TECHNICAL QUALIFICATION REQUIREMENT

Name of Project: **Vishnugad Pipalkoti Hydro Electric Project (4X111MW)**

Name of Customer: **THDC India Limited, Rishikesh, Uttarakhand**

Name of Item: **390kV Surge Arrester and its accessories (400kV class)**

TECHNICAL QUALIFICATION REQUIREMENT
The bidder must have manufactured and supplied least 6 nos. 400kV class Surge Arrester (polymer/ porcelain) in any one year in last 10 years, which are in satisfactory operation for at least two (2) years as on the original scheduled date of technical bid opening of this tender.

SUPPORTING DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH TECHNICAL BID		
Sr	**Required Criteria**	**Supporting Documents**
1	Manufacturing	Approved Drawings / GTP / Approved Quality Plan / Factory Inspection Test Report etc. stabilising bidder as manufacturer of offered item in line with TQR
2	Supply	PO / Dispatch clearance / LR / Material Receipt certificate at site / installation or commissioning certificate etc. stabilising bidder as proven supplier of offered item in line with TQR
3	Successful operation	Successful operation means certificate issued by employer/end-customer or main contractor (along with chain of document from employer/end-customer) stating successful operation without any adverse remark.

NOTES:

1. Bidder to please note that the submitted bid shall be liable to rejection in the absence of submission of valid Technical TQR documents along with technical bid.
2. Consideration of offer shall be subject to customer's approval of bidder's, if applicable.
3. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.
4. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.
5. After satisfactory fulfilment of all the above criteria / requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

PREPARED BY	REVIEWED BY	APPROVED BY
देवनाथ पारते	6/12/22.	

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-382-316-002	REV 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	BY	DKS	VK
Title: **390kV Surge Arrester & its accessories (For 400kV class)** *(Suitable for an altitude of approx. 1101 from Mean Sea Level (MSL))*		SIGN			
		DATE	16.12.22	16.12.22	16.12.22
		GROUP	TBEM		
		WO No.	84008A		

CUSTOMER	THDC India Limited, Rishikesh, Uttarakhand
PROJECT	Vishnugad Pipalkoti Hydro Electric Project (4X111MW)

Contents

Remarks: Bidder to note that data and details of Annexure-D (Guaranteed Technical Particulars) shall not be reviewed during technical evaluation/ scrutiny, hence compliance of guaranteed technical particulars in line with technical specification shall be bidder's responsibility.

Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

CHECKLIST FOR TECHNICAL EVALUATION

Along with the technical offer/ bids, the bidder should submit this checklist confirming the inclusion of the enclosures as listed below,

Sl. No.	Documents to be enclosed	Bidder to confirm (Please tick "Confirmed")
1.	Supporting documents for compliance of Technical Qualifying Requirement.	Confirmed
2.	Unpriced BOQ duly mentioning "Quoted" for all the items, signed and sealed.	Confirmed
3.	Annexure- A duly signed and sealed & Annexure- B duly filled, signed and sealed.	Confirmed

Note: Any bidder not meeting the above requirement shall be liable for non-evaluation. The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Project: Vishnugad Pipalkoti Hydro Electric Project (4X111MW)

Date: Bidder's Stamp & Signature

Contents

SECTION 1:
SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. Scope

This technical specification covers the requirements of design, manufacture, inspection including third party inspection and testing at manufacturer's work before supply, proper packing and delivery to project of equipment **(390kV Surge Arrester & its accessories)** complete with all fittings, accessories, mandatory spares of the equipment complete in all respects for efficient & trouble-free working mentioned under this specification.

This section covers the specific technical requirements of equipment. This constitutes minimum technical parameters for the above item as specified by the BHEL/ THDCIL. The offered equipment Insulated Switchgear shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies/ Service
Section-3	:	Project Details & General Technical Requirements (For all equipment under the Project)
Section-4	:	Annexures Annexure-A: Compliance Certificate to Technical Specification Annexure-B: Deviation/ Change Request to Technical Specification Annexure-C: Guaranteed Technical Particulars Annexure D: Technical Checklist

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed. BHEL/ THDCIL concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations
   In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,
   - o Indian Electricity Act
   - o CEA regulations
   - o The Factory Act
   - o Requirements of other statutory bodies as applicable, e.g. CEA etc.
2. Section-1
3. Section-2
4. Section-3
5. Codes & Standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer and also furnish the basis that is considered for submitting technical offer. BHEL/ THDCIL will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/ THDCIL of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ THDCIL decision on interpretation shall be considered final if need arises during the execution. No additional cost

or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (Annexure-A), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-B), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment is required for the following project:

Name of the Customer	:	**THDC India Limited, Rishikesh, Uttarakhand**
Name of Main Contractor	:	**Bharat Heavy Electricals Limited**
Name of the Project	:	**Vishnugad Pipalkoti Hydro Electric project (4X111MW)**

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the notice inviting tender/ enquiry.

2. Codes & Standards

1. The rating as well as performance and testing of the equipment shall comply with the latest editions and amendments of the following standards as applicable, unless otherwise specified elsewhere in this specification,
   IEC 60099-4 Metal oxide Surge Arresters without Gaps for AC Systems
   IS 5: Colors for ready mixed paints and enamels
   IS: 3070 (Part-III) Specification for Lightning Arrestors for alternating current system
   IS: 2629 Recommended practice for hot dip galvanising of iron and steel.
   IS: 2633 Method for testing uniformity of coating on zinc coated articles.
   IS:5621 Specification for large hollow porcelain for use in electrical installation.
   IS:2147 Degree of protection provided by enclosures for low voltage switchgear and control.
2. For the purpose of this specification all technical terms used hereinafter shall have the meaning as per IEC/ ISS specification.
3. The equipment meeting with the requirements of other authoritative standards, which ensure equal or better quality than the standards mentioned above shall also be acceptable. Where the equipment offered by the bidder confirms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the offer.
4. In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.
5. The equipment shall also conform to the provisions of Indian Electricity Rules, 1956 and other statutory regulations currently in force in the country.
6. In case Indian standards are not available for any equipment, standards issued by IEC/ BS/ VDE/ IEEE/ NEMA or equivalent agency shall be applicable.

3. Specific Technical Requirements

1. The equipment **(390kV Surge Arrester with its Accessories**) shall perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of

installation.

2. Equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc. for the equipment.
3. The equipment shall also comply to facilitate erection of equipment, all items to be assembled at site shall be "match marked".
4. **The equipment shall be installed at the altitude of +1101 approx. and hence, bidder shall submit detailed calculation of altitude correction factor for equipment and changes being done in design as per applicable IS/ IEC. It may please be noted that altitude correction factor may result in increased technical requirement of system parameters (basic impulse level, power frequency withstand voltage and switching impulse withstand voltage etc.) and minimum clearances (phase to phase, phase to earth, min. distance of the lowest earth part of insulators supporting live conductor from top of plinth level and section clearance etc.), applicable.**
5. In addition to this, the other specific technical requirements for the equipment shall be as follows,

390kV Surge Arrester (400kV class)		
Sl. No.	Description	Technical Requirements
1	Rated arrester voltage	390kVrms
2	Type/ class of surge arrester	Station type, heavy duty, outdoor, metal-oxide, non-linear, gapless
3	(i) Nominal discharge current	20kAp of 8/20 micro second wave
	(ii) Discharge current at which insulation coordination will be done	20kAp of 8/20 micro second wave
4	Minimum discharge capability	10kJ/kV referred to rated arrester voltage or as decided in operating duty test
5	Continuous operating voltage at 50 deg C	303kVrms
6	(i) Maximum switching surge protective level	780kVp
	(ii) Maximum residual voltage (discharge voltage) at 10kA (8/20 microsecond current wave)	900kVp@10kA 975kVp@20kA
	(iii) Maximum equivalent front of wave protective level (20kA with voltage wave cresting in 1 microsecond)	1050kVp@20kA
7	Impulse withstand voltage of equipment to be protected viz. outdoor equipment, XLPE cables & GIS equipment	

	(i) Lightning Impulse	±1425kVpeak
	(ii) Switching Surge Withstand	±1050KVpeak
	(iii) One minute power frequency withstand voltage of arrestor housing	630kVrms
8	Radio interference voltage at 266kVrms	Not exceeding 2500 microvolts
9	Partial discharge level at 1.1Un/√3	5 or less pico coulombs
10	Corona extinction voltage	320kVrms
11	Energy level	10kJ/kV
12	Long duration discharge class	Class 4 as per IS-3070 (Part-I)
13	Minimum creepage distance	10500mm
14	Prospective symmetrical fault current for pressure relief test	40kArms
15	Pressure relief class	As per IS-3070 (Part I)
16	Minimum cantilever strength of insulator	150kg
17	Rated frequency	50Hz
18	Number of poles	1
19	System neutral earthing	Effectively earthed
20	Altitude and Installation	+1101 approx. and outdoor

6. The equipment shall include supply of interconnecting cables, terminal boxes, etc., the above supply voltages may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.
   a. 415V±10%, 3 phase, 4 wire, 50 Hz, neutral grounded AC supply.
   b. AC control and protective devices, 240V±10%, single phase, 2 wire, 50 HZ, lighting fixtures, space heaters neutral grounded AC supply.
   c. DC alarm, control and protective devices 220V, DC 2-wire
   d. The above supply voltages may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.
      AC supply - Voltage±10% & Frequency ± 5%
      DC supply - Voltage±10%
7. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc. for the equipment.

4. General Technical Requirements

The general technical requirements for the equipment shall be as follows,

1. Terminal Connector shall be suitable for Universal Take Off i.e. suitable for horizontal as well as vertical entry. The exact conductor details shall be intimated during Detailed Engineering.

2. Insulated copper rod/ strip between Lightning Arrestor and Surge monitor shall be supplied in single length for all Surge Arresters including Main and Spare items (i.e. considering individual length of (min.) 6.0m for 390kV and cross sectional area of 70sqmm.
3. Surge counter/ monitor shall have potential free contacts.
4. Fixing Hardware shall include hardware for inter unit connector for Surge Arrester, Surge Arrester to Mounting Structure (Structure in BHEL scope), Surge Monitor to Structure and Earthing Hardware etc. including base insulators for installation of surge arrester and surge monitors.
5. Other standard fittings and accessories, which are not specifically mentioned but are usually provided with Surge Arrester of type and rating being offered for efficient and trouble free operation.
6. Each Surge Monitor shall have terminals of robust construction for connection to earthing lead and these shall be suitably arranged so as to enable the incoming and outgoing connections to be made with minimum bends.
7. The bidder must fill up all the details required for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.

5. Bill of Quantities

1. Quantities for the equipment shall be as per **Annexure- 390kV Surge Arrester & its accessories**. However, any item not appearing herein but required for completeness of the work and mentioned elsewhere is deemed to be included in bidder's scope.
2. The quantities in BOQ may vary up to ±30% in line with quantity variation clause. However, individual quantities may be deleted or vary up to any extent.

8. Drawings / Documents required for Technical Clearance for Manufacturing

The engineering drawings/ documents, shall be used for providing technical clearance for manufacturing of the equipment, which shall be used for delay analysis, if applicable, by TBMM.

1	**390kV Surge Arrester** - Drawings & Guaranteed Technical Particulars
2	**390kV Surge Arrester**- Type Test Reports
3	**390kV Surge Arrester**- Quality Assurance Plan

Date of Submission of drawings/ documents shall be counted only from the date of submission of reasonably correct drawings/ documents. In case drawing/ document are not duly stamped in category-1/ category-2 by customer, BHEL stamp/ confirmation shall be treated final to proceed further.

The technical clearance for manufacturing shall be provided to TBMM department after completion of engineering approval.

The successful bidder shall have to extend all possible supports like timely submission/ re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer/ THDCIL approval.

6. Type Testing

Bidder shall ensure that the equipment being procured shall be of proven design and should have valid type test certificates as per specified in IS/ IEC standards (amended up to date) at any NABL accredited laboratories.

The validity of type test reports shall be as per the latest CEA guidelines for the validity period of type test(s) conducted on major electrical equipment in Power Transmission system.

In case any of Type tests have not been conducted on the offered design or there has been a change in the design due to high altitude requirement/ any other technical issue after the type tests. The requisite tests shall be conducted by bidder on the offered design without any extra cost and delivery impact to BHEL/ Customer.

Bidder shall provide following type tests, but not limited to,

1. Insulation withstand tests
2. Residual voltage tests
3. Long duration current impulse withstand test
4. Operating duty tests
5. Pressure relief test
6. Test of arrestor dis-connectors
7. Artificial pollution test
8. Partial discharge test
9. Seal leakage test
10. Current distribution test for multi-column arrestor

7. Quality Plan

The successful bidder shall submit Quality Assurance Plan with in-process inspection methods, tests, records, etc. for BHEL/ Customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ THDCIL. In case bidder has reference Quality Assurance Plan agreed with BHEL/ THDCIL same shall be submitted for specific project to BHEL/ THDCIL approval. There shall be no commercial implication to BHEL/ Customer on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment. All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment shall be deemed to be included in bidder's scope.

8. Inspection & Testing

1. Equipment shall be subject to inspection by BHEL/THDCIL or authorized representative at bidder/ manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ THDCIL.
2. Routine and acceptance tests as listed in relevant standard and section-2, technical specifications shall be complied.
3. Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ THDCIL approval in line with specific requirements mentioned in section-2, technical specification.

9. Makes of Equipment/ Components

1. The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
2. Bidder while ordering shall ensure the availability of spare parts and maintenance support services for the equipment at least for 10 years from the date of supply.
3. Bidder shall give a notice of at least one year to the BHEL/ THDCIL before phasing out the products/ spares to enable the owner for placement of order for spares and services.
4. The equipment offered by the bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which are necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment/ accessories shall be supplied without any extra cost. In addition to this, all similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.
5. Specific reference in this specification and documents to any material by trade name, make or catalogue number shall be construed as establishing quality and performance requirements.

10. Packing and Dispatch

1. The equipment shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates/ cases to prevent damage to the finish. Crates/ cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.
2. The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, Packing shall be suitable for long storage (minimum 1 year).

11. Exceptions

Followings are not in bidder's scope of supply (BHEL supplied items)

a. Equipment support structure

12. Definitions Used

The following expressions hereunder and elsewhere in the technical specification used and their

grammatical variations shall unless repugnant to the subject or context thereof, have the following meanings hereunder respectively assigned to them, namely:

1. Bid/ Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.
2. Contract: The totality of agreement between Customer/ Purchaser/ Owner and the Contractor/ BHEL as derived from the contract documents.
3. Contractor: The bidder selected by the Customer/ Purchaser/ Owner for the performance of the work and supply of materials. In this case, it is BHEL.
4. Customer/ Purchaser/ Owner: THDC India Limited
5. Consultant: Any person(s)/ Firm nominated/ assigned by the Customer/ Purchaser/ Owner for providing the engineering consultant services.
6. Bidder/ vendor/ OEM: The bidder selected for this intended work shall be known as vendor/ OEM.

13. Abbreviations Used

The following terminology/ acronym hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following full form hereunder respectively assigned to them, namely,

AC:	Alternating Current
DC:	Direct Current
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
BOQ:	Bill of Quantities
QAP:	Quality Assurance Plan
NIT:	Notice Inviting Tender
OEM:	Original Equipment Manufacturer
BHEL:	Bharat Heavy Electricals Limited
BIS:	Bureau of Indian Standards
BS:	British Standard
ANSI:	American National Standards Institute
ASTM:	American Society for Testing and Materials
IS:	Indian Standards
IEC:	International Electro Technical Commission
IEEE:	Institute of Electrical & Electronics Engineers
CEA:	Central Electricity Authority
NEMA:	National Electrical Manufacturers Association

14. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Annexure- BOQ for 390kV surge arrester and its accessories
2. TB-3-382-316-002: Layout Plan & Section Drawing for Pothead Yard

Annexure- BOQ of 390kV Surge Arrester & its accessories Rev No. 00			
Sl. No.	**Item Description**	**Unit**	**Qty.**
	Supply Item- Main Items		
1	Supply- Surge Arrester: 390kV, 20kA nominal discharge, class-4, 25mm/kV creepage, single phase, gapless (ZNO), Surge Arrester complete with all accessories such as Insulating Base, surge counter/ monitor, corona ring/ grading ring (if required), insulated copper rod/ strip, terminal pad, lugs and fixing/ earthing hardware etc. except terminal connector & connecting cable (Pressure relief class: 40kA).	No	6
2	Supply- Surge Arrester: Terminal connectors for single phase, 390kV surge arrester suitable for Twin ACSR Moose Conductor	No	6
3	Supply- Surge Arrester: Insulating cable/ strip for connetion between surge arrester and surge counter/ monitor etc.	Mtrs	36

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-316-002

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

जाँची गई/CHECKED

अनिल रघुवंशी / Anil Raghuvanshi
वरि. प्रबन्धक (विद्युत परिकल्प)
Sr. Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC India Limited, Rishikesh

16.09.22

1. SCHEDULE OF EQUIPMENT FOR POTHEAD YARD)

ITEM CODE	DESCRIPTION	SYMBOLS	UNITS	QUANTITY
1.	400kV, 2000A, 3-PHASE, 40 kA FOR 1 Sec. HDB ISOLATOR (ELECTRICALLY GANGED MOTOR OPERATED) WITH TWO E/S (MECHANICALLY GANGED MOTOR OPERATED)		Sets	2
2.	400kV, 2000A, 40kA FOR 1 Sec. 1-PHASE, 5 CORE CURRENT TRANSFORMER		Nos.	6
3	400kV, 4400 pF, $\frac{400}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} / \frac{0.110}{\sqrt{3}} / \frac{0.110kV}{\sqrt{3}}$ 1-PHASE , 3 CORE CAPACITOR VOLTAGE TRANSFORMER		Nos.	6
4	390kV, 1-PHASE SURGE ARRESTORS, 20kA, Class-4		Nos.	6
5	400kV, 2000A, 1mH, 40 KA FOR 1 SEC. 1-PHASE WAVE TRAP (PEDESTAL TYPE)		Nos.	4
6	400kV, 40 KA FOR 1 SEC. 1-PHASE, OUTDOOR CABLE SEALING END		Nos.	7
7	400kV, BUS POST INSULATOR		Nos.	2

4. EQUIPMENT CONNECTION SCHEDULE

SL.NO.	DESCRIPTION	DESCRIPTION
1.	EQUIPMENT INTERCONNECTION	TWIN MOOSE ACSR
2.	JUMPER/ DROPPERS	TWIN MOOSE ACSR
3.	EARTH WIRE	7/3.66 (7/9 SWG) GS (10.98mm DIA)

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. INSULATOR DATA
   A. 400KV SINGLE SUSPENSION STRING (SINGLE ANCHORING POINT) = 23 NOS. ANTI FOG TYPE DISC.
   B. ELECTRC-MECHANICAL FAILING LOAD PER DISC = 160 kN
   C. CREEPAGE DISTANCE OF INDIVIDUAL DISC = 470MM
3. ALL POTHEAD YARD EQUIPMENTS ARE PROTECTED FROM 7/3.66 GALVANISED STEEL WIRE.
4. SUPPLY AND STRINGING OF 400kV OUTGOING LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN DEAD END TOWER AND POTHEAD YAED TERMINAL GANTRY ARE NOT IN BHEL SCOPE. HOWEVER, JUMPERING FOR THE RESPECTIVE EQUIPMENT SHIELDING REQUIREMENT FOR PROTECTION OF LIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
5. ALL SWITCHYARD EQUIPMENTS & TOWER STRUCTURE SHALL BE LATTICE TYPE.
6. SEPARATE DRAWING SHALL BE REFERRED FOR ERECTION KEY DIAGRAM, TRENCH LAYOUT FOR LT & 400kV CABLE, EARTHMAT LAYOUT, TOWER/ BEAM, ILLUMINATION SYSTEM, FENCE & GATE ETC.
7. STATIC TENSION ON THE BUSES AND SHIELD WIRE SHALL BE SHOWN IN THE STRUCTURE LOADING DIAGRAM TO BE SUBMITTED SEPARATELY.
8. LOCATION OF DEAD END TRANSMISSION LINE TOWER OF OUTGOING LINE SHALL BE FINALISED BY CUSTOMER & INFORMED TO BHEL.
9. WAVE TRAP SHALL BE PROVIDED IN TWO PHASES AS PER PLCC REQUIREMENTS.
10. SURGE ARRESTOR PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS ANY EQUIPMENT.
11. COMPLETE GROUNDING WORK LIKE INSTALLATION AND SUPPLY SHALL BE IN BHEL SCOPE.
12. CIVIL WORK OF POTHEADYARD, GIS AND CABLE TUNNEL SHALL BE IN CUSTOMER SCOPE, HOWEVER, ONLY DESIGN OF POTHEADYARD SHALL BE IN BHEL SCOPE.
13. ILLUMINATION OF POTHEADYARD SHALL BE IN BHEL PEM NOIDA SCOPE.
14. DG SET AND SWITCHGEAR SHALL BE IN BHEL BHOPAL SCOPE.
15. AIR CONDITIONING & VENTILATION SYSTEM SHALL BE IN BHEL PSNR NOIDA SCOPE.
16. FIRE FIGHTING SHALL BE IN PE&SD BHEL HYDRABAD SCOPE.
17. 400KV XLPE CABLE SHALL BE IN BHEL TBG NOIDA SCOPE.
18. 400KV SPARE CABLE AT POTHEAD YARD END SHALL BE PERMANENTLY CONNECTED WITH OUTDOOR CABLE SEALING END.

JUMPERING ARRANGEMENT AT 400KV CABLE SEALING END AND 400KV CT IN POTHEAD YARD

1. THE OVER HEAD ELECTRCIAL CONNECTION BETWEEN THE CSE(CABLE SEALING END) AND 400KV CTs SHALL BE AS SHOWN BY SOLID LINES. ———
2. HOWEVER IN CASE OF THE 400KV CABLE FAILURE THE HEALTHY CABLE SHALL BE CONNECTED IN SWYD AS SHOWN BY DOTTED LINE. — — —
3. ACCORDINGLY THE CABLE ADAPTER AT THE GIS END SHALL BE SWAPPED TO MAINTAIN THE PHASE SEQUENCE

RECOMMENDED
संस्तुत
शैलेन्द्र सिंह पंवार
Shailendra Singh Panwar
उपमहाप्रबंधक (विद्युत यांत्रिक-परिकल्प)
Dy. General Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC INDIA LTD., RISHIKESH

2. SYSTEM PARAMETERS

SL.NO.	DESCRIPTION	UNIT	AT EL:1000	AT EL:1101.10
1.	NOMINAL SYSTEM VOLTAGE	kV	400	400
2.	HIGHEST SYSTEM VOLTAGE	kV	As per IS/IEC	
3.	BASIC IMPULSE LEVEL	kVP	1425	1443
4.	POWER FREQUENCY WITHSTAND	kVrms	630	638
5.	SWITCHING IMPULSE WITHSTAND VOLTAGE	kVpeak	1050	1060
6.	CREEPAGE DISTANCE (MINIMUM)	mm/kV	25	25
7.	SYSTEM FAULT LEVEL (FOR 1 SEC)	kA	40	40

4. MINIMUM CLEARANCE TABLE (IN AIR)

3. CLEARANCE TABLE IN AIR (MIN.)

SL.NO.	DESCRIPTION	UNIT	AT EL:1000	AT EL:1101.10
1.	PHASE TO PHASE	mm	4200	4254
2.	PHASE TO EARTH	mm	3500	3545
3.	MINIMUM DISTANCE OF THE LOWEST EARTH PART OF INSULATOR SUPPORTING LIVE CONDUCTORS FROM TOP OF PLINTH LEVEL	mm	2550	2550
4.	SECTION CLEARANCE	mm	6500	6583
5.	HEIGHT OF COND. CENTER LINE OF FIRST LEVEL FROM FFL OF PLATFORM	mm	8300	8300

APPROVED
अनुमोदित
16.09.2022
नीरज वर्मा / Neeraj Verma
महाप्रबन्धक (विद्युत परिकल्प)
General Manager (EM-Design)
टीएचडीसी इंडिया लिमिटेड, ऋषिकेश
THDC India Limited, Rishikesh

REFERENCE

REV.	DATE	ALTERED / CHECKED / APPROVED		REV.	DATE	ALTERED / CHECKED / APPROVED		REV.	DATE	ALTERED / CHECKED / APPROVED		REV.	DATE	ALTERED / CHECKED / APPROVED	
09	16.09.22	ALTERED SY / CHECKED DKS / APPROVED VK	-SD-	08	20.07.22	ALTERED SY / CHECKED DKS / APPROVED VK	-SD-	07		ALTERED VYOM / CHECKED JAI KUMAR / APPROVED VK	-SD-	06		ALTERED VYOM / CHECKED JAI KUMAR / APPROVED VK	-SD-
ZONE	AS PER CUSTOMER COMMENTS DATED 05.08.22			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED xxxxx			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED xxxxx.04.2022		
REV.	DATE	ALTERED / CHECKED / APPROVED		REV.	DATE	ALTERED PK / CHECKED SK/SKS / APPROVED AG		REV.	DATE	ALTERED PK / CHECKED SK/DM / APPROVED AG	-SD-	REV.	DATE	ALTERED DM / CHECKED SK / APPROVED RS/DM	-SD-
		ALTERED / CHECKED SK/SKS / APPROVED		04	06.06.19			03	01.01.19			02	09.11.17		
ZONE	THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE. THDC/RKSH/EMD/VPHEP/401-6/2855			ZONE	AS PER MOM DATED 20.05.19			ZONE	AS PER CUSTOMER CUMMENT DATED 05.12.17			ZONE	AS PER CUSTOMER E-MAIL DATED 03.11.17		
REV.	DATE	ALTERED / CHECKED / APPROVED										REV.	01	DATE 19.01.17 ALTERED DM / CHECKED SK / APPROVED RS/AS	-SD-
												ZONE	AS PER CUSTOMER LETTER DATED 07.11.16		

ADDITIONAL INFORMATION
W.O.No.
STATUS OF DRAWING
DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम NAME OF CUSTOMER/PROJECT: THDC INDIA LTD. — 4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

BHEL भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	PK	-SD-	07.10.16
जाँचा CHECKED	SK	-SD-	
स्वीकृत APPROVED	AS	-SD-	

विभाग DEPT. TBEM | कोड CODE 422 | अनुपात / SCALE | कार्ड कोड CARD CODE

शीर्षक/TITLE: LAYOUT PLAN & ELEVATION OF 400KV POTHEAD YARD

ड्राइंग क्र./DRAWING NO. TB-3-382-316-002 | पुन:/REV. 09

पृष्ठ क्र./SHEET No. 01 | अगला पृष्ठ/NEXT SHEET 02

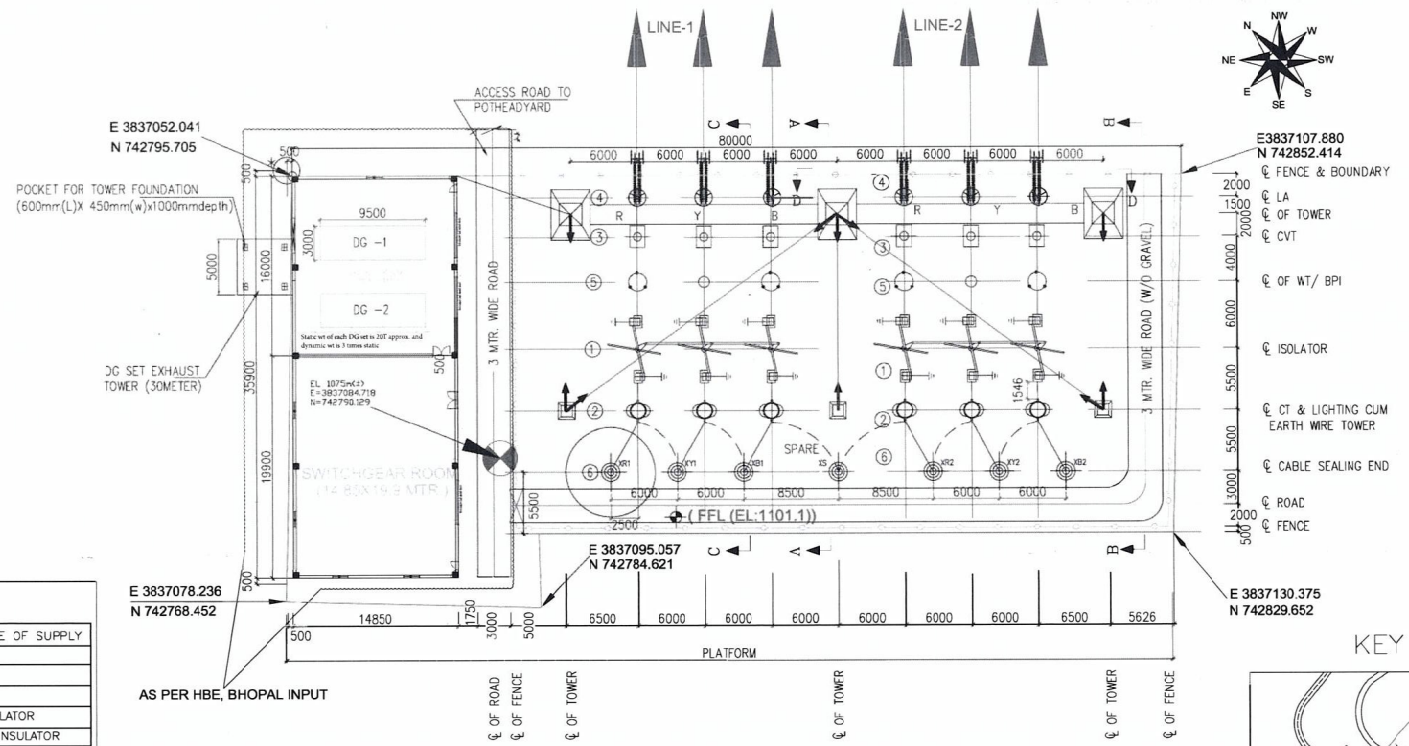
COMPUTER DRG. PATH NAME :
REF. DRG. No.
SIGN. & DATE
INVENTORY No.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-316-002

COMPUTER DRG. PATH NAME :

INVENTORY No. | REF. DRG. No. | SIGN. & DATE

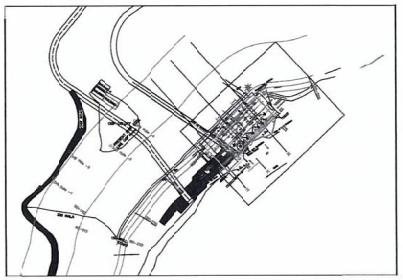


PLAN

LEGEND TABLE

	PRESENT BHEL SCOPE OF SUPPLY
	CUSTOMER SCOPE
	SHIELD WIRE
	FENCE
	TENSION STRING INSULATOR
	SUSPENSION STRING INSULATOR
	LIGHTING CUM EARTH WIRE TOWER
	TOWER WITH PEAK
	CONDUCTOR
	GATE
	PLATFORM AREA
FFL	FINISHED FLOOR LEVEL OF PLATFORM

KEY PLAN



Ref. Drawings:

1. Key Plan– 5061149–C1001_[7]
   VPHEP Pothecd yard Location
2. For Input details for DG set room Please refer BHEL,Bhopal mail Dtd.22.07.2022

16.9.22

REV.	DATE			REV.	DATE			REV.	DATE			REV.	DATE		
09	16.09.22	ALTERED	SY –SD–	08	20.07.22	ALTERED	SY –SD–	07		ALTERED	VYOM –SD–	06		ALTERED	VYOM –SD–
		CHECKED	DKS –SD–			CHECKED	DKS –SD–			CHECKED	JAI KUMAR –SD–			CHECKED	JAI KUMAR –SD–
		APPROVED	VK –SD–			APPROVED	VK –SD–			APPROVED	VK –SD–			APPROVED	VK –SD–
ZONE	AS PER CUSTOMER COMMENTS DATED 05.08.22			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER COMMENTS		

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05	06.11.19	ALTERED	PK	04	06.06.19	ALTERED	PK	03	01.01.19	ALTERED	PK –SD–	02	09.11.17	ALTERED	DM –SD–
		CHECKED	SK/SKS			CHECKED	SK/SKS			CHECKED	SK/DM –SD–			CHECKED	SK –SD–
		APPROVED	AG			APPROVED	AG			APPROVED	AG –SD–			APPROVED	RS/DM –SD–
ZONE	THE LAYOUT IS REVISED TO NCLUDE THE DETAILS FOR THE SPARE 400KV ILPE CABLE UTILISATION . COMMENTS VIED LETTER No. THDC/RKSH/EMD/VPHEP/401–6/2855 DATED – 23/07/2019.			ZONE	AS PER MOM DATED 20.05.19			ZONE	AS PER CUSTOMER CUMMENT DATED 05.12.17			ZONE	AS PER CUSTOMER E–MAIL DATED 03.11.17		

REV.	DATE		
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		CHECKED	SK –SD–
		APPROVED	RS/AS –SD–
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विभाग TBEM DEPT.
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शीर्षक/TITLE
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ड्राईंग.क./DRAWING NO.
TB-3-382-316-002

पुन:/REV. 09

पृष्ठ क./SHEET No. 02 | अगला पृष्ठ/NEXT SHEET 03

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

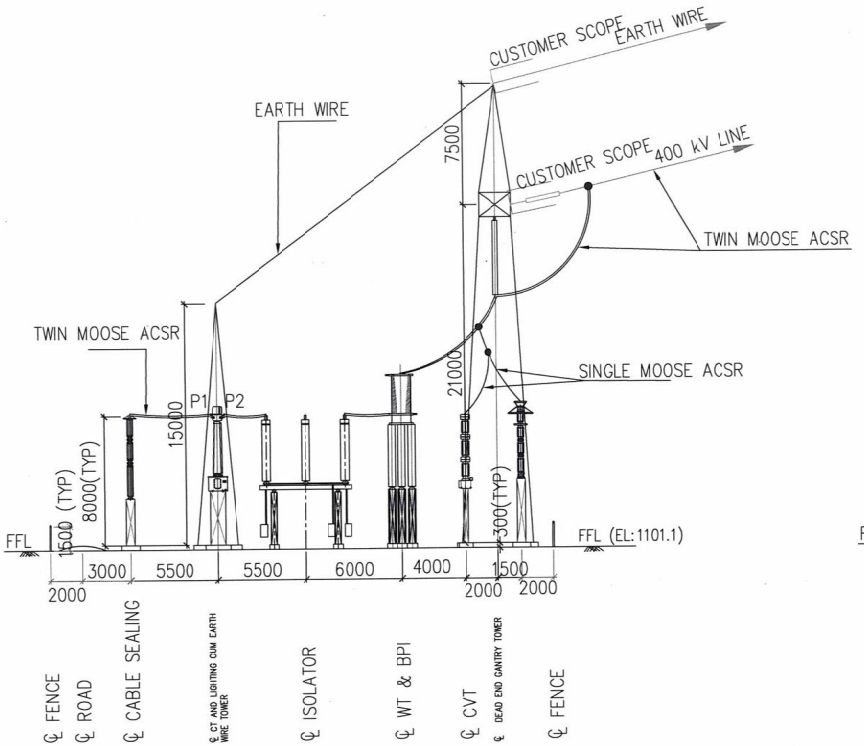
DRAWING No. TB-3-382-316-002

COMPUTER DRG. PATH NAME :

REF. DRG. No.

SIGN. & DATE

INVENTORY No.



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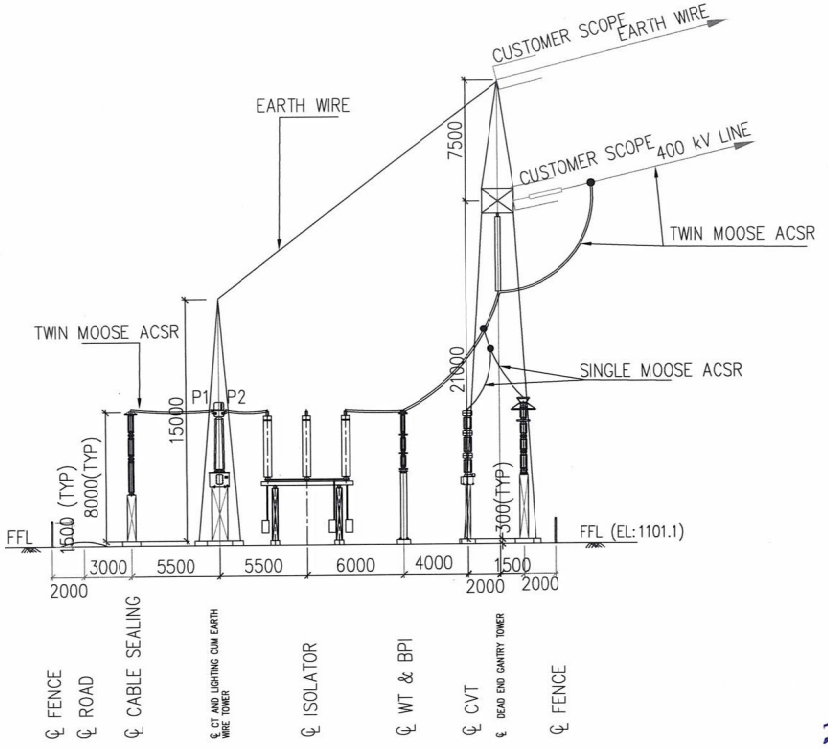

SECTION "C-C"

16.09.22

REV.	DATE			
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		CHECKED	DKS	-SD-
		APPROVED	VK	-SD-

ZONE: AS PER CUSTOMER COMMENTS DATED 05.08.22

REV.	DATE			
08	20.07.22	ALTERED	SY	-SD-
		CHECKED	DKS	-SD-
		APPROVED	VK	-SD-

ZONE: DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022

REV.	DATE			
07		ALTERED	VYOM	-SD-
		CHECKED	JAI KUMAR	-SD-
		APPROVED	VK	-SD-

ZONE: DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022

REV.	DATE			
06		ALTERED	VYOM	-SD-
		CHECKED	JAI KUMAR	-SD-
		APPROVED	VK	-SD-

ZONE: DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER COMMENTS

REV.	DATE			
		ALTERED		
		CHECKED	SK/SKS	
		APPROVED		

ZONE: THE LAYOUT IS REVISED TO INCLUDE THE DETAILS FOR THE SPARE 400KV XLPE

THDC/RKSH/EMD/VPHEP/401-6/2355

REV.	DATE			
04	06.06.19	ALTERED	PK	
		CHECKED	SK/SKS	
		APPROVED	AG	

ZONE: AS PER MOM DATED 20.05.19

REV.	DATE			
03	01.01.19	ALTERED	PK	-SD-
		CHECKED	SK/DM	-SD-
		APPROVED	AG	-SD-

ZONE: AS PER CUSTOMER CUMMENT DATED 05.12.17

REV.	DATE			
02	09.11.17	ALTERED	DM	-SD-
		CHECKED	SK	-SD-
		APPROVED	RS/DM	-SD-

ZONE: AS PER CUSTOMER E-MAIL DATED 03.11.17

REV.	DATE			
01	19.01.17	ALTERED	DM	-SD-
		CHECKED	SK	-SD-
		APPROVED	RS/AS	-SD-

ZONE: AS PER CUSTOMER LETTER DATED 07.11.16

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4X111MW VISHNUGAD PIPALKOTI H.E. PROJECT

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP

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स्वीकृत APPROVED	AS	-SD-	

विभाग DEPT. TBEM
कोड CODE 422

अनुपात / SCALE

कार्ड कोड CARD CODE

शीर्षक/TITLE
LAYOUT PLAN & ELEVATION OF 400KV POTHEAD YARD

ड्राईग. क./DRAWING NO.
TB-3-382-316-002

पुनः/REV. 09

पृष्ठ क./SHEET No. 03

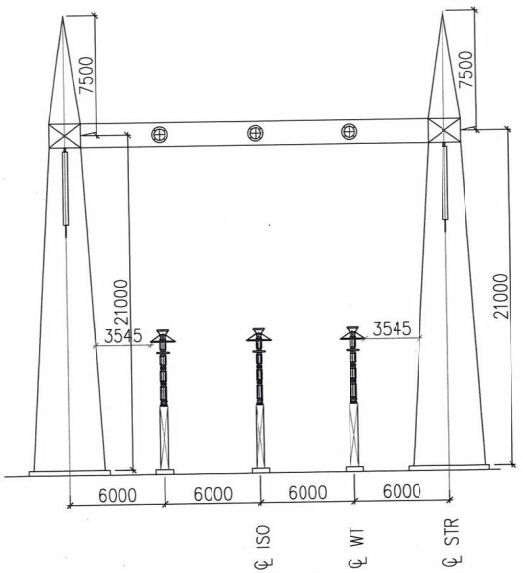
उगला पृष्ठ/NEXT SHEET 04

A3 SIZE

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRAWING No. TB-3-382-316-002

COMPUTER DRG. PATH NAME :



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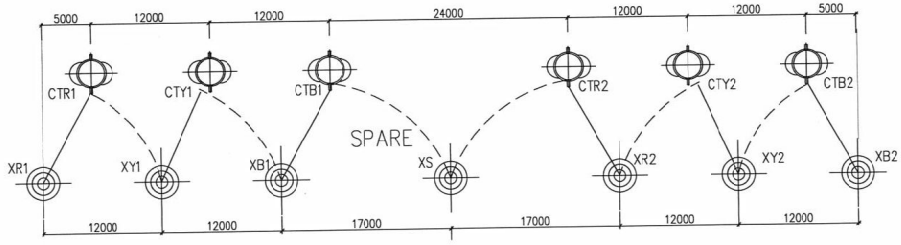

JUMPER SEQUENCE

S. NOS.	DESCRIPTION	CONNECTION DETAILS IN POTHEAD YARD
1.	NORMAL CONDITION INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
2.	R1 CABLE FAILURE INTERCONNECTION	XY1–CTR1 , XE1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTE2
3.	Y1 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XB1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , X32–CTB2
4.	B1 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XS–CTB1 , XR2–CTR2 , XY2–CTY2 , XB2–CTB2
5.	R2 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XY2–CTY2 , X32–CTB2
6.	Y2 CABLE FAILURE INTERCONNECTION	XS–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XR2–CTY2 , XB2–CTB2
7.	B2 CABLE FAILURE INTERCONNECTION	XR1–CTR1 , XY1–CTY1 , XB1–CTB1 , XS–CTR2 , XR2–CTY2 , XY2–CTB2

NOTES:–

1. THE 400KV XLPE TERMINATION ON THE GIS SHALL ALSO BE SWAPPED TO RETAIN THE PHASE SEQUENCE OF THE 400KV SYSTEM .

16.09.22

REV.	DATE			
09	16.09.22	ALTERED	SY	–SD–
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ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 27.06.2022			
REV.	DATE			
04	06.06.19	ALTERED	PK	
		CHECKED	SK/SKS	
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ZONE	AS PER MOM DATED 20.05.19			

REV.	DATE			
07		ALTERED	VYOM	–SD–
		CHECKED	JAI KUMAR	–SD–
		APPROVED	VK	–SD–
ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER EMAIL DATED 12.04.2022			
REV.	DATE			
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REV.	DATE			
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ZONE	DUE TO CHANGE IN THE LOCATION OF THE SWITCHYARD AS PER CUSTOMER COMMENTS			
REV.	DATE			
02	09.11.17	ALTERED	DM	–SD–
		CHECKED	SK	–SD–
		APPROVED	RS/DM	–SD–
ZONE	AS PER CUSTOMER E–MAIL DATED 03.11.17			

REV.	DATE			
01	16.01.17	ALTERED	DM	–SD–
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विभाग DEPT. TBEM
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शीर्षक/TITLE
LAYOUT PLAN & ELEVATION OF 400KV POTHEAD YARD

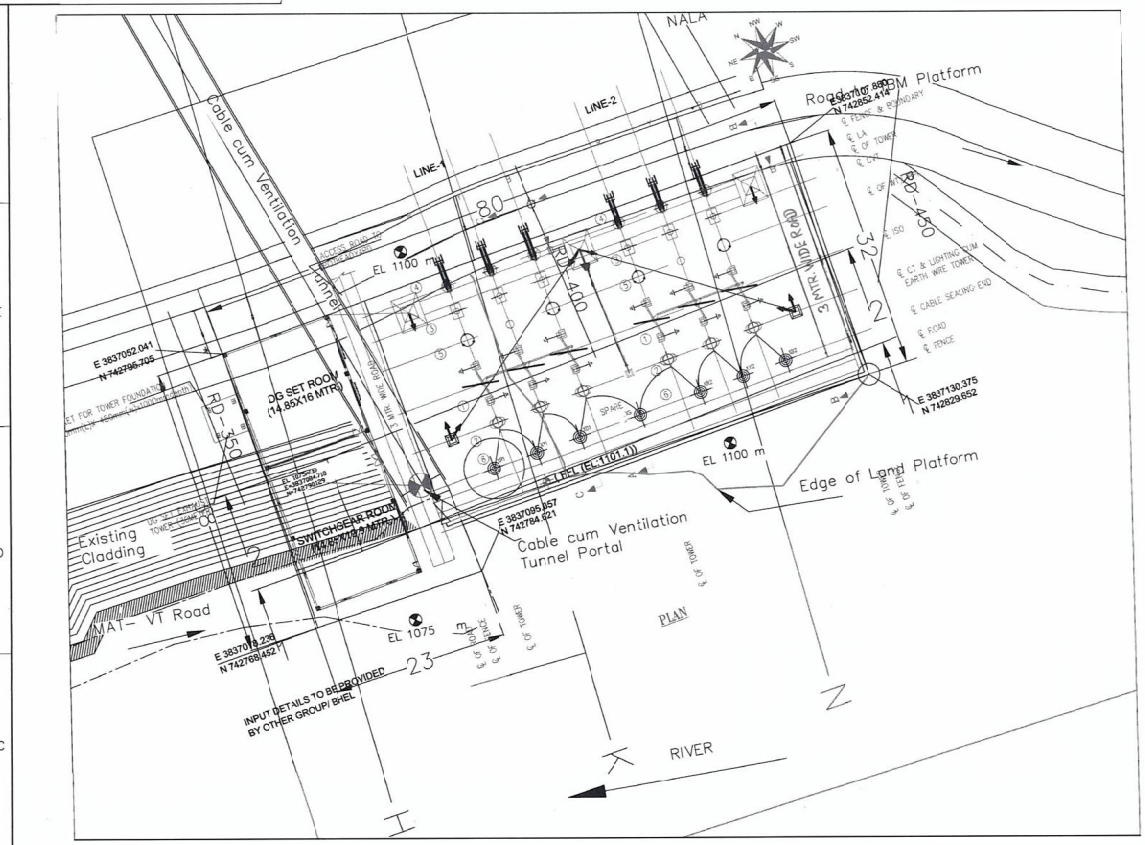
ड्राईंग क्र./DRAWING NO. TB-3-382-316-002
पुनः/REV. 09
पृष्ठ क्र./SHEET No. 04
अगला पृष्ठ/NEXT SHEET 05

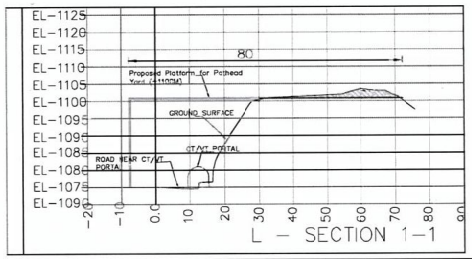
REF. DRG. No.
SIGN. & DATE
INVENTORY No.

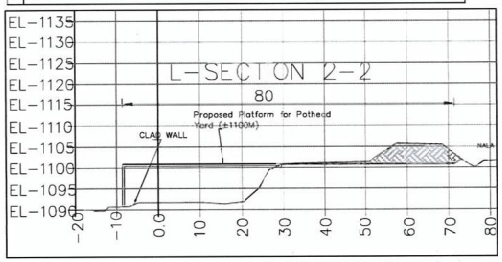
A3 SIZE

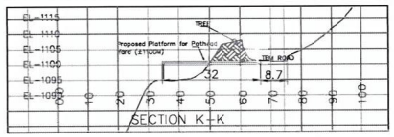
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

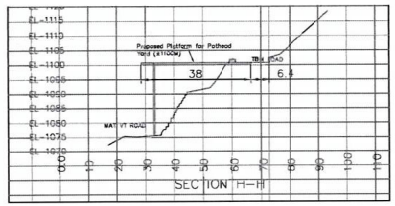
DRAWING No. TB-3-382-316-002

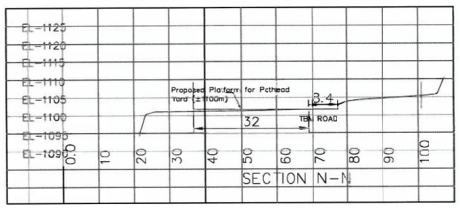












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		APPROVED	RS/AS	–SD–
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पुनः/REV. 09
पृष्ठ क./SHEET No. 05
अगला पृष्ठ /NEXT SHEET

COMPUTER DRG. PATH NAME :
REF. DRG. No.
SIGN. & DATE
INVENTORY No.

A3 SIZE

Contents

SECTION2:

EQUIPMENT SPECIFICATION UNDER SCOPE OF SUPPLIES/ SERVICE

1. **Design Basis Report for 400kV Pot head Yard**
2. **Customer Technical Specificaton for 390kV Surge Arrester & its accessories**

The precedence of order for documents shall be as per follows,

1. Customer confirmation on Deviation Statement
2. Design basis report
3. Customer Technical Specification

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-382-316-055	Rev no.-04	Prepared	Checked	Approved
TYPE OF DOC.	DESIGN BASIS REPORT	NAME	SK/AA	SK	AS
TITLE		SIGN	-SD-	-SD-	-SD-
ELECTRICAL DESIGN BASIS REPORT OF 400 KV POTHEAD YARD		DATE	26.09.16		
		GROUP	TBEM	W.O. No	-
CUSTOMER	THDC INDIA LTD. , UTTARAKHAND				
PROJECT	4X111MW VISHNUGAD PIPALKOTI HYDRO ELECTRIC PROJECT				

CONTENTS

संस्तुत
RECOMMENDED

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अनुमोदित
APPROVED

Approval of this drawing/document does not absolve contractor of its responsibility for manufacturing of the equipment as per ER & GTP for the achievement of designed performance at site and completeness of the equipment.

अपर महाप्रबंधक (विद्युत-यांत्रिक अभिकल्प)
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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS
04	18.12.17	SK	SK	DM/RS	As per THDC letter dated 25.09.17
03	02.09.17	SK SD-	SK SD-	DM/RS SD-	As per THDC letter dated 06.07.17
02	12.06.17	SK SD-	SK SD-	DM/RS SD-	As per THDC letter dated 07.03.17
01	12.01.17	SK SD-	SK-SD-	RS-SD-	As per THDC letter dated 07.11.2016

Distribution	To	TBTS	O/C	TBMM	TBQM	TBCM
	Copies	-	1	-	-	-

1.0 INTRODUCTION:

400kV pothead yard is a part of 4X111MW Vishnugad Pipalkoti Hydro project and BHEL are the EPC contractor for this project.

The scope is based on technical specifications of M/s THDCIL and tender drawings. The scope of works envisaged for the 400 kV Pothead yard/GIS (gas insulated switchgear) shall be as described below.

Sl. No.	Description	Quantities
1.	400 kV GT(Generator Transformer) Bay	4 Nos.
2.	400 kV Line feeder Bays	2 Nos.
3.	400kV Bus coupler bay	1 No.

The Generator Transformers at EL1036 & 420kV GIS at EL 1046 system are located in underground Transformer hall. The 400kV outgoing GIS line feeder bays located in Transformer cavern shall be connected to surface pothead yard by means of 400kV XLPE cables running inside the cable tunnel. The 400kV Pothead yard is located at EL 1101.1. Rev-04

The scope for Pothead yard shall cover all 400 kV equipment like disconnecting switches, current transformers, capacitive voltage transformers, Surge arrestors, post insulators, cables, gantry structure, busbars, ACSR Conductors, Insulators, Clamps & connectors, grounding system , protection panels, 48V DC system , PLCC ,Wave trap , Illumination system and all other accessories as required to complete the system with its desired functionality.

The purpose of DBR document is to elaborate the following for 400 kV outdoor pothead yard.

a) Basic arrangement and layout
b) Standard and codes
c) Pothead yard design data
d) System parameters and clearances
e) Pothead yard Equipment data
f) Mandatory and recommended spare

2.0 BASIC ARRANGEMENT AND LAYOUT

a) Double bus bar arrangement has been provided inside GIS. Two outgoing 400kV lines are connected with GIS through cables. The two outgoing feeders of pothead is located at same level (i.e. EL 1101.1). Outgoing line conductor is Twin Moose ACSR. Rev-04
b) Equipment to equipment connection in Pothead shall be of twin ACSR "Moose" conductor.
c) The bay width of 400kV line feeder bay is 27 m and height of 400kV equipment level is 8.0 m from plinth level . The height of plinth level is 300mm from ground level.

d) Protection against direct lightning strokes shall be provided with the help of 7/9 SWG shield wire. The UTS of 7/3.66mm (overall diameter 10.98 mm) GS earth wire is 68.4kN with total cross sectional area 73.61 sq mm.

e) Lighting fixtures for pothead yard illumination shall be mounted on tower gantries.

f) All pothead structure shall be Lattice type with minimum zinc deposit of 610gms/sq. m

g) Clamps connector shall be bolted type as per IS: 5561

h) Normal tension per sub conductor at minimum temperature and maximum wind condition for design of 400kV pothead take off tower will be 2000 Kg.

i) Main below ground earthmat shall be of 40 mm Dia MS Rod with grid spacing 3m . Earth Electrodes shall be 3 m long, 40 mm Dia MS Rod electrodes. Equipments & structure earthing shall be provided through 75 X 12 and 50 X 6 mm Galvanized steel flats. 40 mm diameter MS rod shall also be used as riser and projected at least 300 mm above finish grade level for equipment connection. Dedicated risers with test link shall be provided for lightning protection.

j) Length of conductor, earthwire, height of structures, High Altitude correction factor, control cable, provision of switchgear installations i.e. DG/ventilation room etc. may vary based on the location of pothead yard and its orientation, availability of bench etc. Due to change in pothead yard location and its orientation, above mentioned parameters will be change and same shall be considered for detailed engineering and design of pothead equipment and associated components.

k) Separate design document for short circuit force (i.e. tensile force during short circuit, tensile force after short circuit and tensile force caused by pinch effect) calculation between equipment's conductor of pothead yard shall be submitted at later stage.

3.0 STANDARD AND CODES:

Standard and codes shall be as per customer Specification/NIT and as per the general practice for Substation Design listed below.

IS 10118 (Part 1 to 4):	Code of practice for selection, installation and maintenance of switchgear and control-gear
IS 802 (Part1):	Use of structural steel in overhead transmission line tower- Code of practice.
IEC 60865-1:	Short Circuit Current- Calculation of effects
IEC 62271-100:	High voltage switchgear and controlgear.
IEEE 80 std-2000:	Guide for safety in AC substation grounding
IEC 60694:	Common specification for high voltage switchgear and control -gear
CBIP report-3:	Manual on layout of substation.
Current Transformer:	IEC -60044-1
Capacitor Voltage Transformer:	IEC -60044-2
Surge Arrestor:	IEC-60099-4
Line Trap:	IEC-60353
Disconnecting switch:	IEC-62271-102

4.0 POTHEAD YARD DESIGN DATA :

Location	:	Outdoor
Minimum ambient Temperature	:	-7.0°C
Maximum ambient Temperature	:	40.0°C
Design ambient temperature	:	40.0°C
Wind speed	:	39 m/s
Seismic Coefficient	:	0.38g (In horizontal direction), 0.19g(In vertical direction) for design purpose
Seismic zone	:	IV
Maximum rainfall	:	293.3 mm in 24 hours
Relative humidity	:	100%
Altitude	:	More than 1000m and less than 2000m

5.0 SYSTEM PARAMETERS AND CLEARANCES:

Description	At EL 1000	At EL 1101.1
Nominal system Voltage	400 kV	400 kV
Highest system voltage	440 kV	440 kV
Rated short time current	40 kA for 1 sec	40 kA for 1 sec
Frequency	50Hz ± 3 %	50Hz ± 3 %
Normal Current	2000A	2000A
Switching Impulse Withstand Voltage - (phase -earth)	1050 kVp	**1060 kVp**
Lightning Impulse Voltage - Phase- to earth	1425 kVp	**1443 kVp**
Power frequency withstand Voltage - (Phase to earth)	630 kVrms	**638 kVrms**
Minimum creepage Distance	25mm/kV	25mm/kV
System earthing	Solidly earthed	Solidly earthed
Phase to phase Clearance	4200 mm	**4254 mm**
Phase to Earth Clearance	3500 mm	**3545 mm**
Sectional Clearance	6500 mm	**6583 mm**

Rev-04

Note – It may be noted that altitude correction factor at EL 1101.1 for pothead yard equipment's shall as per attached Annexure-A.

6.0 POTHEAD YARD EQUIPMENT DATA:

General technical particulars are given here under. The details technical particulars and drawings shall be submitted at later stage.

a) Isolator: (Device No. 89)

The Horizontal double break isolator shall be 400 kV, 2000 A, 40 kA for 1 sec, 3 phase, single pole, and group operated type **(i.e. electrically ganged)**. The earth switch shall be mechanically ganged i.e. three phase of earth switch shall be mechanically linked to a coupling shaft. The isolator and earth switch shall be provided with AC motor driven

mechanism and an emergency manual operation feature along with terminal Connectors, insulator and support structure.

Isolator and earth switch shall be constructional interlocked so that earth switch can be operated only when the isolator is open and vice versa.
All metal parts of blade shall be non - rusting and non-corroding material. Moving contact parts shall be made from tubular section of hard drawn **electrolyte copper.** The thickness of mechanism boxes shall be 2 mm cold rolled sheet steel.

b) Current Transformer: (Device No. CT)

400 kV, 2000 A, 40 kA For 1 sec, 1 Phase, 4 core complete with terminal connectors & structures. 400kV pothead yard line side CT details are mentioned below:

Core No.	Current Ratio	Accuracy Class	Min. Burden	Min kPV (VA)	Max RCT at 75 Deg (Ohms)	Max Im at kPV /2 (mA)	Purpose
1	2000 -1000-500/ 1	PS	-	4000-2000-1000	10-5-2	30-60-120	Line Distance Protn.
2	2000 -1000-500/ 1	PS	-	4000-2000-1000	10-5-2	30-60-120	Line Distance Protn.
3	2000 -1000-500/ 1	PS	-	2000-1000-500	10-5-2	30-60-120	XLPE Cable Protn.
4	2000 -1000-500/ 1	PS	-	2000-1000-500	10-5-2	30-60-120	XLPE Cable Protn.

Note - The Current transformer parameters shall be as per approved CT sizing document no. TB-4-382-510-043.

c) Capacitor Voltage Transformer: (Device No. CVT)

400 kV, 4400 pf., 1 phase, 3 winding complete with terminal connectors and structure. CVT details are furnished below:

Winding No.	Voltage Ratio	Accuracy Class	Min. Burden	Purpose
1	400kV/√3 / 110V/√3	3P	200 VA	Protn/Voltage selection
2	400kV/√3 / 110V/√3	3P	200 VA	Protn/Voltage selection
3	400kV/√3 / 110V/√3	0.2	100 VA	Metering/Synch

Note - The capacitor Voltage transformer parameters shall be as per approved VT sizing document no. TB-4-382-510-043043.

20kA & Class 4, 10kJ/kV, polymer/ porcelain

d) Surge Arrestor: (Device No. LA)

390 kV, Gapless heavy duty , Metal Oxide station type , complete with surge counter, leakage current meter, insulating base, connecting cable, Line terminal connector and structure. Nominal discharge current and long duration discharge class shall be **10kA** and class 3 respectively. The minimum energy handling capacity and pressure relief current of Surge arrester shall be 10kJ/kV and 40kA respectively. The arrester shall be provided with pressure relief device to prevent shattering of porcelain in case of excessive gas pressure builds up.

e) Disc insulator and String Insulator:

400 kV double String insulators with double anchoring point comprising of 2 X 23 Nos. 160 KN anti fog type disc for tension string. 400 kV single String insulators with single anchoring point comprising of 1X23 Nos. 160KN anti fog type disc for suspension string. Creepage distance of individual 160kN disc is 470mm. Size of individual 160kN disc is 305x170 mm.

f) 400kV Post Insulator

Technical parameter of Post insulators are mentioned below at EL 1000.

Sl. No.	TECHNICAL PARAMETERS	400kV
1.	Type	Solid Core
2.	Voltage Class (kV)	420
3.	Applicable IS	2544
4.	Maximum radio interference voltage	1000 micro volt
5.	Corona extinction voltage (kV rms).	320(min.)
6.	Minimum Cantilever strength	**800kg**
7.	Minimum Torsional moment	As per IEC -273
8.	Total height of Insulator (mm)	**3650**
9.	P.C.D	
	Top(min.)	127
	Bottom(min.)	300
10.	No. of bolts.	
	Top	4
	Bottom	8
11.	Diameter of Bolt/holes(mm)	
	Top	M16
	Bottom	18
12.	Pollution levels as per IEC-815	Heavy (III)
13.	Minimum total creepage distance for heavy pollution (mm)	**10500**

g) **ACSR Moose conductor & 7/9 SWG shield wire as per the customer specification.**

h) **AC-DC Distribution boards, battery and chargers shall be as per the customer specification.**

i) **Illuminations as per the customer specification.**

j) **1.1 kV Control & Power and control cables as per the customer specification.**

k) **Cable Trench material as per the customer specification.**

l) **PLCC Equipment**

The PLCC equipment for two outgoing lines shall be provided at Vishnugarh-Pipalkoti HEP end only.

Sl. No.	Items Description	Unit	Quantity
1	Carrier Equipment, Single Channel, SSB, 20W/40W (for speech + protection) (Analogue)	Nos	4
2	Carrier Equipment, Single Channel, SSB, 20W/40W (for speech + Data) (Analogue)	Nos	1
3	Analogue Protection Couplers (4 Commands)	Nos	4
4	Coupling Device	Nos	2
5	HF Cables 75 Ohms Unbalanced	m	500
6	4 wire telephone set with connecting cables	Nos	2
7	5 pair telephone cables , armoured ,0.5mm dia , annealed copper conductor and petroleum jelly filled with polyethene outer jackets .	m	500
8	EPAX – 24/8	Nos	1
9	2 wire Telephones sets with connecting cables	Nos	24
10	2 pair telephone cables (tinned copper)	m	500
11	Print test kit for Testing and maintenance of PLCC equipment.	Set	1

Note: *Remote end PLCC has not been considered. but the PLCC equipment being supplied at VPHEP shall have compatibility with NR Load Dispatch Centre PLCC equipment. Customer will have to co-ordinate with the Utility at Remote end of lines at detailed engineering stage for ensuring that the remote PLCC carrier equipment is of same type. Customer shall also coordinate with the Utility to provide us the approved Frequency Plan for PLCC system.*

Duplicate 48 V Battery and Float cum Boost charger with DCDB for PLCC shall be provided at VPHEP end only.

m) Wave Trap:

Wave Trap of 1 mH, 2000A, 40 kA for 1 Sec, rating shall be provided in phase to phase coupling mode. The Wave Traps shall be **suspension** type.

7.0 MANDATORY AND RECOMMENDED SPARE :

7.1 Mandatory spare

Sl No.	Description	Qty.
(1)	400kV Current Transformer (1phase)	1 No.
(2)	400kV Capacitance voltage Transformer (1 phase)	1 No.
(3)	400kV post insulator without corona ring	1 No.
(4)	One complete pole of 2000A, 40kA for 1 s , HDB Isolator with 2 earth switch with operating mechanism for main Isolator and earth switches with post insulators and without structures and without terminal connectors	1 No.

7.2 Recommended spare – Nil

ANNEXURE-A

CUSTOMER:THDC India Ltd., Uttarakhand

PROJECT: 400kV POTHEAD YARD , 4X111MW Vishnugad Pipalkoti HEP

CALCULATION FOR ALTITUDE CORRECTION FACTOR FOR Pothead yard LOCATED AT EL 1101.1

(A) SYSTEM PARAMETERS REV -01

Altitude correction factor considered in line with IEC-60044-8 (Instrument Transformers), IEC-60137 (Insulated Bushings)

Altitude Correction Factor, K_a =	$e^{m((H-1000)/8150)}$
Height of Pothead yard , H (in meters)	1101.1

Parameters changes due to Altitude factor (for 400 kV pothead yard)	m(As per IEC)	K_a
For Lightning impulse voltage	1	1.012
For switching impulse	0.75	1.009
For power frequency withstand voltage	1	1.012

System parameters for 400 kV Pothead	at 1000 m	at 1101.10m (with ACF)	Value considered for Vishnugad Pothead
	A	$B = K_a * A$	
SWITCHING IMPULSE WITHSTAND VOLTAGE (kVp) - (phase -earth)	1050	1059.814	1060
LIGHTNING IMPULSE VOLTAGE (kVp)- Phase- to earth	1425	1442.787	1443
POWER FREQUENCY WITHSTAND VOLTAGE (kVrms)- (Phase to earth)	630	637.864	638

(B) For Electrical Clearances

As per CBIP, Altitude correction factor for altitude more than 1000m and upto 3000m= Ka= 1.25% per 100m		
Pothead yard height in meter	1101.1	
Altitude correction factor at 1100.39 m= Ka	1.264	%

Clearance parameters for 400 kV Potheadyard	at 1000 m	at 1101.1m (with ACF)	Value considered for Vishnugad Pothead
	A	B = Ka* A	
Phase to Phase clearance (meters)	4200	4253.078	4254
Phase to earth clearance (meters)	3500	3544.231	3545
Section clearance (meters)	6500	6582.144	6583

Section 2: Customer Technical Specification for 390kV Surge Arrester & its accessories

6.1 SCOPE

6.1.1 This section of specification covers the provision of all labour, plant & material and performance of all works necessary for the design manufacture, shop assembly, shop testing, supply, insurance & delivery, ~~storage at site, erection, testing & commissioning, handing over to owner~~ and guarantee of 400 kV interface facility equipments, ~~equipment structures, gantry structures~~ & hardware fittings and accessories and warranting a trouble free safe operation.

~~The bidder shall take delivery of material dispatched by him to site directly from his transporters, store materials in his store and transport the same to erection site as and when required.~~

400 kV interface facility equipments, equipment s~~upport structures, gantry structures~~ and hardware fittings and accessories consists of the following.

6.1.1 Outdoor pothead yard equipments ~~& structures~~ consisting of ~~current transformers, capacitive voltage transformers, isolators with grounding switches at both ends,~~ surge arresters, ~~connection to XLPE cable termination, support structures for CTs, isolators with grounding switches, CVTs, surge arresters, terminal connectors, hardware fittings, string insulators, earth wires, screening clamps, control panels/ marshalling boxes, power & control cables, racks to support the cables etc.~~

6.1.2 ~~Gantry columns and gantry beams, support peaks for shield wire, support attachment for disc insulators and support structures for post insulators, wave traps, illumination and screen wire with provision for fixing/installation of luminaries, (shield) screen wire including all types of bolts, nuts, washers, hangers, step bolts, ladders, step bolts, embedments in concrete and foundations, concrete and foundations, base plates, number plates, phase plates, danger plates, mounting bolts, embedded plates clamps, anti climbing device, bird guards, gusset plates, structure earthing bolts, fixing plates shall also be supplied.~~

6.1.3 ~~Moose ACSR conductors of size 54/7/3.53mm, GI earthwire/shield wire of size 7/3.66mm, aluminum rigid connectors, all type of insulators, hardware fittings, spacers for connectors, all type of clamps, locking pins, jumpers etc required for interconnecting pothead yard equipment including connection to the take-off transmission towers at gantry end of lines~~

6.1.4 The scope of supply shall include all the mandatory spares as indicated in the price schedule. These spares are considered to be sufficient for normal operation of equipments for 5 years. The spares shall be of the same material, dimensions, workmanship and finish as that of original.

6.1.5 Any other equipment not explicitly mentioned herein but is necessary for completeness of works specified shall deemed to be included in the scope.

6.1.6 ~~The metal casing, chassis and frame work/support structures of all the equipments and gantry structure shall be connected with two independent earth systems to be connected to the ground mat riser in the vicinity of the equipment to ensure that the equipments and metal parts or termination of equipments are at earth potential in normal service conditions~~.

6.2 SYSTEM DETAILS

6.2.1 Vishnugad-Pipalkoti H. E. Project envisages installation of 4 nos. of Generating Units (110MW each with 10% continuous overload). The power generated by these units will be stepped up to 420kV through 4 number Transformer banks each comprising of three single phase 46MVA, 13.8/420/$\sqrt{3}$kV Generator Transformers. The transformer banks shall be connected to SF6 Gas Insulated Switchgear (GIS) of double bus bar system comprising of 7 bays i.e. 4 nos. incoming bays, 2 nos. 400kV outgoing bays and one bus coupler bays of 2000A rating. The Generating Units are located in the under ground power house cavern. The Generator Transformers & 420kV GIS systems are also located in underground Transformer Hall.

6.2.2 Two 400kV outgoing GIS feeder bays located in the transformer cavern shall be connected to surface pothead yard by means of 400kV XLPE cables running inside the cable tunnel.

6.3 STANDARDS

6.3.1 All works shall be done strictly as per latest relevant Indian Standards and IS codes of practices whether mentioned in the specification or otherwise. All materials shall be of best quality conforming to the relevant Indian standards or equivalent International standards.

6.3.2 The design, material, manufacture, construction, rating, testing & performance of the pothead yard equipments, support and gantry structures and hardware fittings specified herein shall meet all the requirements as laid in the latest editions of following IEC/IS:

IEC 68	:	Seismic Test Methods for Equipments
IEC 99-4	:	Metal oxide Surge Arresters without Gaps for AC Systems
IEC 129	:	AC Disconnectors and Earthing Switches
IEC 137	:	Outdoor Bushing
IEC 185	:	Current Transformers
IEC 186	:	Voltage Transformers
IEC 270	:	Partial Discharge Measurement
IEC 358	:	Coupling Capacitors and Capacitors Dividers
IEC 506	:	Switching Impulse test on HV Insulators
IEC 1128	:	AC Disconnectors for Line Charging Current Switching
IEC 1129	:	AC Earthing Switches induced Current Switching
IS 335	:	Insulating Oil for Transformers and Switchgear
IS 731	:	Specification for Porcelain Insulator for Overhead Power Lines
IS 802	:	Code of Practice for use of Structural Steel for Overhead Transmission Tower
IS 1364	:	Hexagon Head Bolts, Screw and Nuts for Product Grade A (Part I to V) and B
IS 1367	:	Specification for Hot Dip Galvanizing Coating of Fasteners
IS 1573	:	Specification for Galvanizing of Washers
IS 2016	:	Specification for Plain Washers
IS 2062	:	Specification for Structural Steel Standard Quality
IS 2486	:	Specification for Insulator Fittings for Overhead Power Lines
IS 2629	:	Recommended Practice for Hot Dip Galvanizing of Iron & Steel

IS 2633	:	Methods for Testing Uniformity of Coating in Zinc-Coated Articles
IS 2705	:	Current Transformers
IS 3156	:	Voltage Transformers
IS 5561	:	Electric Power Connectors
IS 5621	:	Hollow Insulation for use in Electrical Installation
IS 6639	:	Specification for Hexagon Bolts & other Fasteners
IS 7215	:	Specification for Tolerance for Fabrication of Structures
ANSI/IEEE	:	Guide for safety in AC Sub-Station Grounding (Std. 80-1986)

IS: 2		Rules for rounding off numerical values
IS: 278		Galvanised steel barbed wire for fencing
IS: 800		Code of practice for use of structural steel in general building construction
IS: 802		Code of practice for use of structural steel in Overhead Transmission line towers
	Part-I	Load and permissible stresses
	Part-II	Fabrication, galvanizing, inspection and packing
	Part-III	Testing
IS: 808		Specification for Rolled Steel Beam, Channel and Angle Sections
	Part-V	Equal leg angles
	Part-VI	Unequal leg angles
IS: 813		Scheme of symbols for welding
IS: 814		Covered electrodes for metal arc welding of structural steel
IS: 815		Classification coding of covered electrodes for metal arc welding of structural steels

IS: 816	Code of practice for use of material arc welding for general construction in mild steel
IS: 817	Code of practice for training and testing metal arc welders
IS: 822	Code of practice for inspection of welds
IS: 823	Code of practice for manual metal arc welding of mild steel
IS: 875	Code of practice for structural safety of buildings: Loading Standards
IS: 919	Recommendation for limits and fits for engineering
IS: 1200	Method of measurement of building and civil works
IS: 1364	Specification for hexagonal bolts, screws, nuts and lock nuts
IS: 1367	Technical supply conditions for threaded steel fasteners
IS: 1573	Specification for electroplated coatings of zinc iron and steel
IS: 1730	Dimensions for steel plate, sheet and strip for structural and general engineering purposes
IS: 1731	Dimensions for steel flats for structural and general engineering purposes
IS: 1893	Criteria for earthquake resistant design of structures
IS: 2016	Specification for plain washers
IS: 2062	Specification for structural steel fusion welding quality
IS: 2633	Method of testing uniformity of coating of zinc coated articles

IS: 2721	Galvanised steel chain link fence fabric
IS: 4759	Specification for hot-dip zinc coatings on structural steel and other allied products
IS: 6639	Specification for hexagonal bolts for steel structures
IS: 7215	Tolerance for fabrication of steel structures
IS: 7318	Approved tests for welders when welding procedure approval is not required
IS: 2363	Black hexagonal bolts, nuts and lock nuts and hexagonal screws
IS: 2629	Recommended practice for hot dip galvanizing of iron and steel
IS: 3063	Specification for spring washers
IS: 806	Code of practice for use of steel tubes in general building construction
IS: 1161	Specification for steel tubes for structural purposes
IS: 209	Specification for zinc
IS: 2066	Specification for weldable structural steel
IS: 3757	High strength structural bolts
IS: 4091	Code of practice for design and construction of foundations for transmission line towers and poles
IS: 6610	Specification for heavy washers for steel structures
IS: 5358	Method of hot dip galvanized coatings on fasteners
IS: 6745	Specification for methods of determination of weight of zinc coating on zinc coated iron and steel articles

IS: 228	Method of chemical analysis of pig iron, cast iron, plain carbon & low alloy steel
IS: 406	Specification for method of chemical analysis for slab zinc
IS: 1083	Precision hexagonal bolts, screws and nuts (BSW & BJF threads)
IS: 1181	Qualifying tests for metal arc welders (engaged in welding structures other than pipes)
IS: 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS: 1363	Specification for black hexagonal bolts, nuts and locks nuts and black hexagonal screws
IS: 1477	Code of practice for finishing of ferrous metal in buildings - Painting and allied finishes - Part-I (Operation and workmanship)
IS: 1599	Method of bend tests for steel products other than sheet, wire & tubes
IS: 1608	Method of tensile testing of steel products other than sheet, strip, wire & tubes
IS: 1852	Specification for rolling and cutting tolerances for hot rolled steel products
IS: 2074	Ready mix paint, red oxide zinc chromate primer
IS: 2551	Danger Notice Plates
IS: 2595	Code of practice for radiographic testing
IS: 3502	Steel for checkered plates
IS: 3613	Acceptance tests for wire flux combination for metal arc welding for mild steel

IS: 3658	Code of practice for liquid penetrant flow detection
IS: 3664	Code of practice for ultrasonic testing by pulse echo method
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners
IS: 5334	Code of practice for magnetic particle flow detection of welds
IS: 5613	Code of practice for design, installation and maintenance of overhead power lines
IS: 8500	Structural Steel – Micro alloyed (Medium & High strength qualities)
IS: 5624	Foundation bolts
SP: 6 (4)	Use of high strength friction grip bolts (IS publication)
IS: 10238	Step bolts for steel structures
IS: 12427	Transmission Tower Bolts
IS: 731 (Part I & II)	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V
IS: 2121 (Part I, II & III)	Specification for conductor and earthwire accessories for overhead lines
IS: 2486 (Part I, II & III)	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V
IS: 3188	Dimensions for disc insulators
IS: 398	Aluminium conductors for overhead lines
IS: 10162	Specification for spacers and spacer dampers for twin horizontal bundle conductors

IS: 5082	Wrought aluminium & aluminium alloy bars, rods buses and sections for electrical purpose
IS: 2678	Dimensions & tolerances for wrought aluminium and aluminium alloy drawn round tubes
IS: 2673	Dimensions of wrought aluminium and aluminium alloy extruded round tubes
IS: 5039	Distribution pillars for voltage not exceeding 1100V AC or 1200V DC
IS: 2147	Degree of protection provided by enclosures for LV switchgear and control gear
IS: 5561	Electric power connectors
IS: 617	Aluminium and aluminium alloy ingots and castings for general engineering purpose
IS: 2544	Porcelain post insulators for system with nominal voltage greater than 1000V
IS: 209	Specifications for zinc
IS: 1521	Method of tensile testing of steel wire
IS: 1778	Reels and Drums for Base conductors
IS: 1841	EC grade aluminium rod produced by rolling
IS: 2633	Method of testing uniformity
IS: 8263	Method of testing radio interferences tests on high voltage installations
IS: 2629	Recommended practice for hot dip galvanising of iron and steel
IS: 5484	E.C grade aluminium rod produced by continuous casting & rolling
IS: 4826	Galvanised coating on round steel wires
IS: 6745	Methods of determination of weight of zinc-coating of zinc coated iron and steel

6.3.3 Any other standards, which ensure equivalent or better performance than those specified in the standards referred above shall also be acceptable.

6.3.4 If the equipment offered conforms to standards which are different from IS or IEC, specified above, the salient points of difference between the standards adopted and the standards mentioned in these specifications shall be clearly brought out in such a case. If the standards referred are in a language other than English, one copy of each of these standards in English shall be furnished during design stage. A copy, each, of the standards to which the equipment offered conform shall be supplied after award of contract.

6.4 GENERAL TECHNICAL REQUIREMENTS

6.4.1 The equipment mounted on supporting structure shall meet the following mandatory requirements:

(a) The minimum vertical clearance from any energised metal part to the top of the plinth shall be 8.0 metres.

(b) The minimum vertical distance from the bottom of the lowest porcelain part of bushing, porcelain enclosures or supporting insulators to the top of plinth shall be 2.55 metres.

(c) The minimum clearance between the live parts and earth shall be 3.5 metres.

(d) The minimum clearance between phases shall be 4.2 metres.

(e) The minimum section clearance shall be as per relevant IS.

6.4.2 All exposed ferrous parts shall be hot dip galvanised as per IS 2633 & IS 4579 or relevant IEC or equivalent authoritative standards.

6.4.3 All current making and breaking contact surfaces shall be silver-plated. The silver plating shall not be less than 25 microns in thickness.

6.4.4 The equipment name plate/ wiring diagram plate shall be of stainless steel. In case of aluminium, it should be at least 2mm thick. The inscription on the name plate/ wiring diagram plate shall be engraved and no punching shall be accepted except for equipment Sl. No. and year of manufacture.

6.4.5 For all main structures i.e. columns and beams (gantry), fully galvanized latticed steel structures using GI bolts and nuts connections shall be used. The structures shall be self-supporting in design so as to carry the weight of conductors during worst case of loading with the necessary insulators, earthwire and all fittings etc.

6.4.6 The contractor shall furnish the most economical design for beams and columns. No welding or riveting shall be allowed in lattice structures. The equipment support structures shall normally be fixed to foundations with foundation plates and bolts. However, the leg members welded with the base plate and gusset plate at the works shall also be accepted.

6.4.7 All the structures shall be so designed that only the rationalized ISI metric sections preferably of mild steel of tested quality as per latest edition of IS: 2062 are used in the columns and beams.

6.5 TECHNICAL REQUIREMENTS OF POTHEAD YARD EQUIPMENTS

6.5.1 CURRENT TRANSFORMERS

6.5.1.1 Type & Rating

6.5.1.1.1 The Current Transformers shall conform to IEC 185. The current transformers shall be of the outdoor type, single phase, 50Hz, oil immersed, self cooled and suitable for operation in climatic conditions prevailing at site without any protection from sun, rain and dust. The Current Transformers shall have the following ratings:

i)	Type of CT	Single phase, oil immersed, self cooled, hermetically sealed suitable for outdoor installation
ii)	Rated voltage (kV rms)	400
iii)	Highest system voltage (kV rms)	440
iv)	Frequency (HZ)	50 ± 3%
v)	Number of phases	Single
vi)	Rated lighting impulse withstand voltage (kV peak)	1425

6.5.3.12 Mountings and Structures

The isolation stack (pedestal) shall be mounted on a lattice steel structures at a height of 2.5m from ground level. The clearance between the adjacent phases is proposed to be kept 4500mm. The bidder shall separately quote for steel structures each of a height of 2.5m, which shall be complete with foundation bolts, etc. for mounting the equipment. A loading diagram for the steel structures under the severest operating conditions of the equipment superimposed with seismic forces shall be given with the bid. The Supplier shall submit structure fabrication drawings and design calculation for approval of the Purchaser.

6.5.3.13 Galvanizing

All ferrous parts except springs but including mechanism housing shall be hot dip galvanized in accordance with latest relevant standard.

6.5.3.14 Name & Rating Plates

Each isolator with their grounding switches shall have non-corrosive name & rating plates legibly & indelibly marked in English & securely attached to it. These shall be provided with information as per normal practice and shall include among other things, the name of manufacture, type of isolator, rating of isolator, weight of isolator, rating of grounding switches, rated voltage etc.

6.5.4 SURGE ARRESTERS

6.5.4.1 Type & Rating

6.5.4.1.1 Each surge arrester shall conform to IEC-99-4 and shall be of hermetically sealed units, self supporting construction, suitable for mounting on tubular/lattice support structures to be supplied by the bidder. The surge arrestor will be connected to the overhead 400kV line having a Twin Moose conductor. The terminal connector of the suitable size shall be provided.

The surge arresters shall have following parameters and ratings (tentative):

Rated voltage of arrester kV (rms)	390
Type/Class of arrester	Station type, heavy duty, outdoor, metal

	oxide, non-linear, gapless
Maximum continuous operating voltage capability, (L-N) kV rms	303
Nominal discharge current (8/20 microsecond wave) kA (Peak)	20kA
Maximum switching surge protective level, kV (Peak)	780kVpeak
Maximum residual voltage (discharge voltage) at 10kA (8/20 microsecond current wave), kV (peak)	975kVpeak@10kA 975kVpeak@10kA
Maximum equivalent front of wave protective level, kV (peak) (20 kA with voltage wave cresting in 1 microsecond)	1050kVpeak@20kA
Impulse withstand voltage of equipment to be protected viz. outdoor equipment, XLPE cables & GIS equipment:	
• Lightning Impulse (kV peak)	1425
• Switching Surge Withstand (kV peak)	1050
Radio interference voltage at 266kV (rms)	Not exceeding 2500 micro volts
Partial discharge level at 1.1 Un /√3	5 or less pico coulombs
Corona extinction voltage kV (rms)	320
Energy level	10kJ/kV
Installation	Outdoor
Long duration discharge class	Class 4 as per IS-3070 (Part-I)
Minimum creepage distance	10500mm
Prospective symmetrical fault current for pressure relief test	40kA (rms)
Pressure relief class	As per IS-3070 (Part I)
One minute power frequency withstand voltage of arrestor housing	630kV (rms)

6.5.4.1.2 The arresters shall have following duty requirements:

a) The surge arresters shall be of heavy duty station class and gapless type without any series or shunt gaps.

b) The surge arresters shall be capable of discharging over-voltages occurring during lightning and switching of unloaded transformers and long lines.

c) The arresters shall be capable of discharging energy equivalent to Class-4 as per IEC or IS-3070 for a 420kV system on two successive operations followed immediately by 50Hz energisation with a sequential voltage profile as specified below:

- 705kVp for 3 peaks
- 580kVp for 0.1 second
- 565kVp for 1 second
- 550kVp for 10 seconds

6.5.4.2 Technical Requirements

6.5.4.2.1 The surge arresters shall be fitted with pressure relief devices suitable for preventing shattering of porcelain housing and providing path for flow of rated fault currents in the event of arrester failure. Necessary details in this regard shall be furnished during detailed design stage.

6.5.4.2.2 The arresters shall not fail due to arrester porcelain housing contamination. Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current.

6.5.4.2.3 I Polymer/ porcelain housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrester.

6.5.4.2.4 The end fittings shall be made of corrosion proof material and shall preferably be nonmagnetic.

6.5.4.2.5 The name plate shall conform to the requirements of IEC incorporating the year of manufacture and other details such as long duration discharge class, pressure relief class, nominal discharge current, etc.

6.5.4.2.6 Self contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit alongwith necessary connection. Suitable leakage current metres should also be supplied within the same enclosure. The reading of milliammeter

and counters shall be visible through an inspection glass panel. The terminals shall be robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. ~~The design of the surge monitor shall be such that it is possible to tilt the surge monitor down wards by an angle of upto 45 degrees from horizontal plane.~~

6.5.4.2.7 Surge monitor consisting of discharge counters and milliammeters should be suitable to be mounted on support structure of the Arrester and should be tested for IP-55 degree of protection. The arresters shall be complete with insulating bases having provision for bolting to the support structure. The standard supporting structure for Surge Arrester shall be provided with a standard mounting pad, for fixing the surge monitor. Grading/corona rings shall be provided on each complete arrester unit as required.

~~Necessary connecting materials such as clamps, bolts, nuts, washers etc. & foundation bolts for fixing the equipment supporting structures to the foundation shall be provided by the Supplier. Design calculations of the supporting structures taking into account all forces including seismic forces shall be supplied at the detailed design stage, for approval of the Purchaser.~~

6.5.4.2.8 The main grounding connection from the surge arrestor to the earth shall be provided by the Supplier. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

6.5.4.2.9 Surge arrester shall be subjected to routine, type and acceptance tests as per IEC-99-4 as listed in Clause 6.8 in presence of the owner's authorised representatives and test reports shall be got approved before shipment of the equipment. All routine tests shall be conducted on hollow column insulators as per IEC-233.

In case of similar surge arrester and insulators have been previously subjected to all of the type tests stated in IEC, certified type test reports may be accepted in lieu of repetition of such tests at Purchaser's option.

6.5.5 MARSHALLING BOXES

6.5.5.1 One no. marshalling box shall be provided for each bay of 400kV Pothead Yard. It is intended to have all interlocking circuits of each bay of the Pothead yard through a separate marshalling box.

6.5.5.2 The marshalling boxes shall be of steel construction, outdoor type,

6.7.7 LIGHTNING PROTECTION SYSTEM

6.7.7.1 Direct stroke lightning protection (DSLP) shall be provided in the pothead yard by overhead shield wires.

6.7.7.2 The direct stroke lightning protection is to be achieved by providing ground wires of 7/3.66 mm dia. above the power conductors, supported by gantry towers and poles/structures of 15.0 m height as indicated in the drawings. The galvanized stranded steel earth wires shall comply with latest editions of IS: 398 (Part-II) and IS: 2141 or any other International Standards which ensure equal or higher quality of material. The shield wires shall be tested as per latest editions of IS: 1521 and it shall be hot dip galvanized as per latest edition of IS: 2629.

6.7.7.3 The direct stroke lightning protection system shall be based on adequate number of towers of appropriate height installed in the pothead yard in such a manner that they provide adequate shielding cover to all the 400kV equipment and conductor, their connections to the bay equipment and other equipment from direct lightning strokes.

6.7.7.4 The structures shall consist of latticed steel structure on the top of which shield wire shall be rigidly fixed suitably by means of clamps, thimbles, lugs etc.

6.7.7.5 Ground conductors shall be used to connect the ground wire and shield wire to the grounding mat by means of proper thimbles.

6.7.7.6 Lightning protection system down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to lightning arrester and voltage transformer earthing leads which shall be directly connected to ground mat.

6.7.7.7 Every down conductor shall be provided with a test joint at about 1500mm above ground level. The test joint shall be directly connected to earthing system.

6.8 INSPECTION & TESTS

6.8.1 General

6.8.1.1 All the equipment, apparatus, materials and supplies covered under these specifications shall be subjected to tests in the shop and at the field in the presence of the representatives of the

Purchaser/consultants for conformity with the requirements of the specifications. The method and procedure for the tests shall be as specified for particular item or shall be in conformity with the applicable standards for making such tests. The details of the test procedures and test equipment to be used should be intimated well in advance i.e. not less than 30 days before these tests are conducted.

6.8.1.2 The test reports shall indicate the tests performed, the results obtained, instruments used, names of personnel carrying out the tests and provision for signature of the witnesses. They shall also show the number and date. The format of these reports shall be submitted alongwith testing procedure for the Purchaser's approval well in advance.

6.8.1.3 The test report shall include, but not necessarily be limited to the following:

- A description of the test equipment with diagram showing arrangement of the test instruments and devices.
- Sample computations, wherever necessary or desirable to show the test values employed in the equations.
- Curves showing relations to tested quantities.
- Data in tabulated form.
- The comparison of the test results with the guaranteed requirements of the specifications.

6.8.2 Type Tests

6.8.2.1 The type test reports of the following type tests conducted on similar or higher rating equipment of the make proposed to be supplied by the Supplier, shall be submitted during the design stage. If the type test reports of any or all the following tests are not submitted and if the type test reports of the tests conducted are not to the satisfaction of the Purchaser, the type tests shall be conducted/reconducted by the Supplier at his own expenses as per relevant IEC/IS standards.

A) Current Transformers (As per IEC 185/IS 2705)

i) Short time current tests
ii) Temperature rise test

iii) Lightning impulse withstand test
iv) Switching impulse voltage withstand test
v) Determination of errors or other characteristics

B) Capacitive Voltage Transformers (As per IEC 186, IEC 358 & IS 3156)

i) Temperature rise test
ii) Lightning impulse withstand test
iii) Switching impulse voltage withstand test
iv) Ferro-resonance tests
v) Transient response tests (Direct test)
vi) Test for accuracy (Direct test)
vii) Determination of errors or other characteristics
viii) Radio noise test as per IEC 358
ix) Stray capacitance and stray conductance measurements of the low voltage terminal (only for capacitors acting as coupling capacitors) as per IEC 358 or IS 9348

C) Isolators and Grounding Switches (As per IS 1818/IEC 129)

i) Dielectric tests
ii) Radio interference voltage (RIV) tests
iii) Temperature rise tests
iv) Measurement of resistance of main circuits (for isolators)
v) Test to prove the capability of carrying the rated peak short circuit current and the rated short time current
vi) Test to prove the short circuit making performance of grounding switches
vii) Operating and mechanical endurance tests
viii) Operation at temperature limits

D) Surge Arrestors (As per IEC 99-4)

i) Insulation withstand tests
ii) Residual voltage tests
iii) Long duration current impulse withstand test
iv) Operating duty tests
v) Pressure relief test
vi) Test of arrestor disconnectors
vii) Artificial pollution test
viii) Partial discharge test

ix) Seal leakage test
x) Current distribution test for multi-column arrestor

6.8.3 Shop Test

6.8.3.1 Routine Tests

All the Routine Tests shall be carried out at the works on various components of the Pothead Yard Equipment, Equipment support structures, gantry structures, hardware fittings and accessories in the presence of Purchaser's representatives:

6.8.4 Performance Tests

6.8.4.1 Performance tests will be required to prove that the equipment meets the requirements of the specifications and guarantees. All the tests conducted by the manufacturer shall be subject to Purchaser's approval. The manufacturer shall supply all labour, consumables, materials, equipment, meters, gauges etc necessary for performance of all the tests and recording the results of the tests. The manufacturer shall have full responsibility for the operation and safety of the equipment during all tests. The reports of all the tests shall be prepared by the manufacturer and incorporated in the final test report. The performance tests shall comprise of:

a) Field stage tests to be carried out during erection to demonstrate that the equipment or any component has been properly erected and functions correctly.

b) Commissioning tests, precedent to the acceptance of work, in respect of the equipment or any section of the equipment to demonstrate proper operation.

c) Final acceptance tests precedent to issue of a final acceptance certificate to prove compliance with performance guarantees.

6.8.4.2 Field Stage Tests

From time to time at various stages of erection, tests on the equipment shall be carried out as instructed by the Purchaser. The manufacturer shall make records of all measurements and shall make corrections or adjustments as required. A record of all field

stage tests shall be embodied in a report. The tests shall include but not limited to the following:

a) Test to check the continuity of wiring and correct operation of electrical systems.

b) Testing of all current carrying and ground connections to all conductors and terminal pads, to determine that the surfaces and all the bolted connections are tightly secured, testing of all the flexible connections to ensure that sufficient slack is available for expansion.

c) Check of cabling between apparatus by the contractor, prior to acceptance tests. Random checks shall be made in the presence of the Purchaser.

d) Measurement of insulation resistance of the various measuring and control circuits including cables, instruments and apparatus wherever practical and feasible.

e) Operation checks of operating mechanism, all control, signaling, measuring, metering, recording and interlocking equipment to confirm complete conformity with design data.

Prior to the commencement of field stage tests, the Supplier shall submit a detailed programme to the Purchaser for approval. Detailed records, including all the details of tests performed and the results obtained shall be prepared by the Supplier and furnished to the Purchaser.

6.8.4.3 Commissioning Tests

On completion of the erection and installation, the Supplier shall give the Purchaser a written certificate stating that the equipment has been erected and installed in accordance with the specifications and approved drawings, thus giving notice of readiness of the equipment before the same is placed into regular service. The Supplier shall demonstrate that all the guarantees have been met and in addition, that the entire equipment, including all auxiliary equipment and accessories, are properly erected, installed and correctly adjusted. The following commissioning tests shall be performed:

a) Voltage tests for the main circuits
b) Voltage tests for the auxiliary and control circuits including marshalling boxes

c) Tests to verify the resistance of the main circuits
d) Operation tests for various equipments

Commissioning tests shall be as per BIS/IEC or equivalent standards and shall not be restricted to the tests stated above. The Supplier shall also recommend any additional commissioning tests.

6.8.4.4 Final Acceptance Tests

After commissioning tests have been satisfactorily completed, the Supplier, in co-operation with and under the supervision of the Purchaser shall conduct the final acceptance tests listed below to determine whether all the manufacturer's guarantees and requirements of the specifications have been fulfilled:

a) 420kV Pothead Yard Equipment complete with all appurtenances shall be operated at continuous rating and at such part loading as may be directed by the Purchaser, continuously for 30 calendar days.

b) Certain routine tests may be repeated at site, if in the opinion of Purchaser, these are necessary to establish the conformity of the equipment with the guarantees and the specifications.

c) A record of all performance tests shall be embodied in a test report.

Successful completion of final acceptance tests shall be a condition precedent to a final acceptance certificate for the equipment.

6.8.5 TESTS FOR HARDWARE FITTINGS

6.8.5.1 The tubular bus conductors shall be subjected to various routine sample tests as per latest edition of IS: 5082. The wall thickness and ovality of the tube shall be measured by the ultrasonic method.

6.8.5.2 The ACSR conductors shall be subjected to various routine sample tests as per latest edition of IS: 398.

6.8.5.3 The insulators shall be tested for power frequency (wet and dry) and impulse withstand voltage in addition to other routine and acceptance tests as per latest edition of relevant Indian Standards.

6.8.5.4 The hardware, fittings shall be subjected to various type, sample and routine tests, specified as per latest edition of IS: 2486.

6.8.5.5 Copies of type test certificates as specified in relevant IS shall be furnished by the Supplier alongwith complete guaranteed technical particulars. If these type test reports are not found to be to the satisfaction of the Purchaser, the same shall be conducted free of cost in presence of the Purchaser. All routine tests shall be conducted in presence of the Purchaser.

6.9 QUALITY CONTROL & ASSURANCE

The supplier has to supply the equipment for Pot Head Yard equipmemts of best quality. The supplier has to maintain quality control and assurance during the manufacturing of equipment as per the approved Owner's quality assurance plans. For details please refer quality assurance plan document.

6.10 GUARANTEED & OTHER TECHNICAL PARTICULARS

Guaranteed & other technical particulars as per Annexure-I shall be adhered to. Particulars, which are not subject to guarantee, can be slightly modified with the approval of the Purchaser.

6.11 SPARE PARTS

The list of Mandatory Spares as identified in the Schedule of Requirements, Clause 2.24 shall be supplied along with recommend additional spare parts, which in his opinion are considered necessary for first five years of normal operation of the Pothead Yard Equipment.

6.12 MAINTENANCE TOOLS & TACKLES

Manufacturer shall supply all tools & tackles required for operation & maintenance of the equipment covered under these specifications. All tools, instruments and equipments either imported or locally procured shall be new and shall remain the property of the Purchaser. The said equipment & tools shall include but not limited to the following:

(a) Two sets of hand tools/spanner sets to fit every type and size of nut and bolt head of the equipments.

(b) Complete set of case hardened wrenches, special wrenches, tools, pulling eyes and other equipment that may be required for most expeditious, assembling, dismantling, operation and maintenance of the equipment.

6.13 TOOLS, TACKLES, SLINGS & TESTING INSTRUMENTS FOR ERECTION, TESTING & COMMISSIONING

The Supplier shall provide all the tools, tackles, slings etc. and testing instruments required for successful erection, testing and commissioning of the equipment at site on lump-sum hire charge basis. A complete list of such tools, tackles, slings etc. and testing instruments shall be submitted during detailed design stage. Any additional requirements of tools, tackles, slings and testing instruments shall be the responsibility of the Supplier and the same shall be provided without any extra cost to the Purchaser.

Contents

SECTION 3:
PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS
(FOR ALL EQUIPMENT UNDER PROJECT)

1. GENERAL

1. This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.
2. The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other respective sections and are not exclusive. However, in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

2. PROJECT INFORMATION AND SYSTEM PARAMETERS

Project information and System parameters shall be as follows,

A.	**Project Information**	
a)	Customer/ Purchaser/ Owner	THDC India Ltd., Rishikesh, Uttarakhand
b)	Consultant/ THDCIL	SMEC
c)	Project Title	Vishnugad Pipalkoti Hydro Electric Project (4X111MW)
d)	Location	The Vishnugad Pipalkoti Hydro Electric Project (4 x 111 MW) is located on Alaknanda River, a major tributary of river Ganga, in district Chamoli in the state of Uttarakhand.
e)	Transport Facilities	The nearest railhead is Rishikesh (225 Km) and the nearest Airport is Jolly Grant, Dehradun (240 Km). The project is approachable by an all-weather road (National Highway No. 58).
f)	Postal Address	It shall be provided separately
B.	**Site Conditions**	
a)	Maximum ambient Temperature	40^0C
b)	Minimum ambient Temperature	-7^0C

c)	Design ambient temperature for electrical equipment design	40^0C
d)	Relative humidity	100%
e)	Pollution Severity	Heavily Polluted
f)	Seismic zone	IV
g)	Seismic Coefficient	0.38g (In horizontal direction), 0.19g (In vertical direction) for design purpose
h)	Basic Wind speed	39m/sec
i)	Maximum rainfall	293.3mm in 24 hours
C. System Parameters and Clearances (At EL 1000)		
i)	Nominal system Voltage	400kV
ii)	Highest system voltage	440kV
iii)	Rated short time current	40kA for 1 sec
iv)	Frequency	50Hz±3 %
v)	Normal Current	2000A
vi)	Lightning impulse withstand voltage	1425kVp
vii)	Switching Impulse voltage	1050kVp
viii)	Power frequency withstand Voltage	630kVrms
ix)	Minimum creepage Distance	25mm/kV
x)	System earthing	Solidly earthed
xi)	Phase to phase Clearance	4200mm
xii)	Phase to Earth Clearance	3500mm
xiii)	Sectional Clearance	6500mm
D. Auxiliary Power Supply		

i)	3 phase A.C power supply	415V ± 10%, 50 Hz ± 3%, 3-phase 4 wire, solidly earthed , Frequency variation under extreme condition ± 5%
ii)	1 phase A.C power supply	240V ± 10%, 50 Hz ± 3%, 1-phase , 2 wire , AC supply , Frequency variation under extreme condition ± 5%
iii)	D.C. power supply	220V + 20% to -25%, 2-wire ungrounded 48V + 20% to -25% , 2 wire system positively earthed
iv)	Combined variation of voltage ± 10%, and frequency ± 5%,	

3. GENERAL TECHNICAL REQUIREMENTS

i. Type Tests

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / vendor shall furnish the reports of all the type tests carried out within last ten years from the date of signing of contract (i.e. 18.11.2014) as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/ similar components /equipment/systems to those offered / proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Vendor is not able to submit report of type test(s) conducted in last ten years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

ii. Codes and Standards

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification. Other International/National standard such as DIN, VDI, BS etc. shall be accepted for only material codes and manufacturing standards, subject to the employer's approval.

ASTM (American Society for Testing Materials), AISI (American Iron and Steel Institute), DIN (German Industrial Standards) and BSI (British Standards) are approved standards for the supply of Materials.

Material tests according to DIN 50049-3.1 C shall be provided for all important parts of the equipment such as: steel plates for parts under hydraulic pressure, all major castings (runner, shutoff valve, etc.), large forgings (turbine and generator shaft etc.), high stressed large bolts etc.

For less important parts, certificates according to DIN 50049-2.3 are acceptable.

Materials shall be new and of first-class quality, suitable for the purpose, free from defects and imperfections, and the classifications and grades in conformance with the latest issue of the respective ASTM, AISI, DIN or BS standard. Material to other standards may be used if approval by the Owner has been obtained. Material specifications, including grade or class data, shall be shown on the appropriate detail drawings submitted for review.

The vendor shall indicate in the Technical Data Schedules, the materials and applicable standards for all major parts of the supply.

The materials shall be carefully selected for the intended purpose and due consideration of the site conditions and the tropical environment. Higher grade material shall be used where ordinary material is insufficient.

"Not withstanding reference made to various standards all equipment and works as per provisions and requirements of relevant and latest Indian Standards shall be acceptable".

In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

The international SI-system of units shall be used for documents, calculations, correspondence, drawings etc.

4. MATERIAL/ WORKMANSHIP

i. General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts

shall be accurately positioned and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture’s limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The vendor/ contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The vendor/ contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the vendor/ contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian vendor/ contractor. The same shall be applicable to other consumables too.

The vendor/ contractor shall furnish the following:

- All oil for initial filling of all equipment supplied, plus 10% additional.
- Grease if required for initial filling of all of the equipment, plus 10% additional.

- Flushing fluids to flush and clean all systems.

ii. Provisions for Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipment's located in non-air conditioned areas shall also be of same type.

5. COLOUR SCHEME AND CODES FOR PIPE SERVICE/ PANELS

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Owner. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 204. In cable having 5 conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than 5 conductors colour coding in accordance with IEC Recommendations 204 shall be used.

The vendor/ contractor shall propose a colour scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include,

Live parts of electrical connections shall be colour coded as follows,

Conductor Designation	Coding Alphanumeric	Symbol	Colour
AC network 3 phase	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
AC single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green yellow
DC network	Positive	a	Red
	Negative	b	Black

Colour Coding for Mimic Diagrams

Mimic diagrams to be arranged on switchgear cubicles, control panels/desks, etc., shall be colour coded as follows,

420kV	Gold
13.8kV	Signal red
415V	Black
220V DC	Violet
48V DC	White

All the steel works shall be thoroughly cleaned of rust, scale, oil, grease, dirt and scarf by pickling, emulsion cleaning, etc. The sheet steel shall be phosphated /oven dried and then painted with two coats of zinc rich primer paints. After application of the primer, two coats of finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS 5 /RAL 7032 for all switchboard /MCC/distribution board, control panels etc.

Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface and for other miscellaneous items, colour scheme will be approved by the purchaser.

6. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

7. FUNGI-STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish

8. SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

9. GALVANIZING

The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sqm minimum.

10. TRANSPORT AND PACKING

i. Packing

The bidder is advised to have a total study of all aspects of transportation of equipment's to site and should make schedule of transportation in accordance with the prevailing conditions at site. The bidder shall specifically understand that the Purchaser will do the general co-ordination of storage and erection works as well as civil engineering works of power house. An appropriate Period for transportation shall be considered accordingly.

The delivery dates, transportation and erection periods and for all other associated activities indicated in the Contract Documents shall be strictly adhered to. Changes, which are unavoidable or necessary, will be regulated in accordance with the stipulations laid down in the General Conditions of Contract.

From the time of manufacturing until commissioning all parts of the plant shall be protected and insured at the vendor/ contractor's expense against loss & damage of any kind. Parts, which are damaged during transport, storage, erection or trial operation, shall be replaced at the vendor/ contractor's expense.

ii. Packing and Marking

The vendor/ contractor shall prepare all plant, devices and materials for shipment to protect them from damage in transit, and shall be responsible for and make good all damages due to improper preparations, loading or shipment.

After the workshop assembly and prior to dismantling for shipment to the Site, all items of machinery and plant shall be carefully marked to facilitate site erection. Wherever applicable, these markings shall be punched or painted so that are clearly visible.

Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and for handling on the Site under the special conditions of the Project.

All individual pieces shall be marked with the correct designation shown on the vendor/ contractor's detailed drawings and other documents (packing, lists, spare part lists, in Operating and Maintenance Instructions, etc.).

Each piece, separately shipped, or smaller parts packed within the same case or box, shall be legibly, marked to show the unit to which it is a part and match-marked to show its relative Position in the unit.

Unit marks and match-marks shall be done preferably by punching the marks into the metal before painting, galvanizing, etc., and shall be clearly legible after painting, galvanizing etc. In labelling, the vendor/ contractor shall endeavour to use as few designations as possible, and each part of identical size and detail shall have the same designation, regardless of its final position in the plant.

All parts of the plant shall be packed at the place of manufacture; the packing shall be suitable for shipment by sea and for all special requirements of the transportation to Site. Where necessary, double packing shall be used in order to prevent damage and corrosion during intermediate storage.

All identical members shall be packed together, if reasonably possible, in a form convenient for shipment and handling.

Small items shall be packed in boxes and large items shall be protected where necessary, by timber, straw and sacking. Drums shall be used for electric cables, steel ropes, steel wire and similar materials. All bolts, nuts, washers. etc., shall be packed in containers. Each container shall include only bolts, nuts or washers of identical size.

All parts shall be suitable protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc.

All electrical parts shall be carefully protected from damage by sand, moisture, heat or humid atmospheric conditions by packing them in high pressure polyethylene foil. Where parts may be affected by vibration, they shall be carefully protected and packed to ensure that no damage will occur while they are being transported and handled.

Spare parts shall be packed separately and designated as specified and shall be delivered properly and adequately packed for several years' storage. All packing costs shall be included in the scope of Work.

iii. Shipping marks

The vendor/ contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows,

Consignee:

Contract No.:

Port of destination:

Item number (if applicable):

Package number, in sequence:

Quantity per package:

Description of Work:

Net and gross weight, volume, Dimensions:

iv. Packing lists

The vendor/ contractor shall provide the Purchaser with one (1) original and two (2) copies of all shipping documents and relevant packing lists of each shipment of equipment items after the same has been shipped. One copy (1) of the packing list shall sent to the Purchaser's Representative. All packing lists shall contain the name of the vendor/ contractor or supplier and shall show the complete markings on each packed box or crate that has been shipped. Separate packing lists shall be prepared for each and all shipments made. One copy of the packing list shall be placed inside each box or crate, and one copy inserted in a weatherproof envelope affixed to the outside of each box or crate.

11. HANDLING, STORING AND INSTALLATION

Vendor/ contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Vendor/ contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, vendor/ contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Vendor/ contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Vendor/ contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the vendor/ contractor. The vendor/ contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the vendor/ contractor shall immediately proceed to correct the discrepancy at his risks and costs.

12. DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc. to be installed shall be provided with degree of protection as detailed here under,

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-42

c) Installed in covered area IP:52

d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/ IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

13. RATING PLATES, NAME PLATES AND LABELS

Each major and auxiliary item of equipment shall have a nameplate permanently affixed thereto, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacture, rated capacity, speed, electrical characteristics, and other significant information, as applicable. Nameplates of distributing agents only will not be acceptable. Nameplates shall also be provided for identification of all panels, cubicles and other enclosures as well as for panel-mounted devices, dials, gauges instruments and control devices. Nameplates shall be marked with the nomenclature and units of measurement used in the metric system (SI- units), and a schedule of such markings shall be submitted for review. Type of nameplates and wording on identification nameplates shall be submitted in **English for approval**. The Owner will translate the text if needed and the vendor/ contractor shall furnish and attach the nameplates.

Cautionary signs: English shall be used as prime language on nameplates required for caution or warning signs, identification plates for control devices, and instruction plates.

Other nameplates: Nameplates which are not required for the operation of the equipment and are not of a cautionary or warning nature required for the safety of personnel, i.e. showing motor speeds, horsepower, electrical characteristics, name and address of manufacturer and other information necessary for maintenance and repair work are to be in English.

14. EARTHING

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

All equipment such as cubicles, motors, etc. shall be connected directly to the grounding system using copper wire of area not less than 50 mm2 at two different points. In general all iron parts such as supports, covers, railing, etc. shall be connected to the grounding system. Each conductor shall have its own separate connection point. Pressed on closed shoes shall be used for connections to bars.

15. TERMINAL BLOCKS AND WIRING

i. Wiring

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be stranded copper and shall be not smaller than 2.5 mm2, except as otherwise agreed by the Owner. Larger size wiring shall be used where needed for the current carrying capacity requirements.

Cables shall have at least 1100 V PVC insulation except for 220V DC and telemetering or communication system equipment for which 650V and 300V rating respectively are acceptable.

For current and potential transformer secondary circuits the cross section of the conductors shall not be less than 6 mm2 and 4 mm2 respectively.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in conduits accessible from the front door. The conduits shall not be filled more than 70%.

Each cubicle shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and

other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

ii. Terminal blocks

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers. Control wiring terminal shall be equipped with facilities for opening the circuit. It shall be possible to interchange a single terminal block for a new one without dismantling a whole row. Current transformer terminal blocks shall have provisions for short circuiting. Not more than two wires shall be connected to any one terminal. Terminal blocks using screws acting directly on the wire will not be accepted. At least 20% spare terminals shall be provided. Terminals shall be marked with printed labels.

But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge** or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with **test links and isolating facilities.** The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

16. ELECTRICAL EQUIPMENT ENCLOSURE

i. General

All electrical equipment, apparatus and devices shall be of suitable design for satisfactory operation under the conditions prevailing at the Site. The equipment shall operate satisfactorily under normal load and voltage variations in accordance with IEC Publications.

The design shall also include all necessary provisions ensuring the safety of the operating and maintenance personnel.

All electrical connections and contacts shall be of ample cross section and capacity for carrying continuously the specified currents without undue heating and shall be secured by bolts or set-screws of ample size, fitted with locknuts or lock washers of approved types.

Unless otherwise expressly stated, conductors and all other current carrying parts shall be electrolytic copper in accordance with approved, applicable standards.

Cubicles and other enclosures containing electrical equipment shall be especially treated to prevent corrosion. All cubicles shall be provided with a door switched lighting fixture and a single phase socket for power outlet.

All interior surfaces of electrical apparatus, enclosures etc. including contactors, relays, coils, etc., shall be treated in an approved manner to prevent mould growth. Such treatment shall in no way interfere with the proper operation of the equipment either electrically or mechanically.

Bigger assemblies such as switchboards, etc., shall be designed to present suitable transportation divisions adapted to the local conditions within the plant.

Unless otherwise specifically called for or described in these Contract Documents all electrical appliances shall conform to the applicable IEC Publications.

ii. Construction requirements

All cubicles and enclosures shall be of good quality standard production subject to approval by the Owner. Cubicles shall be free floor standing type, of rigid frame covered with removable steel sheets. The frame shall be bolted to the floor. There shall be provision and enough space for entrance of cables from above or below as necessary. The cubicles shall be ventilated if needed; in this case removable filter inserts shall be fitted to the air entrance openings. Provision for cable fastening shall be inside the cubicles and enclosures, and sufficient space from cable fastenings to nearest terminal. All control and indicating instruments such as contactors, circuit breakers, auxiliary relays, indicating instruments, switches etc., shall be functionally displayed in appropriate location. All indicating devices shall be visible with the door closed. The layout is subject to the approval of the Owner.

If required, flush mounted hinged steel doors with latches shall be available: doors shall be with approved locks. The locks shall be of the same type throughout the plant. All panels and cubicles shall have a uniform appearance.

The cubicles and enclosures shall be of protection class IP 54 or higher according to their location, unless otherwise, there are constraints which may prevent to maintain above protection class and same shall be justified by the vendor/ contractor and approval shall be taken from the owner for the deviation. All cubicles shall be equipped with automatically controlled heating elements for protection against internal condensation and moisture.

All panels/cubicles shall have approximately 20% space for mounting of future devices.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets.** The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/ box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

17. SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

18. QUALITY

All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the vendor/ contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the vendor/ contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

Manufacturing Quality Plan will detail out for all the components and equipment, various tests/ inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by vendor/ contractor's/ sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/

performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the vendor/ contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

The Bidder shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/ standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval.

No material shall be dispatched from the manufacturer's works before the same is accepted, subsequent to pre dispatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for dispatch by issuance of Material Dispatch Clearance Certificate (MDCC).

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/ standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

The vendor/ contractor shall submit to the Employer Field/ Site Welding Schedule for field welding activities. The field/site welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, procedures etc. at least ninety days before schedule start of erection work at site.

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/ BS-4870 or other International equivalent standard acceptable to the Employer.

All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

All brazers, welders and welding operators employed on any part of the contract either in vendor/ contractor's/ sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS- 4871 or other equivalent International Standards acceptable to the Employer.

Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

Any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

No welding shall be carried out on cast iron components for repair.

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

The vendor/ contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the vendor/ contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the vendor/ contractor and finalised with the Employer, shall be subject to Employer's approval. The vendor/ contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion.

For components/equipment procured by the vendor/ contractors for the purpose of the contract, after obtaining the written approval of the Employer, the vendor/ contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/ contract between the vendor/ contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery

conditions shall be furnished to the Employer on the monthly basis by the vendor/ contractor.

Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the vendor/ contractor's or their sub-contractor's quality management and control activities. The vendor/ contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

The vendor/ contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Vendor/ contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the vendor/ contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

19. DOCUMENTATION

i. List of Documents

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless anything is waived.

All engineering data submitted by the vendor/ contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

ii. Drawings

All drawings submitted by the vendor/ contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnection between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the vendor/ contractor shall be clearly marked with the name of the Employer, the unit designation, THDCIL contract no. and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the vendor/ contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the vendor/ contractor's risk. The vendor/ contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of vendor/ contractor's drawing or work by the Employer shall not relieve the vendor/ contractor of any of his responsibilities and liabilities under the Contract.

iii. Approval Procedure

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 3 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The vendor/ contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer below mention Title block for Submission of Documents.

Title Block

Customer	M/s THDC India Ltd., Rishikesh, Uttarakhand
Project:	Vishnugad Pipalkoti Hydro Electric Project (4X111MW)
Vendor/ contractor:	Bharat Heavy Electricals Ltd.

iv. Documents to be Submitted along with Offer

1. Drawings
2. Guaranteed Technical Particulars
3. Type Test Reports
4. Manufacturing Quality Plan

v. Documentation Schedule

Sl. No.	Description	Tender Stage	Contract stage for approval	Final Documentation	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	5	10	-
2	Drawings "As Built "	-	-	10	04
3	Type Test Reports	1	2	3	-
4	Erection Manuals	-	2	4	-
5	Operation and Maintenance Manuals	-	2	4	-
6	Manufacturing Quality Plan	1	2	4	-
7	Field Quality Plan	1	2	4	-
8	Inspection Test Reports	-	-	4	-

Soft copies of drawings at contract stage shall also be submitted in **PDF format**. Drawings will also be submitted in CD in **AUTOCAD** package for all major items. Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

20. ELECTRICAL MEASUREMENTS

All Electrical instruments shall be of flush mounted design, dust and moisture-proof. AC Ammeter and Voltmeters shall have moving iron system of not less than 1.5 accuracy class for connection to the secondary side of instruments transformer.

The indicating elements of each digital indicator shall be seven segment LED illumination type. The number of digits of each digital indicator shall be selectable to be sent the required indication. The watt and the var indicators for the circuits where direction of power flow may be changed, shall be provided with "+" and "- "signs.

All transducers shall be solid –state type with an output signal range of 4-20mA DC OR 1 to 5V DC, unless otherwise specified.

All wells for capillary type thermometers, resistance temperature sensors and thermocouples shall be of the weld-in type. Wells for thermometers and temperature sensors of the screw-in type shall be restricted to measuring points for lubrication oil, and to such measuring points where welding is not suitable, e.g., at cast-iron parts. Shop-welded thermometer wells be covered by screw caps for protection during transportation and erection.

Resistance thermometers and thermocouples shall be equipped with waterproof connection heads. Thermometer arrangements shall be such that the connection heads do not become warmer than 80OC, and the measuring inserts are easily exchangeable.

The temperature sensors shall be selected in such a way to minimize the number of different spare inserts.

Contents

ANNEXURE-A: Compliance Certificate of Technical Specification

The bidder shall confirm compliance to the following by signing and stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation(s) with respect to specification other than those furnished in the schedule of deviations.

3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of technical offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date: Bidder's Stamp & Signature

ANNEXURE-B: Deviation(s) of Technical Specification

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

Sl. No.	Page No.	Clause No.	Deviation	Reason/ Justification(s)

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Bidder's Stamp & Signature

ANNEXURE-C: Technical Checklist

Sl. No.	Particulars	Confirmation by Bidder	
1	**Technical Qualifying Requirement**		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
1.2	The bidder's scope includes supply only. The bid shall be submitted by the Supplier/ Manufacturer only. The Bidder's scope includes supply only.	Confirmed	Yes/ No
2	**Un-priced BOQ**		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof. Record the same in schedule of technical deviations.	Confirmed	Yes/ No
2.2	The Specification envisages design, type testing, manufacture, testing at factory, packing and delivery to site of 390kV Surge Arrester, complete with all fittings and accessories.	Confirmed	Yes/ No
2.3	Any other item required for the execution for the complete supply is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items required for completeness of supply is to be attached, if required and prices for same deemed to be included in prices of main items.	Confirmed	Yes/ No
3	**Technical**		
3.1	Catalogues, indicative OGA of the offered equipment is attached.	Confirmed	Yes/ No
3.2	Surge Arrester shall be supplied complete with hot dip galvanized hardware for inter unit joining and fixing to structure (both top & bottom).	Confirmed	Yes/ No
4	**Technical Deviations**		
4.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid shall not be considered.	Confirmed	Yes/ No
5	**Guaranteed Technical Particulars**		
5.1	All equipment being supplied shall conform to Guaranteed	Confirmed	Yes/ No

	Technical Particulars as per technical specification and applicable IS/ IEC.		
6	**Type Tests Requirements**		
6.1	All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.	Confirmed	Yes/ No
6.2	In case the test reports are not found technically valid during contract stage by BHEL/ Customer, the bidder shall repeat these test(s) at no extra cost to BHEL/ THDCIL and no delivery implication.	Confirmed	Yes/ No
6.3	The validity of type test reports shall be as per the latest CEA guidelines (amended time to time) as on the original scheduled date bid submission for BHEL tender. In case, where type test certificates are older than period as per latest CEA guidelines (amended time to time), bidder/ manufacturer shall carry out the type tests prior to dispatch of equipment without any commercial implication on BHEL/ THDCIL.	Confirmed	Yes/ No

Date: Bidder's Stamp & Signature

ANNEXURE-D: Guaranteed Technical Particulars (390kV Surge Arrester & its accessories)

Sl. No.	Description	Particulars
1	General	
a)	Manufacturer's Name	
b)	Manufacturer's Type/Designation	
c)	Applicable standards	
2	Electrical characteristics	
a)	Arrestor class and type	
b)	Rated arrestor voltage	
c)	Maximum continuous operating voltage at design ambient temperature	
d)	Nominal discharge current	
i)	8/20 micro second wave	
ii)	Maximum discharge current	
e)	Minimum dicharge capability reffered to rated voltage at minimum	
f)	Maximum equivalent front of wave protection level (discharge voltage with 0.5 x 1.5 micro second, 20kA impulse current)	
g) i)	Minimum switching surge residual voltage at 1kA	
ii)	Maximum switching surge residual voltage at 10kA	
h)	Maximum residual voltage for 8/20 micro second current wave	
i)	At 50% normal discharge current	
ii)	At 100% normal discharge current	
iii)	At 200% normal discharge current	
i)	One minute power frequency (dry) withstand voltage of arrestor	
j)	Impulse withstand test voltage of arrestor housing with 1.2/50 micro second wave	
k)	Impulse current withstand	
i)	High current short duration (4/10 micro second wave)	
ii)	Low current long duration	
l)	Maximum internal ionisation at 50Hz voltage equal to:	
i)	1.05 COV	
ii)	1.0 COV	
m)	Reference voltage and corresponding voltage reference current of Arrestor	
n)	Maximum internal leakage current at:	
i)	COV	

ii)	1.1 COV	
iii)	COV at 150°C	
iv)	Reference voltage	
o)	Pressure relief class	
p)	Details of the affect of protection levels by pollution of external insulation, if any	
q)	Energy absorption capability per operation of the arrestor, during a switching surge discharge	
r)	Maximum amount of energy that may be despatched into the arrestor during discharge assuming that discharge takes place within 1 minute period and state the switching surge current	
s)	Internal pressure required to operate pressure relief device as a percentage of burst pressure of porcelain	
t)	Dynamic overvoltage withstand for:	
i)	3 peaks	
ii)	0.01 second	
iii)	0.1 second	
iv)	1 second	
u)	Minimum prospective symmetrical fault current (kA rms) and short circuit capability	
v)	Rating of insulated base for installation of discharge counter	
w)	Rejection rate of ZnO blocks during manufacturing and operation for the past three years separately	
x)	Rated voltage of ZnO disc	
i)	No. of ZnO discs in a unit	
ii)	No. of Units/Arrestor	
iii)	Height/Thickness of ZnO discs	
iv)	Diameter of ZnO discs	
3	External Insulation	
a)	Type	
b)	Applicable Standard	
c)	Impulse voltage withstand test voltage of housing with 1.2/50 micro second wave	
d)	One minute power frequency withstand voltage of arrestor housing dry & wet	
e)	Total creepage distance of arrestor housing	
f)	Cantilever strength of complete arrestor	
4	Overall Dimensions	
a)	Overall Dimensions	

i)	Overall Height	
ii)	Height upto top of terminal pad from mounting plane	
iii)	Material of terminal pad	
iv)	Size of terminal pad	
v)	Mounting dimensions and diameter of mounting holes	
vi)	Diameter of insulator	
vii)	Cantilever strength	
b)	Total weight of complete arrestor	
5	Clearance in air (minimum)	
a)	Between phases	
b)	Between terminals & earth	
6	Tests to be conducted at supplier's work	
a)	Type tests	
b)	Routine tests	
7	Details & weight of supporting structure	
8	Details & size of earth conductor	

Date: Bidder's Stamp & Signature