बी एच ई एल BHEL	**BHARAT HEAVY ELECTRICALS LIMITED** **SOLAR BUSINESS DIVISION** **MALLESHWARAM, BANGALORE - 560055**	**BUYER ADDED ADDITIONAL TERMS & CONTRACTS (ATC)**	**TENDER NO. SHAPV00013** **Supply of Outdoor PCU Inverter as per BHEL Specifications**

TERMS & CONDITIONS:

NOTE:

These Conditions shall be read in conjunction with GeM Terms & Condition. In case of any conflict or inconsistency, the requirement of Buyer Added Additional Terms & Conditions shall prevail.

All corrigenda, addenda, amendments, time extensions, clarifications etc. to the Tender will be hosted on https://gem.gov.in only. Bidders should regularly visit this website to keep themselves updated.

Bidder to provide signed & Sealed GEM BID, BHEL Specifications, Additional Terms and Conditions, PAN, GST number with their offer.

Deviation of any kind with price implication is not acceptable.

1.	Type of Contract	FOR SITE BASIS (SUPPLY)
2.	Item details	Supply of items as per below details:

SN	MATERIAL CODE & DESCRIPTION		Qty	UoM	PROJECT NAME
10	PS0679081755	Supply of 2.5 MW OUTDOOR PCU	1	NO	**100MW GSECL Raghanesda Phase-1**
20	PS0679099875	Supply of 4.4. MW OUTDOOR PCU	1	NO	**100MW GSECL Raghanesda Phase-2**

3.	Project Name	100MW GSECL Raghanesda Phase-1 & 2
4.	Consignee Details (Ship To) [To be mentioned in LR/Suppliers' Invoice etc.]	To, STORES INCHARGE - BHEL SITE OFFICE, 100MW Solar PV Power Plant Phase - 2 (Gujarat State Electricity Corporation Limited) Raghanesda Ultra Mega Solar Park, Post – Kundaliya, Tahseel - Vav Distt. – Banaskantha, Gujarat - 385 520 Consignee address in LR should be strictly as per above/as mentioned in PO.
5.	Buyer and Paying Authority	C/o: Sr. Manager/ Material Management Dept. BHARAT HEAVY ELECTRICALS LIMITED SOLAR BUSINESS DIVISION (FORMERLY KNOWN AS ELECTRIC & PHOTOVOLTAIC DIVISION) PROF. C.N.R RAO CIRCLE, SCIENCE INSTITUTE POST, MALLESWARAM BENGALURU-560 012 Hardcopy of Bills and supporting documents to be send to **BHEL-SBD Bangalore (Sr. Manager/ Material Management Dept.)** for payment processing
6.	Buyer e-mail ID	For Commercial Clarifications: shashisharma@bhel.in ; Phone: 9123510405 ; nagarajpk@bhel.in

(Seal & sign of Bidder as token of acceptance)

		For Technical Clarifications: penmi@bhel.in ; Phone: 08049723323
7.	Buyer IEC CODE/ GST No.	IEC CODE: 0588138690 / GST No: 29AAACB4146P1ZB
8.	Price Basis	FIRM, till the completion of Contract.
9.	Mode of Dispatch	By Rail/Road It is also the Seller/Contractor's responsibility to ensure material is dispatched through shortest possible route. Note: It is Seller/Contractor's responsibility to ensure availability of Trucks/Trains schedule etc. well in advance for dispatch of material to meet contractual delivery requirement. Part shipment is allowed. Transshipment is not allowed. The material shall be dispatched on pre-paid basis to BHEL Site. Road Permit/E-way bill, if required, to be arranged by Seller/Contractor.
10.	Transit Insurance	In Vendor's Scope
11.	Unloading at Site	Unloading will be in the scope of BHEL.
12.	Delivery Schedule	**Supply: Supply shall be completed within 12 weeks from the date of manufacturing clearance.** **I&C: BHEL shall call the supplier for commissioning support anytime within the warranty period.**
13.	Drawing / Quality Plan Submission:	**Following Documents to be submitted:** 1). Drawing and GTP to be submitted within 7 days after receipt of PO. 2). Vendor shall provide inspection call to BHEL for routine tests. 3). Vendor shall submit the detailed Manufacturing Quality Plan (MQP) for approval. **NOTE:** Revised documents (if required) to be submitted within 07 days from the date of comments from BHEL. Also note that the delay in document submission/re-submission shall be suitability adjusted (reduced) from the agreed delivery period
14.	Pre-Shipment Inspection (PSI)	BHEL reserves the rights to carry out inspection before dispatch.
15.	LD Clause	LD as per GeM General T&C: Liquidated Damages: If the Seller/Service Provider fails to deliver any or all of the Goods/Services within the original/re-fixed delivery period(s) specified in the contract, the Buyer will be entitled to deduct/recover the Liquidated Damages for the delay, unless covered under Force Majeure conditions aforesaid, @ 0.5% of the contract

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		value of delayed quantity per week or part of the week of delayed period as pre-estimated damages not exceeding 10% of the contract value of delayed quantity without any controversy/dispute of any sort whatsoever.
16.	Payment terms	FOR SUPPLY OF ITEMS: **For Supply portion:** **A)** 90% of basic price of material supplied, as per PO, along with 100% taxes & duties (as applicable) & freight charges, shall be paid on pro-rata basis within: 1. 45 days for Micro & Small Enterprises (MSEs) 2. 60 days for Medium Enterprises 3. 90 days for Non-MSME from the date of receipt of goods & receipt of complete documents as per order/contract subject to acceptance of materials. Statutory deductions will be made from payment, certificate if any will be issued by BHEL. . **B)** Balance Ten percent (10%) of basic price of the materials supplied, as per PO, shall be payable on completion of I&C against submission of Supplementary Invoice along with proof of completion of I&C.
17.	Invoice registration in Suvidha portal	The facility for Online Invoice Registration and Document Upload has been enabled in the SUVIDHA Portal https://suvidha.bhel.in/suvidha/ for all BHEL Suppliers and Contractors. With effect from 01-0ctober-2025, it will be mandatory for all Suppliers/Contractors to register their invoices exclusively through the SUVIDHA Portal along with the required documents. For net invoice amount exceeding 5 lakhs inclusive of taxes, uploading of a Class 3 digitally signed tax invoice is mandatory. For invoices up to ₹5 lakhs inclusive of taxes, a scanned copy may be uploaded however, submission of the hard copy is mandatory if a Class 3 digitally signed tax invoice is not uploaded. All Suppliers/Contractors are therefore requested to register on the SUVIDHA Portal and ensure compliance from 01-October-2025 onwards.
18.	Warranty/Guarantee Clause	**The Warranty period shall be 5 years from the date of receipt of the PCU at site.**
19.	Documents to be Submitted by Vendor	**For Supply Package:** a. Original GST compliant Tax Invoice + 2 Copies b. LR/E-Way Bill/Delivery Challan/Packing List & Original Receipted LR or Material Receipt Certificate (MRC) c. GTP and MQP approval d. Warranty Certificate e. Original Hardcopy of Bank mandate (EFT) in BHEL's prescribed format and cancelled cheque
20.	Quantity Variation	Not Applicable.

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21.	Integrity Pact	Not Applicable.
22.	Details of IEM	APPLICABLE (AS PER ATTACHED FORMAT) - a) IP is a tool to ensure that activities and transactions between the Company and its Bidders/ Contractors are handled in a fair, transparent and corruption free manner. b) In case of any complaints arising out of the tendering process, the matter may be referred to any of the below e-mail IDs. iem1@bhel.in iem2@bhel.in iem3@bhel.in As on date, the positions of Independent External Monitors (IEMs) are vacant in the Company. As and when the IEMs join based on due approval of the Competent Authority, any complaint(s) received will be shared with the IEMs. c) The IP as enclosed with the tender is to be submitted (duly signed by authorized signatory) along with techno-commercial bid (Part-I, in case of two/ three-part bid). Only those bidders who have entered into such an IP with BHEL would be competent to participate in the bidding. In other words, entering into this Pact would be a preliminary qualification. d) Please refer Section-8 of IP for Role and Responsibilities of IEMs. In case of any complaint arising out of the tendering process, the matter may be referred to any of the above IEM(s). All correspondence with the IEMs shall be done through email only. Note: No routine correspondence shall be addressed to the IEM (phone/ post/ email) regarding the clarifications, time extensions or any other administrative queries, etc. on the tender issued. All such clarification/ issues shall be addressed directly to the tender issuing (procurement) department's officials whose contact details are provided below: Name: NAGARAJ P.K | Dept.: MM | Address: SBD, Bangalore Phone: (Landline/ Mobile) 080-22182272 / +91-9483501488 Email: nagarajpk@bhel.in
23.	Contract Performance Bank Guarantee (CPBG)	**APPLICABLE.** a. The vendor shall submit Contract Performance Bank Guarantee **within 14 days** from the date of PO for 10% of 100% of Order/ Contract value (excluding taxes and duties) to cover the due performance of Order/ Contract and to fulfill the guarantee conditions stipulated in the Order/ Contract and if any amendment arises during later

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		stages, then they will submit the additional/revised BG for 10% for different value within 14 days from PO amendment. b. Validity of the Bank Guarantee shall be for the entire Guarantee period + 3 months claim period. Initially, it should be at least 60 months + 3 months claim period, later extended to cover the entire guarantee period, two months before its expiry. c. Purchaser reserves the right to encash the bank guarantee and forfeit the amount in the event of any default, failure or neglect on part of the Seller/ Contractor in fulfillment of performance of the Order/ Contract. d. Equivalent amount shall be recovered from payment due to the Seller/ Contractor, before releasing any payment, in absence of a valid bank guarantee. e. Bank Guarantees shall be from Consortium Bank as per Annexure-X. Bank guarantees from cooperative banks/ non-scheduled banks are not acceptable. f. In case of private sector banks, a clause to be incorporated in the text of bank guarantee that it can be enforced by being presented at any branch of the bank located in Bangalore. g. Two witness signatures from bank officials, other than the bank official who has already signed is a must. BG is to be submitted directly by the issuing bank to concerned purchase officer, under registered post (A/D). h. The Bank Guarantee to be provided in the hard and not in the SFMS format". Our bank details are as follows: i). Name of the Bank & Branch: IDBI Bank Limited, Trade Finance ii). Address of the Branch: Trade Finance, IDBI House, 58, 1st Floor, Mission Road, Bengaluru-560027 iii). NEFT IFSC Code: IBKLO000377 iv). Account No.: 008103000003605 v). RTGS IFSC Code: IBKL0000377 Bidder agrees to submit performance security required for execution of the contract within the time period mentioned. In case of delay in submission of performance security, enhanced performance security which would include interest (SBI MLCR rate + 6%) for the delayed period, shall be submitted by the bidder. Further, if performance security is not submitted till such time the first bill becomes due, the amount of performance security due shall be recovered as per terms defined in NIT I contract, from the bills along with due interest.
24.	Conflict of Interest	The bidder notes that a conflict of interest would said to have occurred in the tender process and execution of the resultant contract, in case of any of the following situations: i) If its personnel have a close personal, financial, or business relationship with any personnel of BHEL who are directly or indirectly related to the procurement or execution process of the contract, which can affect the decision of BHEL directly or indirectly; ii)The bidder (or his allied firm) provided services for the need assessment/ procurement planning of the Tender process in which it is participating;

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		iii)Procurement of goods directly from the manufacturers/ suppliers shall be preferred. However, if the OEM/ Principal insists 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 both the manufacturer/ supplier and the agent, bid received from the agent shall be ignored. However, this shall not debar more than one Authorised distributor (with/ or without the OEM). from quoting equipment manufactured by an Original Equipment Manufacturer (OEM) in procurements under a Proprietary Article Certificate. iv)A bidder participates in more than one bid in this tender process. Participation in any capacity by a Bidder (including the participation of a Bidder as a partner/ JV member or sub-contractor in another bid or vice-versa) in more than one bid shall result in the disqualification of all bids in which he is a party. However, this does not limit the participation of an entity as a sub-contractor in more than one bid if he is not bidding independently in his own name or as a member of a JV. The Bidder declares that they have read and understood the above aspects, and the bidder confirms that such conflict of interest does not exist and undertakes that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder{s), in this regard. This applies in particular to prices, specifications, certifications, Subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process. In case, the Bidder is found having indulged in above activities, the same will be considered as a violation of the tender conditions, and suitable action shall be taken by BHEL as per extant policies/ guidelines.
25.	Conciliation Clause	The Conciliation Scheme 2018 attached as **Annexure-A** shall be applicable. The Signed & Stamped copy of the same to be attached along with the offer as a mark of acceptance.
26.	Certification for percentage of local content, in line with PPP-MII order, if applicable	Certification (as applicable) giving the percentage of local content, in line with PPP-MII order, if applicable to be submitted as per attached **Annexure-F (i)** for procurement value from Rs. 5.00 Lac to Rs. 10.00 Crore or **Annexure-F (ii)** for procurement value more than Rs. 10.00 Crore.
27.	Relaxation in Public Procurement Norms for Startups	For all public procurement, the criteria of prior turnover and prior experience for all Startups is relaxed subject to their meeting of quality and technical specifications. DPIIT (Department for Promotion of Industry and Internal Trade) Certificate of Recognition for Startups to be submitted for availing benefits.
28.	Declaration by bidder regarding protection of commercial interests of BHEL	The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in

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		the bidding process. In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines.
29.	Breach of contract, Remedies and Termination	BREACH OF CONTRACT: The following shall amount to breach of contract: i. Non-supply of material/ non-completion of work by the Supplier/Vendor within scheduled delivery/ completion period as per contract or as extended from time to time. ii. The Supplier/Vendor fails to perform as per the activity schedule and there are sufficient reasons even before expiry of the delivery/ completion period to justify that supplies shall be inordinately delayed beyond contractual delivery/ completion period. iii. The Supplier/Vendor delivers equipment/ material not of the contracted quality. iv. The Supplier/Vendor fails to replace the defective equipment/ material/component as per guarantee clause. v. Withdrawal from or abandonment of the work by the Supplier/Vendor before completion as per contract. vi. Assignment, transfer, subletting of Contract by the Supplier/Vendor without BHEL's written permission resulting in termination of Contract or part thereof by BHEL. vii. Non-compliance to any contractual condition or any other default attributable to Supplier/Vendor. viii. Any other reason(s) attributable to Vendor towards failure of performance of contract. In case of breach of contract, BHEL shall have the right to terminate the Purchase Order/ Contract either in whole or in part thereof without any compensation to the Supplier/Vendor. ix. Any of the declarations furnished by the contractor at the time of bidding and/ or entering into the contract for supply are found untruthful and such declarations were of a nature that could have resulted in non-award of contract to the contractor or could expose BHEL and/ or Owner to adverse consequences, financial or otherwise. x. Supplier/Vendor is convicted of any offence involving corrupt business practices, antinational activities or any such offence that compromises the business ethics of BHEL, in violation of the Integrity Pact entered into with BHEL has the potential to harm the overall business of BHEL/ Owner. Note- Once BHEL considers that a breach of contract has occurred on the part of Supplier/Vendor, BHEL shall notify the Supplier/Vendor by way of notice in this regard. Contractor shall be given an opportunity to rectify the reasons causing the breach of contract within a period of 14 days. In case the contractor fails to remedy the breach, as mentioned in the notice, to the satisfaction of BHEL, BHEL shall have the right to take recourse to any of the remedial actions available to it under the relevant provisions of contract.

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		REMEDIES IN CASE OF BREACH OF CONTRACT. i. Wherein the period as stipulated in the notice issued under clause 14.1 has expired and Supplier/Vendor has failed to remedy the breach, BHEL will have the right to terminate the contract on the ground of "Breach of Contract" without any further notice to contractor. ii. Upon termination of contract, BHEL shall be entitled to recover an amount equivalent to 10% of the Contract Value for the damages on account of breach of contract committed by the Supplier/Vendor. This amount shall be recovered by way of encashing the security instruments like performance bank guarantee etc available with BHEL against the said contract. In case the value of the security instruments available is less than 10% of the contract value, the balance amount shall be recovered from other financial remedies (i.e. available bills of the Supplier/Vendor, retention amount, from the money due to the Supplier/Vendor etc. with BHEL) or the other legal remedies shall be pursued. iii. wherever the value of security instruments like performance bank guarantee available with BHEL against the said contract is 10% of the contract value or more, such security instruments to the extent of 10% contract value will be encashed. In case no security instruments are available or the value of the security instruments available is less than 10% of the contract value, the 10% of the contract value or the balance amount, as the case may be, will be recovered in all or any of the following manners: iv. In case the amount recovered under sub clause (a) above is not sufficient to fulfil the amount recoverable then; a demand notice to deposit the balance amount within 30 days shall be issued to Supplier/Vendor. v. If Supplier/Vendor fails to deposit the balance amount within the period as prescribed in demand notice, following action shall be taken for recovery of the balance amount: a. from dues available in the form of Bills payable to defaulted Supplier/Vendor against the same contract. b. If it is not possible to recover the dues available from the same contract or dues are insufficient to meet the recoverable amount, balance amount shall be recovered from any money(s) payable to Supplier/Vendor under any contract with other Units of BHEL including recovery from security deposits or any other deposit available in the form of security instruments of any kind against Security deposit or EMD. c. In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against defaulted supplier/Vendor. vi. It is an agreed term of contract that this amount shall be a genuine pre-estimate of damages that BHEL would incur in completion of balance contractual obligation of the contract through any other agency and BHEL will not be required to furnish any other evidence to the Supplier/Vendor for the purpose of estimation of damages.

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		vii. In addition to the above, imposition of liquidated damages, debarment, termination, de-scoping, short-closure, etc., shall be applied as per provisions of the contract. Note: 1) The defaulting Supplier/Vendor shall not be eligible for participation in any of the future enquiries floated by BHEL to complete the balance work. The defaulting contractor shall mean and include: (a) In case defaulted Supplier/Vendor is the Sole Proprietorship Firm, any Sole Proprietorship Firm owned by same Sole Proprietor. In case defaulted Supplier/Vendor is The Partnership Firm, any firm comprising of same partners/ some of the same partners; or sole proprietorship firm owned by any partner(s) as a sole proprietor.
30.	Risk & cost	Not applicable
31.	No Interest Payable to Contractor	Notwithstanding anything to the contrary contained in any other document comprising in the Contract, no interest shall be payable by BHEL to Contractor on any moneys or balances including but not limited to the Security Deposit, Performance Security, EMD, Retention Money or the Final Bill, or any amount withheld and/or appropriated by BHEL etc., which becomes or as the case may be, is adjudged to be due from BHEL to Contractor whether under the Contract or otherwise.
32.	CLOSING OF CONTRACTS	The Contract shall be considered completed and closed upon completion of contractual obligations and settlement of Final Bill or completion of Guarantee period whichever is later. Upon closing of Contract, BHEL shall issue a performance/ experience certificate as per standard format, based on specific request of Contractor as per extant BHEL guidelines through the online portal available at https://siddhi.bhel.in only.
33.	Cartel Formation	The Bidder declares that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s). This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process. In case, the Bidder is found having indulged in above activities, suitable action shall be taken by BHEL as per extant policies/ guidelines
34.	MSE Purchase Preference	To get MSE preference, bidder to choose MSE purchase preference on GEM portal otherwise purchase preference shall not be applicable.

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35.	MII Preference	To get MII preference, bidder to choose MII purchase preference on GEM portal and bidder to submit signed local content declaration otherwise purchase preference shall not be applicable.
36.	Technical specification	Technical specification doc no. PS 439-1752-Spare FOR GSECL-RAGHANESDA PHASE-1 PS 439-1759-Spare FOR GSECL-RAGHANESDA PHASE-2

37. ANNEXURE – J: Provisions for MSE vendors- Category

Any Bidder falling under MSE category shall furnish the following details & submit documentary evidence/ Govt. Certificate etc. in support of the same along with their techno-commercial offer.

Type under MSE	Please specify Yes or No (If applicable)
SC/ST Owned	
Women Owned	
Others (excluding SC/ST & Women Owned)	
Micro	
Small	

Note: If the bidder does not furnish the above in the tender, offer shall be processed construing that the bidder is not falling under MSE category.

38. ANNEXURE – K: CHECKLIST OF ENCLOSURES

S. No.	DETAILS REQUIRED	Requirement fulfilled (Yes / No / NA/ Value)	Whether proof / document enclosed (YES / NO)
1	Signed & stamped GeM bidding document		
2	Signed & stamped Buyer Added Additional Terms & Contracts		
3	Signed PQR		
4	Integrity Pact		
5	GST% along with HSN code		

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6	GSTIN certificate should be submitted		
7	Bank Mandate with Cancelled cheque		
8	Udyam Registration		
9	Freight %		
10	Nil Deviation declaration		
11	SEALED & SIGNED ANNEXURE-A (Conciliation)		
12	SEALED & SIGNED ANNEXURE-D		
13	SEALED & SIGNED ANNEXURE-E (Compliance of MoP Order)		
14	SEALED & SIGNED ANNEXURE-F (Declaration for PPPMII, along with Local Content declaration)		
15	Annexure-I: Declaration of authorized Signatory		
16	Annexure-J: Provisions for MSE vendors- Category		

(Seal & sign of Bidder as token of acceptance)

PRE-QUALIFICATION CRITERIA

1. **Eligibility:** The Bidder should be either:
   a) an OEM (Original Equipment Manufacturer), or
   b) an agency duly authorized by the OEM.

2. **Technical Experience: For 2.5 MW Inverter (Raghanesda-I):**

   The Bidder should have supplied a minimum cumulative capacity of 50 MW outdoor inverters with IP65 class of protection in the past 3 years from the date of opening of Part-I bid.

   Out of the above, the Bidder should have supplied at least 3 units of 2.5 MW capacity or higher rating. The higher rating inverter can also be degraded to 2.5 MW capacity.

   For 4.4 MW Inverter (Raghanesda-II):

   The Bidder should have supplied a minimum cumulative capacity of 50 MW outdoor inverters with IP65 class of protection in the past 3 years from the date of opening of Part-I bid.

   Out of the above, the Bidder should have supplied at least 3 units of 4.4 MW capacity or higher rating.

3. **Performance Requirement**: The supplied inverters should have been in successful operation for a minimum of 1 year from the date of opening of Part-I bid, anywhere across the globe.

4. **Documentary Evidence:** As proof of meeting the above PQC, the Bidder shall submit:

- Copy(ies) of Purchase Order(s) and dispatch documents; Or supply completion certificate(s) from end users/customers (solar power plant developers, solar power generating companies, EPC contractors of solar power plants, etc.), and
- Commissioning certificate(s) from the end users.

(Seal & sign of Bidder as token of acceptance)

Technical specification

for

Supply, installation and commissioning of

3-phase Grid-connected Power Conditioning Units of 2.5 MW outdoor type inverter (IP65 & protection class II or higher)

at

100 MW GSECL Raghanesda-I Site

Note: This specification is to be read along with civil foundation drawing no. **BHEL-GSECL-CIV-PCU-PLTFRM-117.**

R00 dated 30.08.2025			
	Prepared by: Penmi Kashung **Penmi Kashung**	***Approved by:*** varun jain **Varun Jain**	***Date*** **30.08.2025**

INTRODUCTION:

This technical specification provides details of supply of Outdoor for 3-phase Grid-connected Power Conditioning Units (PCU). The scope also includes commissioning of the supplied units at the project site for synchronizing the generated ac power with LV side of a transformer that connects to 33kV grid on HV side.

1.0 Scope of supply

SL No	Item Description	Qty
1.1	Supply of outdoor type inverter (IP65 & protection class II or higher) a) 2.5 MW outdoor inverter consisting of 3-phase, Grid-connected Power Conditioning Unit (PCU) of 1500V rating and suitable power rating along with other auxiliary items. Outdoor type invertor shall be minimum IP65 protection or higher. **1 SET = Total Quantity of items used in 1 PCU of rating 2.5 MW.**	01 sets
1.2	**Supply of Spares** for power conditioning units. List of items with quantity is as follows: 1) Control Cards for PCU ** Quantity = 1 set of each type 2) Fuses Quantity = 1 set of each type and rating 3) Surge Protection Device Quantity = 1 set of each type and rating 4) MCCBs, MCBs Quantity = 1 set of each type and rating 5) AC Contactor, DC Contactor, Air Circuit Breaker – 1 no each **Notes:** (a) **1 SET = Total Quantity of items used in 1 PCU of rating 2.5MW.** (b) The above spare quantities are for contingency purposes over and above the warranty requirements. (c) Item-wise BOQ and break-up prices shall be provided in the offer. (d) Control cards for 1 PCU refers to all the electronics cards used in the PCU including main microprocessor cards, protection cards, I/O cards, gate driver cards and any other PCB used in the PCU not specifically indicated above.	01 sets
1.3	**Commissioning of PCUs along with Training at site.** BHEL scope of activities at site for installation and commissioning: (1) Movement and positioning of outdoor PCU panels at the earmarked position on the outdoor RCC platform. (2) Crimping the incoming (DC side) and outgoing (AC side) cables (BHEL supply) using the	01 sets

	cable lugs provided by the vendor. (3) Connecting at the respective termination ends of the panels using the cable glands and fastening hardware (nuts, bolts, washers etc) provided by the vendor. Vendor scope of activities at site for commissioning: (1) All the electrical checks that are required to confirm that solar DC parameters (current, voltage) are available at the DC input side of PCUs. (2) Service engineers shall be present at site during installation of PCUs, commissioning of solar power plant, providing all necessary guidance and support to achieve successful synchronization of PCU output with grid and also to trouble-shoot / resolve the technical problems associated with PCU. Commissioning / Service Engineer shall be from OEM. (3) Guidance and support to BHEL team, at the time of installation and commissioning of SCADA, in respect of connection of communication cables to PCUs and technical problems related to receiving data signals at SCADA station from PCUs. (4) Training: Vendor shall provide training at site to BHEL and customer's engineers during commissioning. Training shall cover various technical aspects such as functional/ operational features, trouble-shooting procedures, maintenance schedules, requirements, safety, emergency precautions etc. Both the theory and practical (hands on) training shall be covered. Note: Supply and installation of integrated SCADA system for the overall power plant is within BHEL scope. The lump-sum price shall include all the costs that will be incurred by the vendor towards commissioning including travel, boarding, lodging and any other contingency expenses.	

2.0 Warranty

Vendor shall provide comprehensive warranty for 60 months from date of commissioning or 63 months from date of supply, whichever is earlier. Vendor shall enclose, along with technical bid, the complete scope, terms and conditions of the warranty.

During the warranty period, whenever a technical problem is encountered with the PCU, BHEL will report the same to the vendor. Vendor shall ensure that the problem is attended to by their service engineer within two days from the date of reporting.

3.0 Technical Documents to be submitted along with offer

1. Vendor has to enclose the deviation sheet clause wise separately in case any deviations are sought by the vendor. Absence of any deviation sheet shall be taken as compliance of BHEL specification in total without any deviation.
2. Product datasheet of the offered PCU model.

3. Overall General Arrangement of PCU including DC and AC Combiner Panels.
4. List of spares offered (with quantity) and without prices.
5. List of type tests /IEC certifications available along with test certificates. Supporting test reports shall be provided by vendor during detailed engineering.
6. Filled in format-A enclosed with this specification regarding manufacturing capacity and orders under execution.

4.0 Technical specification of Power Conditioning Units

4.1 Basic requirements (PCU type, Standards, Technology, Interconnections, Interfaces etc)

<table>
<tr><th>#</th><th>Parameter</th><th>BHEL specification</th></tr>
<tr><td>4.1.1</td><td>PCU type</td><td>Grid-interactive.

PCU shall remain connected to the grid as per Central Electricity Authority Technical (standards for connectivity to the grid) regulation 2007 with all latest amendments and its components shall be designed accordingly.

Low power mode:

The control system that continuously monitors the output of the solar PV plant until pre-set value is exceeded and begins to export power provided there is sufficient solar energy and the grid voltage and frequency are in the specified range.

Further, the inverter shall be capable of operation under reduced power mode and shall not trip when the PV array output voltage is below MPPT range under high temperature conditions.

Active MPPT mode (high power mode):

When solar radiation increases further, PCU shall enter maximum power point tracking (MPPT) mode and adjust the voltage of the SPV array to maximize solar energy fed into the grid. When the solar radiation falls below threshold level, the PCU shall enter lower power mode.

Sleep mode:

Automatic ‘sleep’ mode shall be provided so that unnecessary losses are minimized at night. Vendor shall provide threshold DC voltage level / power level of the PCU as to when it shall enter into the sleep mode and back to low power mode and MPPT mode during detailed engineering for BHEL/customer approval.

Low Voltage mode:

The Inverter shall be capable of operating under reduced power mode and shall not trip when the PV array output is below MPPT range under high temperature conditions.</td></tr>
<tr><td>4.1.2</td><td>Compliance with standards</td><td>
<table>
<tr><th>Sl.</th><th>Standard</th><th>Description</th></tr>
<tr><td>1</td><td>IEC 61683</td><td>Photovoltaic systems - Power conditioners – Procedure for measuring efficiency</td></tr>
<tr><td>2</td><td>IEC 62109-1 & 2</td><td>Safety of power converters for use in photovoltaic power systems</td></tr>
<tr><td>3</td><td>IEC 61000-6-2</td><td>Electromagnetic compatibility (EMC) - Part 6-2: Generic standards-Immunity Standard</td></tr>
</table>
</td></tr>
</table>

		for industrial environments
4	IEC 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards- Emission standard for industrial environments
5	IEC 62116/ IEEE 1547/IEE 519 / UL 1741 / Equivalent EN/ BIS standard	Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures, Anti Islanding
6	IEC 62103/ IEC 62109-1 & 2	Photovoltaic (PV) systems - of the Characteristics utility interface
7	IEC 60068-2/ IEC 62093	Environmental testing / MPPT
9	IEC 60721-3 -3	Classification chemically active substance 3C2 & 3S2
8	Grid Connectivity - CEA Technical Standards for Connectivity to the Grid Regulations 2007 with latest amendment and latest CERC /GERC Regulations and Grid Codes - including LVRT requirement	

All the type test certificates as per the standards mentioned above shall be submitted for approval.

4.1.3	Output transformer	PCU shall be of 'transformer-less' design.
4.1.4	Maximum Power Point Tracking (MPPT)	MPPT shall be integrated in the power conditioning unit to maximize energy drawn from the solar PV array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be submitted during the detailed engineering. The operating voltage range of PCU and the MPPT shall be large enough such that it satisfactorily operates for PV modules exposed to the maximum ambient temperature of 50 deg C. The MPPT unit shall confirm to IEC 62093 for design qualification.
4.1.5	AC-DC conversion	3-phase Inverter stack
4.1.6	Built-in support systems	PCU shall be provided with protection circuits, monitoring circuits, data logging & storage system, provisions to download data to PC/Laptop, MODBUS communication outputs for SCADA interface etc as per Cl. 4.7 of this specification.
4.1.7	Heat exchangers	Vendor shall submit HVAC calculations during detailed engineering.
4.1.8	DC input and AC output terminations	Input and output terminations together with cable glands, lugs, hardware shall be provided to match the connections using BHEL cables as specified under related clauses of this specification. Terminals should be shrouded.
4.1.9	Environment protection	All PCB cards shall be provided with suitable coating (epoxy etc) for protection.

4.2 Technical parameters

#	Technical parameter	BHEL specification
4.2.1	Output power rating	2500 kW minimum, 1500V (at 50 deg C ambient) – No derating upto 50degC
4.2.2	AC grid connection	3-phase
4.2.3	Output frequency	50 Hz +/- 5%
4.2.4	Nominal output voltage	Value to be indicated by vendor
4.2.5	Maximum DC input voltage (Max open circuit PV voltage)	1500 V DC
4.2.6	MPPT Range of control system	Range to be indicated by vendor.
4.2.7	DC side peak power	Vendor shall confirm that PCU is suitable for overloading of DC input power. Vendor to indicate the value in % . Minimum requirement is 40%
4.2.8	Max DC operating current	Value to be indicated by vendor.
4.2.9a	Max AC output current	Value to be indicated by vendor corresponding to the rated output power of the PCU.
4.2.9b	Output voltage	630 V
4.2.10	Power factor	Designed operation close to unity PF. Adjustable window 0.85 lead to 0.85 lag
4.2.11	Ambient temperature	0 to 50 deg C.
4.2.12	Relative Humidity	Upto 95% non-condensing
4.2.13	Protection class	IP 65 (Outdoor duty).
4.2.14	Grid Frequency tolerance	+/- 3 Hz
4.2.15	Grid Voltage tolerance	- 10% and + 10%
4.2.17	AC output THD limits	Less than 3% at rated pow earth leakage er
4.2.18	Maximum noise level	Value to be indicated by vendor
4.2.19	DC injection (as % of nominal load current)	DC injection shall be limited to 1% of the rated current of the inverter as per IEC 61727/IEE929/BDEW 2008.
4.2.20	Flicker	Shall be as per IEC 61000/IEE 519
4.2.21	Set point pre-selection for active power and VAR control	PCU shall be provided with all necessary features that will enable set point selection through SCADA. For this PCU vendor shall furnish the Modbus mapping for the set points or suggest the possible method for selecting VAR control. Operator shall be able to limit the total power (Active and Reactive)

		injected in the grid through manual intervention as and when required in view of grid security.
4.2.22	Re-synchronization time	In case of grid failure, the PCU shall be re-synchronized with grid after revival of power supply. Vendor shall indicate the time taken by PCU to be re-synchronized after restoration of grid supply.
4.2.23	European Efficiency at 100% load	> 98%, measured as per IEC 61683 standard for measuring efficiency
4.2.24	Peak Efficiency	Inverter No Load / Full Load Loss Calculation must be submitted by the Bidder.
4.2.25	PCU availability	The up-time of Inverters should be of 99% in a year, in case of failing to achieve this due to failure of any component of inverter the vendor shall either replace the inverter or the component at their own cost
4.2.26	No load loss	No load loss shall be < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%.
4.2.27	Voltage Ride Through	The PCU shall remain connected to the grid during temporary dip or rise in grid voltage as per the LVRT requirements of CEA Technical Standards for Connectivity to the Grid Regulations. The PCU shall also be able to inject reactive power during the period of voltage dip.
4.2.28	Active power regulation	The PCU shall be able to limit the active power exported to the grid based on the set point provided through PCU front control panel. The PCU shall also be able to automatically the limit the active power after an increase in grid frequency above a pre-set value. The ramp rate shall be adjustable during operation and start-up after fault. The applicability of the requirement shall be as per CEA regulation and compliance.
4.2.29	Reactive power control	The PCU shall be able to inject /absorb reactive power to/ from the grid based on the set point provided through PCU front control panel. The same shall be performed automatically with adjustable ramp rate based on dynamic changes in grid voltage or reactive power reference
4.2.30	Enclosure	IP65 –outdoor IEC-60068-2 (environmental)

4.3 Protection systems

4.3.1	Protection systems for current, voltage, temperature, surges, ground faults, fan failure etc. Fault indication shall be communicated to SCADA system	AC & DC over current
4.3.2		AC & DC short circuit
4.3.3		DC reverse polarity
4.3.4		Over temperature protection: Heat sink, Cabinet
4.3.5		Synchronization loss
4.3.6		Anti-islanding protection
4.3.7		EMI and RFI

4.3.8		Grid monitoring Protection against any sustained fault (lightning effect etc) in grid / feeder line.
4.3.9		Ground fault protection
4.3.10		Power regulation in the event of thermal overloading
4.3.11		SPD-based overvoltage protection on both DC and AC sides. SPD shall consist of MOV type arrestors. It shall have thermal disconnectors to interrupt surge current arising from internal / external faults. Type-II surge protective device (SPD) conforming to IEC 61643-11 shall be connected between positive/ negative bus and earth.
4.3.13		Fan failure – Alarm contact shall be provided for air flow loss / rise of temperature of cooling fan

4.4 DC, AC side load break disconnecting switch / breaker provisions

4.4.1	DC side (Clause to be read in conjunction with clause 4.8.2)	Load break disconnecting mechanism required on DC side – MCCB of rating 400 A shall be used for input protection. DC current shall be communicated to SCADA (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY)
4.4.2	AC side	(a) ACBs shall be provided on the AC output side.
		(b) Remote operating and controlling facility for Circuit Breaker from the Main Control Room shall be provided.
		(c) Aux contacts (ON/OFF feedback) from both ACB and DC Switch Disconnector shall be made available at TB terminals to enable external wiring for SCADA monitoring purpose.
		(d) Surge protection device (3P) with suitable rating shall be provided at the input of the ACB.
		(e) Indication for grid side supply ON / OFF status shall be available on the Door Interface.
		(f) Interconnection between the ACB Panel and PCU supply/provision of cables / busbars as applicable shall be in the scope of the vendor.

4.5 Front panel display and control

4.5.1	Front panel screen (LCD display, etc) with browsing / navigation provisions to 1) select display parameters	Instantaneous DC power input DC input voltage DC Current of each SMB (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY) Total DC Current

4.5.2	2) provide settings for various parameters	Instantaneous active AC power output Instantaneous reactive AC power output AC voltage (all the 3 phases and line) AC current (all the 3 phases and line) Frequency Power Factor Energy (kWh) produced during entire day Total Energy (kWh) produced during its life
4.5.3		Faults
4.5.4		Other event logs
4.5.5		Other features as may be necessary for supervisory control and operation of the PCUs shall be provided.

4.6 Data logging, storage, retrieval, downloading, uploading

4.6.1	Provision of built-in systems for data logging, storage, retrieval, downloading, uploading etc.	Date-cum-time stamped logging of DC and AC side parameters (current, voltage, frequency, phase, power factor, power, export energy etc), faults and other events.
4.6.2		Data storage with retrieval features.
4.6.3		Provision of all necessary built-in systems, ports etc for downloading the data into a PC / Laptop etc that will be required for reporting, data analysis and trouble-shooting purposes.
4.6.4		Provision of all necessary built-in systems, ports etc for uploading of software etc that will be required for replacing, revising, upgrading the system.

4.7 Provisions for SCADA interface

4.7.1	SCADA interface requirement	Solar PV power plant will have an integrated SCADA, which is within BHEL scope, whereby all the PCUs will be integrated with other data systems such as solar array string monitoring, weather monitoring, HT side transformers / breakers monitoring, etc. Accordingly, PCU shall have necessary communication protocol and output ports to facilitate SCADA interface as per Clause 4.7.2. SCADA shall be OPC server based.
4.7.2	Communication protocol	Dedicated MODBUS TCP/IP on Ethernet Interface for networking with SCADA.
4.7.4	Parameters for SCADA	All DC and AC parameters (current, voltage, frequency, phase, power factor, power, export energy etc), grid data, temperature, faults, other event logs, date/time logs etc from each PCU will be required at SCADA control desk. PCU shall provide for this requirement. (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY)
4.7.5	Remote monitoring features	PCU shall have features to facilitate remote monitoring via telephone modem or mini web server.

4.8 DC Inputs and termination details for 2500kW PCU.

Vendor shall supply the PCU with the termination features on DC side as tabulated below. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc. shall be submitted for BHEL approval.

4.8.1	DC input terminals	**13 inputs + 1 spare** Hence, a minimum of **14 DC input** terminals (each for DC +ve and –ve) shall be provided.
4.8.2	Fuses / DC Ckt Breaker on DC input side	Fuse current rating **400A (min)** shall be provided on each positive DC input terminal. Alternately, DC circuit breaker can also be provided as per design. If DC breaker is provided for each input, then DC switch disconnector as per clause 4.4.1 is not mandatory.
4.8.3	Max DC input current rating of PCU	Vendor shall indicate the rating. In addition, max rating of each individual DC input shall be indicated
4.8.4	DC cable entry into panel	Bottom entry. Cable supply is within BHEL scope. 1Cx400 sq-mm Aluminium, multi-strand, Al,armoured, XLPE insulation, PVC sheath cable will be used for each DC input. Exact size shall be provided during detailed engg. DC termination shall be suitable for the above cable.
4.8.5	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.8.6	Cable glands	Nickel plated brass, double compression type cable glands of reputed make (Make: Comet or any other reputed make) shall be provided by the vendor. To enable right selection of glands, final cable O.D will be provided by BHEL at the time of manufacturing. Approval of make and type/size shall be taken from BHEL before procurement of glands. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all the glands fixed on the gland plates.
4.8.7	Cable lugs, plain washers, spring washers, bolts and nuts	Similarly, cable lugs, bolts, nuts & plain washers, Zinc coated spring washers shall be provided by the vendor. Make for lugs: Dowells or any other reputed make with CE/VDE/UL/CSA/BIS. Approval of make and type/size shall be taken from BHEL before procurement of lugs. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all these items fixed on the bus bars at

		their respective positions. DC Cables in BHEL scope shall be Aluminium type. Suitable cable lugs in PCU vendor scope shall be based on the type of busbars being used in PCU : a) If Aluminium busbars used, aluminium lugs to be provided. c) If copper busbars used, Cu-Al Bi-metallic lugs to be provided.
4.8.8	Bus bar design	Tinned Copper or Aluminium Busbars shall be provided.
4.8.9	In case of separate DC termination panel	(a) In case the DC terminations are not within the main PCU panel with the vendor design featuring a separate panel, the add-on panel shall also be included in the offer. (b) General arrangement showing views and details of termination panel, with cable entry particulars, shall be submitted as part of technical bid. (c) Interconnecting the add-on DC termination panel with the main panel, including supply of cables for this purpose, shall be within the scope of vendor.
4.8.10	DC Side Negative Grounding	DC side negative grounding system shall be provided for the PCU. The same shall be indicated in the GA/SLD/Schematics and BOM.

4.9 AC Output and termination details **for 2500kW PCU.**

Vendor shall supply the PCU with the termination requirements on AC side as tabulated below. General arrangement showing views of termination shall be submitted as part of technical bid. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted within seven days after receipt of purchase order for BHEL approval.

4.9.1	Number of AC outputs	Three phases: R, Y, B terminals
4.9.2	AC cable entry into panel	Bottom entry. Cable supply is within BHEL scope. For each phase, 7 runs of 1Cx400 sq.mm aluminium, multi-strand, armoured, XLPE insulation, PVC sheath cable will be used.
4.9.3	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.9.4	Cable glands	Nickel plated brass, double compression type cable glands of reputed make (Make: Comet or any other reputed make) shall be provided by the vendor. Approval of make and type shall be taken from BHEL before procurement of glands. PCUs shall be supplied with all glands fixed on the gland plates.
4.9.5	Cable lugs, plain washers, spring washers, bolts and nuts	Similarly, cable lugs, bolts, nuts & plain washers, Zinc coated spring washers shall be provided by the vendor. AC Cables in BHEL scope shall be Aluminium type. Suitable cable lugs in PCU vendor scope shall be based on the type of busbars being used in PCU:

		a) If Copper busbars used, Cu-Al Bi-metallic lugs to be provided. b) If Aluminium busbars used, Aluminium lugs to be provided. Make for lugs: Dowells or any other reputed make with CE/VDE/UL/CSA/BIS. Approval of make and type shall be taken from BHEL before procurement of these items. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all these items fixed on the bus bars at their respective positions.
4.9.6	Bus bar design	Tinned Copper or Aluminium busbars shall be provided.
4.9.7	Aux. Transformer taping	Vendor should give provision for tapping Axillary transformer from AC SIDE BUS BAR xxxv/415 volt
4.9.8	In case of separate AC termination panel	In case the AC output terminations are not within the main PCU panel with the vendor design featuring a separate panel, the add-on panel shall also be included in the offer. General arrangement showing views and details of termination panel, with cable entry particulars, shall be submitted as part of technical bid. Interconnecting the add-on AC termination panel with the main panel, including supply of cables for this purpose, shall be within the scope of vendor.

4.10 Panel related parameters

4.10.1	Structure sheets	Doors and frames - Type of enclosure and size/thickness details of the doors and frames shall be indicated by vendor Gland plate: Minimum 3mm thk min sheet steel or 4 mm thk non-magnetic material
4.10.2	Bus bars	Busbars shall be of appropriate size to match current rating, based on vertical / horizontal layouts and bus bar orientations. Insulation sleeves (PVC etc.) shall be used wherever necessary. Bus bars (both AC and DC) shall be suitably colour coded.
4.10.6	Fixing of PCU	PCU shall be suitable for fixing on the cable trench channels by the means of tack welding.
4.10.7	Earthing terminals as per relevant standards	Earthing terminals shall be provided using tinned copper / aluminium bars of suitable cross section. Terminals shall be brought out to facilitate external connections.
4.10.8	Insulation clearances	AC side: Phase to Phase / neutral: As per relevant standards DC side: As per relevant standards.
4.10.9	Painting	Epoxy based powder coating. Powder coating shall meet the requirement of IS 13871 Paint shade shall be informed during detailed engineering.

4.10.10	Overall dimensions	Width x Depth x Height in mm shall be indicated in the offer.
4.10.11	Weight	Panel weight shall be indicated in the offer.
4.10.12	Air Flow Requirement (m3/hr)	To be indicated by vendor for each PCU. - HVAC calculations shall be provided by vendor during detailed engg including CFD analysis for ventilation.

5.0 Testing and inspection

5.1 Routine tests, as per relevant standards (IEC etc), shall be carried out on the PCUs and shall be witnessed by BHEL & Customer/ Customer authorized third party inspection agency). Vendor shall submit Manufacturing Quality Plan (MQP) and detailed Test Procedure along with drawings for formal approval by customer prior to inspection.

Routine tests shall be carried out by vendor on all the PCUs as per customer approved MQP. Following are the minimum tests to be conducted but not limited to:

(a) HV and IR tests on 100% PCUs.

(b) Functional tests

(c) Load testing of inverter on 1No. PCU:

- Verification of inverter performance in its stand-alone operational mode with a defined power (up to 100% rated full load power) and DC input voltage (up to max value). All parameters: DC voltage, current, power, grid voltage / current of R, Y, B lines, line frequency, ac output power, ac output energy, power factor, line current, efficiency, THD, etc. to be measured at 25%, 50%, 75% and 100% of the rated nominal power and checked against specified acceptance norms.

(d) Heat Run Test at rated full load on 1 no. panel

(e) Protection tests (by direct method or simulation method)

- Verification of automatic disconnecting and reconnecting of Inverter to the grid, based on rise and fall of heat sink and cabinet temperature with reference to set points.
- DC Reverse Polarity protection test
- DC Ground Fault
- AC and DC Overvoltage
- Abnormal voltage and frequency

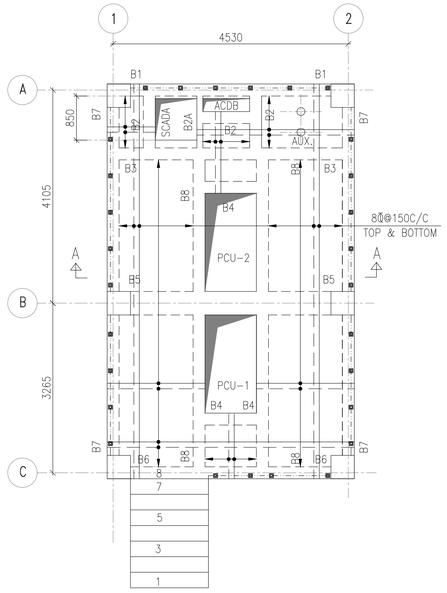
Test reports shall be submitted prior to dispatch of the system to the site.

6.0 Documents to be submitted after receipt of purchase order

6.1	Following documents shall be submitted for approval within seven days from date of purchase order. 1. GTP/Datasheet 2. General Arrangement of PCU and other auxiliary equipment, lighting, HVAC details,etc 3. BOM for complete PCU including all major components of PCU, AC and DC Combiner Panels 4. Type test reports 5. Spares List 6. Manufacturing Quality Plan (MQP) Vendor shall proceed with Manufacturing only after final approval of all the listed documents.

7.0 Documents to be submitted along with consignment

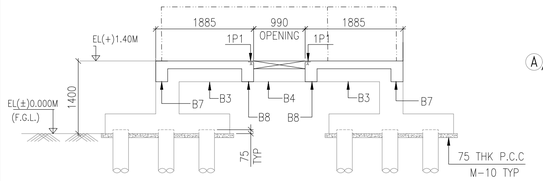
7.1	Following documents shall be submitted at the time of dispatch: a. Test reports on individual PCUs b. Technical manual with system specifications, installation guidelines, commissioning guidelines, schematic drawings, circuit board overlays, system set points, calibration settings, hardware settings, cable schedule, general arrangement drawings, panel details. c. Operation and Maintenance manual including final As Built and tested drgs and datasheet, test reports, Catalogs of individual components, schematic drgs shall be provided (segregated section wise) in both hard copy and soft copy.



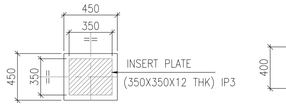
PLAN AT TOP EL(+)1.40M LVL.

FOR SHOWING SLAB R.F ONLY

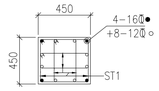
BARS TO BE CUT SUITABLTY AROUND OPENING



SECTION A-A



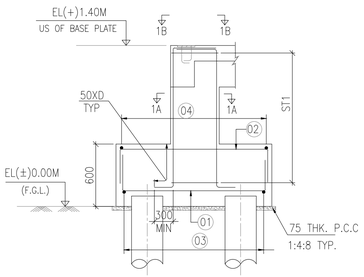
VIEW 1A-1A



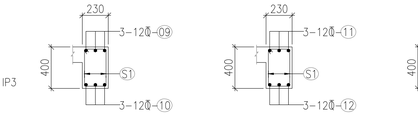
SECTION 1A-1A

COLUMN MKD C1

STIRRUPS SCHEDULE
ST1 =8Ø@100C/C

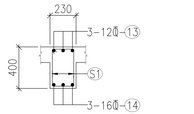


SECTION A-A



BEAM MKD B1(230X400)

BEAM MKD B2(230X400)



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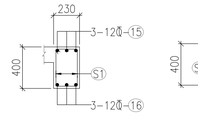

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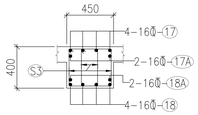

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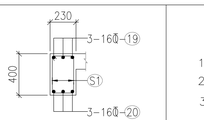

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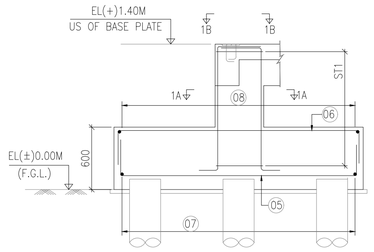
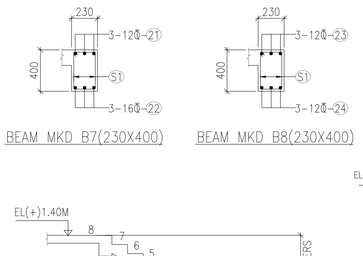


SECTION 2-2



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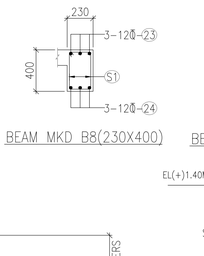

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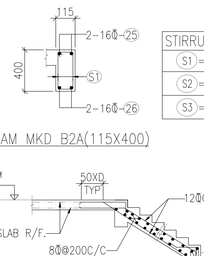

BEAM MKD B2A(115X400)

STIRRUPS SCHEDULE
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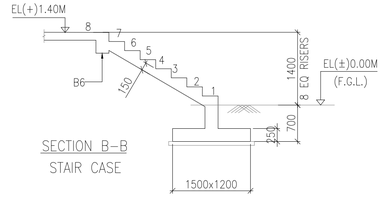
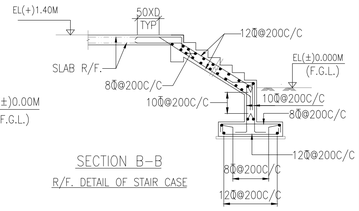
(S2)=2L-8Ø@150C/C
(S3)=4L-8Ø@150C/C



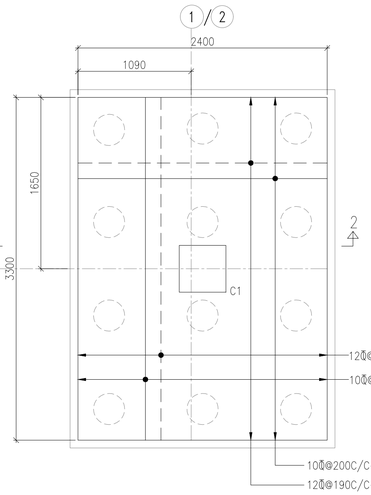
SECTION B-B

STAIR CASE

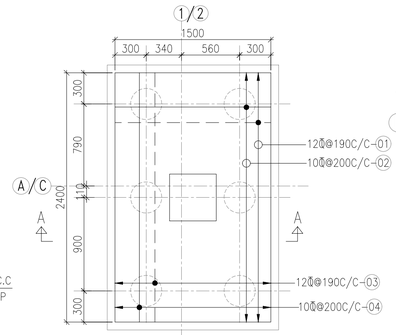


SECTION B-B

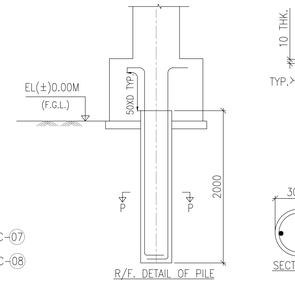
R/F. DETAIL OF STAIR CASE



DETAIL OF PILE CAP MKD. PC2

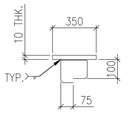


DETAIL OF PILE CAP MKD. PC1

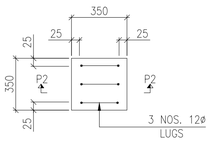


300Ø PILE 2.00 M LONG (BORED CAST IN SITU)

THE MAX CAPACITY OF PILE IS 2.2T IN COMPRESSION AND MAX. UP LIFT IS 1.5T BELOW 2.00M FROM F.G.L

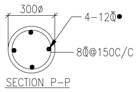


SECTION P2-P2

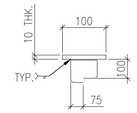


DETAIL OF INSERT PLATE

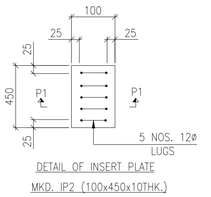
MKD. IP3 (350x350x10THK.)



SECTION P-P

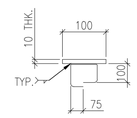


SECTION P1-P1

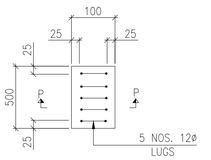


DETAIL OF INSERT PLATE

MKD. IP2 (100x450x10THK.)

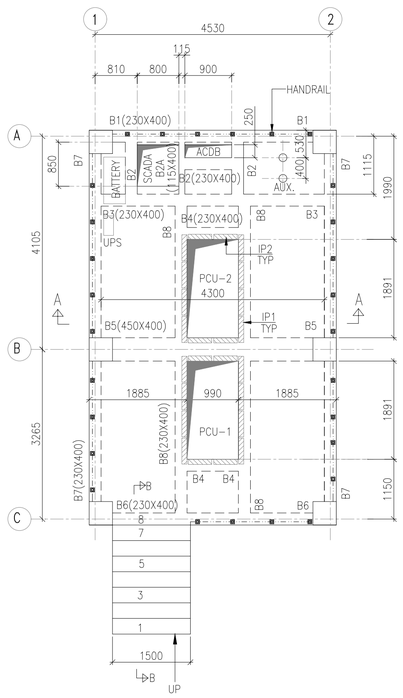


SECTION P-P



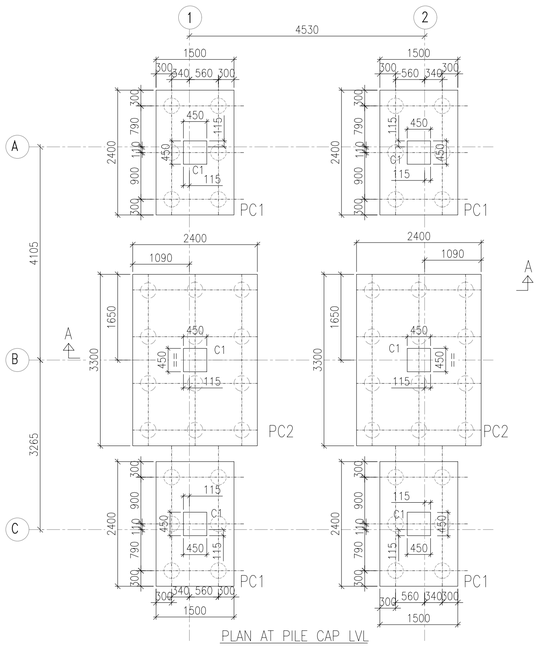
DETAIL OF INSERT PLATE

MKD. IP1 (100x500x10THK.)

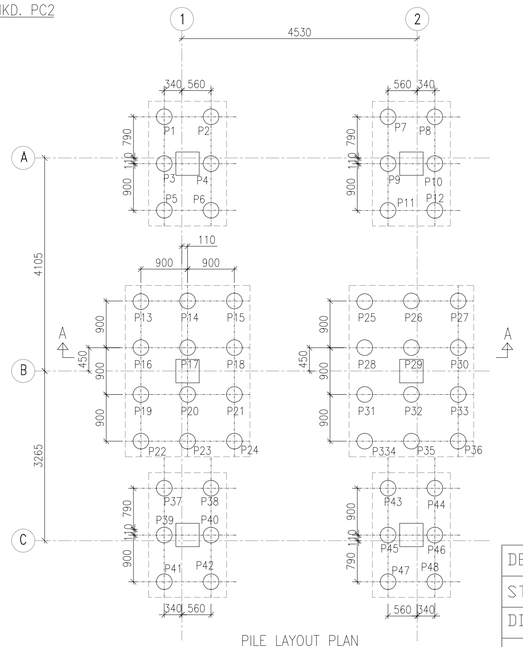


PLAN AT TOP EL(+)1.400M LVL.

SLAB 125THK.



PLAN AT PILE CAP LVL



PILE LAYOUT PLAN

48NOS. 300 DIA PILE

NOTES:-

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES.
2. FIGURED DIMENSIONS ONLY SHALL BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCH./MECH DWG.
4. ALL R.C.C. SHALL BE MIX M-25
5. ALL REINFORCEMENT SHALL BE IN FORM OF H.Y.S.D. STEEL BARS OF GRADE Fe 500 CONFORMING TO IS:1786-1985.
6. CLEAR COVER TO REINF. INCLUDING LINKS FOR R.C.C MEMBERS SHALL BE AS UNDER:- COLUMN= 40mm,PILE CAP/PILE= 75mm BEAM= 25mm.
7. STANDARD 'L' HOOKS SHALL BE PROVIDED AT THE ENDS OF ALL BARS.
8. PROVIDED LAP LENTH/DEVELOPMENT LENGTH 'L_d' FOR BOTH COMPRESSION AND TENSION MAIN R/F BAR SHALL BE=50XDIA OF BAR
9. LAPS SHALL BE STAGGERED AND AVOIDED AT THE SECTIONS OF MAX. BENDING MOMENT
10. NET SAFE BEARING CAPACITY HAS BEEN TAKEN AS 4 T /SQM AT 0.70M BELOW F.G.L
11. BOTTOM BAR INDICATES :- — — — — —
12. TOP BAR INDICATES :- ———————

REFERENCE DWG. NO:-

1. PLOT PLAN FOR GSECL RAGHANESDA (PHASE 1)
   DWG. NO:- BHEL-GSECL-CIV-PLOT_PLAN-111

LEGEND:

F.G.L. - FINISHED GROUND LEVEL
F.F.L. - FINISHED FLOOR LEVEL
T.O.C. - TOP OF CONCRETE
THK. - THICKNESS
TYP. - TYPICAL
U.N.O. - UNLESS NOTED OTHERWISE
℄ - CENTER LINE
B.O.B. - BOTTOM OF BEAM
T.O.B. - TOP OF BEAM
A.L.T. - ALTERNATE

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	APPD	CHD	REV.	DATE	ALTD	APPD	CHD
00	17.08.20	SUNIL	VIPIN	DKU	01	28.08.20	KARAM	VIPIN	DKU	02	19.09.20	KARAM	VIPIN	DKU	03	06.10.20	KARAM	VIPIN	DKU
	ISSUED FOR APPROVAL					REVISED AS PER COMMENTS					REVISED AS PER COMMENTS					REVISED AS PER COMMENTS			

DEPT.	SC&PV
STATUS	CONTRACT
DISTRIBUTION	

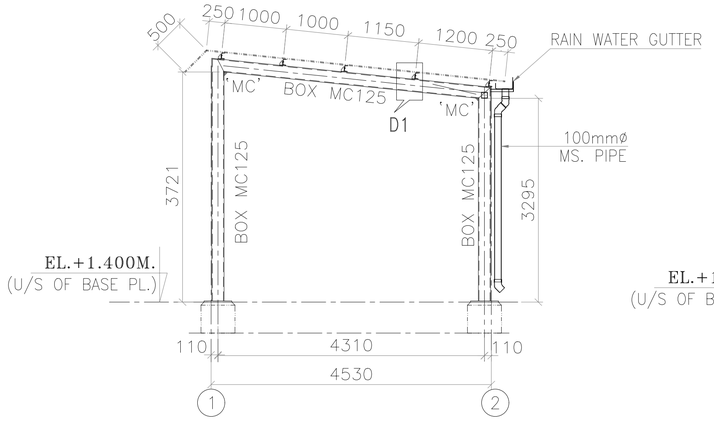
100MW GSECL SPV PROJECT AT RAGHANESDA GUJARAT (PHASE-1)

BHARAT HEAVY ELECTRICALS LTD
ELECTRONICS DIVISION, BANGALORE

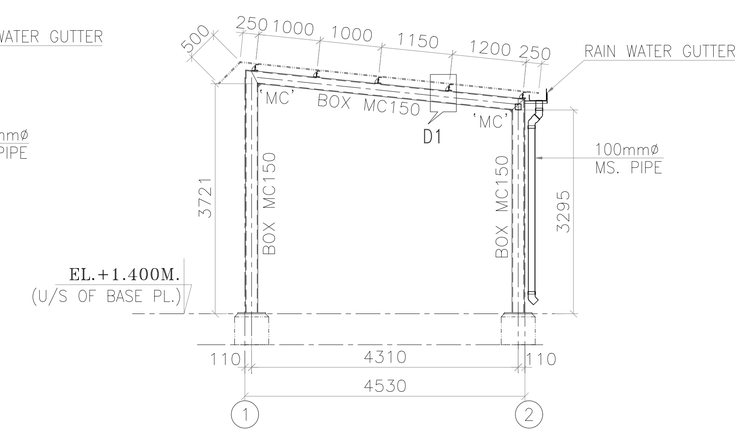
TITLE

PCU PLATFORM - GA AND DETAILS OF PLATFORM & SHED

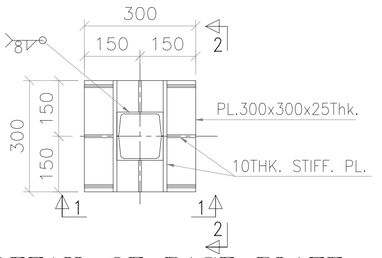
SCALE 1: 75 | DRAWING NO. BHEL-GSECL-CIV-PCU-PLTFRM-117 | SHEET 1 OF 1 | REV. 03



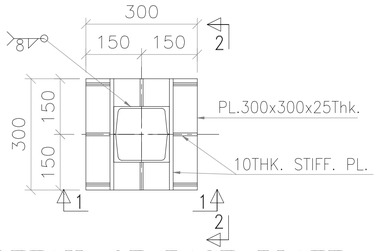
ELEVATION ALONG GRID A & C



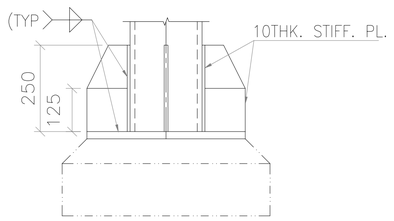
ELEVATION ALONG GRID B



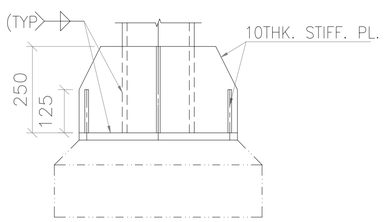
DETAIL OF BASE PLATE
(BP-1)



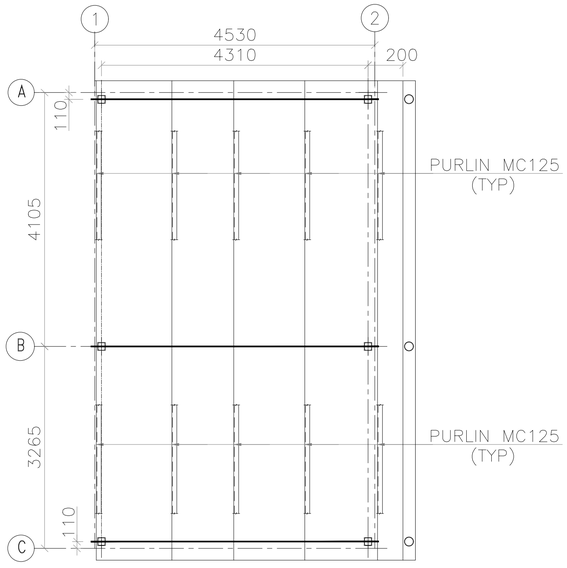
DETAIL OF BASE PLATE
(BP-2)



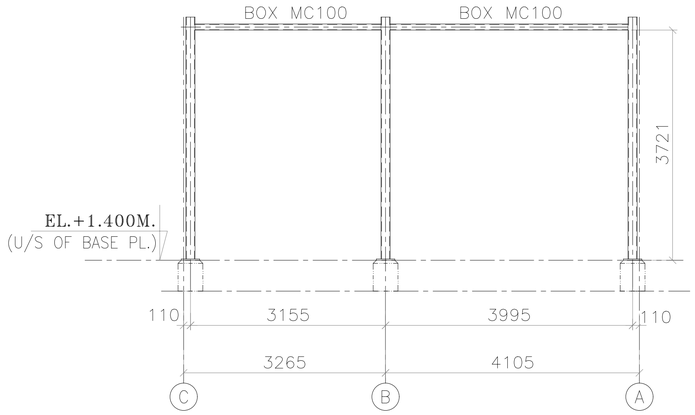
SECTION 1-1



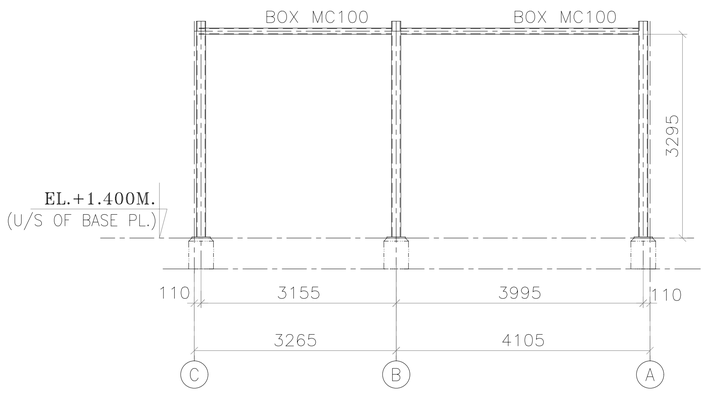
SECTION 2-2



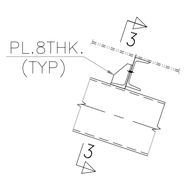
PLAN AT RAFTER LEVEL



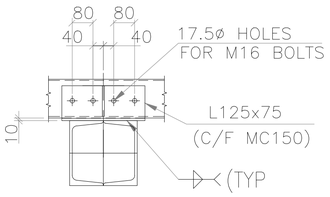
ELEVATION ALONG GRID 1



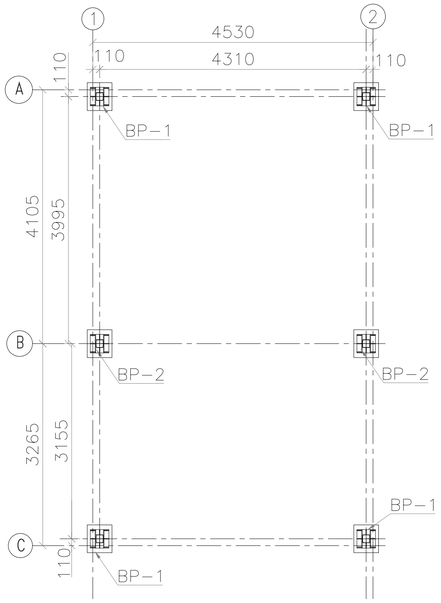
ELEVATION ALONG GRID 2



DETAIL D1



SECTION 3-3



PLAN AT BASE PLATE LEVEL

1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES UNLESS NOTED OTHERWISE
2) THIS DRAWING IS NOT BE SCALED,ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3) ALL FILLET WELDS ARE 6mm FILLET WELDS U.N.O.
4) ALL BUTT WELDS SHALL BE PROVIDED WITH A SEALING RUN
5) ALL GUSSET PLATES SHALL BE 8mm THK U.N.O.
6) ALL INCLINED MEMBERS AND GUSSET PLATES ARE TO BE CHECKED BY FULL SHOP LAYOUT
7) ALL ERECTION HOLES ARE 18ø FOR 16ø ERECTION BOLTS(U.N.O.)
8) ALL PERMANENT HOLES ARE 22ø FOR 20ø PERMANENT BOLTS(U.N.O.)UNLESS OTHERWISE SPECIFIED
9) ALL CONTACT SURFACES OF GUSSET PLATES HAVING ERECTION BOLTS SHALL BE WELDED AFTER ERECTION AND ALIGNMENT.

* 'MC' – MOMENT CONNECTION

NOTES:-
STRUCTURAL STEEL SHALL BE PAINTED TWO COAT OF RED OXIDE AND THREE COAT OF OIL PAINT.

DEPT.	SC&PV
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD	CHD	APPD
0	17-08-20	TAPAN	N.D	DKU
	ISSUED FOR APPROVAL			
1	28-08-20	TAPAN	N.D	DKU
	REVISED AS PER COMMENT			
2	19-09-20	TAPAN	N.D	DKU
	REVISED AS PER COMMENT			
3	06-10-20	ARINDAM	N.D	DKU
	REVISED AS PER COMMENT			

100MW GSECL SPV PROJECT AT RAGHANESDA GUJARAT (PHASE-I)

BHARAT HEAVY ELECTRICALS LTD
ELECTRONICS DIVISION, BANGALORE

TITLE
PCU PLATFORM – GA AND DETAILS OF PLATFORM & SHED

SCALE 1:75 | DRAWING NO. BHEL-GSECL-CIV-PCU-PLTFRM-117 | SHEET 2 OF 2 | REV. 03

Technical specification

for

Supply, installation and commissioning of

3-phase Grid-connected Power Conditioning Units of 4.4 MW outdoor type inverter (IP65 & protection class II or higher)

at

100 MW GSECL Raghanesda-II Site

Note: This specification is to be read along with civil foundation drawing no. **BHEL-GSECL-R2-PCU-PLTFRM-008.**

R00 dated 30.08.2025			
	Prepared by: Penmi Kashung **Penmi Kashung**	***Reviewed & approved by:*** varun jain **Varun Jain**	***Date*** **30.08.2025**

INTRODUCTION:

This technical specification provides details of supply of Outdoor for 3-phase Grid-connected Power Conditioning Units (PCU). The scope also includes commissioning of the supplied units at the project site for synchronizing the generated ac power with LV side of a transformer that connects to 33kV grid on HV side.

1.0 Scope of supply

SL No	Item Description	Qty
1.1	Supply of: Outdoor type inverter a) Outdoor inverter consisting of 3-phase, Grid-connected Power Conditioning Unit (PCU). Outdoor type invertor shall be minimum IP65 protection. Voltage Rating: 1500V Power Rating of each PCU: 4.4 MW **1 SET = Total Quantity of items used in 1 PCU of rating 4.4 MW.**	01 sets
1.2	**Supply of Spares** for power conditioning units. List of items with quantity is as follows: 1) Control Cards for PCU ** Quantity = 1 set of each type 2) Fuses Quantity = 1 set of each type and rating 3) Surge Protection Device Quantity = 1 set of each type and rating 4) MCCBs, MCBs Quantity = 1 set of each type and rating 5) AC Contactor, DC Contactor, Air Circuit Breaker – 1 no each 6) Dust filters – 25% of total qty **1 SET = Total Quantity of items used in 1 PCU of rating 4.4 MW.** **Notes:** **(a) The above spare quantities are for contingency purposes over and above the warranty requirements.** **(b) Item-wise BOQ and break-up prices shall be provided in the offer.** **(c) Control cards for 1 PCU refers to all the electronics cards used in the PCU including main microprocessor cards, protection cards, I/O cards, gate driver cards and any other PCB used in the PCU not specifically indicated above.**	01 Set

1.3	**Commissioning of PCUs along with Training at site.** BHEL scope of activities at site for installation and commissioning: (1) Movement and positioning of outdoor PCU panels at the earmarked position on the outdoor RCC platform. (2) Crimping the incoming (DC side) and outgoing (AC side) cables (BHEL supply) using the cable lugs provided by the vendor. (3) Connecting at the respective termination ends of the panels using the cable glands and fastening hardware (nuts, bolts, washers etc.) provided by the vendor. Vendor scope of activities at site for commissioning: (1) All the electrical checks that are required to confirm that solar DC parameters (current, voltage) are available at the DC input side of PCUs. (2) Service engineers shall be present at site during installation of PCUs, commissioning of solar power plant, providing all necessary guidance and support to achieve successful synchronization of PCU output with grid and also to trouble-shoot / resolve the technical problems associated with PCU. Commissioning / Service Engineer shall be from OEM. (3) Guidance and support to BHEL team, at the time of installation and commissioning of SCADA, in respect of connection of communication cables to PCUs and technical problems related to receiving data signals at SCADA station from PCUs. (4) Training: Vendor shall provide training at site to BHEL and customer's engineers during commissioning. Training shall cover various technical aspects such as functional/ operational features, trouble-shooting procedures, maintenance schedules, requirements, safety, emergency precautions etc. Both the theory and practical (hands on) training shall be covered. Note: Supply and installation of integrated SCADA system for the overall power plant is within BHEL scope. The lump-sum price shall include all the costs that will be incurred by the vendor towards commissioning including travel, boarding, lodging and any other contingency expenses.	01 sets

2.0 Warranty

Vendor shall provide comprehensive warranty for 60 months from date of commissioning or 63 months from date of supply, whichever is earlier. Vendor shall enclose, along with technical bid, the complete scope, terms and conditions of the warranty.

During the warranty period, whenever a technical problem is encountered with the PCU, BHEL will report the same to the vendor. Vendor shall resolve the problem within two days from the date of reporting including the visit of their service representative, if required, within this duration for repair/replacement of failed items and re-commissioning of the PCU.

3.0 Technical Documents to be submitted along with offer

1. Vendor has to enclose the deviation sheet clause wise separately in case any deviations are sought by the vendor. Absence of any deviation sheet shall be taken as compliance of BHEL specification in total without any deviation.

2. Product datasheet of the offered PCU model(s).
3. Overall General Arrangement of PCU including DC and AC Combiner Panels.
4. List of spares offered (with quantity) and without prices.
5. List of type tests /IEC certifications available along with test certificates complying with Cl.4.12 of this specification. Supporting test reports shall be provided by vendor during detailed engineering.

4.0 Technical specification of Power Conditioning Units

4.1 Basic requirements (PCU type, Standards, Technology, Interconnections, Interfaces etc)

<table>
<tr><th>#</th><th>Parameter</th><th>BHEL specification</th></tr>
<tr><td>4.1.1</td><td>PCU type</td><td>Grid-interactive.

PCU shall remain connected to the grid as per Central Electricity Authority Technical (standards for connectivity to the grid) regulation 2007 with all latest amendments and its components shall be designed accordingly.

Low power mode:

The control system that continuously monitors the output of the solar PV plant until pre-set value is exceeded and begins to export power provided there is sufficient solar energy and the grid voltage and frequency are in the specified range.

Further, the inverter shall be capable of operation under reduced power mode and shall not trip when the PV array output voltage is below MPPT range under high temperature conditions.

Active MPPT mode (high power mode):

When solar radiation increases further, PCU shall enter maximum power point tracking (MPPT) mode and adjust the voltage of the SPV array to maximize solar energy fed into the grid. When the solar radiation falls below threshold level, the PCU shall enter lower power mode.

Sleep mode:

Automatic ‘sleep’ mode shall be provided so that unnecessary losses are minimized at night. Vendor shall provide threshold DC voltage level / power level of the PCU as to when it shall enter into the sleep mode and back to low power mode and MPPT mode during detailed engineering for BHEL/customer approval.

Low Voltage mode:

The Inverter shall be capable of operating under reduced power mode and shall not trip when the PV array output is below MPPT range under high temperature conditions.</td></tr>
<tr><td>4.1.2</td><td>Compliance with standards</td><td>
<table>
<tr><th>Sl.</th><th>Standard</th><th>Description</th></tr>
<tr><td>1</td><td>IEC 61683</td><td>Photovoltaic systems - Power conditioners – Procedure for measuring efficiency</td></tr>
<tr><td>2</td><td>IEC 62109-1 & 2</td><td>Safety of power converters for use in photovoltaic power systems</td></tr>
<tr><td>3</td><td>IEC 61000-6-2</td><td>Electromagnetic compatibility (EMC) - Part 6-2: Generic standards-Immunity Standard</td></tr>
</table>
</td></tr>
</table>

				for industrial environments
		4	IEC 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards- Emission standard for industrial environments
		5	IEC 62116/ IEEE 1547/IEE 519 / UL 1741 / Equivalent EN/ BIS standard	Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures, Anti Islanding
		6	IEC 60068-2/ IEC 62093	Environmental testing / MPPT
		7	Grid Connectivity - CEA Technical Standards for Connectivity to the Grid Regulations 2007 with latest amendment and latest CERC /GERC Regulations and Grid Codes - including LVRT requirement	
	All the type test certificates as per the standards mentioned above shall be submitted for approval.			
4.1.3	Output transformer	PCU shall be of 'transformer-less' design.		
4.1.4	Maximum Power Point Tracking (MPPT)	MPPT shall be integrated in the power conditioning unit to maximize energy drawn from the solar PV array. The MPPT should be microprocessor based to minimize power losses. The details of working mechanism of MPPT shall be submitted during the detailed engineering. The operating voltage range of PCU and the MPPT shall be large enough such that it satisfactorily operates for PV modules exposed to the maximum ambient temperature of 50 deg C. The MPPT unit shall confirm to IEC 62093 for design qualification.		
4.1.5	AC-DC conversion	3-phase Inverter stack		
4.1.6	Built-in support systems	PCU shall be provided with protection circuits, monitoring circuits, data logging & storage system, provisions to download data to PC/Laptop, MODBUS communication outputs for SCADA interface etc as per Cl. 4.7 of this specification.		
4.1.7	Heat exchangers	Vendor shall submit HVAC calculations during detailed engineering.		
4.1.8	DC input and AC output terminations	Input and output terminations together with cable glands, lugs, hardware shall be provided to match the connections using BHEL cables as specified under related clauses of this specification. Terminals should be shrouded.		
4.1.9	Environment protection	All PCB cards shall be provided with suitable coating (epoxy etc) for protection.		

4.2 Technical parameters

#	Technical parameter	BHEL specification
4.2.1	Output power rating	As per Cl. 1.1. Vendor to specify ratings being offered. No derating upto 50degC

4.2.2	AC grid connection	3-phase
4.2.3	Output frequency	50 Hz +/- 5%
4.2.4	Nominal output voltage	Value to be indicated by vendor
4.2.5	Maximum DC input voltage (Max open circuit PV voltage)	1500 V DC
4.2.6	MPPT Range of control system	Range to be indicated by vendor.
4.2.7	DC side peak power	Vendor shall confirm that PCU is suitable for overloading of DC input power. Vendor to indicate the value in %. Minimum requirement is 40%
4.2.8	Max DC operating current	Value to be indicated by vendor.
4.2.9a	Max AC output current	Value to be indicated by vendor corresponding to the rated output power of the PCU.
4.2.9a	Output voltage	690 V
4.2.10	Power factor	Designed operation close to unity PF. Adjustable window 0.85 lead to 0.85 lag
4.2.11	Ambient temperature	0 to 50 deg C.
4.2.12	Relative Humidity	Upto 95% non-condensing
4.2.13	Protection class	IP65
4.2.14	Grid Frequency tolerance	+/- 3 Hz
4.2.15	Grid Voltage tolerance	- 10% and +10%
4.2.17	AC output THD limits	Less than 3% at rated power
4.2.18	Maximum noise level	Value to be indicated by vendor
4.2.19	DC injection (as % of nominal load current)	DC injection shall be limited to 1% of the rated current of the inverter
4.2.20	Flicker	Shall be as per IEC 61000/IEEE 519
4.2.21	Set point pre-selection for active power and VAR control	PCU shall be provided with all necessary features that will enable set point selection through SCADA. For this PCU vendor shall furnish the Modbus mapping for the set points or suggest the possible method for selecting VAR control. Operator shall be able to limit the total power (Active and Reactive) injected in the grid through manual intervention as and when required in view of grid security.
4.2.22	Re-synchronization time	In case of grid failure, the PCU shall be re-synchronized with grid after revival of power supply. Vendor shall indicate the time taken by PCU to be re-synchronized after restoration of grid supply.

4.2.23	European efficiency	≥ 98%, measured as per IEC 61683 standard for measuring efficiency
4.2.24	Peak Efficiency	Inverter No Load / Full Load Loss Calculation must be submitted by the bidder during detailed engineering.
4.2.25	PCU availability	The up-time of Inverters should be of 99% in a year, in case of failing to achieve this due to failure of any component of inverter the vendor shall either replace the inverter or the component at their own cost
4.2.26	No load loss	No load loss shall be < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%.
4.2.27	Voltage Ride Through	The PCU shall remain connected to the grid during temporary dip or rise in grid voltage as per the LVRT requirements of CEA Technical Standards for Connectivity to the Grid Regulations. The PCU shall also be able to inject reactive power during the period of voltage dip.
4.2.28	Active power regulation	The PCU shall be able to limit the active power exported to the grid based on the set point provided through PCU front control panel. The PCU shall also be able to automatically the limit the active power after an increase in grid frequency above a pre-set value. The ramp rate shall be adjustable during operation and start-up after fault. The applicability of the requirement shall be as per CEA regulation and compliance.
4.2.29	Reactive power control	The PCU shall be able to inject /absorb reactive power to/ from the grid based on the set point provided through PCU front control panel. The same shall be performed automatically with adjustable ramp rate based on dynamic changes in grid voltage or reactive power reference. Night time VAR compensation as per CEA regulation and compliance
4.2.30	Enclosure	Suitable for Outdoor duty and IP class 65

4.3 Protection systems

4.3.1	Protection systems for current, voltage, temperature, surges, ground faults, fan failure etc. Fault indication shall be communicated to SCADA system	AC & DC over current
4.3.2		AC & DC short circuit
4.3.3		DC reverse polarity
4.3.4		Over temperature protection: Heat sink, Cabinet
4.3.5		Synchronization loss
4.3.6		Anti-islanding protection
4.3.7		EMI and RFI
4.3.8		Grid monitoring Protection against any sustained fault (lightning effect etc) in grid / feeder line.
4.3.9		Ground fault protection

4.3.10		Power regulation in the event of thermal overloading
4.3.11		SPD-based overvoltage protection on both DC and AC sides. SPD shall consist of MOV type arrestors. It shall have thermal disconnectors to interrupt surge current arising from internal / external faults. Type-II surge protective device (SPD) conforming to IEC 61643- 11/12, shall be connected between positive/ negative bus and earth.
4.3.13		Fan failure – Alarm contact shall be provided for air flow loss / rise of temperature of cooling fan

4.4 DC, AC side load break disconnecting switch / breaker provisions

4.4.1	DC side	Load Break Switch Disconnector required on DC side (if fuses are used on each DC input). **(To be read in conjunction with clause 4.8.2)** DC current shall be communicated to SCADA. (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY)
4.4.2	AC side	(a) ACBs shall be provided on the AC output side.
		(b) Remote operating and controlling facility for PCU from SCADA Panel in Main Control Room shall be provided.
		(c) Surge protection device (3P) with suitable rating shall be provided after the ACB.
		(d) Indication for grid side supply ON / OFF status shall be available on the Door Interface.
		(e) Interconnection between the ACB Panel and PCU supply/provision of cables / busbars as applicable shall be in the scope of the vendor.

4.5 Front panel display and control

4.5.1	Front panel screen (LCD display, etc) with browsing / navigation provisions to 1) select display parameters 2) provide settings for various parameters	Instantaneous DC power input DC input voltage DC Current of each SMB (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY) Total DC Current
4.5.2		Instantaneous active AC power output Instantaneous reactive AC power output AC voltage (all the 3 phases and line) AC current (all the 3 phases and line) Frequency Power Factor Energy (kWh) produced during entire day Total Energy (kWh) produced during its life
4.5.3		Faults

4.5.4		Other event logs
4.5.5		Other features as may be necessary for supervisory control and operation of the PCUs shall be provided.

4.6 Data logging, storage, retrieval, downloading, uploading

4.6.1	Provision of built-in systems for data logging, storage, retrieval, downloading, uploading etc.	Date-cum-time stamped logging of DC and AC side parameters (current, voltage, frequency, phase, power factor, power, export energy etc), faults and other events.
4.6.2		Data storage with retrieval features.
4.6.3		Provision of all necessary built-in systems, ports etc for downloading the data into a PC / Laptop etc that will be required for reporting, data analysis and trouble-shooting purposes.
4.6.4		Provision of all necessary built-in systems, ports etc for uploading of software etc that will be required for replacing, revising, upgrading the system.

4.7 Provisions for SCADA interface

4.7.1	SCADA interface requirement	Solar PV power plant will have an integrated SCADA, which is within BHEL scope, whereby all the PCUs will be integrated with other data systems such as solar array string monitoring, weather monitoring, HT side transformers / breakers monitoring, etc. Accordingly, PCU shall have necessary communication protocol and output ports to facilitate SCADA interface as per Clause 4.7.2. SCADA shall be OPC server based.
4.7.2	Communication protocol	Dedicated MODBUS TCP/IP on Ethernet Interface for networking with SCADA.
4.7.4	Parameters for SCADA	All DC and AC parameters (current, voltage, frequency, phase, power factor, power, export energy etc), grid data, temperature, faults, other event logs, date/time logs etc from each PCU will be required at SCADA control desk. PCU shall provide for this requirement. (ALL SMB CURRENT SHALL BE MEASURED & DISPLAYED INDEPENDENTLY)
4.7.5	Remote monitoring features	PCU shall have features to facilitate remote monitoring via telephone modem or mini web server.

4.8 DC Inputs and termination details.

Vendor shall supply the PCU with the termination features on DC side as tabulated below. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted for BHEL approval.

4.8.1	DC input terminals	**20 inputs + 1 spare** Hence, a minimum of **21 DC input** terminals (each for DC +ve and –ve) shall be provided.
4.8.2	Fuses / DC Ckt Breaker on DC input side	Fuse current rating **500A (min)** shall be provided on each positive and negative DC input terminal.

		Alternately, DC circuit breaker can also be provided as per design. If DC breaker is provided for each input, then DC load break switch disconnector as per clause 4.4.1 is not mandatory.
4.8.3	Max DC input current rating of PCU	Vendor shall indicate the rating. In addition, max rating of each individual DC input shall be indicated
4.8.4	DC cable entry into panel	Bottom entry. Cable supply is within BHEL scope. 1Cx400 sq-mm Aluminium, multi-strand, Al, Armoured, XLPE insulation, PVC sheath cable will be used for each DC input. Exact size shall be provided during detailed engg. DC termination shall be suitable for the above cable.
4.8.5	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.8.6	Cable glands	Nickel plated brass, double compression type cable glands of reputed make (Make: Comet or any other reputed make) shall be provided by the vendor. To enable right selection of glands, final cable O.D will be provided by BHEL at the time of manufacturing. Approval of make and type/size shall be taken from BHEL before procurement of glands. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all the glands fixed on the gland plates.
4.8.7	Cable lugs, plain washers, spring washers, bolts and nuts	Similarly, cable lugs, bolts, nuts & plain washers, Zinc coated spring washers shall be provided by the vendor. Make for lugs: Dowells or any other reputed make with CE/VDE/UL/CSA/BIS. Approval of make and type/size shall be taken from BHEL before procurement of lugs. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all these items fixed on the bus bars at their respective positions. DC Cables in BHEL scope shall be Aluminium type. Suitable cable lugs in PCU vendor scope shall be based on the type of busbars being used in PCU: a) If Aluminium busbars used, aluminium lugs to be provided. c) If copper busbars used, Cu-Al Bi-metallic lugs to be provided.
4.8.8	Bus bar design	Tinned Copper or Aluminium Busbars shall be provided.
4.8.9	In case of separate DC termination panel	(a) General arrangement showing views and details of termination panel, with cable entry particulars, shall be submitted as part of technical bid. (b) Interconnecting the add-on DC termination panel with the main panel, including supply of cables for this purpose, shall be within the scope of vendor.

4.8.10	DC Side Negative Grounding	DC side negative grounding system shall be provided for the PCU. The same shall be indicated in the GA/SLD/Schematics and BOM.

4.9 AC Output and termination details.

Vendor shall supply the PCU with the termination requirements on AC side as tabulated below. General arrangement showing views of termination shall be submitted as part of technical bid. Detailed drawings of termination arrangements with bus bar particulars such as positions, dimensions, hole sizes, spacing between holes, support to bus bar, etc shall be submitted within seven days after receipt of purchase order for BHEL approval.

4.9.1	Number of AC outputs	Three phases: R, Y, B terminals
4.9.2	AC cable entry into panel	Bottom entry. Cable supply is within BHEL scope. For each phase, 7 runs of 1Cx630 sq.mm aluminium, multi-strand, armoured, XLPE insulation, PVC sheath cable will be used. Note: Cable termination is through cable adaptor box, which is already available at site under BHEL's scope.
4.9.3	Gland plates	Drilled Gland plates shall be provided with holes to accommodate the cable glands.
4.9.4	Cable glands	Nickel plated brass, double compression type cable glands of reputed make (Make: Comet or any other reputed make) shall be provided by the vendor. Approval of make and type shall be taken from BHEL before procurement of glands. PCUs shall be supplied with all glands fixed on the gland plates.
4.9.5	Cable lugs, plain washers, spring washers, bolts and nuts	Similarly, cable lugs, bolts, nuts & plain washers, Zinc coated spring washers shall be provided by the vendor. AC Cables in BHEL scope shall be Aluminium type. Suitable cable lugs in PCU vendor scope shall be based on the type of busbars being used in PCU : a) If Copper busbars used, Cu-Al Bi-metallic lugs to be provided b) If Aluminium busbars used, Aluminium lugs to be provided. Make for lugs: Dowells or any other reputed make with CE/VDE/UL/CSA/BIS. Approval of make and type shall be taken from BHEL before procurement of these items. Part no. and qty shall be indicated in the BOM. PCUs shall be supplied with all these items fixed on the bus bars at their respective positions.
4.9.6	Bus bar design	Tinned Copper or Aluminium busbars shall be provided.
4.9.7	Aux. Transformer taping	Vendor should give provision for tapping Axillary transformer from AC SIDE BUS BAR xxxv/415 volt (where xxx is the PCU AC nominal

		voltage output).

4.10 Panel related parameters

4.10.1	Structure sheets	Doors and frames - Type of enclosure and size/thickness details of the doors and frames shall be indicated by vendor Gland plate: Minimum 3mm thk min sheet steel or 4 mm thk non-magnetic material
4.10.2	Bus bars	Busbars shall be of appropriate size to match current rating, based on vertical / horizontal layouts and bus bar orientations. Insulation sleeves (PVC etc.) shall be used wherever necessary. Bus bars (both AC and DC) shall be suitably colour coded.
4.10.6	Fixing of PCU	PCU shall be suitable for fixing on the cable trench channels by the means of tack welding.
4.10.7	Earthing terminals as per relevant standards	Earthing terminals shall be provided using tinned copper / aluminium bars of suitable cross section. Terminals shall be brought out to facilitate external connections.
4.10.8	Insulation clearances	AC side: Phase to Phase / neutral: As per relevant standards DC side: As per relevant standards.
4.10.9	Painting	Epoxy based powder coating. Powder coating shall meet the requirement of IS 13871 Paint shade shall be informed during detailed engineering.
4.10.10	Overall dimensions	Width x Depth x Height in mm shall be indicated in the offer.
4.10.11	Weight	Panel weight shall be indicated in the offer.
4.10.12	Air Flow Requirement (m3/hr)	To be indicated by vendor for each PCU. - HVAC calculations shall be provided by vendor during detailed engg including CFD analysis for ventilation.

5.0 Testing and inspection

5.1	Routine tests, as per relevant standards (IEC etc), shall be carried out on the PCUs and shall be witnessed by BHEL & Customer/ Customer authorized third party inspection agency). Vendor shall submit Manufacturing Quality Plan (MQP) and detailed Test Procedure along with drawings for formal approval by customer prior to inspection. Routine tests shall be carried out by vendor on all the PCUs as per customer approved MQP. Following are the minimum tests to be conducted but not limited to: (a) HV and IR tests on 100% PCUs.

(b) Functional tests

(c) Load testing of inverter on 1No. PCU:

- Verification of inverter performance in its stand-alone operational mode with a defined power (up to 100% rated full load power) and DC input voltage (up to max value). All parameters: DC voltage, current, power, grid voltage / current of R, Y, B lines, line frequency, ac output power, ac output energy, power factor, line current, efficiency, THD, etc. to be measured at 25%, 50%, 75% and 100% of the rated nominal power and checked against specified acceptance norms.

(d) Heat Run Test at rated full load on 1 no. panel

(e) Protection tests (by direct method or simulation method)

- Verification of automatic disconnecting and reconnecting of Inverter to the grid, based on rise and fall of heat sink and cabinet temperature with reference to set points.
- DC Reverse Polarity protection test
- DC Ground Fault
- AC and DC Overvoltage
- Abnormal voltage and frequency

Test reports shall be submitted prior to dispatch of the system to the site.

6.0 Documents to be submitted after receipt of purchase order

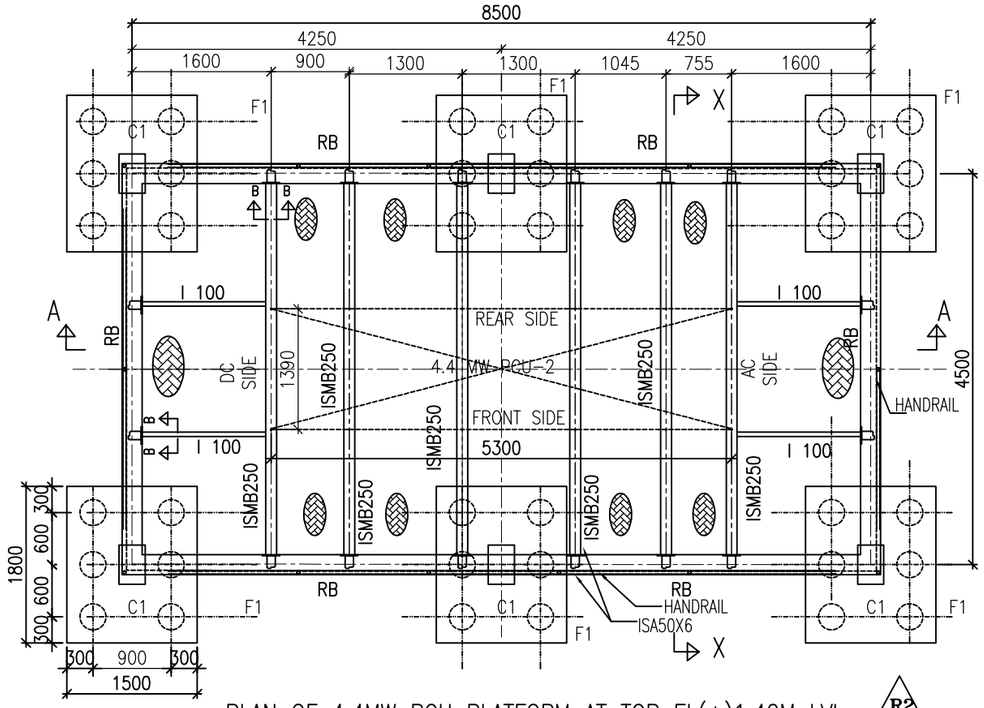
6.1 Following documents shall be submitted for approval within seven days from date of purchase order.

1. GTP/Datasheet
2. General Arrangement of PCU and other auxiliary equipment, lighting, HVAC details,etc
3. BOM for complete PCU including all major components of PCU, AC and DC Combiner Panels
4. Type test reports
5. Spares List
6. Manufacturing Quality Plan (MQP)

Vendor shall proceed with Manufacturing only after final approval of all the listed documents.

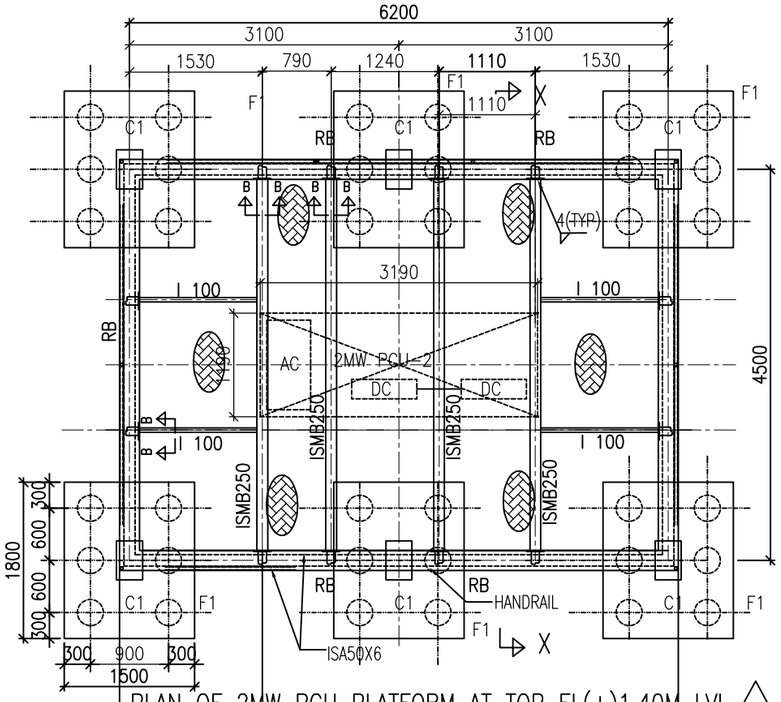
7.0 Documents to be submitted along with consignment

7.1	Following documents shall be submitted at the time of dispatch: a. Test reports on individual PCUs b. Technical manual with system specifications, installation guidelines, commissioning guidelines, schematic drawings, circuit board overlays, system set points, calibration settings, hardware settings, cable schedule, general arrangement drawings, panel details. c. Operation and Maintenance manual including final As Built and tested drgs and datasheet, test reports, Catalogs of individual components, schematic drgs shall be provided (segregated section wise) in both hard copy and soft copy.



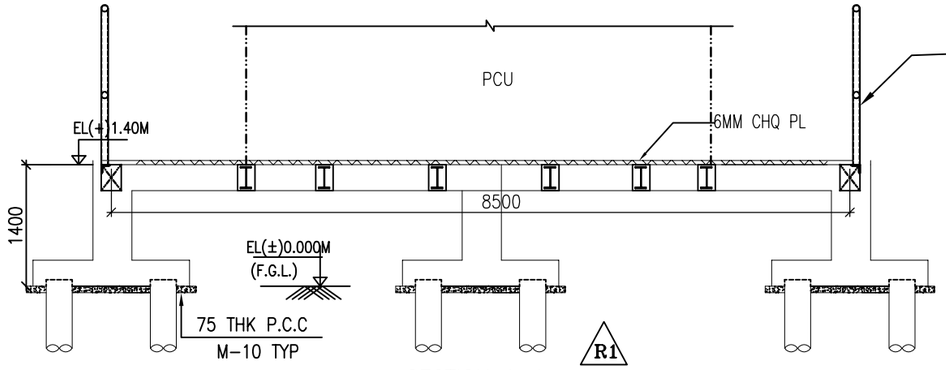
PLAN OF 4.4MW PCU PLATFORM AT TOP EL(+)1.40M LVL.

R2



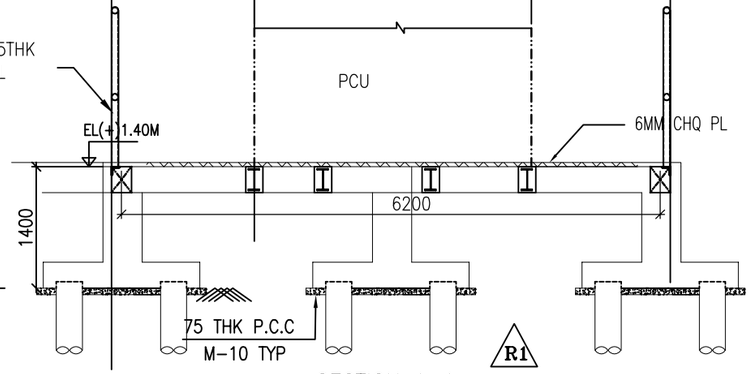
PLAN OF 2MW PCU PLATFORM AT TOP EL(+)1.40M LVL.

R2



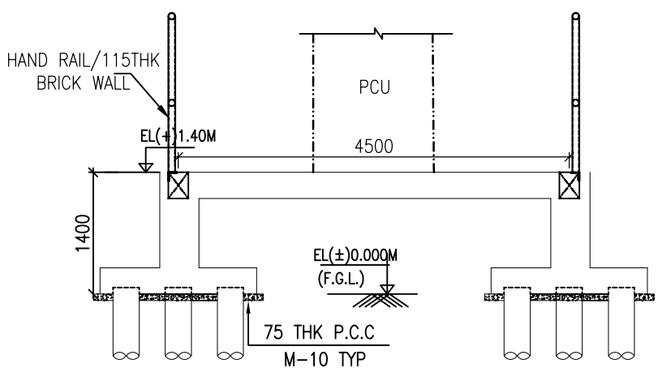
SECTION A-A

R1

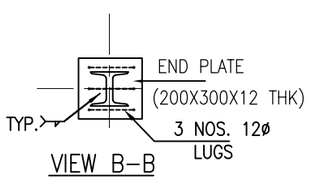


SECTION A-A

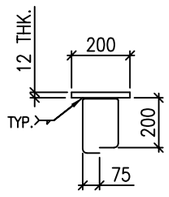
R1



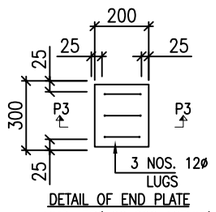
SECTION X-X



VIEW B-B



SECTION P3-P3



DETAIL OF END PLATE
MKD. EP(300x200x12THK.)

NOTES:-

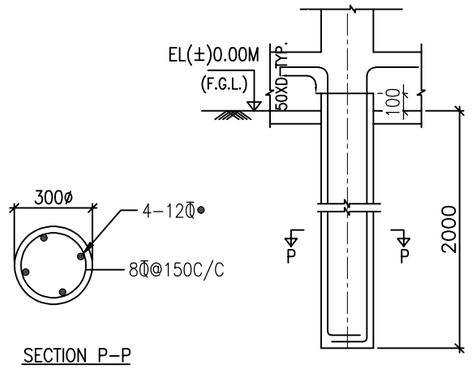
1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES.
2. FIGURED DIMENSIONS ONLY SHALL BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCH./MECH DWG.
4. ALL R.C.C. SHALL BE MIX M-25
5. ALL REINFORCEMENT SHALL BE IN FORM OF H.Y.S.D. STEEL BARS OF GRADE Fe 415 CRS CONFORMING TO IS:1786-1985.
6. CLEAR COVER TO REINF. INCLUDING LINKS FOR R.C.C MEMBERS SHALL BE AS UNDER:- COLUMN= 40mm,PILE CAP/PILE= 75mm BEAM= 25mm.
7. STANDARD 'L' HOOKS SHALL BE PROVIDED AT THE ENDS OF ALL BARS.
8. PROVIDED LAP LENTH/DEVELOPMENT LENGTH 'L_d' FOR BOTH COMPRESSION AND TENSION MAIN R/F BAR SHALL BE=50XDIA OF BAR
9. LAPS SHALL BE STAGGERED AND AVOIDED AT THE SECTIONS OF MAX. BENDING MOMENT
10. NET SAFE BEARING CAPACITY HAS BEEN TAKEN AS 8.9 T /SQM AT 2m DEPTH.
11. BOTTOM BAR INDICATES :- — — —
12. TOP BAR INDICATES :- ———
13. PREFABRICATED ALUMINIUM LADDER WILL BE FIXED SUIT TO SITE.

REFERENCE DWG. NO:-

1. FOR LOCATION REFER: PLOT PLAN FOR GSECL RAGHANESDA (PHASE 2) DWG. NO:- BHEL-GSECL-R2-CIV-PLOT_PLAN-003 (LATEST REV)
2. ELECTRICAL INPUT DRG.BHEL-GSECL-R2-ELEC-GTP-INV-019

LEGEND:

F.G.L. – FINISHED GROUND LEVEL
F.F.L. – FINISHED FLOOR LEVEL
T.O.C. – TOP OF CONCRETE
THK. – THICKNESS
TYP. – TYPICAL
U.N.O. – UNLESS NOTED OTHERWISE
℄ – CENTER LINE
B.O.B. – BOTTOM OF BEAM
T.O.B. – TOP OF BEAM
A.L.T. – ALTERNATE



SECTION P-P

R/F. DETAIL OF PILE

300ø PILE 2.0 M LONG (BORED CAST IN SITU)

REV	DATE	DRN	CHD	VER	REV	DATE	DRN	CHD	VER
01	17.03.21	TC	PK	BS	00	08.03.21	TC	PK	BS
REVISED AS PER CUSTOMER COMMENT					SUBMITTED FOR APPROVAL				

DEPT. SC&PV
STATUS CONTRACT
DISTRIBUTION

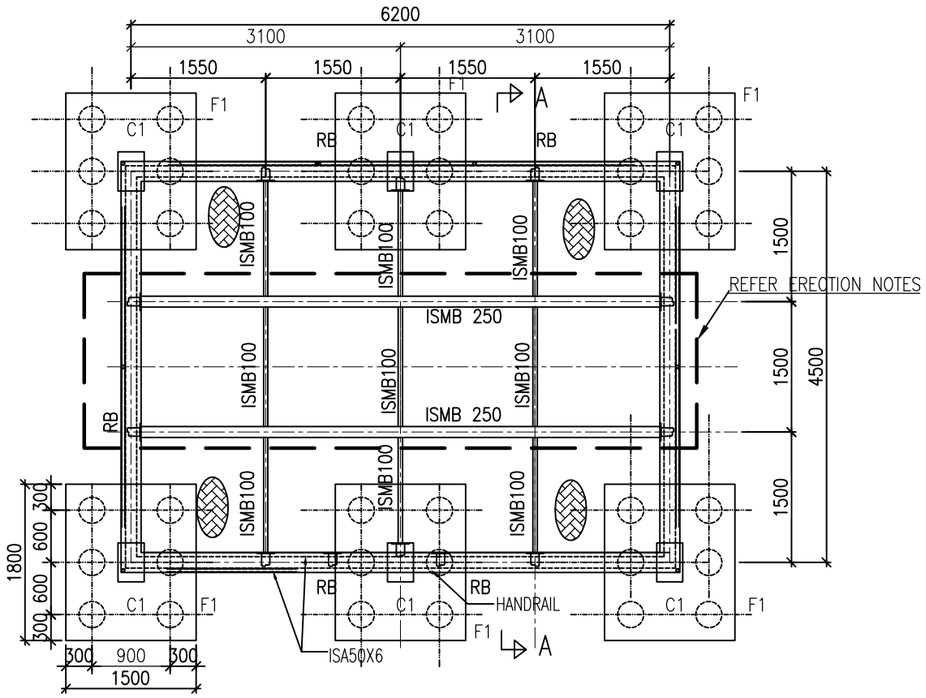
100MW GSECL SPV PROJECT AT RAGHANESDA GUJARAT (PHASE-2)

BHARAT HEAVY ELECTRICALS LTD ELECTRONICS DIVISION, BANGALORE

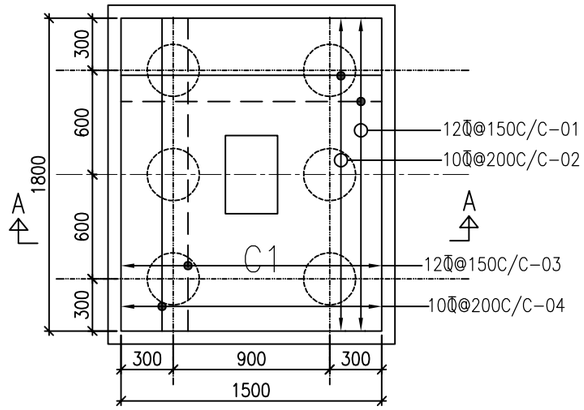
TITLE

PCU PLATFORM – GA AND RCC DETAILS OF PLATFORM

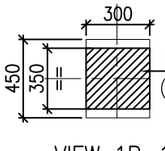
SCALE 1:75 | DRAWING NO. BHEL-GSECL-R2-PCU-PLTFRM-008 | SHEET 1 OF 3 | REV. 02



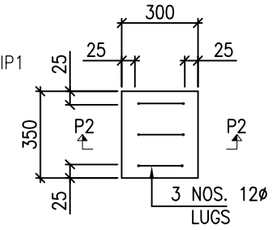
PLATFORM FOR BATTERY, ACDB, AUX.TRANS & SCADA AT TOP EL(+)1.40M LVL. R2



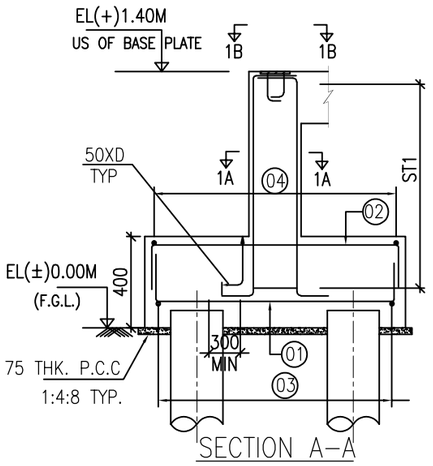
DETAIL OF PILE CAP MKD. PC1



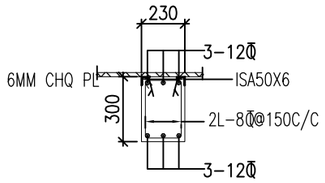
VIEW 1B–1B



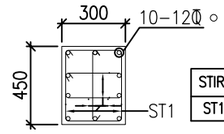
DETAIL OF INSERT PLATE
MKD. IP/IP1 (350x300x12THK.)



SECTION A–A

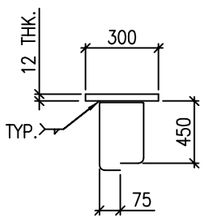


BEAM MKD RB(230X300)



STIRRUPS SCHEDULE
ST1 =8Ø@100C/C

SECTION 1A–1A
COLUMN MKD C1



SECTION P2–P2

NOTES:–

1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES.
2. FIGURED DIMENSIONS ONLY SHALL BE FOLLOWED.
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCH./MECH DWG.
4. ALL R.C.C. SHALL BE MIX M–25
5. ALL REINFORCEMENT SHALL BE IN FORM OF H.Y.S.D. STEEL BARS OF GRADE Fe 415 CRS CONFORMING TO IS:1786–1985.
6. CLEAR COVER TO REINF. INCLUDING LINKS FOR R.C.C MEMBERS SHALL BE AS UNDER:– COLUMN= 40mm,PILE CAP/PILE= 75mm BEAM= 25mm.
7. STANDARD 'L' HOOKS SHALL BE PROVIDED AT THE ENDS OF ALL BARS.
8. PROVIDED LAP LENTH/DEVELOPMENT LENGTH 'L_d' FOR BOTH COMPRESSION AND TENSION MAIN R/F BAR SHALL BE=50XDIA OF BAR
9. LAPS SHALL BE STAGGERED AND AVOIDED AT THE SECTIONS OF MAX. BENDING MOMENT
10. NET SAFE BEARING CAPACITY HAS BEEN TAKEN AS 8.9 T /SQM AT 2m DEPTH.
11. BOTTOM BAR INDICATES :– — — —
12. TOP BAR INDICATES :– ———
13. PREFABRICATED ALUMINIUM LADDER WILL BE FIXED SUIT TO SITE.

REFERENCE DWG. NO:–

1. FOR LOCATION REFER: PLOT PLAN FOR GSECL RAGHANESDA (PHASE 2) DWG. NO:– BHEL–GSECL–R2–CIV–PLOT_PLAN–003 (LATEST REV)
2. ELECTRICAL INPUT DRG.BHEL–GSECL–R2–ELEC–GTP–INV–019

ERECTION NOTES:

ISMC 100 NEED TO BE SUPPLIED IN EXCESS (APPROX 12 M LENGTH) FOR CUTTING & WELDING AT SITE FOR SUPPORTING ELECTRICAL COMPONENTS IN MIDDLE BAY.

LEGEND:

F.G.L. – FINISHED GROUND LEVEL
F.F.L. – FINISHED FLOOR LEVEL
T.O.C. – TOP OF CONCRETE
THK. – THICKNESS
TYP. – TYPICAL
U.N.O. – UNLESS NOTED OTHERWISE
℄ – CENTER LINE
B.O.B. – BOTTOM OF BEAM
T.O.B. – TOP OF BEAM
A.L.T. – ALTERNATE

REV	DATE	DRN	CHD	VER	REV	DATE	DRN	CHD	VER
01	17.03.21	TC	PK	BS	00	08.03.21	TC	PK	BS
REVISED AS PER CUSTOMER COMMENT					SUBMITTED FOR APPROVAL				

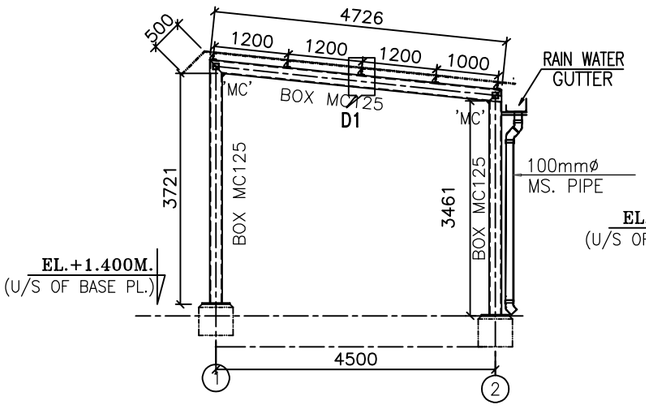
DEPT. SC&PV
STATUS CONTRACT
DISTRIBUTION

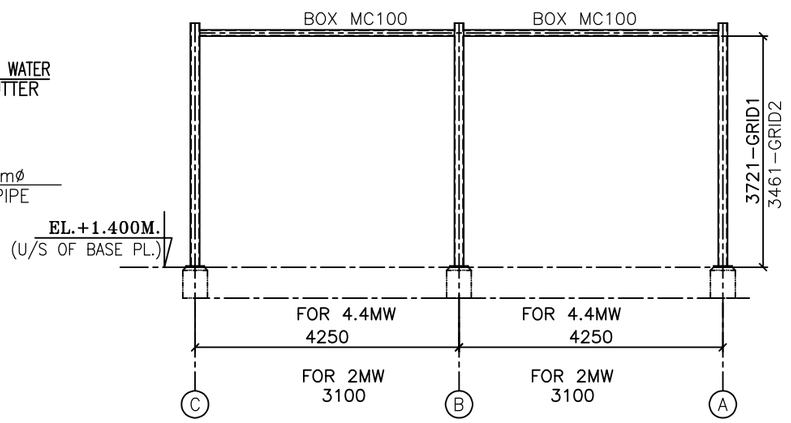
100MW GSECL SPV PROJECT AT RAGHANESDA GUJARAT (PHASE–2)

BHARAT HEAVY ELECTRICALS LTD ELECTRONICS DIVISION, BANGALORE

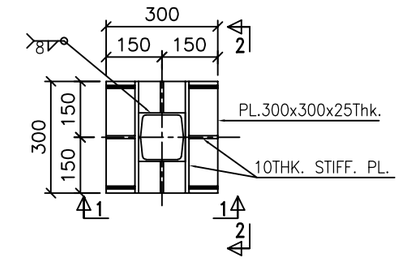
TITLE
PCU PLATFORM – GA AND RCC DETAILS OF PLATFORM

SCALE 1: 75 | DRAWING NO. BHEL–GSECL–R2–PCU–PLTFRM–008
SHEET 2 OF 3 | REV. 02





ELEVATION ALONG GRID 1&2

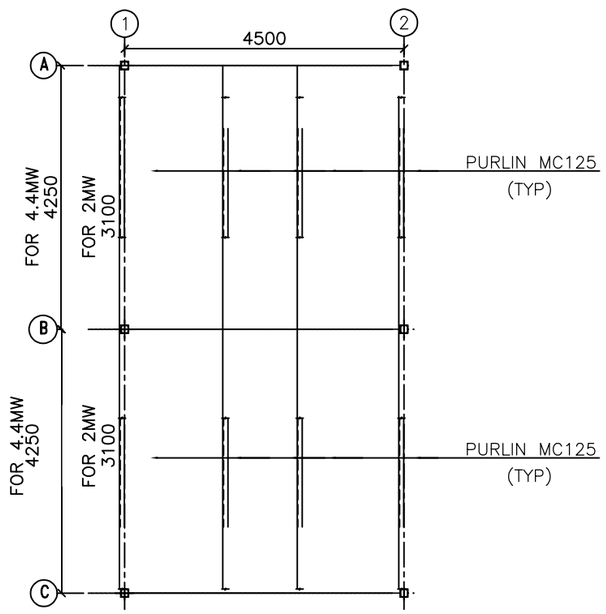


DETAIL OF BASE PLATE

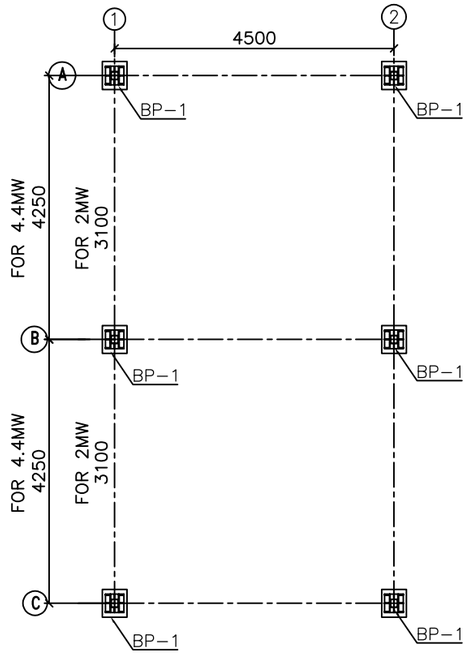
(BP-1)

1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES UNLESS NOTED OTHERWISE
2) THIS DRAWING IS NOT BE SCALED,ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3) ALL FILLET WELDS ARE 6mm FILLET WELDS U.N.O.
4) ALL BUTT WELDS SHALL BE PROVIDED WITH A SEALING RUN
5) ALL GUSSET PLATES SHALL BE 8mm THK U.N.O.
6) ALL INCLINED MEMBERS AND GUSSET PLATES ARE TO BE CHECKED BY FULL SHOP LAYOUT
7) ALL ERECTION HOLES ARE 18ø FOR 16ø ERECTION BOLTS(U.N.O.)
8) ALL PERMANENT HOLES ARE 22ø FOR 20ø PERMANENT BOLTS(U.N.O.)UNLESS OTHERWISE SPECIFIED
9) ALL CONTACT SURFACES OF GUSSET PLATES HAVING ERECTION BOLTS SHALL BE WELDED AFTER ERECTION AND ALIGNMENT.

ELEVATION ALONG GRID A,B&C

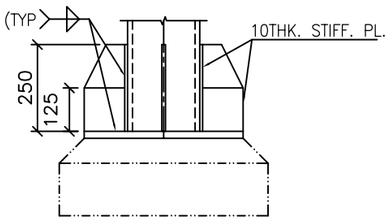


PLAN AT RAFTER LEVEL

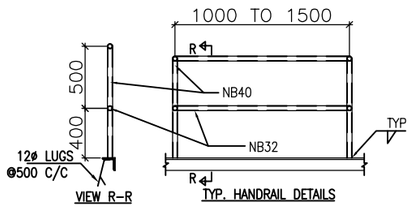


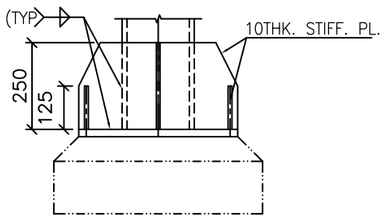
PLAN AT BASE PLATE LEVEL

* 'MC' – MOMENT CONNECTION

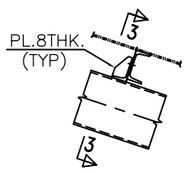


SECTION 1-1

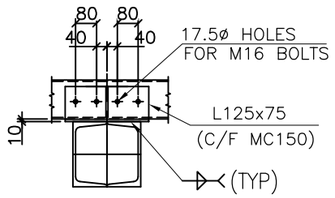




SECTION 2-2



DETAIL D1



SECTION 3-3

NOTES:-
STRUCTURAL STEEL SHALL BE PAINTED AS PER SPECIFICATION

REV.	DATE	DRN	CHD	APPD
01	18-03-21	TC	PK	BS
REVISED AS PER CUSTOMER COMMENTS				

REV.	DATE	DRN	CHD	APPD
0	08-03-21	TC	PK	BS
ISSUED FOR APPROVAL				

DEPT.	SC&PV
STATUS	CONTRACT
DISTRIBUTION	

100MW GSECL SPV PROJECT AT RAGHANESDA GUJARAT (PHASE-2)

BHARAT HEAVY ELECTRICALS LTD ELECTRONICS DIVISION, BANGALORE

TITLE

2MW&4.4MW PCU PLATFORM- GA AND DETAILS OF PLATFORM SHED

SCALE 1:75	DRAWING NO. BHEL-GSECL-R2-PCU-PLTFRM-008
	SHEET 3 OF 3 REV. 01