motor DOL start/stop controls and dry run protection. Pumps shall have covered lockable shed for security and protection. These pumps shall draw water from the surface storage tank and distribute same at pressure all over the PV plant.

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	UPVC piping with required valves and fittings for laying network of pipes to reach water to various part of the PV plant The general requirements of the components shall be as follows: a) Vendor has to plan and install all the necessary equipment, accessories, tool & tackles, pumps, tankers, tractors and piping arrangement pertaining to module cleaning system. b) Vendor shall design and submit the piping and instrumentation diagram P&ID of water washing arrangement including the physical sequence of branches, reducers, valves, pressure gauge, delivery points and location of pumps and water storage tanks for BHEL/HPPCL approval during detailed engineering. The diagram shall show locations of pipelines, valves, delivery points etc as superimposed on the solar array layout, Bill of materials (item-wise description, type / rating, make, model number / part number, quantity) of water washing arrangement with necessary calculations of water flow / pressure / discharge etc for BHEL/HPPCL approval during detailed engineering c) Surface pump (booster pump) with pressure regulating tank of appropriate size/ rating shall be installed at every tank location. Suitable RCC civil pedestal and housing chamber shall be constructed for this arrangement. Chamber shall have necessary canopy (for prevention of water entry), door/lock provision, steel sections/ steel sheets to withstand wind load etc, corrosion protection painting, fasteners etc. Vendor shall submit drawings for BHEL/HPPCL approval during detailed engineering. d) Vendor shall employ armoured electrical cables of suitable size/rating for all electrical connections. Cables with cable accessories (glands/ lugs/ termination hardware etc) shall be in vendor scope of supply and installation. Cabling to the pumps shall be from DB panels in the control rooms. Cables shall be laid underground as per IS: 1255. All cable terminations including the ones at DB panels shall be in vendor scope. e) In addition to operating from control rooms, outdoor type switch box with MCB etc shall also be provided to switch ON/OFF the pump directly from solar field. Such components shall be suitably mounted within the housing chamber. f) Water pressure gauge of appropriate size/rating shall be installed at every tank location. g) UPVC pipes as per relevant IS standards, heavy duty, 6 Kg/sq.cm: pump suction/ header pipes (40NB minimum), Feeder pipes (25NB minimum). h) UPVC elbows, Tees, bends, couplers as applicable, as per relevant IS standards, for jointing and leak-proof pressurized pipe fittings. i) UPVC pipes shall be directly buried in ground at least 150mm below FGL. GI/ Hume pipes (75NB minimum) shall be used at road and drain crossings. j) UPVC raiser pipes with ball valves (25NB minimum, metal body, IS marked) and reducer nozzles for fitting hose pipes, at every delivery point. Every raiser pipe shall be fixed in the soil using concrete (PCC) pedestal construction with foundation depth of 200mm minimum. k) Delivery points shall be made available in the space between every two rows of solar array with max 30m spacing between delivery points. Accordingly, number of delivery points shall be provided for cleaning of the entire solar array. m) Air release valve fittings (metal body, IS marked) for feeder pipes at appropriate locations. n) Control gate valve for header pipes; for maintenance (IS marked) at appropriate locations. o) Control gate valve for feeder pipes; for maintenance (IS marked) at appropriate locations. p) Non-returnable valves (NRV) shall be provided wherever applicable.
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	q) Hose pipes, heavy duty 25NB minimum: 10 rolls each of 50m (minimum) long r) All necessary hardware items such as GI clamps/ screws/ bolts/ nuts/ plain washers/ spring washers etc wherever applicable. s) Any other items as required to complete the technical/ operational requirements of module washing system. t) At road crossings and wherever heavy/impact load applicable, UPVC pipes shall be covered with higher diameter GI pipes for protection against such loads. u) All necessary labour, machinery, tools, instruments shall be in vendor scope																		
5.33	Firefighting / detection/ alarm systems a) Firefighting systems: Fire extinguishers and sand buckets The solar PV plant need to be equipped with suitable fire protection and fighting systems for entire PV array area, Transformer yard stations, main control room and switchyard as per the NFPA fire safety standards and local fire authority requirements. Firefighting of transformers and other electrical equipment's as required should be in accordance to tariff advisory committee, CBIP, IS 10028, NFPA 70 and NFPA 15. Vendor shall provide fire extinguishers/ sand buckets as follows for fighting fire of oils, solvents, gases, paints, varnishes, electrical wiring, live machinery fires and flammable liquid/ gas as per recommendation by relevant fire safety authority and as per relevant standards IS: 2171 and IS: 10658 marked. Make shall be Safex/ Ceasefire/ Vintex/ Unicore fire safety or any other reputed equivalent subject to BHEL/HPPCL approval. ▪ DCP type (ABC) 10 Kg designed/tested IS 15683 with safety release valve, NRV and CE approved valve. Dry powder IS 14609 with standard accessories. ▪ CO2 type Hand 9 Kg with wheel. Designed/tested IS 2878 complete with hose, screw valve, CO2 gas IS 1522, cylinder IS 7285, valve IS 3224. Tested at 250 Kg/cm2. ▪ Foam type hand 9Kg, squeeze grip CO2 cartridge type, throw period 35s, range of Jet 6m, designed/tested IS:15683, Gas cartridge IS:4947. ▪ Hand portable pressurized water CO2 9 Ltr designed/tested IS: 15683, rubber hose, safety release valve, NRV and CE approved valve, throw of jet 6m. ▪ Sand bucket should be wall mounted made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546 at strategic locations. Quantity requirements: <table><tr><td></td><td>DCP type (ABC) 10 Kg</td><td>CO2 type Hand 9 Kg</td><td>Foam type hand 9 Kg</td><td>Hand portable pressurized water CO2 9 Ltrs</td><td>Sand buckets</td></tr><tr><td>Main control room CMCS</td><td>1</td><td>4</td><td>2</td><td>-</td><td>4</td></tr><tr><td>Each LT Panel room at Transformer vard</td><td>1</td><td>2</td><td>-</td><td>-</td><td></td></tr></table>		DCP type (ABC) 10 Kg	CO2 type Hand 9 Kg	Foam type hand 9 Kg	Hand portable pressurized water CO2 9 Ltrs	Sand buckets	Main control room CMCS	1	4	2	-	4	Each LT Panel room at Transformer vard	1	2	-	-	
	DCP type (ABC) 10 Kg	CO2 type Hand 9 Kg	Foam type hand 9 Kg	Hand portable pressurized water CO2 9 Ltrs	Sand buckets														
Main control room CMCS	1	4	2	-	4														
Each LT Panel room at Transformer vard	1	2	-	-															

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	Each transformer yard	2	1	1	-	4
	Security room	-	-	-	2	2
b) Microprocessor based fire alarm system for inverter/ main control rooms Vendor shall provide intelligent microprocessor-based main fire alarm panels of modular construction complete with central processing unit, input and output modules, power supply module, supervision control and isolator modules with 10% spare provisions. Fire detection alarm system shall include but not limited to the following items: (a) Fire alarm control panel (b) Multi sensor smoke detector (c) Hooter cum strobe (d) Manual call point (e) Hooter (f) Fault isolation modules (g) Control modules (h) Cables from sensors to fire panels (i) Digital output from fire detection system shall be integrated with SCADA (RS485 compatible) Multi sensor type smoke detectors shall be provided below false ceiling areas of control room. One sensor shall be provided for each 25 sqm of area. Fire Alarm Control Panel Indication (a) Alarm conditions shall be immediately displayed on the control panel. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, 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. (b) During alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged. (c) If the audible alarm signals are silenced for any reason, they shall automatically resound if another zone is activated. (d) 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. Vendor shall submit integrated layout of fire detection/alarm system in the main control room along with Bill of Materials (make, model number/ part number, quantity) etc for BHEL/HPPCL approval during detailed engineering. Make of the system shall be Hochiki/ Notifier or any other reputed brand subject to BHEL/HPPCL approval. (1) Supply of all items (including cables, earthing items, hardware, miscellaneous items) in vendor scope. 1.1. Fire Extinguishers Liquefied CO₂ / foam/ ABC type fire extinguisher shall be upright type of capacity 10 kg having IS:2171.7, IS:10658 marked. The fire extinguisher shall be suitable						

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	for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and all Flammable Liquid & Gas. 1.2. Sand Bucket Sand buckets should be wall mounted made from at least 24 SWG sheet with bracket fixing on wall conforming to IS 2546. Bucket stands with four buckets on each stand shall be provided in the Transformer Yard.																					
5.34	Other safety related items Vendor shall supply the following safety related items. Make / part number of each item shall be submitted to BHEL/HPPCL for approval prior to procurement. <table><tr><td>1</td><td>Gas Mask</td><td>1 Nos</td></tr><tr><td>2</td><td>First Aid Box with essential medicines and bandage cotton, antibiotic cream, Dettol, etc.</td><td>1 set</td></tr><tr><td>3</td><td>Hand Gloves 33 KV for GOS operation</td><td>2 sets</td></tr><tr><td>4</td><td>Hand Gloves 1KV for Maintenance of String Inverters</td><td>2 sets</td></tr><tr><td>5</td><td>Discharge rod</td><td>1 No</td></tr><tr><td>6</td><td>Safety Helmet</td><td>10 Nos</td></tr><tr><td>7</td><td>Safety shoes</td><td>10 pairs</td></tr></table>	1	Gas Mask	1 Nos	2	First Aid Box with essential medicines and bandage cotton, antibiotic cream, Dettol, etc.	1 set	3	Hand Gloves 33 KV for GOS operation	2 sets	4	Hand Gloves 1KV for Maintenance of String Inverters	2 sets	5	Discharge rod	1 No	6	Safety Helmet	10 Nos	7	Safety shoes	10 pairs
1	Gas Mask	1 Nos																				
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5	Discharge rod	1 No																				
6	Safety Helmet	10 Nos																				
7	Safety shoes	10 pairs																				
5.35 A	CCTV system/ cameras a. CCTV cameras shall be supplied, installed and commissioned at main entry gate (covering all the entry/exit round the clock 24 hours). The cameras shall be located along the plant at specific locations to cover the area and at Control room (covering entry/exit and activities within the rooms). Accordingly, to meet this requirement, number of cameras shall be proposed by vendor. Whereas the monitoring screen shall be installed in control room office, the cameras shall be provided at exact locations that will be finalized by BHEL/HPPCL during detailed engineering. b. CCTV system shall be designed as a standalone IP based network architecture. System shall use video signals from different cameras at defined locations, process the video signals for viewing on monitors at control room and security rooms and simultaneously record all video streams using latest compression techniques. The monitor size shall be 32 inches minimum. c. Camera shall be colour, suitable for day and night surveillance (even under complete darkness) and network compatible. d. It shall be possible to control all cameras i.e., PTZ auto/ manual focus, selection of pre-sets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitor for live video. e. The system shall support video analytics in respect of the following: 1. Video motion detection 2. Object tracking 3. Object classification f. Camera server shall be provided with sufficient storage space to storage recordings of all cameras at HD mode for a period of 30 days. All recordings shall have camera ID, location, date and time of recording.																					

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	g. Details of make, model number, part number, GTP, layout drawings showing camera locations, electrical scheme etc for BHEL/HPPCL approval during detailed engineering.
5.35 B	Intercom system: a) The intercom system must be of reputed make having rugged built and quality for the purpose of communication from one room to another and at various location in the field. It should have the functionality to work in the event of main power failure also for at least 10 hours. b) The intercom system shall be installed in all the rooms in the control building, security rooms at the main entrance and various other locations in the field. c) The locations in the field shall be at least 8 different points to be finalized during detailed engineering. d) The no. of intercom sets and points in the offices, reception, and conference hall and security rooms shall be finalized during detailed engineering. e) The intercom sets in the field shall be adequately enclosed in aesthetic enclosures with the IP code conforming to IP65.
5.36	Identification marking using painting Following items shall be identified by way of artistic painting in black letters with yellow background. For danger symbol/text, white letters in red background. Identification number/ text to be painted shall be submitted for BHEL/HPPCL approval during detailed engineering for the following. (1) Solar array structures: Nos as installed (2) String Inverter: 101 Nos (3) Size/ source/ destination of LT cable 4Cx50, 1Cx500, 1Cx400 with arrow mark (power flow direction). (4) SI front side: SI ID number (1-101) with rating 50kW, AC chamber/ DC chamber, Danger text/symbol. (5) ACCB : String Nos ID numbers, cable size (1Cx300 +,-) with upward arrow mark, danger text/symbol (6) LTPDB : back side: Inv Trnfmr ID, cable size (8Rx1Cx300 / ph) with downward arrow mark, danger text/symbol (7) Same way as above, the corresponding panel ID with rating, cable destination with arrow mark in power flow direction, danger text/symbol shall be painted for all VCB panels, Inverter transformers (HV and LV sides), Aux transformer (HV and LV sides), ACDB panel. (8) For UPS/ FCBC/ SCADA/ ABT metering panels, C&R panel, all DB boards/ fire alarm panels/ N2 fire protection panel, ID number shall be painted. Cable size/ destination/ arrow marks not required to be painted as cable tags shall be adequate. (9) For all the plant lighting poles of power plant, ID numbers shall be painted. (10) For earth chambers of Switch yard and main control room, ID number shall be painted. (11) All switchboards shall be painted with ID number. (12) Lightning arrestors (ESE)

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5.37	Cable markers and cables tags (1) Cable markers and joint markers for underground cables shall be provided along the route of the cables as per section “ Cable installation methodology ” of this specification. (2) Cable tags shall be provided at either of the cable (at the entry point to the panel / equipment to which it is connected / terminated) shall be provided as per section “ Cable installation methodology ” of this specification. Vendor shall submit the respective schemes of marking and tagging for BHEL/HPPCL approval during detailed engineering.																											
5.38	Display boards and sign boards <table><tr><td>1</td><td>Board displaying instruction chart for restoration from Electric Shock</td><td>4 Nos</td></tr><tr><td>2</td><td>Board displaying instruction chart for artificial respiration</td><td>4 Nos</td></tr><tr><td>3</td><td>Board displaying dos and don'ts.</td><td>4 Nos</td></tr><tr><td>4</td><td>Board displaying fire extinguishers details and operations</td><td>4 Nos</td></tr><tr><td>5</td><td>“No smoking” board</td><td>8 Nos</td></tr><tr><td>6</td><td>Board showing list of O&M staff with name, qualification and work responsibility</td><td>1 No</td></tr><tr><td>7</td><td>Board showing list of contact details of BHEL, O&M team, O&M security, police station, fire service, hospital, medical store etc with names, address, mobile numbers etc</td><td>2 Nos</td></tr><tr><td>8</td><td>Danger boards: 33000V with danger symbol in Hindi, English</td><td>10 Nos</td></tr><tr><td>9</td><td>Identification boards, of suitable sizes, within and outside control room such as Main Office room, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room, Pantry room etc. BHEL will provide list.</td><td>15 Nos (approx.)</td></tr></table> (a) 5mm thick sun board with LG make vinyl sticker (computerized cutting and pasting) shall be used for Sl Nos 5, 8 and 9. (b) For others, flex banner with design & printing shall be used. Note: In addition to the above, hoarding board for the overall power plant shall be fabricated in consultation with BHEL/HPPCL and installed at a suitable location near the main entrance gate of the plant.	1	Board displaying instruction chart for restoration from Electric Shock	4 Nos	2	Board displaying instruction chart for artificial respiration	4 Nos	3	Board displaying dos and don'ts.	4 Nos	4	Board displaying fire extinguishers details and operations	4 Nos	5	“No smoking” board	8 Nos	6	Board showing list of O&M staff with name, qualification and work responsibility	1 No	7	Board showing list of contact details of BHEL, O&M team, O&M security, police station, fire service, hospital, medical store etc with names, address, mobile numbers etc	2 Nos	8	Danger boards: 33000V with danger symbol in Hindi, English	10 Nos	9	Identification boards, of suitable sizes, within and outside control room such as Main Office room, Store room, Gents toilet, Ladies toilet, SCADA room, Battery room, Pantry room etc. BHEL will provide list.	15 Nos (approx.)
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5.39	Electrical insulation mat (1) Vendor shall supply electrical insulating mats as follows: (a) Reputed make as shall be approved by BHEL/ HPPCL (b) As per IS: 15652:2006 (c) Class B (d) Thickness 2.5 mm minimum (e) Size = 2m x 1m minimum, exact size shall be as approved by BHEL/HPPCL during detailed engineering. (f) Color: to be approved by BHEL/HPPCL (g) Max use voltage = 33 kV (h) Marking of IS standard on the mat (2) Test certificate shall be provided by vendor																											

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	(3) Vendor shall lay the mats in front of all the indoor electrical panels viz. PCUs, VCB panels, ACDB panels, SCADA panels, UPS panels, FCBC battery charger, battery banks etc.																																																																												
5.40	Chequered plates Vendor shall supply and install checkered plates made of MS for closing the cable trenches (a) behind/ in front, as applicable, of the panels such as PCUs, LT panels, ACDB panels etc in inverter rooms / main control room to cover up the cable trench and also (b) all other open trench areas. (1) MS plates shall have a suitable handle (welded to the plate) to facilitate ease of lifting and movements. (2) Plate thickness = 6 mm minimum (3) Width and length of checkered plates shall be selected so that the cable trenches are neatly sealed without any gaps. (4) Plates shall be red oxide coated followed by black painting. (5) BHEL/HPPCL approval shall be obtained for overall arrangement of checkered plate.																																																																												
5.41	Air conditioner (1) Air conditioner (3 Nos of 1 ton) of split type for SCADA room, supervisor room, (2) Size / capacity shall be selected based on the room size and shall be approved by BHEL/HPPCL. (3) It shall be of reputed make as shall be approved by BHEL / HPPCL																																																																												
5.42	Tool kits and instruments Vendor shall supply the following tool kits and measuring instruments: A. Measuring instruments <table><tr><td>1</td><td>Digital Earth Resistance Tester</td><td>Reputed make</td><td>DET-2000</td><td>1 Nos</td></tr><tr><td>2</td><td>Digital multimeter</td><td>Reputed make</td><td></td><td>2 Nos</td></tr><tr><td>3</td><td>AC-DC Clamp Meter Amp range</td><td>Lutron</td><td>DM-6506</td><td>2 Nos</td></tr><tr><td>4</td><td>AC-DC clamp meter mA range</td><td>Lutron</td><td></td><td>2 Nos</td></tr><tr><td>5</td><td>Thermometer, Laser Beam</td><td>Fluke</td><td>62 Mini</td><td>2 Nos</td></tr><tr><td>6</td><td>Digital thermometer (wall hanging)</td><td>Reputed Make</td><td></td><td>2 Nos</td></tr><tr><td>7</td><td>Digital megger – 5KV type</td><td>Reputed Make</td><td></td><td>2 Nos</td></tr><tr><td>8</td><td>Electrical Tester</td><td>Reputed Make</td><td></td><td>2 Nos</td></tr></table> Note: Make / model number etc shall be approved by BHEL/HPPCL prior to procurement. B. Tool kits <table><tr><td>1</td><td>Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18</td><td>2 Nos each</td></tr><tr><td>2</td><td>Screwdriver Set</td><td>1 Set</td></tr><tr><td>3</td><td>Crimping tool with Dye range 50-500sq-mm cable, mechanical gear power, hand operated</td><td>1 Set</td></tr><tr><td>4</td><td>Crimping tool up to 6 sq-mm cable</td><td>1 set</td></tr><tr><td>5</td><td>Drilling machine AC, hand operated, with bit size up to 20 mm</td><td>1 set</td></tr><tr><td>6</td><td>Measuring Tape, 5m</td><td>2 Nos</td></tr><tr><td>7</td><td>Measuring Tape, 30 m</td><td>2 Nos</td></tr><tr><td>8</td><td>Allen Key set</td><td>1 Set</td></tr><tr><td>9</td><td>Adjustable spanner 2-inch size</td><td>1 No</td></tr><tr><td>10</td><td>Hammer</td><td>2 Nos</td></tr><tr><td>11</td><td>Rough file kit</td><td>1 Set</td></tr></table>				1	Digital Earth Resistance Tester	Reputed make	DET-2000	1 Nos	2	Digital multimeter	Reputed make		2 Nos	3	AC-DC Clamp Meter Amp range	Lutron	DM-6506	2 Nos	4	AC-DC clamp meter mA range	Lutron		2 Nos	5	Thermometer, Laser Beam	Fluke	62 Mini	2 Nos	6	Digital thermometer (wall hanging)	Reputed Make		2 Nos	7	Digital megger – 5KV type	Reputed Make		2 Nos	8	Electrical Tester	Reputed Make		2 Nos	1	Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18	2 Nos each	2	Screwdriver Set	1 Set	3	Crimping tool with Dye range 50-500sq-mm cable, mechanical gear power, hand operated	1 Set	4	Crimping tool up to 6 sq-mm cable	1 set	5	Drilling machine AC, hand operated, with bit size up to 20 mm	1 set	6	Measuring Tape, 5m	2 Nos	7	Measuring Tape, 30 m	2 Nos	8	Allen Key set	1 Set	9	Adjustable spanner 2-inch size	1 No	10	Hammer	2 Nos	11	Rough file kit	1 Set
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	12	Cutting Pliers	2 Nos																						
	13	Nose Pliers	2 Nos																						
	14	Vaccum for cleaning the panels	1 Nos																						
	Note: Prior to procurement, vendor shall obtain approval from BHEL for the make and specification of the items.																								
5.43	General specification of LT cables (1) LT power and control cables LT Power & control cables shall be of minimum 1100 volts grade XLPE / PVC insulated conforming to IS 1554 for utilization voltages less than equal to 415 V. Codes and Standards All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes: <table><tr><td>IS :1554 - I</td><td>PVC insulated (heavy duty) electric cables for working Voltages up to and including 1100V.</td></tr><tr><td>IS : 3961</td><td>Recommended current ratings for cables</td></tr><tr><td>IS : 3975</td><td>Low carbon galvanized steel wires, formed wires and tapes for armoring of cables.</td></tr><tr><td>IS : 5831</td><td>PVC insulation and sheath of electrical cables.</td></tr><tr><td>IS:7098 (Part -I)</td><td>Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.</td></tr><tr><td>IS : 8130</td><td>Conductors for insulated electrical cables and flexible cords.</td></tr><tr><td>IS : 10418</td><td>Specification for drums for electric cables.</td></tr><tr><td>IS : 10810</td><td>Methods of tests for cables.</td></tr><tr><td>ASTM-D -2843</td><td>Standard test method for density of smoke from the burning or decomposition of plastics.</td></tr><tr><td>IEC-754 (Part-I)</td><td>Tests on gases evolved during combustion of electric cables.</td></tr><tr><td>IEC-332</td><td>Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).</td></tr></table> (2) LT power cables The cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.			IS :1554 - I	PVC insulated (heavy duty) electric cables for working Voltages up to and including 1100V.	IS : 3961	Recommended current ratings for cables	IS : 3975	Low carbon galvanized steel wires, formed wires and tapes for armoring of cables.	IS : 5831	PVC insulation and sheath of electrical cables.	IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.	IS : 8130	Conductors for insulated electrical cables and flexible cords.	IS : 10418	Specification for drums for electric cables.	IS : 10810	Methods of tests for cables.	ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.	IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.	IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).
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If cables are to be laid underground, laying shall be as per latest relevant IS code.

Copper/aluminum conductor used in power cables shall have tensile as per relevant standards. Conductors shall be stranded.

XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C.

PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core un armored cables, shall have distinct extruded PVC inner sheath of black color as per IS: 5831.

For single core armored cables, armoring shall be of copper/aluminum wires/ formed wires. For multicore armored cables, armoring shall be of galvanized steel as follows:

Sl	Calculated nominal dia of cable under armour	Size and Type of armour
i)	Upto 13 mm	1.4mm dia GS wire
ii)	Above 13 up to 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
iii)	Above 25 up to 40 mm	0.8mm thick GS formed wire / 2.0 mm dia GS wire
iv)	Above 40 up to 55mm	1.4 mm thick GS formed wire/ 2.5 mm dia GS wire
v)	Above 55 up to 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
vi)	Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

The aluminum used for armoring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm² per meter at 20 deg C. The sizes of aluminum armoring shall be same as indicated above for galvanized steel.

The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armoring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armor wire / formed wire. Zinc rich paint shall be applied on armor joint surface of GS wire / formed wire.

Outer sheath shall be of PVC as per IS: 5831 & black in color for power cables. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

(a.) Oxygen index of min. 29 (as per IS 10810 Part-58).

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	(b.) Acid gas emission of max. 20% (as per IEC-754-I). (c.) Smoke density rating shall not be more than 60 % (as per ASTM D-2843). Cores of the cables shall be identified by coloring of insulation. Following color scheme shall be adopted: <table> <tr> <td>1 core -</td><td>Red, Black, Yellow or Blue</td></tr> <tr> <td>2 core -</td><td>Red & Black</td></tr> <tr> <td>3 core -</td><td>Red, Yellow & Blue</td></tr> <tr> <td>4 core -</td><td>Red, Yellow, Blue and Black</td></tr> </table> For reduced neutral conductors (in case of power cable), the core shall be black. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one meter -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3. Allowable tolerances on the overall diameter of the cables shall be ± 2 mm maximum, over the declared value in the technical data sheets. Repaired cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable. Cable selection & sizing Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage (c) Short circuit withstand capability This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the let out energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time. De rating Factors De rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:	1 core -	Red, Black, Yellow or Blue	2 core -	Red & Black	3 core -	Red, Yellow & Blue	4 core -	Red, Yellow, Blue and Black
1 core -	Red, Black, Yellow or Blue								
2 core -	Red & Black								
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	a) Variation in ambient temperature for cables laid in air b) Grouping of cables c) Variation in ground temperature and soil resistivity for buried cables. Cable lengths shall be considered in such a way that straight through cable joints are avoided. Cables shall be armored type if laid in switchyard area or directly buried. All LT power cables of sizes more than 120 sq.mm shall be XLPE insulated. CONSTRUCTIONAL FEATURES for LT Power Cables 1.1 KV grade XLPE power cables shall have compacted aluminium/ copper conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I). Cables which are directly buried shall be armoured. 1.1KV grade PVC power cables shall have aluminium/ copper conductor (compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I). CONSTRUCTIONAL FEATURES for LT control cables 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I). 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968. Minimum conductor size shall be 2.5 sq mm. TESTS Indicative list of tests / checks, routine and acceptance tests shall be as per Quality Assurance and Inspection table of LT power cables enclosed at relevant section. 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 cable price. All cables to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for BHEL/HPPCL approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of 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
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an independent laboratory or should have been witnessed by a client.

However if the 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 BHEL either at third party lab or in presence of BHEL/HPPCL representative and submit the reports for approval.

The type test reports once approved for any projects shall be treated as reference. Minor changes if any shall be highlighted on the endorsement sheet.

The reports for following type tests shall be furnished:

Sl	Type Test	Remarks
	Conductor	
1.	Resistance test	
	For Armour Wires / Formed Wires	
2.	Measurement of Dimensions	
3.	Tensile Test	
4.	Elongation test	
5.	Torsion test	For round wires only
6.	Wrapping test	
7.	Resistance test	
8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
8(b)	Adhesion test	For GS wires/formed wires only
	For XLPE insulation & PVC Sheath	
9.	Test for thickness	
10.	Tensile strength and elongation test before ageing and after ageing	
11.	Ageing in air oven	

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	12.	Loss of mass test	For PVC outer sheath only.
	13.	Hot deformation test	For PVC outer sheath only.
	14.	Heat shock test	For PVC outer sheath only
	15.	Shrinkage test	
	16.	Thermal stability test	For PVC outer sheath only
	17.	Hot set test	For XLPE insulation only
	18.	Water absorption test	For XLPE insulation only
	19.	Oxygen index test	For PVC outer sheath only
	20.	Smoke density test	For PVC outer sheath only
	21.	Acid gas generation test	For PVC outer sheath only
	22.	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only
	23.	Insulation resistance (volume resistivity method)	
	24.	High voltage test	
	(3) LT control cables The cables shall be suitable for laying on racks, in ducts, trenches, conduits and underground buried installation with chances of flooding by water. All cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification. Conductor of control cables shall be made of stranded, plain annealed copper. Outer sheath shall be of PVC as per IS: 5831 & grey in colour for control cables.. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a) Oxygen index of min. 29 (as per IS 10810 Part-58). (b) Acid gas emission of max. 20% (as per IEC-754-I). (c) Smoke density rating shall not be more than 60 % (as per ASTM D-2843). Cores of the cables shall be identified by coloring of insulation. Following color scheme shall be adopted:		

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	1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black For control cables having more than 5 cores, core identification shall be done by numbering the insulation of cores sequentially, starting by number 1 in the inner layer (e.g. say for 10 core cable, core numbering shall be from 1 to 10). The number shall be printed in Hindu-Arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of insulation. The colour of insulation for all the cores shall be grey only. The numerals shall be legible and indelible. The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing between consecutive numbers shall not exceed 50 mm. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a) Cable size and voltage grade - To be embossed (b) Word 'FRLS' at every 5 metre - To be embossed (c) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. All cables except module inter-connecting DC cable shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3. Repaired cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable. Cable selection & sizing Control cables shall be sized based on the following considerations: (a) The minimum conductor cross-section shall be 1.5 sq.mm. (b) The minimum number of spare cores in control cables shall be as follows: <table border="1"> <thead> <tr> <th>No. of cores in cable</th><th>Min. 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-12C</td><td>2</td></tr> <tr> <td>14C & above</td><td>3</td></tr> </tbody> </table> CONSTRUCTIONAL FEATURES for LT control cables 1.1 KV Grade Control Cables shall have stranded copper conductor and shall be multicore PVC	No. of cores in cable	Min. No. of spare cores	2C, 3C	NIL	5C	1	7C-12C	2	14C & above	3
No. of cores in cable	Min. No. of spare cores										
2C, 3C	NIL										
5C	1										
7C-12C	2										
14C & above	3										

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	insulated, PVC inner sheathed, armoured / unarmoured, FRLS PVC outer sheathed conforming to IS: 1554. (Part-I). (4) Cable Drums (a) Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. However, for single core cables up to 6 sqmm size, supplier can do alternative packaging of whole drum/spool to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418. (b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stenciled on both sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.																		
5.44	Cable installation Methodology 1. CODES AND STANDARDS All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable. <table border="0"> <tr> <td>IS:513</td><td>Cold rolled low carbon steel sheets and strips.</td></tr> <tr> <td>IS:802</td><td>Code of practice for the use of Structural Steel in Overhead Transmission Line Towers.</td></tr> <tr> <td>IS:1079</td><td>Hot Rolled carbon steel sheet & strips</td></tr> <tr> <td>IS:1239</td><td>Mild steel tubes, tubulars and other wrought steel fittings</td></tr> <tr> <td>IS:1255</td><td>Code of practice for installation and maintenance of power cables upto and including 33 KV rating</td></tr> <tr> <td>IS:1367 Part-13</td><td>Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).</td></tr> <tr> <td>IS:2147</td><td>Degree of protection provided by enclosures for low voltage switchgear and control gear</td></tr> <tr> <td>IS:2309</td><td>Code of Practice for the protection of building and allied structures against lightning.</td></tr> <tr> <td>IS:2629</td><td>Recommended practice for hot dip galvanising of</td></tr> </table>	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
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	iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:3063	Fasteners single coil rectangular section spring washers.
IS:6745	Methods for determination of mass of zinc coating on zinc coated iron & steel articles.
IS:8308	Compression type tubular in- line connectors for aluminium conductors of insulated cables
IS:8309	Compression type tubular terminal ends for aluminium conductors of insulated cables.
IS:9537	Conduits for electrical installation.
IS:9595	Metal - arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands elastomers and plastic insulated cables. Indian Electricity Act. Indian Electricity Rules.
Equipment complying with other internationally accepted standards such as IEC, BS, DIN, USA, VDE, NEMA etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith 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.	

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2. DESIGN AND CONSTRUCTIONAL FEATURE

Inter Plant Cabling

Interplant cabling for main routes shall be laid in Cable trenches/duct banks. Cables from main plant to control room shall be laid in Cable trenches/duct banks. In case of Duct banks, pull-pits shall be filled with sand and provided with a PCC covering. Directly buried cables, if essential, shall not have concentration of more than 4 cables in one route. All buried cables shall be armoured.

Trenches

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

No subzero level cable vault/trenches shall be provided below control building/switchgear rooms in plant.

General

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

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

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

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

3. Cable accessories

3.1 Cable trays, Fittings & Accessories

- Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be 3 mm.
- Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of thickness 2 mm and shall be hot dip galvanised

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	as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm. 3.2 Support System for Cable Trays (a) Cable tray support system shall be pre-fabricated similar or equivalent to "Unis rut make". (b) Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:-having provision of supporting cable trays on both sides. The support system shall be the type described hereunder: 1. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc. 2. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanized. 3. 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 galvanized surface shall be brushed and red lead primer, oil primer & aluminum paint shall be applied. 4. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation. 5. Support system shall be able to withstand • weight of the cable trays • weight of the cables (75 Kg/Metre run of each cable tray) • Concentrated load of 75 Kg between every support span. • Factor of safety of minimum 1.5 shall be considered. 3.3 Pipes, Fittings & Accessories a) 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 b) GI Pipes shall be of medium duty as per IS:1239 c) 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. d) Hume pipes shall be NP3 type as per IS 458.
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3.4 Junction Boxes

- a) 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 galvanized 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.
- b) 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.

3.5 Terminations & Straight Through Joints

- a) Termination and jointing kits for 33kV, 11kV, 6.6 kV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 33kV, 11kV and 6.6 kV grade joints and terminations shall be type tested as per IS: 13573. 3.3kV grade joints and terminations shall be type tested as per VDE0278. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solderless crimping type cable lugs & ferrule as per DIN standard.
- b) Straight through joint and termination shall be capable of withstanding the fault level for the system.
- c) 1.1 KV grade Straight Through Joint shall be of proven design.

3.6 Cable glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.7 Cable lugs/ferrules

Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment's. Cable lugs and ferrule shall conform to relevant standard.

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3.8 Trefoil clamps

Trefoil clamps for single core cables shall be pressure die cast aluminum or fiber 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.

3.9 Cable Clamps & Straps

The cable clamps required to clamp multicore cables on vertical run shall be made up of Aluminum 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.

3.10 Receptacles

Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped galvanized 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.

3.11 Galvanising

- Galvanising of steel components and accessories shall conform to IS: 2629, IS: 4759 & IS: 2633. Additionally galvanising shall be uniform, clean smooth, continuous and free from acid spots.
- The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367 . The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.

3.12 Welding

The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595.

4. CABLE INSTALLATION

4.1 Cable tray and Support System Installation

- a) 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.

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	b) 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. c) The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated. d) 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. e) 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. f) 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 aluminum paint. 4.2 Conduits/ Pipes/ Ducts Installation a) 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) 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. c) 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. d) 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
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	otherwise									
	<table> <tr> <th>Conduit /pipe size (dia).</th><th>Spacing</th></tr> <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> </table> e) For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth. 4.3 String Inverters Installation String Inverters shall be mounted at a height of 600mm 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, and ceiling or equipment foundations. 4.4 Cable Installation b) Cable installation shall be carried out as per IS: 1255 and other applicable standards. c) For Cable unloading , pulling etc following guidelines shall be followed in general : - o 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. - o 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. d) Cables shall be laid on cable trays strictly in line with cable schedule	Conduit /pipe size (dia).	Spacing	Upto 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm and above
Conduit /pipe size (dia).	Spacing									
Upto 40 mm	1 M									
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	e) 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 aluminum strips at every five meter interval and at every bend. f) Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255. g) Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/HDPE pipe. h) 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. i) 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. j) Wherever few cables are branching out from main trunk route troughs shall be used. k) Wind loading shall be considered for designing support as well Cable trays wherever required. l) Where there is a considerable risk of steam, hot oil or mechanical damage cable routes shall be protected by barriers or enclosures. m) The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
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4.5 Separation

At least 300mm clearance shall be provided between :

- HT power & LT power cables,
- LT power & LT control/instrumentation cables,

4.6 Segregation

- Segregation means physical isolation to prevent fire jumping.
- All cables associated with the unit shall be segregated from cables of other units.
- Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.
- In switchyard, control cables of each bay shall be laid on separate racks/trays.

4.7 Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:

No. of cores in cable	No. of spare cores
2C,3C	NIL
5C	1
7C-10C	2
14C and above	3

4.8 Directly Buried Cables

- Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS: 1255. Reference drawing for buried cables is included as a tender drawing and enclosed with this specification.
- RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

4.9 Cable tags shall be provided on all cables at each end (just before entering the equipment

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	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. 4.10 While crossing the floors, un armored cables shall be protected in conduits up to a height of 500 mm from floor level if not laid in tray. 5. Cable Terminations & Connections a) 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. b) 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. c) 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. d) 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. e) 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. f) All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
5.45	General civil works This section describes the technical requirements of various civil works related to this specification such as design mix for concrete, brick masonry/ plastering/ painting etc for earth chambers, RCC foundation for transformers, foundation for security room/ watchman cabin/ street lighting poles, , transformer yard fencing works / gate etc.

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1) Concrete/ RCC Works All RCC works shall be with design mix as per IS: 456 and the materials used viz. Cement, coarse & fine aggregate, Reinforcement steel etc. shall conform to relevant BIS standards. The contractor shall carry out concrete mix design well in advance prior to construction through NABL accredited laboratory/ Reputed Engineering Institute (IITs/NITs/ Government Engineering Institutes only). The minimum grade of RCC shall be M25 except for underground (UG) water tank where the grade of concrete shall be minimum M30. PCC shall be of min. grade M10 (equivalent nominal Mix – 1:3:6) unless otherwise specified. Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383. Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116 Reinforcement steel shall be of high strength TMT bars of grade Fe500 D conforming to IS: 1786. Ductile detailing in accordance with IS: 13920 shall be adopted for superstructure and sub-structure of all RCC buildings and structures. For grouting works anti shrink ready mix grout of approved make or cement mortar (CM) grout with non-shrink additive shall be used. The grout shall be high strength grout having min. characteristic strength of 30 N/ mm² at 28 days. Foundation system shall be made to transfer loads safely to the soil for structures such as lightning arrestors etc, 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 up to NGL. All loads shall be considered in line with IS: 875. Seismic loads for design shall be in accordance with IS: 1893 and relevant Standards. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete IS: 5525 and SP: 34 shall be followed for reinforcement detailing. A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456. 2) Masonry Works	
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	Brick work shall be in cement mortar (CM) 1:6 & 1:4 for 230 mm and 115 mm thick brick wall respectively. Bricks shall be of class designation 7.5 conforming to IS: 1077, IS: 2212 & IS: 3495. All concrete blocks shall be of min. compressive strength of 7.5 N/mm² and shall be of Grade-A conforming to IS: 2185. 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. Suitable damp proof course (DPC) shall be provided. The DPC shall be with PCC (1:2:4) using 6 down coarse aggregate and water proofing admixture. The min. thickness of DPC shall be 40mm 3) Plastering, Pointing & Coping Works All brick masonry work shall be provided with plaster. Wall and ceiling plaster shall be in cement mortar (CM) – 1:6 and 1:3 respectively. Thickness of plaster shall be 18mm and 12mm for rough and smooth surface of the brick wall respectively. The ceiling plaster shall be 6mm thick. All joints in stone masonry shall be raked and pointed in cement mortar (CM) – 1:3 except specified otherwise. Exposed top surface of brick or stone masonry shall be provided with 50 thick plain cement concrete (PCC) coping (1:2:4) with trawl finish. All exposed coping shall be provided with suitable slope and projection for easy drainage of water. 4) Foundation calculations The foundation system shall be made to transfer loads safely to the soil for the various 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 up to NGL. All loads shall be considered in line with IS: 875. Seismic load for design shall be in accordance with IS: 1893 and relevant Standards. IS: 2502 Code of Practice for Bending and Fixing of Bars for concrete IS: 5525 and SP: 34 shall be followed for reinforcement detailing. A minimum 75 mm thick PCC shall be provided below RCC wherever RCC is laid over the ground. Proper and sufficient formwork/shuttering shall be provided for the required period as per IS: 456.
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5) Design Loads

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

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

#	Area	Imposed Load
a	Roof	150 kg/ Sqm
b	Building floors	1000 kg/ Sq
c	RCC Floors (General)	500 kg/ Sqm
d	Outdoor platforms, Stairs, Landing/ Balconies, Walkway, Chequered plate & Grating floor	500 kg/ Sqm
e	Road	As per IRC Standard
f	Road culverts & allied structures over drain & pipe crossings	Design for class - 'AA' loading (Wheeled & Tracked both) and check for Class - 'A' loading as per IRC Standard
g	Underground structures such as Sumps, Pits, Trench, Drain etc.	In addition to Earth pressure and Ground water table at FGL, a surcharge of 1 T/Sqm shall also be considered
h	Pre-cast cover over cable trench	400 kg/ Sqm

Primary Loads

1. Dead Load (DL)
2. Live Load (LL)
3. Wind Load (WL) – Both along X & Z directions
4. Seismic Load (EL) – Both along X & Z direction

Design Load combinations

1. DL+LL
2. DL+LL ± WL_x
3. DL +LL± WL_z
4. DL+LL ± EL_x
5. DL+LL ± EL_z

All buildings, structures and foundations shall be designed to withstand loads corresponding to worst design load combinations. Unless otherwise specified elsewhere in the specifications, the DL, LL, WL and EL shall be estimated as per provisions of relevant BIS standards.

Wind Load Factors K₁, K₂ and K₃ – As per IS 875 (Part-3). However, minimum value for K₁, K₂ and K₃ shall be 1.0.

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	Unless otherwise specified elsewhere in the specifications, the Seismic Load shall be considered corresponding to Earth quake zone at site as per IS: 1893 – (Part- 4) 6) Structural Steel All structural steel shall design shall carried out as per IS 800. Structural steel shall conform IS 2062, Pipe shall be as per medium/high grade of IS 1161, Chequered plates shall conform to 3502 and Hollow steel sections for structural use shall conform to IS: 4923. 7) Grouting Cement mortar (1:2) grout with non-shrink additives shall be used for grouting below base plate of column. The grout shall be high strength grout having a minimum characteristic compressive strength of min 30 N/mm² at 28 days. The grout shall be chloride - free, cement based, free flowing, non-metallic grout. 8) Transformer yards / transformer foundations / oil pits / fencing / gate - Transformer and equipment foundations shall be founded on piles/isolated spread footings depending on the final geotechnical investigation report. - Transformer foundations shall have its own pit which would cover the area of the transformer and cooler banks, so as to collect any spillage of oil or oil drainage in case of emergency. The oil pit shall be filled with granite stone gravel of 40 mm size uniformly graded. The retention capacity of the transformer pit shall be min. 1/3 volume of the transformer oil which is filled with gravel with 300mm free space above gravel fill. The individual transformer oil pit shall be connected to an oil collection pit which shall be sized to accommodate full oil volume of the transformer connected to it, without backflow. The oil collection pit shall be connected to oily water drainage system. Dimensions of the discharge pipe shall consider rainfall intensity also. The water shall be discharged into the nearest drain by gravity flow or pumping. Both, the transformer pit and the oil collection pit shall be of RCC. The oil collection pit shall be provided with RCC cover. - Transformer track rails shall conform to IS: 3443. - The switchyard area around the transformer and other equipment shall be covered with gravel. v. Transformer yard fencing / gate - The area shall be provided with galvanized chain link fence of height min 1.8 m with gate. The fencing shall be of GI chain link mesh fabric, max. mesh size 40x40mm (minimum wire gauge 3.15mm), both ends twisted conforming to IS 2721 with suitable internal, corner and stay posts of GI angles along with 230 thick brick/ 300 thick RR masonry toe wall, 150mm height above GL. - The brick masonry toe wall shall be plastered with 15 thick CM (1:4) plaster on both faces and shall have min. 50 thick PCC (1:2:4) coping finished smooth and projecting 40mm on either side of the wall and top sloping inwards. - Minimum size of angle for internal, corner and stay post shall be 50x50x6 mm. Spacing of intermediate posts shall not be more than 2.5m. Every 10th intermediate post shall be provided with a stay post along fence and every corner post shall be provided with two stay posts along either side fence. The Main entry gate shall of rugged design with GI steel sections. The gate shall be complete with MS flat guide track, castor wheel(s), all fittings and fixtures like hinges, aldrop, locking arrangement, posts etc.
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	d) The Gate of size (width) 3.5m shall be of MS pipe frame with welded wire fabric mesh including all accessories and fittings. MS angle posts shall conform to IS: 2062. The portion of the fence covering towards rail track shall be made of removable type for movement of transformer during erection /removal.																								
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			1) Oil filtration: Equipment of adequate evacuation/ heating/ oil circulation capacity shall be deployed at site for this purpose. Filtration shall be carried out adequately in order to achieve the BDV, ppm, tan delta values within the limits as per relevant standards and as measured by NABL accredited laboratory. The machine shall have built-in BDV measuring set up for in-situ checking of BDV during filtration process. 2) IR tests LV-HV, HV-E, LV-E 3) Vector group 4) Voltage ratio 5) Magnetizing current 6) Magnetic balance 7) Winding resistance at all taps 8) Fault simulation checks (at VCB breaker panels): Buchholz, OTI, WTI, PRV, LOLA etc 9) Alarm, trip settings (S1, S2) for WTI, OTI 10) Oil level at conservator (to be topped up, if required)	
		B3	Indoor CTs 33kV	
			1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Ratio tests / primary injection	
		B4	Indoor PTs 33kV including Bus PTs	
			1) IR tests (all cores): Pri-Sec, Sec-Sec, Pri-E, Sec-E 2) Voltage ratio test 3) Polarity test	
		B5	Indoor VCB breakers 33kV	
			1) IR tests 2) Contact resistance measurement (CRM) 3) Timing test: close/ open/ close-open 4) Functional checks: breaker open/close, spring-charged motor 5) Remote operation from SCADA panels: open/close, command/status, lamp indications	
		B6	Numerical relays at VCB breaker panels	
			1) Relay calibration using applicable kit/ software 2) IDMT, DT curves with timing/pickup settings in all relays based on gradation across from downstream to upstream taking into account settings at STU substation 3) Overcurrent/ earth fault pickup/ tripping time tests	
		B7	CT ratio / PT ratio to be set in meters/relays	
			i. All MFM meters ii. ABT meters iii. Protection relays	
		B8	ACB breaker settings (with the help of LTPDB OEM service engineer at site)	
			1) Over load, Short time fault, ground fault	
		B9	Earth resistance measurements for all chambers of vendor scope	
			1) With electrode connected to grid 2) Without connecting electrode to grid	

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			B10	UPS/ FCBC charger/ Battery bank
				1) All functional checks: battery charging/ discharging, FCBC/ battery output parameters etc as per OEM checklists
		C	Testing agency	
				Credentials of testing agency shall be submitted to BHEL for approval prior to awarding of work.
		D	Coordination and Liaison activities to be carried out by vendor:	
				1) Vendor shall carry out the process of obtaining approval from Transco/ DISCOM/ CEIG/ CEA etc as applicable for line charging/ grid synchronization/ plant commissioning. 2) Liaison responsibility for getting the above approvals rests with the Vendor. Vendor shall suitably coordinate/liaison with the concerned state/central approving agencies to make the approval process successful. Accordingly, vendor shall participate in direct discussions with the approving agency whenever necessary. Also, all the necessary payments/expenditures to be incurred with ref to such coordination/ liaison in this regard shall be borne by the vendor. 3) Vendor shall suitably coordinate with the respective OEMs of BHEL supplied equipment such as Transformers and String inverters for mobilization of inputs from them necessary for the approval process. 4) Following are the areas of approval, as applicable, for the SPV-side portions including solar array and up to 33kV side of plant upto Zero point as defined by HPPCL for point of injection of energy into Utility grid. (a) Schemes/ layouts/ calculations such as earth mat design, solar array layout, lighting arrestor layout, module cleaning system, cable trench layout, plant lighting system, fire alarm system etc. (b) GTP/ datasheets/ GA drawings/ Bill of materials, MQP etc of supply items. (c) GA drawings of installation such as foundation/ oil pits of inverter transformers / auxiliary transformer etc. (d) Factory test reports of supply items including BHEL-supplied items. (e) Site test reports of transformers, transformer oil, VCB breakers, CTs, PTs, ABT meters, resistance of earth mat grids etc (f) Interaction with supervising/ inspection agency such as MRT departments, Transco, CEIG, CEA etc, as applicable, for applying to them/ inviting them for supervision/ inspection at site. (g) Interaction/ coordination with customer (HPPCL) in the above process as and when required. (h) All necessary testing kits/ instruments shall be arranged as per the requirements of inspection agency. Basic instruments such as digital multimeter, 5kV digital megger with PI feature, earth resistance meter, VCB open/close timing test kit, clamp meters etc shall be organized at site at the time of inspection. Competent electrical technician shall also be made available at the site.

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				(i) Subsequent to site inspection by the concerned agency, vendor shall support and carry out follow up with BHEL to obtain clearance for line charging/ grid synchronization. (j) Vendor shall implement all the observations of CEIG related to SPV-side portion including solar array and up to 33kV side of injection point (Zero point).
			E	Commissioning of power plant
				1) Vendor shall organize presence of an electrical consultant at site at the time of commissioning with no additional charges to BHEL. The consultant shall have adequate expertise in the form of knowledge/ experience in this field. He shall be able to guide the site team on the steps/ procedure/ precautions to be adopted during commissioning. Also, he shall be cable of extempore trouble-shooting in case of any technical problems encountered on SPV portions up to 33kV side of 3.15 MVA transformer. Vendor shall submit credentials of the proposed consultant for BHEL/HPPCL approval prior to awarding of work/ availing their service. 2) Vendor shall organize all necessary tools/ measuring instruments required to operate the various electrical equipments at the time of commissioning: Digital megger 5KV with PI feature, Earth resistance tester, Phase sequence meter, Clamp meters etc, discharge rods, PPE safety gadgets (helmets, shoes etc). 3) It is the responsibility of the vendor to interact technically with upstream/ downstream contractors for successful charging of 33 kV grid line followed by charging of 33 kV transformer at SPV plant end and grid synchronization of inverters/ plant commissioning. 4) Vendor shall participate actively in the commissioning until it is established that there is successful export of power from all the String inverters / Transformers and through the 33kV transmission line/ switchyards of power plant.
5.47	Spares required to be supplied along with main consignment: 1) 33kV termination kits: 3 Nos each type 2) 33kV straight through jointing kit: 3 Nos each type 3) Fuses of all types: 10% of total population of respective items 4) MCCB, MCB of all types: 10% of total population of respective items 5) Indicating lamp set of all types: 10% of total population of respective items 6) Surge protection devices/ MOV: 10% of total population of respective items 7) Plant lighting LED lamps: 5% each type. Notes: (a) 1 set refers to total quantity of the item used in one transformer. (b) In case percentage is a decimal figure, it shall be rounded up to next higher integer.			

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6.0 General conditions applicable during supply, installation and commissioning and O&M phase

6.1	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 vendor.
6.2	All necessary tools and tackles such as crimping tool (including heavy duty tools for crimping copper/ aluminium cables up to 500 sq-mm), screw driver set, power screw drivers, cutting pliers, nose pliers, spanner sets, adjustable spanners, hole-saw cutter set, bending tools, torque wrenches, hack saw blades, pipe wrenches, flat / round files, HV termination tools, drilling machines, welding machines, concrete mixers, steel bar bending tools / templates/ shuttering materials for RCC works, spade, shovel, hammer etc shall be organized by the vendor.
6.3	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. List of instruments shall be mentioned in the offer.
6.4	Vendor 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 vendor.
6.5	Vendor 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.
6.6	Vendor shall maintain updated labour register, with name, age, qualification, salary, attendance details etc at the site.
6.7	Vendor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
6.8	Vendor 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 vendor in all respect to prevent accidents at the site and safeguard their labour from accidents.
6.9	Vendor 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, vendor shall finish the land neatly with necessary leveling, rolling etc.
6.10	Vendor shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, vendor shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
6.11	70% of the jobs created due to the project in the supervisory and executivel cadres & 80% Of the jobs that will be created in other cadres shall be filled in by employing local persons.

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	"the expression Local person shall mean a person domiciled in Himachal State for 15 years prior to applying for employment to vendor
6.12	Any damages on the building, structures etc attributable to the acts of labour / employees of vendor shall be rectified and made good by the vendor at their own cost.
6.13	No child labour shall be employed for execution of the present contract.
6.14	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 vendor as part of the offer.
6.15	Special instruction for earthing: In compliance with Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode. Accordingly, all cases such as cable support structures, cable ladders, cable trays (control room) etc shall be earthed.
6.16	BHEL/HPPCL shall witness routine/ acceptance/ type tests performed at manufacturer works for the items supplied by vendor. Vendor shall accordingly provide inspection call to BHEL with submission of quality assurance plan in advance. For the items bought out from dealers, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/HPPCL for procurement of the item from dealers.
6.20	Field Quality Plan / Quality control system Vendor 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/HPPCL. Vendor shall deploy a well experienced quality control engineer to monitor all QC activities at site as per approved FQP. Specifically with reference to civil works, vendor shall submit all concrete mix designs and bituminous mix designs for BHEL/HPPCL approval before starting of the work. All the third party testing should be conducted in NABL approved laboratories only. Vendor shall submit the FQP for the civil construction works before starting of the works for approval of BHEL/HPPCL.
6.21	Any deviations shall be discussed with BHEL/HPPCL site engineers and implementation shall be taken up only after approval from BHEL /HPPCL.
6.22	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.
6.23	Vendor shall, as and when required by BHEL/HPPCL, participate in the review meetings conducted by BHEL/HPPCL at project site, BHEL-EDN (Bangalore), BHEL-Corporate office (New Delhi), HPPCL office (Berra Dol) etc.

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6.24	General Guidelines a) Any civil or electrical work which is not mentioned or included in this tender document but necessary for functional requirements of the plant shall be carried out by vendor. b) Vendor shall prepare all designs / drawings based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard. c) Vendor shall provide type test reports and datasheet/ GTP for all equipments covered under vendor scope of supply. d) BHEL reserves right to modify the design at any stage to meet local site conditions / project requirements. e) All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules formed thereunder and as amended from time to time.
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7.0 Operations and Maintenance

7.1	Date of commencement of operations and maintenance Zero date for O&M shall be the actual date on which the power plant is commissioned with synchronization of SPV Plant to grid / export of power for full 5.04MW (AC) and completion of all punch points. O&M shall be for 5 years with scope of SPV portions on the solar plant end including solar array and termination point of the 33 kV evacuation cable from the Control room upto Zero point on the HSEBL line passing near the Control room.
7.2	O&M personnel 1. Vendor shall deploy following minimum personnel: (a) Technical / administrative / office personnel - One manager-cum-administrative incharge with atleast bachelor's degree in electrical / mechanical engineering having 5 years experience in erection and commissioning of solar PV plants of capacity 1 MW and above responsibility for complete plant operations. The in-charge shall have competence to deftly handle technical and operational / crisis problems. - Two technicians with diploma in electrical / mechanical engineering having 5 years experience in erection and commissioning of solar PV plants of capacity 1 MW and above for operating plant equipment, taking measurements, data logging / maintaining registers, preparation of reports in computer. - Four unskilled persons for regular house-keeping (cleaning / mopping etc) and water cleaning of SPV modules. Note: At least one among the technical personnel shall essentially be a certified / licensed person for HT operations (33kV minimum). This is a mandatory requirement. (b) Security personnel - Minimum 7 security guards with competence to handle tough situations and safeguard the plant from miscreants. - Among these, three shall be deployed during night shift, two during morning shift and two during evening shift. 2. Vendor shall provide uniforms for the O&M staff. 3. Similarly, O&M personnel shall be provided with raincoats, toolsets, earthing rods, safety gloves, safety goggles, gumboots, helmets and all other personal protective equipment (PPE) that will be relevant to ensure human safety. 4. Names, qualification, work responsibility of personnel shall be listed on a display board within control room. 5. Attendance register shall be maintained for both the teams.

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	6. Vendor shall ensure statutory requirements such as ESI, PF and labour license for their O&M personnel posted at site. 7. BHEL/HPPCL shall have right to disallow any O&M employee, if found unfit to perform. BHEL instructions issued in writing shall be binding on vendor who shall replace the person. 8. O&M personnel at site shall conform to general regulations in force at site and to any special instructions from HPPCL administration. 9. O&M personnel at site shall be deemed to be aware of damages and risks incidental to conditions of ordnance factory (OFMK) land & works from time to time and BHEL/HPPCL shall not be responsible for any injury to personnel arising there from. 10. Training to O&M personnel It is the absolute responsibility of vendor to ensure imparting of necessary training to their O&M personnel to get them acquainted with the operations of various electrical and mechanical equipment of the power plant. For this purpose, vendor shall identify the O&M personnel well in advance and involve them during installation and commissioning stages so that they become well versed with various functional aspects of the power plant. 11. Availability of O&M personnel at power plant (a) Vendor shall ensure that operating staff are present in the power plant during 7:30 AM – 6:30 PM every day. (b) Vendor shall ensure that certain minimum operating staff are present at the power plant even on festivals, public holidays and any other unique occasions so that the plant is run under competent supervision on all days. 12. O&M personnel shall, strictly, not use any part of the power plant for their personal / residential purposes. Their presence at the plant shall, strictly, be meant only for the purpose of operation and maintenance of plant.
7.3	Responsibility of vendor during PG test Vendor shall, in addition to the O&M activities (as per this specification), carry out the Performance Guarantee test (PG test) that commences on a date (as mutually decided by BHEL/HPPCL) after successful completion of initial acceptance test that is carried out for 7 continuous days and evaluated with reference to performance ratio (PR). PG test is the final acceptance test (conducted for a period of 30 days as decided by HPPCL within the O&M period) to prove the performance of the power plant with reference to PR. Vendor shall carry out the following activities during this period: 1. O&M activities as per this specification 2. Monitoring of power plant parameters as per SCADA reports 3. Reporting power plant parameters to BHEL/HPPCL on daily basis

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7.4	O&M operations – daily basis (1) Water cleaning of SPV modules (2) Inverter room / main control room cleaning – dry sweeping, wet mopping (3) Water wash cleaning of toilets, urinals (4) Gardening of landscaping areas: watering of plants, trimming of plants as applicable and necessary. (5) Logging of DC, AC, grid parameters (current, voltage, power, energy) at PCUs & VCB panels, transformer temperatures, equipment tripping/ breakdown, grid outage etc as per BHEL formats. (6) SCADA data station / PC operations for daily monitoring of weather parameters, trend graphs and urgent reporting to BHEL/HPPCL in case of any problems / anomalies observed with any of the parameters. (7) Drinking water to be arranged for O&M personnel at site.
7.5	O&M activities – weekly basis (1) Removal of garbage from solar array field, switchyard, roads, drains, pathways, sand buckets; logging in registers with signatures of operating persons and in-charge. (2) Monitoring and logging of fire extinguisher levels / pressures as per BHEL formats
7.6	O&M activities – monthly basis (1) Inspection of fire extinguishers (weight, pressure indication, physical status etc) followed by refilling actions, if necessary, based on indications. Report to be submitted as per BHEL approved recording formats. (2) Earthing resistance measurements for solar array structures, control room equipment, switchyard equipment, lightning arrestors: measured values shall be recorded in registers and reported to BHEL as per BHEL approved recording formats. (3) Submission of values / status of plant parameters and events for the corresponding month, as below, as per BHEL approved formats: a. Daily values of solar array strings (SMB parameters) b. Daily values of weather parameters (solar energy, wind speed, ambient temperature) c. Daily energy generation d. Events (with date, time) of faults / tripping / breakdown of equipment e. Events (with date, time) of grid outage f. Events (with date, time) of equipment damages, accidents and thefts g. Activities of module cleaning (4) Monthly reports shall be submitted to BHEL for all the above data. (5) Energy generation / meter reading report to be prepared and submitted to the concerned department. Signatures from HPPCL representatives shall be obtained wherever required.
7.7	O&M activities - quarterly basis (1) Cleaning of PCUs, LT panels, VCB panels, UPS panels etc to remove accumulated dust. (2) Monitoring and status review, followed by rectification/ calibration/ replenishment/ replacement actions as necessary and applicable for following: (a) Spare items of all electrical equipment (b) First aid box items - medicines and accessories (c) Safety gadgets (d) Tool kits and measuring instruments (e) Yard lights (f) Pumps, starters (g) Control room appliances: air conditioners, lights, fans, exhaust fans, switch boards etc

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	(3) Pest control for control room (rats, snakes etc) – sprays, chemicals, medicines etc to be applied wherever required. (4) Submission of quarterly report on above activities to BHEL.
7.8	O&M activities – half yearly basis (1) Cleaning of water storage tanks (2) Tilting of Module mounting structures at specified angles
7.9	O&M activities – yearly basis (1) BDV measurements for oil samples from all transformers and submission of report to BHEL/ HPPCL. (2) Filtration of oil to be arranged, if required, based on BDV measurement report. (3) Lubrication of moving contacts (VCBs etc) with appropriate grease etc (4) Cleaning of sewerage lines, septic tanks (if found necessary) (5) Painting of main gate, switchyard gate / fencing, earthing chambers, other steel structures within control room and switchyard if required based on conditions of rusting etc. (6) Checking tightness of hardware in solar array structures and tightening wherever required. (7) Checking tightness of power cable terminations in SPV modules (MC4), SMBs, electrical panels of control room and switchyard.
7.10	O&M activities - as and when required (contextual basis) (1) Monitoring and operation of plant electrical equipment as and when required: (a) VCB on/off: local operations from outdoor VCB panel and remote operations from SCADA system. (b) Settings of numerical relays in VCB panels: review and revision in consultation with BHEL. (c) ACB and MCCB on/off operations on LT side (d) PCU operations: emergency close, LCD displays (selection of settings, monitoring the DC/AC/event/fault status parameters), operation of duct fans (e) UPS panels and Battery bank operations (f) Booster pump operations to fill the water storage tanks (2) Coordinating, on behalf of BHEL, and obtaining renewal of statutory licenses, clearances and approvals from state departments such as electricity boards, CEA/CEIG etc. (3) Repair and replacement of vendor supplied items, by vendor, with urgent action plans and implementation, when the items are found non-working / damaged. The same shall be reported to BHEL within 12 hours from time of observation. (4) Reporting, on an immediate basis (within max 2 hours) of functional problems / damages in BHEL supplied items to facilitate repair / replacement by BHEL. Further, vendor shall correspond / coordinate with respective equipment vendors / service centers, on behalf of BHEL, for getting the service engineers to the site. Later, coordinating with the service engineers during their visit to site, and assisting them in the trouble shooting process until the problem is resolved. Vendor shall report to BHEL (within max 2 hours) immediately after the problem is resolved. (5) Vendor shall keep updating the spares inventory at the site every time there is consumption of spare items towards replacement. In case of shortage of spares, the same shall be reported on an urgent basis (with max 2 hours) to BHEL. (6) Coordinating with sub-station upon grid failures, line problems etc and implementing the needful steps to restore the plant to normal operation. (7) Theft incidents: immediate reporting to BHEL, filing FIRs with police stations on behalf of BHEL, coordination for site inspection by insurance companies and clearance of insurance claims, logging of events (date, time) and maintaining records.

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	(8) Accidents: immediate reporting to BHEL, coordinating with hospitals, logging of events (data, time) and maintaining records.
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8.0 Documents to be submitted to BHEL/HPPCL approval during detailed engineering

8.1	BHEL/HPPCL 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).
8.2	Name of vendor/ make, model number/ part number, specification/ sizes/ dimensions/ drawings/ datasheets/GTPs shall be submitted for all the vendor supplied items.
8.3	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 cable trays for internal cable trench, cable ties (for dressing on cable trays of internal cable trench), HDPE DWC conduits for control/ communication cables from transformer marshaling box to SCADA/ HT panels etc, 33kV termination kits, 33kV straight through jointing kits, cable glands, cable lugs, (2) All cables viz DC, LT AC, HT AC, Control/Communication & OFC . (3) Underground trench for 1Cx500, 1Cx400, 33kV HT cables, Aux AC cables, OFC cable: routing layout/ cross sections etc. (4) Earth mat grid for LTPDB & Switchyards: design calculations, layout, BoM etc. (5) Earth mat grid for main control room: design calculations, layout, BoM etc. (6) Earth chambers of solar array/ inverter/ACCB/Switchyard/main control rooms: GA, cross section, BoM with GTP/ datasheets etc. (7) UPS/ FCBC/ Battery bank sizing calculations for main control room. (8) Plant lighting system: lux calculations, lighting layouts, GA drawings of street light pole/ wall-mounted/ column-mounted/ fence-mounted systems, SLD, BoM with GTP/ datasheets etc. Note- Capacity of UPS/Battery sufficient to maintain the supply for at least 12 hours (9) Fire detection/ alarm system: layout in Switch yards, layout in main control room, overall layout with zones/ sensor/ hooter/ control panel locations, BoM with GTP/ datasheets etc. (10) Intercom system: layout in all the rooms of main control room, security rooms and the various locations in the field (11) Any other designs/ schemes/ layouts etc. as per BHEL/HPPCL requirements that will be discussed during detailed engineering.
8.4	Manufacturing Quality Plans for all the vendor supplied items
8.5	Field quality plan for the field work: civil works, electrical works
8.6	Detailed activity-time chart for project implementation
8.7	Detailed manpower deployment schedule
8.8	Installation manuals for chemical earthing electrodes, fire alarm system etc.

	ANNEXURE-1 TO PURCHASE SPECIFICATION Design, supply and erection of Pre-Engineered Buildings (PEB) including civil works of 6340KWp Solar PV ground mounted system at Berra Dol, Tehsil Sri Naina Devi ji, District Bilaspur, Himachal Pradesh	PS-439-1176 A1
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1.0 Scope of supply and I&C for Pre-Engineered buildings

#	Item Description	Quantity
1.	Supply of PEB structural materials such as columns, rafters, beams, purlins, steel sheets, insulation etc for control rooms.	1 set
2.	Supply of PEB structural materials such as columns, rafters, beams, purlins, steel sheets, insulation etc for RTU rooms (Note: 1 set is for one RTU room).	2 set
3.	Supply of PEB structural materials such as columns, rafters, beams, purlins, steel sheets, insulation etc for security rooms	2 set
4.	Supply of PEB architectural items such as doors, windows, rolling shutters, partitions etc for control room. (Note: 1 set is for one inverter room).	1 set
5.	Supply of PEB architectural items such as doors, windows, rolling shutters, etc for RTU rooms as per clause 8.2. (Note: 1 set is for one RTU room).	2 set
6.	Supply of PEB architectural items such as doors, windows, etc for security rooms as per clause 8.2.	2 set
7.	Supply of electrical items like LED lights, fans, switchboard, cables etc for control room as per clause 8.3 (Note: 1 set is for one CONTROLL room).	2 set
8.	Supply of electrical items like LED lights, fans, switchboard, cables etc for RTU rooms as per clause 8.3. (Note: 1 set is for one RTU room).	1 set
9.	Supply of electrical items like LED lights, fans, switchboard, cables etc for security rooms as per clause 8.3.	2 set
10.	I&C: Erection of PEB RTU room structural materials as per clause 8.5 (Note: 1 AU represents one RTU room)	2 AU
11.	I&C: Erection of PEB control room structural materials as per clause 8.5 (Note: 1 AU represents one control room)	1 AU
12.	I&C: Erection of PEB security room structural materials as per clause 8.5	2 AU
13.	I&C: Erection of PEB RTU room architectural items as per clause 8.6 (Note: 1 AU represents one RTU room)	2 AU

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14.	I&C: Erection of PEB control room architectural items as per clause 8.6	1 AU
15.	I&C: Erection of PEB security room architectural items as per clause 8.6	2 AU
16.	Construction of Civil Foundation including cable trench for RTU room as per clause 8.4	2 AU
17.	Construction of Civil Foundation including cable trench for control room as per clause 8.4	1 AU
18.	Construction of Civil foundation for Security room as per clause 8.4	2 AU
19.	I&C: Electrical items like LED lights, fans, switchboard, cables etc for RTU rooms as per clause 8.7. (Note: 1 set is for one RTU room).	2 AU
20.	I&C: Electrical items like LED lights, fans, switchboard, cables etc for control room as per clause 8.7. (Note: 1 set is for one controll room).	1 AU
21.	I&C: Electrical items like LED lights, fans, switchboard, cables etc for security room as per clause 8.7.	2 AU

2.0 Enclosures to this tender specification

2.1	Typical layout of PEB RTU room showing electrical panel placement (tender purpose only)
2.2	Typical layout of PEB control room showing electrical panel placement (tender purpose only)
2.3	Indicative field quality plan of HPPCL

Notes:

- 1) Overall base area of PEB RTU room shall be 9 sqm minimum.
- 2) Overall base area for PEB security room shall be 6.25 sqm minimum.
- 3) Height of vertical column structure of PEB / control room / room shall be 3.5m minimum above FFL.

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3.0 Technical specification – Design, supply and erection of PEB rooms

3.1 Design and supply of PEB structural materials

- After receipt of BHEL PO, following documents shall be submitted to BHEL/HPPCL for approval: 1. Structural design calculations including STADD.Pro 2. GA drawings along with BOM.
- Design calculations, checked and certified by IIT/NIT, shall be submitted to BHEL/HPPCL for approval.
- Vendor shall supply the structural materials such as columns, rafters, beams, purlins, tie rods, sheets, wall cladding/roofing PUF insulation, hardware etc to the site as per the HPPCL approved drawings. Raw materials for steel sections, sheets etc shall be of reputed make such as Jindal, RINL, SAIL, Tata steel etc. Vendor shall take prior approval from BHEL for the make prior to proceeding with procurement action.
- Vendor shall also supply the J bolts/nuts/washers, alignment plates and other related hardware that are used for positioning and anchoring of the PEB structures to the RCC foundation.
- All the items shall be supplied directly to the project site.
- Relevant clauses of “**Detailed specification of PEB rooms**” section shall be adopted.

3.2 Design and supply of PEB architectural items

- After receipt of BHEL PO, vendor shall submit GA drawings along with BOM (item-wise description, quantity, make, model etc) of the architectural items for BHEL/HPPCL approval.
- The architectural items submitted for approval shall meet the requirements of various aspects of the room such as electrical, illumination, ventilation, exhaust, thermal, safety, security etc.
- Accordingly, this shall include all items such as windows with shades, doors with shades/lock/key, rolling shutters with lock/key, ventilator provisions, exhaust provisions, rain water gutters/ down comers/ pipes etc.
Vendor shall take prior approval from BHEL for the make prior to proceeding with procurement action.
- Vendor shall supply the items directly to the project site.
- Relevant clauses of “**Detailed specification of PEB rooms**” section shall be adopted.

3.3 Design and supply of PEB room electrical items

- After receipt of BHEL PO, vendor shall submit Electrical layout drawings along with BOM (item-wise description, quantity, make, model etc) for BHEL/HPPCL approval.

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- b) The electrical items submitted for approval shall meet the requirements of various aspects of the room such as electrical, illumination, ventilation, exhaust, thermal, safety, security etc.
- c) Accordingly, this shall include all items such as lighting fixtures, fans, exhaust fans, sockets, switchboards, LDBs, cables etc. Vendor shall take prior approval from BHEL for the make prior to proceeding with procurement action.
- d) Vendor shall supply the items directly to the project site.
- e) Relevant clauses of “**Detailed specification of PEB rooms**” section shall be adopted.

3.4 Design and construction of PEB room foundations including cable trench

- a) After receipt of BHEL PO, vendor shall submit the foundation drawing of PEB rooms including cable trench for BHEL/HPPCL approval.
- b) The foundation drawing submitted for approval shall be supported with design documents.
- c) Cable trench shall be constructed as per drawing enclosed in this tender specification.
- d) Necessary cable tray support structures and panel support structure shall be provided in the cable trench
- e) Vendor shall supply the items directly to the project site.
- f) Relevant clauses of “**Detailed specification of PEB rooms**” section shall be adopted.

3.5 Erection of structures of PEB rooms:

- a) Vendor shall erect the structural items such as columns, rafters, beams, purlins, tie rods, sheets, wall cladding/roofing insulation, hardware etc as per the BHEL/HPPCL approved drawings / BoM.
- b) Vendor shall also carry out necessary finishing activities such as painting etc.
- c) Vendor shall deploy qualified/competent team at site to carry out the above erection activity.
- d) Vendor shall also deploy their specialized team during plinth casting of J bolts / alignment (base) plates etc.
- e) All necessary labour, tools & tackles, shuttering materials, measuring instruments, machinery shall be in vendor scope of supply. This shall include spanner sets, drilling machines, welding machines, hydra, JCB, truck, trolley etc as required for the erection work.
- f) For the above, relevant clauses of “**Detailed specification of PEB rooms**” section shall be adopted.

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3.6 Erection of architectural items of PEB room:

- Vendor shall carry out erection of the architectural items such as windows with shades, doors with shades/lock/key, rolling shutters with lock/key, structural provisions for ventilators / exhausts, rain water gutters/ down comers/ pipes etc as per the BHEL/HPPCL approved drawings / BoM.
- Vendor shall also carry out necessary finishing activities such as painting etc.
- Vendor shall deploy qualified/competent team at site to carry out the above erection activities.
- All necessary labour, tools & tackles, shuttering materials, measuring instruments, machinery shall be in vendor scope of supply. This shall include spanner sets, drilling machines, welding machines, hydra, JCB, truck, trolley etc as required for the erection work.
- For the above, relevant clauses of “**Detailed specification of PEB inverter room/ PEB security room**” section of this specification shall be adopted.

3.7 Erection of electrical items of PEB rooms:

- Vendor shall carry out erection of the electrical items such as lighting fixtures, fans, exhaust fans, sockets, switchboards, LDBs, wiring etc as per the BHEL/HPPCL approved drawings / BoM.
- Vendor shall deploy qualified/competent team at site to carry out the above erection activities.
- All necessary labour, tools & tackles, measuring instruments, machinery shall be in vendor scope of supply. This shall include spanner sets, drilling machines, welding machines, hydra, JCB, truck, trolley etc as required for the erection work.
- For the above, relevant clauses of “**Detailed specification of PEB RTU room/ PEB security room**” section of this specification shall be adopted.

4.0 Detailed specification of PEB rooms:

4.1 PEB RTU room / control room / security room /

The **RTU room** / control room / Security room / shall be made of Pre-Engineered Buildings (PEB). The PEB shall be made of structural steel construction with double skinned metal roofing and wall cladding of approved profile. It shall be designed, manufactured, supplied and erected by the bidder/PEB agency. PEB shall be, metal fascia, metal gutter, rain water down comers, sun-shades, openings, etc., along with associated structural steel, cladding and roofing work insulation, Trims & Flashings. Each item of PEB like panels, masonry, plastering, flooring, foundation, fittings etc. shall be suitable or complete life of solar plant. The

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construction methodology for PEB shall also be submitted for HPPCL approval before start of works.

The layout of Inverter room / Security room shall be designed so as to divert the heat generated from each inverter outside the room. The inverter room / security room shall be designed for a life of 25 years. The successful bidder shall have to get the structural design done as per the prevailing Indian standard codes and International Standard. **The structural design of inverter room of each type shall have to be proof checked by any IIT / NIT and subsequently submitted to HPPCL for approval before actual start of the work.**

To provide general idea about work to be performed under the scope of the contract. The PEB shall have robust water tightness at all joints and connections. The building shall have a high class durability and performance during the adverse weather conditions.

4.2 Structure and material specification

The PEB inverter room / security room shall have a steel frame primary structural members. Primary members fabricated from plates shall conform to IS2062 min Grade E250 Quality BR/ ASTM A572-12 Grade 50 with minimum yield strength of 345 MPa. Steel shall be semi-killed/killed. Minimum thickness of steel plates shall be 4 mm. Hot rolled primary structural members and Rod/Angle bracing shall conform to IS2062 Grade E250 Quality A. Secondary members for Purlins and Girts shall conform to the specification of IS 811 or ASTM A1003-12 made from steel sheets conforming to ASTM A1011-12b Grade 50 having a minimum yield strength of 345 MPa. The minimum thickness of secondary members shall be 3.15 mm. All other miscellaneous secondary members shall have minimum yield strength of 250 MPa.

Insulated wall cladding or roofing shall consist of double skin metal cladding with Poly Urethane Foam (PUF). PUF must be made of continuous method PU foam and must be CFC free, self-extinguishing, fire retardant type with density 40 +/-2 kg/m³ and thermal conductivity 0.019-2.2 W/(m.K) at 10°C. The PUF panels shall be a factory made item ready for installation at site.

4.3 Fasteners & Connections:

Special coated self-drilling screws/fastener shall be used conforming to class 3 as per AS: 3566.1 and AS: 3566.2. Steel bolts, nuts and washers complying with AS 1112:2000. High Strength Bolts for Primary Connections IS: 1367 (Part III) Gr. 8.8 / ASTM A325. Bolts for Secondary Connection IS: 1367 (Part III) Gr. 4.6 / ASTM A307. Anchor/foundation Bolts shall conform to IS: 5624 and relevant IS code.

4.4 Roof and Wall cladding:

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PUF panels shall be made of troughed permanently color coated metal sheets of steel for roofing and side cladding (internal and external) shall conform to the requirements of Table-1 and IS: 513 for Hot-dip Zinc coated or Al/Zn coated sheets. The insulation material thickness and details shall be as specified at relevant para in the specification.

PUF insulated panels Metal Sheet for Roofing and side cladding consist of external sheet as troughed permanently color coated sheet & internal sheet as plain permanently color coated sheet.

Chemical composition of Troughed permanently color metal sheet for roofing and side cladding shall conform to the provisions of same reference code to which the mechanical properties conform to.

Plain permanently color coated steel metal sheet for ridge and hips, flashing, trimming, closure for vertical and horizontal joints, capping etc. shall conform to the same requirements as those of troughed permanently color coated metal sheet for roof and side cladding.

The maximum spacing of the fastener shall be 390 mm c/c along the length of purlins / runners. However exact spacing shall be as per the design done by the bidder of the fastener considering the wind load, self-load and other associated load. Minimum diameter of the fastener shall be 5.5 mm and at least 3 nos. of fastener shall be used per sheet.

Fillers blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The fillers blocks shall be manufactured from black synthetic rubber or any other material approved by engineer.

4.5 Roof Insulation and type:

Both metal sheets shall have an under insulation of minimum 70 mm thick PUF with density 40 +/- kg/m³ and thermal conductivity 0.019-2.2 W/(m.K) at 10°C with gutters and down take pipes along with Flashing & Top cap of required size and color complete with all necessary hardware complete. Roof shall be projected at-least 300 mm from the wall.

Stiffening ribs / subtle fluting for effective water shedding and special male/female ends with full return legs on side laps for purlin support and anti-capillary flute in side lap.

Both upper and lower sheets shall be separated through spacers and fastened through zinc /zinc-tin coated self-drilling screws. The fastener size shall be calculated as per the design or manufacturers recommendations.

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Bidder may also alternatively make the PEB roofing with composite slab (RCC slab with permanent frame work). The composite slab scheme, design and drawings shall be subject to approval from HPPCL before start of work.

4.6 Wall Insulation:

All voids of external and internal metalled walls shall have an under insulation of minimum 60 mm thick PUF with density 40 +/- kg/m³ and thermal conductivity 0.019-2.2 W/(m.K) at 10°C with proper supports etc. as approved.

Both the walls should be separated by spacers system made up of cold formed steel bars and fastened through zinc /zinc-tin coated self-drilling screws.

The external wall of Inverter room / security room facing the transformer area shall be as per IS: 1646 - Code of practice for fire safety of buildings (general): electrical installations.

4.7 Doors Frames:

Door frames shall be of T-iron frame of mild steel Tee-sections as per DSR-2013 item no 10.13. All doors shall be provided necessary fittings like hinges, handles, mortise locks, tower bolts, stopper, hydraulic door closer, etc. of CP brass complete.

Black powder coated aluminum doors shall be with extruded built up standard tubular sections, appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixed to Pre-Engineered structure including necessary filling up of gaps at junctions with required PVC/neoprene felt etc. including hinges / pivots and double action hydraulic floor spring of approved brand and manufacture IS: 6315 marked, lock, handle and all necessary fittings as detailed in tender drawing or submitted by bidder in shop drawing and approved by HPPCL

The door entrance shall include Mild Steel single leaf door. The structural steel shall conform to IS: 7452 and IS: 2062. The holdfasts shall be made from steel flats (50 mm and 5 mm thick). The fixtures, fastenings and door latch are to be made with same materials.

4.8 Windows Frame:

Aluminium black powder coated section, frame shall be of 92x31 mm, minimum 16G thick as per approved design. Tinted glass and aluminium grill shall be provided.

4.9 Ventilators:

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Aluminium black powder coated frame of minimum size 62x25 mm and 16G thick as per approved design. Ventilators/duct shall be provided with bird guard. Size of opening at wall for ducts shall be as per PCU manufacture and min 18 gauge GI sheet. Ducts shall be supported with suitable means, as approved during detail engineering.

All accessible ventilators and windows of all buildings shall be provided with min. 4mm thick float glass, tinted for preventing solar radiations. Suitable sunshades made out of approved colour sheet will be provided to all external windows and door. The minimum projection for the sunshades will be 450 mm and 300mm wider than the width of the opening.

4.10 Rolling shutter:

Rolling shutter (Hand operated) 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.

4.11 Paint and Coating:

Steel shall be colour coated with total coating thickness of 25 microns (nominal) dry film thickness (DFT) comprising of silicon modified polyester (SMP with silicon content of 30% to 50 %) paint or Super Durable Polyester (XRW) paint of 20 microns (nominal) on one side (exposed face) on 5 micron (nominal) primer coat and 10 microns (nominal) SMP or Super Durable Polyester paint over 5 micron (nominal) primer coat on other side. SMP and polyester paints system shall conform to Product type 4 as per AS/ANZ 2728.

The structural steel shall be hot-dipped galvanized, conform to IS: 4759 or relevant Indian standard

4.12 Lighting:

The building shall be provided with electric light to achieve average illumination level of 400 Lux. However building should be designed to utilize maximum natural light during the day.

All Compact Florescent Lamp fixtures shall be indoor type & pre-wired comprising of Lamp(s) with lamp holder(s) and Electronic Ballast(s) with metal reflector(s). The lamp fitting shall be covered by Glass or Perspex material. The PF of the electronic ballast shall be more than 0.4. The fixtures should be of reputed make like Philips/Bajaj/Crompton/G.E. etc., however, vendor shall submit the sample of lighting fixtures to BHEL for approval before supply & installation. Alternatively, LEDS may be used after submitting detailed descriptions illumination computations and Test certificates from reputed test centers.

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4.13 Plinth Protection:

1000mm wide plinth protection 50 mm thick of cement concrete 1:3:6 (1cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) over 75 mm bed of dry brick ballast 40 mm nominal size well rammed and consolidated and grouted with fine sand including finishing the top smooth, shall be provided around the Pre-engineered Structure

4.14 Foundation and platform with cable trench

Required foundation shall be designed by the vendor to safely take the equipment load as per the details given below and drawings shall be furnished for BHEL approval and all the civil works is in vendor scope.

- a. each Inverter Room -15 Tons
- b. Control Room-10 Tons
- c. Each Security Room-1 Ton

Highest weight of individual equipment is 3 Ton. Design shall be done for highest weight

Cable trench details shall be furnished during detailed engineering.

4.15 Floor Finish

Flooring, including preparation of surface, cleaning etc shall be of cement concrete flooring as per IS 2571-1970 with ironite hardener. The building floor shall be at least 50cm above the ground level.

- Store area: Cement flooring in concrete mix (1:2:4) using 10 mm aggregates as per IS 2571: 1970.
- Control Room cum supervisor room: Heavy Duty Vitrified tiles 10 mm thickness.
- SCADA Room: Heavy Duty Vitrified tiles 10 mm thickness.
- Equipment room: Heavy Duty Vitrified tiles 10 mm thickness.
- Battery Room: Acid/ Alkali resistant tiles of suitable thickness.
- Toilets: Ceramic tiles 8 mm thickness.
- Lobby: Vitrified Tiles 10 mm thickness.

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4.16 Provision for Ducting arrangement

Ducting, exhaust fans etc. are required for extracting hot air from inverters which is required for healthy air circulation. Drawings for ducting arrangement shall be provided by BHEL during detailed engineering. Necessary provisions for placing of ducting arrangement shall be provided by the vendor. Supply of ducting materials shall be the in the scope of BHEL.

4.17 Point wiring

This shall include all works necessary for wiring to the point of utilization of the load to be applied for the wiring of light, fan or plug point etc.,

Point wiring shall include all works necessary in complete wiring of a Piano Type switch Circuit of any length from the tapping point from the Junction Box to the following, via the switch.

Ceiling Rose in case of all lighting & fan points.

Socket Outlet in case of sockets.

The followings shall be deemed to be included in the point wiring:

Switch & ceiling rose as required, Bushed Conduit or Porcelain tubing or PVC pipe where cable through etc., Earth wire for three pin socket point to the common earth station, all metal blocks, board & boxes sunk type including those required for mounting fan regulator bus excluding those under the DB and control switch, All fixing accessories such as nails, screws, plugs etc., as required., Joint for junction Boxes & connecting the same as required. One no. of 63A three phase industrial socket & 2nos of 15A single phase socket to be provided at SCADA rooms.

Indoor point wiring will be casing capping type with 1.1 kV PVC insulated 2 x 1.5mm² (min. size) copper wire including Wooden switch Board covered with Bakelite Cover, Ceiling Rose supply of wire, casing-capping, appropriate size bare copper earth wire, screw & and other accessories etc., as such where required. The work includes supply of all requisite materials. Standard ISI marked Anchor or equivalent good make materials are to be used for point wiring. PVC casing capping and all accessories shall be of Heavy gauge Polyphone with all accessories and white in color. Conduit / buses through wall shall be flash after cutting wall and including mending well the damages. Casing capping on wall shall be fixed with suitable screws at an interval not less than 300mm.

All out door point wiring will be with hard PVC conduits of approved make. Suitable hard PVC bends, saddles, Tees etc., are to be used for outdoor wiring

4.18 Plumbing and sanitary items

Vendor shall supply and install required plumbing and sanitary items of reputed make for toilets. Toilets shall be provided in Control room. Construction of soak pits and septic tanks as required shall be in vendor's scope. Inspection chambers for letting out sewage and sullage are to be constructed. Septic tank to be provided with RCC lid with ventilation pipe. The septic tank (15 persons capacity) PVC pipes of 160mm dia for transmission of sewage to be used.

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The toilet room in Control room shall have separate partitions for gents and ladies, each shall contain a Western commode (W.C) and wash basin with mirror. The layout shall be as shown in the control room layout drawing enclosed. The toilets shall have CP brass towel rail, soap holder and liquid soap dispenser.

For toilets and pantry, the water required shall be supplied from an overhead tank of min. 1000 litres capacity which shall be mounted on the roof of pre-fab building (wherever toilets are considered). Roof shall be designed take the load of overhead tank. Supply of overhead tanks (sintex or reputed make as approved by BHEL) shall be in the scope of vendor. GI pipes of Medium quality conforming to IS 1239 (Part I) and IS 1795 for Mild Steel pipes shall be used for all water supply and plumbing works. Required piping and pump connection from and to tank shall be in vendor's scope.

4.19 False Ceiling and partition

SCADA room and Office room in control room should have false ceiling. (Grid type-Mineral fiber board).

The partition wall shall be of brick for toilets and for the other rooms it can be metal framed gypsum partition / brick work partition

4.20 Design Parameters and Design Loads:

The structure shall be designed for loads and load combination as per Indian Standards (latest revisions) such as IS: 875, IS: 1893, IS: 800, IS: 456 etc.

Dead Load: Self Weight of Structure including Purlins, Sheeting, Girts, Bracings, weight of turbo ventilators to be added as Dead load etc.

Imposed Load (Live Loads) Live loads shall be as per IS - 875. For sloped roofs up to 10 deg. it shall be 0.75 KN/M².

Wind Load: The basic wind speed of the site is taken as 150 km/hr. Design wind load co-efficient shall be as per IS: 875-III.

Earthquake Load: All PEB structures shall be designed for Seismic forces. Vertical Deflection and Horizontal Sway Limits:

- Limiting Deflection: The limiting permissible vertical deflection for structural steel members shall be as per IS 800 2007.
- The limiting permissible horizontal deflection for as per IS 800 2007 code where 'h' is height of building at eaves.

4.21 Descriptions of PEB Structures:

Primary Members: Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns, beams, truss member, base plate.

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Secondary Members: Secondary structural framing shall include the purlins, girts, eave struts, bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

Sealant: Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non staining material and be flexible enough not to interface with fit of the sheets.

Closures: Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations.

Flashing and Trim: Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Colour shall be matching with the colour of wall. Material shall be 26 gauge thick conforming to the physical specifications of sheeting.

Gutters and Down comers: Gutters shall be fabricated out of same metal sheet. Material shall be same as that of sheeting. Down comers shall be of galvanized steel pipes or PVC designed to ensure proper roof drainage system.

Group	Grade/ Reference code	Yield strength (min) MPa	Tensile strength (min) MPa	Coating class designation	BMT (mm)	+ve tolerance (mm)	Upper limit of BMT	-ve tolerance (mm)	Lower limit of BMT (mm)
I	G250/ AS1397	250	320	Z275	0.6	0.04	0.64	-0.04	0.56
	SS255/ ASTM A653M	255	360						
	S250GD/ EN10326	250	330						
II	G350/ AS1397	350	420	AZ150	0.5	0.04	0.54	-0.04	0.46

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	SS340 Class 4/ ASTM A792M	340	410						
	S350GD/	350	420						
	EN10326								

NOTE: Minimum elongation % shall be as per relevant Standard and Code.

All steel materials supplied by the Agency shall be in a sound condition, of recent manufacture, free from defects, loose mill scale, slag intrusions, laminations, pitting, flaky, rust, etc. and be of full weight and thickness specified.

5.0 General Specification of Civil works

- Foundation bed concrete for leveling course to be laid in cement concrete 1:4:8 for a depth of 15 Cms.
- Size stone masonry in cement mortar 1:6 for foundation as per IS specification
- Size stone masonry in cement mortar 1:6 for basement and the size stones neatly dressed with quoins for a width of 50mm for all the corner stone's on both the edges.
- Pointing of joints by racking to a depth of 20mm and filled with cement mortar 1:3.
- Plastering in cement mortar 1:5, 1:6 and 1:3 shall be applied to all internal cable trench respectively as per IS1542.
- Painting of internal walls shall be of Acrylic distempering.
- Table molded bricks with minimum compressive strength of 50 ksc are to be used for burnt brick masonry in CM 1:6. For every 5000 bricks test reports are to be submitted for its suitability
- 115 mm thick brick wall for partition are to be constructed with CM 1:4 by providing 2 Nos of 6 mm tor steel tied with binders at 30 Cms C/C and extended in main walls.
- 40mm thick water proof flush doors with one side teak wood veneering as approved by BHEL.
- Glazed aluminum doors of standard gauge, covered with glass of 5.5mm thick with aluminum handles, lever, locks, chrome plated floor type door latches, heavy duty double action floor springs as per the approved drawing.

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11. For bath and toilets standard make PVC door frames with PVC shutters to be provided.
12. Three way track glazed aluminum windows with ventilators as per standard with necessary guard bars as per the approved drawing.
13. The fixtures for doors, windows and ventilator are to be approved by the Engineer.
14. External Plastering for a thickness of 18mm with CM 1:6 with cement finish.
15. Parapet wall for a height of 85 Cm with 5 Cm thick coping concrete with intermediate brick pillars as per the approved drawings.
16. Granite slab flooring for accommodations wherever necessary as approved by BHEL Engineer.
17. Acid proof flooring tiles for the accommodations wherever necessary as approved by BHEL Engineer.
18. Anti skid ceramic tiles for flooring in bath and toilets and glazed tiles dadoing for a height up to linter level for bath rooms and 0.90 Mtrs. Height glazed tiles dadoing in toilets.
19. Flagging Concrete : To be laid for a width of 0.90 Mts from the basement in Cc 1:4:8 and plastered with CM 1:4.
20. Anti termite treatment for foundation and all round the structure.

6.0 General construction requirements

6.1 Structural Steel

All structural steel design shall be carried out as per IS 800. Structural steel shall conform to IS 2062, Pipe shall be as per medium/high grade of IS 1161, checkered plates shall conform to 3502 and Hollow steel sections for structural use shall conform to IS: 4923.

6.2 Grouting

Cement mortar (1:2) grout with non-shrink additives shall be used for grouting below base plate of column. The grout shall be high strength grout having a minimum characteristic compressive strength of min 30 N/mm² at 28 days. The grout shall be chloride-free, cement based, free flowing, non-metallic grout.

6.3 List of applicable Indian Standards

Indian codes, and/or standards shall govern, in all the cases wherever they are available. In case of a conflict between such codes and/or standards and the specifications, the stringent provisions shall govern. Such codes and/or standard referred to shall mean the latest revision, amendments/changes adopted and published by the relevant agencies. In case of

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any further conflict in this matter the same shall be referred to the Engineer-in-charge, whose decision shall be final and binding.

Other internationally acceptable standards shall be accepted, only if, no Indian Standards are existing. However, other standards also will be accepted if the Contractor establishes that the works are meeting the requirements of Indian Standards also. A brief list of Indian Standards applicable to these works is as below:

General

IS: 875-I	Code of Practice for Design Dead Loads for Building and Structures
IS: 875-II	Code of Practice for Design Imposed Loads for Building and Structures
IS: 875-III	Code of practice for design loads (other than earthquake) for buildings and structures.
IS: 1893	Criteria for earthquake resistant design of structures.
IS: 4326	Code of Practice for earthquake resistant design and construction of buildings

Steel structures

IS:800	Code of practice for use of structural steel in general building construction
IS:801	Code of practice for use of cold-formed light gauge steel structure members
IS:802	Code of practice for use of structural steel in overhead 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

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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 aluminium and its alloys
IS:2395-I	Paintings 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

Miscellaneous

IS:19805	Code of practice for structural use of un-reinforced masonry
IS:3067	Code of practice for general design details and preparatory works for damp/water proofing
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

7.0 General conditions applicable during supply, installation and commissioning phase

7.1	Vendor shall organize construction power supply on their own. Accordingly, if required, DG sets of suitable capacity shall be deployed by the vendor for construction works.
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7.2	Similarly, water required for construction works shall be organized by vendor.
7.3	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys, concrete mixers, Ajax machines etc necessary for movement and installation of materials shall be organized by the vendor.
7.4	All necessary tools and tackles such as 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, drilling machines, welding machines, steel bar bending tools / templates for RCC works, spade, shovel, hammer etc shall be organized by the vendor.
7.5	All necessary measuring instruments such as measuring tapes, digital multimeters, electrical testers, meggers etc shall be organized by the vendor.
7.6	Vendor 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 vendor.
7.7	Vendor shall organize all necessary steps to meet statutory requirements such as labour license, PF, ESI, insurance 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.
7.8	Vendor shall organize activities such as receipt of all supply items of PEB rooms at site, unloading from the trucks, safe storage at site, movement from storage location to point of construction etc. Vendor shall deploy their own security watch and ward to safeguard their supply items from pilferage. Insurance for the supplied items until the completion of erection of all the PEB rooms shall be the responsibility of vendor.
7.9	Vendor shall maintain updated labour register, with name, age, qualification, salary, attendance details etc at the site.
7.10	Vendor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
7.11	Vendor 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 vendor in all respect to prevent accidents at the site and safeguard their labour from accidents.
7.12	Vendor shall, at the completion of every work, clear off the debris, which resulted out of the work.

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7.13	Vendor shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, vendor shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
7.14	Any damages on the other buildings, structures etc of the site, if attributable to the acts of labour / employees of vendor, shall be rectified and made good by the vendor at their own cost.
7.15	No child labour shall be employed for execution of the present contract.
7.16	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 vendor as part of the offer.
7.17	BHEL / HPPCL shall witness routine / acceptance tests performed at manufacturer works for the items supplied by vendor. Vendor shall accordingly provide inspection call to BHEL with submission of quality assurance plan in advance. For the items bought out from dealers, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/HPPCL for procurement of the item from dealers.
7.18	Field Quality Plan / Quality control system: Vendor shall make arrangements for testing of all construction materials in accordance with FQP (Field quality control plan) as approved by BHEL/HPPCL. If required for this purpose, an exclusive testing laboratory shall be established at site. Vendor shall deploy a well experienced quality control engineer to monitor all QC activities at site as per approved FQP.
7.19	Any deviations during construction shall be discussed with BHEL / HPPCL site engineers and implementation shall be taken up only after approval from BHEL / HPPCL.
7.20	Vendor shall submit periodic status report, on daily as well as weekly consolidated basis, to BHEL on the progress of the contract.

Typical cable trench views for Control room

