



Purchase Indent

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP, NOIDA
Engineering Management

Project	PI No	PI Date	Rev No	Rev Date	GeMAR&PTS REPORT ID	Item Available on GeM
LTHPL LANCO TEESTA (NHPC)	2912200298	28-Mar-22	0		GEM/GARPTS/16032022/124S7PHNQKL8	Not Available

Main Equipment: PLCC

Emergency: N

Est.Category: J (75-100 L)

Tender Type: CUSTOMER APPROVED TENDER

Comments [if any] by TBEM:

Equipment Details

SN	Material Code	Equipment	HSN Code	Phy Unit	Qty	Plan Dt	Comments
1.000	TB9290000804	SUPPLY- PLCC : COUPLING DEVICE (PH-PH)		SET	4.00		
2.000	TB9290000154	SUPPLY- PLCC : HF CABLE 75OHMS UNBALANCED		MTR	2000.00		
3.000	TB9290000054	SUPPLY- PLCC : POWER LINE CARRIER TERMINAL SINGLE CHANNEL ANALOGUE TYPE FOR SPEECH + PROTECTION		NO	8.00		
4.000	TB9290000061	SUPPLY- PLCC : POWER LINE CARRIER TERMINAL SINGLE CHANNEL ANALOGUE TYPE FOR SPEECH +DATA		NO	2.00		
5.000	TB9290000216	SUPPLY- PLCC : ANALOG PROTECTION COUPLER 4 COMMAND		NO	8.00		
6.000	TB9290000835	SUPPLY- PLCC : VFT MODEM		NO	2.00		
7.000	TB9290000845	SUPPLY- PLCC : EPAX ALONG WITH ALL CONNECTING CABLES (8 LINE)		SET	1.00		
8.000	TB9290000921	SUPPLY- PLCC : EXPRESS TELEPHONE INSTRUMENT ALONGWITH ASSOCIATED ACCESSORIES, WIRING ETC		NO	16.00		
9.000	TB9290000292	SUPPLY- PLCC : 5 PAIR TELEPHONE CABLES, ARMOURED, 0.5 SQMM ANNEALED COPPER CONDUCTOR AND PETROLEUM JELLY FILLED WITH POLYETHENE OUTER JACKETS		MTR	1000.00		
10.000	TB9290000245	SUPPLY- PLCC : 2 WIRE TELEPHONE INSTRUMENT (ALONG WITH TELEPHONE WIRING)		NO	10.00		

SN	Material Code	Equipment	HSN Code	Phy Unit	Qty	Plan Dt	Comments
11.000	TB9290000321	SUPPLY- PLCC : 2 PAIR TELEPHONE CABLE (TINNED COPPER)		MTR	2000.00		
12.000	TB9290000171	SUPPLY- PLCC : TESTING & MAINTENANCE EQUIPMENT (PRINT TEST KIT)		SET	2.00		
13.000	TB8290000873	SPARES- PLCC : LEVEL METER WITH LEVEL OSCILLATOR, FREQUENCY 50HZ-500KHZ		SET	1.00		
14.000	TB8290000371	SPARES- PLCC : POWER SUPPLY MODULE FOR PLCC PANELS		NO	2.00		
15.000	TB8290000884	SPARES- PLCC : OTHER ELECTRONIC CARDS OF EACH TYPE USED IN PLCC PANELS		SET	1.00		
16.000	TB8290000905	SPARES- PLCC : TELEPROTECTION COUPLER		NO	1.00		
17.000	TB8290000891	SPARES- PLCC : MODEM		NO	1.00		
18.000	TB8290000851	SPARES- PLCC : OTHER CARDS OF EACH TYPE USED FOR TELEPHONE EXCHANGES		SET	1.00		
19.000	TB8290000935	SPARES- PLCC : EXPRESS TELEPHONE INSTRUMENT FOR DIRECT VOICE COMMUNICATION		NO	2.00		
20.000	TB3290000863	SERVICES- PLCC : SYSTEM ENGINEERING INCLUDING COMPUTER STUDY , FREQ. PLANNING AND SNR CALCULATIONS. INCLUDING COORDINATION WITH CENTRAL/STATE AGENCIES FOR APPROVAL.		LOT	1.00		
21.000	TB3290000565	SERVICES- PLCC : SUPERVISION OF PRE-COMMISSIONING (PANEL WISE)		NO	10.00		
22.000	TB3290000576	SERVICES- PLCC : SUPERVISION OF TESTING AND COMMISSIONING (LINK WISE)		LOT	2.00		

Prepared By: Puneet Chawla

Checked By: Ranajit Dey

Approved By: VIVEK KAPIL

[Handwritten signatures and dates]
 22/12/17
 28.3.22

TECHNICAL PRE QUALIFICATION REQUIREMENT

Name of Project : - 4x125MW Teesta-VI HEP
Name of Customer : - LTHP Ltd. (A wholly owned subsidiary of NHPC Ltd.)
Name of Consultant : - NHPC Limited
Name of Item : - PLCC Equipment

TECHNICAL PRE QUALIFICATION REQUIREMENT	
a)	The bidder should have manufactured, supplied and commissioned relevant similar PLCC equipment earlier during the last ten (10) years ending on 31.12.2019.
b)	The PLCC equipment should have been in successful operation at least at three power station/ installations.
c)	Should be an ISO certified company.

SUPPORTING DOCUMENTS TO BE ATTACHED		
Sr	Required Criteria	Supporting Documents to be submitted by bidder along with technical bid
1	Manufacturing	Approved Drawings / GTP / Approved Quality Plan / Factory Inspection Test Report e.t.c
2	Supply	PO / Dispatch clearance / LR / Material Receipt certificate at site / installation or commissioning certificate e.t.c
3	Commissioning	Pre commissioning report / commissioning report / Site Visit report for supervision of testing or pre-commissioning / certificate issued by employer or EPC contractor stating supervision of commissioning or pre-commissioning by bidderetc.
4	Successful operation	Satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.
5	ISO certified company	ISO document

Notes (General points):

1. Consideration of offer shall be subject to customer's approval of bidder's, if applicable.
2. 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.
3. 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.
4. 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

Contents

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2. **Codes & Standards**
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6. **Other General Requirements**
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9. **Quality plan**
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SECTION 1

SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. SCOPE

This technical specification covers the requirement of design, manufacture, testing at works, proper packing & dispatch of PLCC equipment as per contract. The electrical scope of work under this requisition shall include but not be limited to engineering, manufacturing, supply, transportation, inspection at manufacturer's work, commissioning including site testing, performance testing, acceptance testing of the PLCC equipment. The scope also includes the training of Employer's personnel for the commissioned equipment and guarantee for two years of PLCC equipment as per the specifications, along with necessary equipment, supply of all mandatory spares, all tools and tackles as required in drawings, standard specifications, standards etc. attached or referred with technical specification. No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer.

The fitments offered shall be of LTHP/NHPC approved make or its subsequent approval from LTHP/NHPC shall be bidder's responsibility, with no commercial implications to BHEL. If any of the make offered by the bidder is not acceptable to M/s LTHP/NHPC, the bidder has to supply alternate LTHP/NHPC approved make, meeting the specification, with no commercial implications to BHEL.

Wherever bidder offers any item/spare in lieu of the same being "Built-in feature" of any fitment or the same being "Not applicable" is subject to approval by LTHP/NHPC. No price implication will be entertained by BHEL at contract stage if any separate item is insisted by LTHP/NHPC to meet the contract requirement.

This section covers the specific technical requirements of the equipment (*PLCC System*). This constitutes minimum technical parameters for the above item as specified by the BHEL/LTHP/NHPC. The offered equipment (*PLCC System*) shall also comply with the Section-2 (Equipment Specification Under Scope of Supplies) of this specification and Section-3 (Project Details and General technical requirements for all equipment under the Project)

Note: The terms used in this specification namely, "Employer/Purchaser" refers to LTHP/NHPC, "Contractor" refers to BHEL & "Sub-contractor" refers to successful bidder.

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies
Section-3	:	Project Details & General Technical Requirements (For All Equipment under the Project)
Section-4	:	Schedule of Guaranteed Technical Particulars
Section-5	:	Check List
Annexures		Annexure A- Schedule of Technical Deviations Annexure B- Compliance Certificate to Technical Specification

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/ LTHP/NHPC concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations
2. Section-1
3. Section-2
4. Section-3

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/ LTHP/NHPC will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ LTHP/NHPC 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-B), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-A), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment (*PLCC System*) is required for the following project:

Name of the Customer:	LTHP Ltd. (A wholly owned subsidiary of NHPC Ltd.)
Consultant:	NHPC Limited
Name of Main Contractor:	Bharat Heavy Electricals Limited
Name of the Project:	4x125MW Teesta-VI (HEP)

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

2. CODES & STANDARDS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards. Further rules, guidelines and standard laid down by international/ national agency shall be applicable in this specification.

3. SPECIFIC TECHNICAL REQUIREMENTS

Technical requirements for the equipment (*PLCC System*) shall be as per Section-2. Specific requirement is follows:

Sl. No.	Technical Parameters	Particulars
	Equipment	PLCC System
(i)	Type/designation	Single channel, single side band (SSB), Amplitude Modulated
(ii)	Carrier Frequency	40 to 500kHz
(iii)	Power Output at HF Terminal	20/40/80Watt
(iv)	System Voltage	48V DC

Notes:

1. The PLCC equipment shall be used for protection, data transfer and voice communication between two ends of Teesta H.E. Project, Stage-VI and Rangpo pooling station through 220kV double circuit overhead transmission line.
2. The PLCC panels and for Teesta H.E.P Stage-VI end shall be located in Power House and the PLCC equipment for remote end i.e. Rangpo sub-station shall be located in Grid substation.
3. There shall be two PLCC panel each for sending and receiving ends.
4. **Bidder to decide the wattage of its PLC terminals to ensure that the Power output (PEP) at HF terminal shall be 20/40/80Watt as per the specification and offer accordingly. Any input, if required, to validate the offered wattage of its PLC terminal shall be arranged by the bidder.**
5. It is bidder's sole responsibility to correctly offer the complete PLCC system, and submit the requisite drawing/document for approval, successfully commission and handover the PLCC system to LTHP/ BHEL. It is to be noted that if at any stage the wattage of the offered PLC terminals is found inadequate, the PLC terminal shall be modified / replaced with higher wattage terminal without any price implication to BHEL.

4. BILL OF QUANTITIES

1. Quantities for supply and services for the equipment (*PLCC System*) shall be as below. However, any item/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.
2. Cut lengths of HF cable shall be furnished to the successful bidder.
3. **Quantity variation for items at Sl. No.2, 9 & 11 shall be +/-50%. Overall contract value may vary by +/-20%.**
4. **All other special/data /telephone cable required for completion/interfaces of PLCC system shall be in the scope of the bidder. This shall also include telephone cable as required for connecting telephone sets and EPAX.**
5. **Supervision of Testing and Commissioning is required for all the items as per BoQ and 1 Lot (Link-wise) will include Supervision of Testing and Commissioning for all the below items at both ends of each link/ direction**
6. Modem and protection coupler to be mounted in the respective PLCC panel by the bidder.
7. 2 pair telephone cable (Tinned Copper) shall be armoured.

SN	Detailed Description	Unit	Sending End	Receiving End	Total Qty
1.	Coupling device (1set=2LMU +1BT)	Set	2	2	4
2.	HF cable(75ohms,unbalanced)	m	1000	1000	2000
3.	PLCC Analogue Type (for speech and protection)	Nos.	4	4	8
4.	PLCC Analogue Type (for data)	Nos.	1	1	2
5.	Analog Protection coupler 4Command	Nos.	4	4	8
6.	VFT Modem	Nos.	1	1	2
7.	EPAX along with all connecting cable (8lines)	Set	1	NIL	1
8.	Express telephone instrument (Along with telephone wiring)	Nos.	8	8	16
9	5 pair telephone cables, armoured, 0.5sq mm dia annealed copper conductor and petroleum jelly filled with polyethene outer jackets	m	500	500	1000
10	2 wire telephone instrument (Along with telephone wiring)	Nos	10	NIL	10
11	2 pair telephone cable (Tinned Copper)	m	2000	NIL	2000
12	Testing & maintenance equipment(print test kit only)	Set	1	1	2
13	Special Tools: Level meter with level Oscillator, frequency 50Hz-500kHz	Set	1	NIL	1
14	Mandatory Spares: Power supply module for PLCC panels	Nos.	2	NIL	2
15	Mandatory Spares: Other Electronic cards of each type used in PLCC panels	Set	1	NIL	1
16	Mandatory Spares: Teleprotection Coupler	Nos.	1	NIL	1
17	Mandatory Spares: Modem	Nos.	1	NIL	1
18	Mandatory Spares: Other cards of each type used for telephone exchanges	Set	1	NIL	1
19	Mandatory Spares: Express telephones for direct voice communication	Nos.	2	NIL	2
20	Services: System engineering including Computer study, Carrier freq. planning and SNR Calculations. Including coordination with Central/state agencies for approval thereof.	Lot	1	NIL	1
21	Services: Supervision of pre-commissioning (panel wise)	Nos.	5	5	10
22	Services : Supervision of Testing and commissioning (link wise)	Lot		2	2

5. TECHNICAL PRE-QUALIFYING REQUIREMENT:

Please refer document: *Annexure_TQR*

6. OTHER GENERAL REQUIREMENTS

The other general requirements for the equipment (*PLCC System*) shall be as follows:

1. **Site Testing & Commissioning**
 - a. Bidder shall depute qualified testing & commissioning engineer (s) including supply of all testing instruments/ kits.
 - b. Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/ LTHP/NHPC/ Consultant.
 - c. The erection, testing and commissioning of PLCC system shall be done under the supervision of the Equipment manufacturer (Bidder).
2. **Manuals** – Required receipt, storage, installation, testing, commissioning manuals covering all equipment of PLCC system shall be supplied by bidder as per project requirement. OEM manual / OEM certified manuals are to be provided for
 - a. Storage and preservation manual
 - b. Safety manual
 - c. Erection Manual
 - d. Testing and commissioning manual
 - e. Operation & Maintenance manual
 - f. Repair process / procedure manual for equipment / system
3. **Carrier freq. planning and coordination with Central/state agencies for approval thereof is in the scope of the successful bidder.**
4. The bidder shall include in his proposal the deployment of all special tools and tackles required for erection, testing commissioning and maintenance of the equipment. The Special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. A list of all such devices shall be furnished.
5. The bidder shall handover the spares and test equipment as per BoQ.
6. The equipment shall be suitable for providing superimposed data and tele printer facilities at a later date without major modifications and high cost. The Bidder shall clearly indicate in his bid the provision made in his proposal for future development and the extent to which such additional facilities can be added at a later date.

7. TYPE & ROUTINE TEST:

7.1. TYPE TESTING FOR PLCC Equipment

The manufacturer is required to carry out all type tests as per relevant IEC/ International standards on one apparatus of each type of similar rating and shall submit the reports to the

employer. The type tests may not be mandatory if similar equipment has been type tested and test certificates for relevant tests are accepted by the employer.

The shop test to be carried out on PLCC equipment at manufacturer's work are mentioned in Section-II (Clause 13.2)

8. DRAWINGS & DOCUMENTATION

8.1. Documents to be submitted along technical bid

Bidder shall furnish following documents during tendering stage itself for information purpose. The same shall be reviewed and commented during contract stage only. (Bidder to please note, deviations if any needs to be submitted in schedule of technical deviation only. Deviations submitted elsewhere in bid document / in any calculations shall not be considered.)

Sr No.	Name of Documents	
1	SCHEDULE OF GUARANTEED TECHNICAL PARTICULAR (as per attached format)	
2	List of Type Test Reports	Details of Test object, test name, Test Lab, Report number & report date.
3	Any other calculation / design document as applicable in line with technical specification and / or relevant section of IEC / IS etc.	

8.2. Drawings / documents required for engineering manufacturing clearance

The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance of the equipment (PLCC system) and furthermore, it shall be used for delay analysis, if any from bidder. The successful bidder is required to submit drawings and documents that shall cover but not limited to the following:

Sl.	Description of Drawing
1	General Arrangement Drawings of Coupling Device, PLC Terminals, EPAX etc.
2	Guaranteed Technical particulars for each type of item offered
3	Type Test Report as per relevant IEC Standards
4	Model Quality Assurance plan
5	Performance & Design calculation as per C13.6.3 of Section-II

9. QUALITY PLAN

The successful bidder shall submit Quality Assurance Plan in line with reference QAP attached in Section-2 for the equipment (PLCC system) with in-process inspection methods, tests, records, etc. for BHEL/ LTHP/NHPC approval. LTHP/NHPC hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ LTHP/NHPC. In case bidder has reference Quality

Assurance Plan agreed with LTHP/NHPC, same shall be submitted for specific project to BHEL/LTHP/NHPC approval. There shall be no commercial implication to BHEL/LTHP/NHPC 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 (PLCC system). 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.

During fabrication/manufacturing or assembly, the equipment shall be subjected to inspection by BHEL/NHPC/LTHP or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.

Note-Inspection and testing shall be done as per technical specification. However, any other test not mentioned but required as per relevant IEC/IS shall also be performed.

10. PACKING AND DISPATCH

1. All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 2 years) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
2. The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.
3. All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.
4. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
5. Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
6. Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment

giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.

7. All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
8. Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
9. Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.
10. The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract as per relevant Clause of Section 2 & Section-3.

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TEESTA H. E. PROJECT, STAGE - VI

13. PLCC SYSTEM

13.1. Scope of Work

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, insurance, training of Employer's personnel, handing over to employer and guarantee for two years of PLCC system, as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The scope of work shall be a comprehensive functional system covering all supply and services including but not be limited to following:

13.1.1. Detailed Scope of Works

13.1.1.1. Scope of supply

- A. PLCC panels with protection couplers - 8 Nos.
(2 Nos. each for sending and receiving ends)
- B. 8 line telephone exchange - 1 Nos.
(1 Nos. for sending end only)
- C. Ten (10) nos., 2 wire telephone set connected to exchange,
- D. 4 wire telephone set for direct connection to PLCC - 2 Nos. with each panel (Express telephone)
- E. One set of necessary card/module along with accessories required for data telemetry, etc at both end as per clause no. 13.5.2
- F. Coaxial Cable, Cables, LMU, Protection device and other accessories to complete the system at both ends,
- G. Coordination and provision of necessary contacts and/or ports for integration with plant SCADA system.
- H. Carrier frequency planning and coordination with Central/ state agencies for approval thereof.
- I. One (1) set of spare as per clause no. 13.8 of this section.
- J. One (1) set of tools and instruments as per clause no. 13.9 of this section.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.



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13.2. Specific Parameters and Layout Conditions

13.2.1. Layout and General Arrangement

The PLCC equipment shall be single channel and suitable for protection, data transfer and voice communication between two ends of Teesta H. E. Project, Stage-VI and Rangpo pooling station through 220 KV double circuit overhead transmission lines.

The PLCC panels for Teesta H. E. Project, Stage-VI end shall be located in Power House. The PLCC equipment for receiving end i.e. Rangpo sub-station shall be located in the Grid sub stations. The Contractor shall install and commission the equipment with complete scheme as per direction of the Employer. Necessary coordination with PGCIL and shutdown of the line shall be provided by employer. Contractor shall commission the PLCC equipment for both ends.

Ten Nos. telephones at project end shall be located in different areas of power house & pothead yard and wired to the 8 line telephone exchanges being provided along with PLCC panels.

The other equipment like CVTs, Wave traps etc for project end shall be supplied by the Contractor of Pothead yard equipment of this contract.

For remote end (receiving end), the Contractor shall supply PLCC panel with protection coupler, coaxial cable, LMU, four wire telephone sets with cable etc. to make the scheme similar to sending end.

Mode of coupling of the line shall be phase to phase.

The coaxial cable shall be laid on cable trays through existing trenches/ cable trays.

For Teesta H. E. Project, Stage-VI end, 48V DC power supply for PLCC panel shall be provided at 48V DC distribution board at Power House. For Rangpo end, 48V DC power supply for PLCC panel shall be provided at 48V DC distribution board of Rangpo substation. AC power supply for PLCC panels shall be provided at nearest AC distribution boards at Power house/Pothead yard/GIS and distribution board in Rangpo. Power cables for supplying power to PLCC panels for Rangpo and Teesta H. E. Project, Stage-VI end shall be supplied and erected by EM-I contractor.

13.3. Rating and Functional Characteristics

PLCC panels will be single channel, single side band (SSB), Amplitude Modulated. PLCC panels meant for protection trip transfer shall be provided with protection coupler. Panel at each end shall be provided with inbuilt (8 line) telephone exchange facility. All the channels shall be suitable for data transfer & voice communication through direct Hot line & four wire telephone set.

13.4. Performance Guarantee

The PLCC System along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The



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Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

13.5. Design and Construction

13.5.1. Standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the following applicable standards. In the event of other standards being applicable they will be compared for specific requirement and specifically approved during detailed engineering for the purpose:

Standard	Description
IS: 9528 (Part I and II)	Manual for planning of (SSB) PLC system
IEC 62488-1	Power line communication systems for power utility applications – Part 1 : Planning of analogue and digital power line carrier system operating over EHV/HV/MV electricity grids
IEC 60481	Coupling devices for power line carrier systems

13.5.2. PLCC Panels

For design and construction of PLCC equipment, the following factors shall be taken into consideration:

- ◆ Frequency range allotted for PLCC in INDIA (40 kHz-500kHz),
- ◆ Phase to phase coupling device sets on each transmission line,
- ◆ Optimum use of bandwidth and channels,
- ◆ High immunity to electrical interference,
- ◆ Easy maintainability.

PLCC panel with protection coupler shall also have the loop test facilities. It should be possible to check the transmitter and receiver of the same station without any external instrument or signal.

Phase to phase coupling will be provided for each 220 KV line.

All the PLCC terminals shall be of multipurpose type. The Contractor shall confirm that the total transmission time for teleprotection shall not exceed 30 ms. Speech and teleprotection channels shall independently fulfil the SNR requirements out of the power allocated to its channel from the total power of the PLCC terminals.

The equipment for protection signals shall have high degree of reliability and speed. It shall be guaranteed to function reliably in the presence of noise impulse caused by isolator or breaker operation. It shall also be



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possible to effect direct tripping of breaker at one end when the other end breaker opens out either manually or by relays such as Bus fault relay etc.

For transfer of teleprotection inter trip commands between Teesta H. E. Project, Stage-VI and Rangpo substation, protection couplers shall be provided in the PLCC scheme. Wiring of the inter trip signals from PLCC panel to Line relay panels shall be done by the contractor of package "EM-I Power and Control Cable (Cabling system)" and shall be coordinated. The telemetry data like MW, voltage, line current and other digital signals like status of breakers and isolators shall also be transferred to RLDC through PLCC scheme. The telemetry data shall be provided by contractor of EM-I package and shall be coordinated. Speech communication in dialling mode between two stations with inbuilt telephone exchange in PLCC panel is also required to be provided. Detail of signal and telemetry data will be finalized during detailed engineering as per guideline and regulation issued from time to time.

13.5.3. Line matching unit (2LMU+1BT)

The line matching unit (Coupling device) with suitable mounting accessories shall be interposed between CVT and connecting line to the PLC transmitter/ receiver. It shall ensure:

- ◆ Composite loss (maximum) less than 2 dB
- ◆ Return loss not less than 12 dB
- ◆ Efficient transmission of carrier frequency signals
- ◆ Impedance matching between the power line and the carrier frequency connection.

13.5.4. Protection device

Three elements protection device comprising of earthing switch, lightning arrester and drain coil shall be provided for safety of personnel and protection of the low voltage parts and installation against the effect of power frequency voltage and transient over voltage.

13.5.5. Coaxial cables

The coaxial cables shall have following properties:

- ◆ Co-axial H.F cable with 75 ohms (± 3 ohms) characteristic impedance (unbalanced),
- ◆ Rated Capacitance per meter – 67 pF approx.,
- ◆ Dielectric strength of core – 8 kV (rms)
- ◆ Discharge test (corona test)- not less than 4.0KV (rms)
- ◆ Nominal Size of Inner conductor – 7 strands of 0.4mm dia each or single conductor of dia 1.120mm
- ◆ Type -Armoured
- ◆ Material of



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- Inner conductor -plain annealed and high conductivity Electrolytic copper wire
- Outer conductor -Tinned copper braided wire
- ◆ Material of armouring -GI wire braid.
- ◆ Attenuation constant - 0.1dB/m maximum at measuring frequency of 200Mhz

13.6. Drawings, Documents and Design Calculations

13.6.1. Design memorandum

The Contractor shall submit to Employer a design memorandum prepared in accordance to clause 1.6 "Record and Documentation" of "Section 1- General Technical Requirements."

After completion of work, a complete set of As built drawing as per layout shall be developed and submitted by contractor for future reference.

13.6.2. Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in "Section 2 - Technical Documents" of "General Technical Specification (GTS)".

13.6.3. Design calculation

The Contractor shall submit the design calculation in accordance to Clause 2.6 of "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

i). Performance calculation

The signal at receiver terminal and the SNR at the receiving terminal coupling capacitor shall be determined to calculate the channel performance. The received signal level shall be calculated for fair weather conditions and then a fade margin shall be added to determine receiver sensitivity requirements. The SNR shall be calculated for foul weather conditions and for this it shall be determined if the channel has adequate transmitter power to perform properly.

ii). Calculation and current requirement required for equipment along with telephone exchange.

The Contractor shall also provide other calculations as required by the Employer for his approval of the Contractor's design.



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13.7. Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 "Delivery, Installation and commissioning" of "Section 1 - General Technical Requirements."

13.8. Spare Parts

Specified spare parts to be supplied under this section are as follows:

S. No.	Description	Quantity
1	Power supply module for PLCC panels	2 nos.
2	Other Electronic cards used in PLCC panels	1 nos. of each used type
3	Teleprotection coupler	1 nos.
4	Modem	1 nos.
5	Other cards used in telephone exchanges	1 nos. of each used type
6	Four wire telephones for direct voice communication (Express telephone)	2 nos.

13.9. Tools and Instruments

The Contractor shall supply all necessary tools and instruments etc. for installation, repair and maintenance in accordance to clause 1.9 "Tools and Instruments" of "Section 1 - General Technical Requirements".

13.9.1. Special tools

The Contractor shall propose the list of special tools including their make and detailed specification as recommended by manufacturer(s), to be accepted by the Employer.

The proposed list of special tools must include the following in addition to tools recommended by manufacturer(s)

- ◆ Two (2) sets of card / module extraction tools,
- ◆ One (1) level meter with level oscillator, frequency 50 Hz-500 KHz.

13.10. Quality Assurance and Testing

The Contractor shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)".



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13.11 Print testing kit for PLCC terminal, E/M interface & subscriber unit, Protection coupler & EPAX

-- comprising of following items of reputed make in addition to any other special items required for testing and maintenance of this equipment packed in a carrying brief case:

1. Screw driver set with multi up fixing feature
2. Nose pliers
3. Cutting pliers
4. Ordinary Pliers
5. Adjustable wrench
6. Soldering iron with tip earthed
 - a) 150 watts - 1 No.
 - b) 35 Watts - 1 No
 - c) 10 watts - 1 No.operated with isolated (step down) transformer having provision for interchangeable taps.
7. Desoldering pump
8. Print extender
9. Print puller
10. Large selection of test leads
11. Solder wire
12. Large selection of plugs, jacks & pistol probes compatible with equipment supplied
13. Dummy load
14. Interface card/print for Tx to Rx loop-back
15. Test oscillator/tone generator with indicating meters - either built in or separate
16. ESD wrist band
17. ESD conducting mat



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13 PLCC

13.1 Guaranteed Technical Particulars

Item / Clause No.	Parameter	Unit	Employer's Requirement	Bidder's confirmation / seal / signature
1	Type/ designation	-	Single channel, single side band (SSB), Amplitude Modulated	Confirmed
2	Frequency band effectively transmitted	-	40 to 500 kHz	Confirmed
3	Main data			
3.1	Number of PLCC panels (systems)			
	- total, sending and receiving ends	Nos.	8 Nos.	Confirmed
	- per line, sending end	Nos.	2	Confirmed
	- per line, receiving end	Nos.	2	Confirmed
3.2	Carrier frequency range (programmable)	kHz	40 to 500 kHz	Confirmed
3.3	Mode of operation (e.g. SSB, full duplex two-way etc.)	-	SSB	Confirmed
3.4	One set of necessary card/module along with accessories required for data telemetry, etc at both end as per PTS clause no. 13.5.2	-	Yes	Confirmed
3.5	Number of channels provided for			
	- for protection	-	Yes	Confirmed
	- for data transfer	-	Yes	Confirmed
	- for voice communication	-	Yes	Confirmed
3.6	Telephone Exchange (EPABX)			
3.6.1	Capacity of subscribers	Nos.	min. 16	Confirmed
3.6.2	Capacity of trunk line	Nos.	8	Confirmed
3.6.3	Number of connections to parallel exchange	Nos.	min. 8	Confirmed
3.6.4	Software features included	-	Yes	Confirmed
3.6.5	Number of telephone sets	Nos.	10	Confirmed
3.6.6	Type of telephone sets	-	2 wire telephone sets	Confirmed
3.6.7	Total transmission time for teleprotection	ms	< 30 ms	Confirmed
4	Coaxial Cable			
4.1	Type designation	-	Armoured Co-axial cable	Confirmed
4.2	Material of			
	- Inner conductor	-	Electrolytic copper wire	Confirmed
	- Outer conductor	-	Tinned copper	Confirmed
4.3	Material of armouring	-	GI wire braid	Confirmed
4.4	Withstand test voltage	Kv	4 kV RMS	Confirmed
4.4.1	Period of test voltage	min	1 minute	Confirmed
4.5	Capacitance per meter	pF	67	Confirmed
4.6	Characteristic Impedence	ohm	75	Confirmed
4.7	Attenuation constant			
4.7.1	At 200MHz	dB/m	0.1	Confirmed
5	Compliance of latest standards as per PTS clause no. 13.5.1	-	Yes	Confirmed

Bidder's Seal and Signature
 of Authorized Representative

EM-II, Volume IIC (TDS)

13.1 Type Test

The contractor is required to carry out all type tests as per relevant IEC / International Standards on one apparatus of each type of similar rating and shall submit the reports to the Employer. The type test may not be mandatory if similar equipment has been type tested and test certificate(s) for relevant tests are accepted by the Employer.

13.2 Shop Test

The PLCC equipments such as Carrier Equipments, VFT Equipments, Protection Equipments, Line Matching Units, Co-axial Cable, Telephone Exchange etc. shall be routine tested as per relevant IEC with latest amendments. Following tests shall be carried out by the manufacturers at their works:-

Test on PLC Terminals as per IEC: 60495

- **Carrier equipment:**
 - System integration & Testing for functions.
 - Carrier frequency level.
 - Frequency Accuracy.
 - Loss of speech/ signal level.
 - Signals level.
 - Automatic Gain control.
 - Transmit /receive frequency difference.
 - All Alarm indications.
 - Voltage withstand test & Supply voltage variation test.
- **VFT Equipment:**
 - System integration & Testing for functions.
 - Supply voltage variation test.
 - Transmit Signal Frequency measurement.
 - Transmit signal level.
 - Channel distortion at nominal level.
 - Measurement of O/P waveform.
 - Data transmission PC to PC.
 - Receiver output relay operation.
- **Protection Equipment:**
 - System integration & Testing for functions.
 - Supply voltage variation test.
 - Frequency measurements.
 - Guard frequency tests.
 - Trip command frequency Test.
 - Transmitter output level.
 - Receiver level.
 - Trip input & output test.
 - Transmission time.
 - Operation loop testing.
 - Unblocking.
 - Provision for integration with plant SCADA system.

The details of tests are given in Model Quality Assurance Plan of PLCC.



SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents 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 prevail.

3.1 PROJECT DETAILS

Name of the Project:	Teesta-VI H.E. Project (4x125 MW)
Name of the Customer:	LTHP LTD. (A wholly owned subsidiary of NHPC Ltd.)
Name of Consultant :	NHPC

Teesta (stage-VI) H.E Project is the last of the six projects in cascade development hydro power potential of Teesta River in the state of Sikkim. Teesta-VI Project is located in south (District) of Sikkim. It is a run of river scheme, with a barrage proposed across River Teesta at Sirwani about 100km downstream of L D Kazi Bridge, near Singtam village on singtam-Dikchu Road. Barrage site is located about 4 km from Singtam. The river has been diverted through the completed barrage bays on the left side to facilitate construction of the remaining barrage and Desilting Basin and all other components (Head Regulator Intake, De- silting Basin, Tunnel intake, head Race Tunnel, Surge shaft, pressure shaft, MIV cavern, power House, Transformer cavern, Tail Race Tunnel and pot Head yard) which are on the right bank of river Teesta. Power House site will be near Subin khore 27.5 km from Singtam and about 31.5 km from Barrage site by road. A gross head of 116 m between the HRT intake site and the power house site is to be utilized for power generation.

It is a run of the river scheme for power generation. The power house will have an installed capacity of 500 MW (4x125MW) and the annual energy production is estimated to be 2400 MU with 95% machine availability.

3.2 Location of Project:

The approximate distance of Project Barrage site from different important towns is as below:

From Singtam to Barrage Site	4.0 kms (approx.)
From Rangpo to Power House Site	12.5 kms (approx.)
From Singtam to Silliguri	95 kms (approx.)
From Barrage site to Silliguri	99 kms (approx.)
From Power House site to Silliguri	67 kms (approx.)
From Silliguri to Kolkata	577 kms

3.3 Salient Features:

Location:

• Country	India
• State	Sikkim
• District	South
• River	Teesta
• Nearest Village	Singtam
• Dam site Near	Sirwani
• Latitude	27 deg 14'42" N
• Longitude	88 deg 29'15" E
• Nearest Rail Head	Siliguri, West Bengal, India
• Nearest Airport	Bagdogra, West Bengal, India

Hydrology:

• Catchment Area at diversion site	4558 Sq. Km
• Rain fed catchment	2295 Sq. Km
• Snow catchment	2263 Sq. Km.
• Average Annual Rainfall	2544 mm
• Maximum Temperature	37 deg
• Minimum Temperature	8 deg
• Maximum Relative Humidity	96.4%
• Minimum Relative Humidity	5.8%
• Standard Project Flood	11600 Cumec (SPF)
• Average annual yield	11861 Mcum

POWER HOUSE COMPLEX:

• Location	Right Bank
• Type	Underground
• Installed capacity	500 MW
• Number and capacity of units	4 Nos. of 125 MW each
• Size of Power House Cavern	142.75m x t8.5m x 52.44 m high
• Size of Transformer cum GIS Cavern	128mx14.5mx21 m high
• Service bay level	EL 248.34 m
• Type of turbine	Francis, vertical axis
• C/L of turbine	EL 235 m
• Rated head (Weighted Average Head)	105 .4 m
• Type of switchgear	GIS (Indoor)
• Size of pothead yard	100 m (L) x 30 m (w)

3.4 Seismic Zone

The project is situated in a hilly seismic area and falls within Zone-IV of the seismic zoning Map of India. The forces being caused by earthquake including hydraulic loads which may occur additionally shall be taken in to account for computations. More over vertical and

horizontal acceleration shall be combined in the most unfavourable way. For horizontal and vertical accelerations, a factor of 0.15 g and 0.075 g respectively shall be assumed. Stresses resulting after including these loads shall not exceed permissible stresses.

The Contractor shall design all equipment supplied under this contract to satisfy the seismic criteria. The Contractor shall submit to the Employer the method of calculation and relevant codes he intends to use for this purpose.

In addition to the above, the IS-1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipment in addition to hydro static loads.

3.5 Transportation and Storage

The Contractor shall inform himself fully as to all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Contractor shall also be responsible for obtaining from the Indian railway or highway authorities any permit that may be required for the transport of loads exceeding the normal gauges.

The Contractor shall provide means for all unloading and reloading for all consignments of plant; both during transport to Site and on the Site. Consignments shall be unloaded immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc. All parts of the plant shall be brought, as far as possible, to their final place of erection. The Contractor shall construct their own storage facilities at site.

The warehouses shall be weatherproof, with good ventilation and solid floors. The floors of the warehouses and storage areas shall be designed to carry the loads imposed on them by the stored parts. The following parts shall be stored inside enclosed warehouses:

Bolts, pins, packing, tools, insulation materials, electrical parts with electrical devices attached, electric motors, instruments, welding material and equipment, all small parts and all parts of the plant which already have been finally painted.

If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts, which are not packed suitably and those so packed, but whose packing has been damaged shall be kept in suitable places from the moment of storage to the moment of installation. All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity. All the equipment shall be stored as per standard storage and preservation instructions etc. of the suppliers. Dehumidifiers shall be installed in store/enclosed area as per direction of Engineer-in-charge.

3.6 Transport Limitation

For shipments, the Manufacturer shall pack the items to meet size and weight restrictions of the Indian railways and road systems. Shipments from Manufacturer's work (in case offshore consignments) shall travel to Port of entry - India, from where these will be transported, after necessary port clearances etc., by the Contractor to nearest rail head for the Project, and

further transported to site. However, in certain cases the Contractor may be required to transport the materials from Port of entry to Project site directly by road transport. For onshore consignments, the Contractor shall be responsible in all respects for transportation of all material and equipment up to the project site.

The Contractor shall consult with the concerned authorities in railways and highways to ensure that his packaging will be such as to permit him to transport the plant and equipment within such imposed limits. The Contractor shall arrange to deliver the maximum sized sub-assemblies consistent with safe and convenient transport.

All materials and equipment etc. arrived at nearest railhead for the Project will be unloaded from rail wagons and reloaded on to road transport for shipment to project site by the Contractor. All components shall be so designed and constructed as would enable easy assembly of components at works and at the same time permit easy transportation. The weights and sizes of the components/packages shall be within the permissible transport limits for the project site.

3.7 Main features of Project

The project shall comprise of following major components:

- i) Four units of 125 MW each at generator terminal at rated condition,
- ii) An underground Power house housing four (4) main inlet valves of butterfly biplane lattice type in MIV cavern, (4) vertical-shaft generating units, each composed of a Francis turbine directly coupled to a synchronous generator and other related auxiliaries in power house cavern,
- iii) A Transformer cavern having 13 nos. 11/220/ $\sqrt{3}$ kV single phase generator transformers,
- iv) A 245kV GIS hall in Transformer cavern for installing 245kV GIS,
- v) A 245 kV outdoor pothead yard for evacuation of generated power through 220kV transmission lines.
- vi) installed Capacity - 500 MW
- vii) No. and size of Units - 4 units of 125 MW each
- viii) Generation voltage – 11kV
- ix) Transmission voltage – 220kV
- x) Type of Power House – Underground
- xi) Type of Switchyard - Indoor type GIS
- xii) GSU Transformer - 13 nos. 51 MVA, Single Phase, 50 Hz, 11/220/ $\sqrt{3}$ kV OFWF/ ODWF type
- xiii) Method of connection between Transformer and GIS - GIB

3.8 Operating Requirement, Specification

The equipment/system to be supplied under this contract shall be suitable for continuous operation under varying grid parameters as allowed in latest "Indian Electricity Grid Code" and "Indian Electricity Rule". The equipment supplied shall also be compliant with latest Central Electricity Authority-Technical Standards for Construction of Electrical Plants and Electric Line Regulations and latest CERC norms at the time of supply of equipment.

The equipment/system shall be designed to operate continuously without any problem under +/-10 % voltage variation and +/-5% frequency variation, Temperature rise/ variation limit for equipment shall be determined considering the above variation. Frequent start/stop

requirement of all equipment for daily operation shall be taken into consideration while designing.

3.9 Auxiliary voltages

The electrical equipment like switchboards, MCCB, Surge Protection Devices, motors, contactors, relays, luminaries, heaters, switches, sockets, Terminal Blocks, Power outlets etc. should be rated for any of the following voltages:

A) AC power

Three-phase system with grounded neutral for feeding 3-phase and 1-phase equipment (connected between phase and neutral), type TN-C 415/240V +/-10% and 50Hz +/-5%. All motors and other electrical apparatus should be designed to work continuously under +/-5% frequency variation and +/-10% voltage variation.

B) DC power

- i) 220V +/- (Plus/minus) 10% DC Systems, ungrounded, with earth fault detection for the supply to main control circuits for high and medium voltage switchgear, protection circuits and to other larger essentials loads,
- ii) Other voltage systems eventually needed, shall be generated from the above systems by means of dc/dc converters, inverters etc.

3.10 Performance Guarantee

The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment systems covered in these specifications.

The Contractor shall demonstrate all the guarantees covered herein during functional guarantee/ acceptance tests.

3.10.1 SYSTEM PARAMETERS

S. No.	Description of parameters	220 kV System
1.	System operating voltage	220 kV
2.	Maximum operating voltage of the system(rms)	245 kV
3.	Rated frequency	50 Hz
4.	No. of phase	3
5.	Rated Insulation levels	
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	-
iii)	One minute power frequency dry withstand voltage (rms)	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	460 kV
6.	Corona extinction voltage	156 kV
7.	Max. radio interference voltage for frequency between 0.5MHz and 2MHz	1000 micro-Volt at 156kV rms
8.	Minimum creepage distance (25mm/kV)	6125 mm
9.	Min. clearances	
i)	Phase to phase	2100 mm
ii)	Phase to earth	2100 mm
iii)	Sectional clearances	5000 mm
10.	Rated short circuit current for 1 sec. duration	40 kA

11.	System neutral earthing	Effectively earthed
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3.10.2 Control and Monitoring

The system shall be controlled and monitored by the SCADA system. The details of "Control and Monitoring System" and "Protection System" are covered under separate package EM-I.

It shall be the responsibility of the Contractor to make all necessary provisions required to achieve seamless and compatible interfacing of control and monitoring systems of all equipment with plant SCADA system.

Provisions of all transducers/ sensors, instruments, gauges for mechanical parameters (temperature, pressure, flow, vibration, etc.) and electrical parameters (current, voltage, frequency, power, MVAR, KWH, etc.) and spare contacts of relays, breakers, isolators push buttons, control/selector switches etc. from various equipment for monitoring, alarm, annunciation, control function etc. through plant SCADA system are in the scope of this contract.

For connecting marshalling box/junction box with various equipment in field, multi-pin plug connector system shall be used, if feasible. The contact carriers shall have two capacitive PE connects each to give the proper earthing to the system and it shall be suitable for electrical data equivalent to 250V/10A. The contact type shall fulfil the requirement of IEC 60 352/ DIN EN 60 352. The contact carriers shall be covered by housing made up of polyamide 6.6 of V0 in flammability class in accordance with UL 94 and fulfil the requirement of IP65 at least. The housing shall be directly sealable on the mounting wall without the need of any kind of wall mounting base. The complete arrangement shall be highly reliable even under harsh conditions, due to high degree of protection."

It shall also be possible to control locally the main elements of the system from local control cubicles. Local control shall be performed in a standalone manner independent of SCADA system, and all information (faults, alarms, measurements, status) necessary for such control shall be displayed locally. Provision of control selector switch for selection of control through Local Control Cubicle, Unit Control Board / Local Control Board and plant SCADA system shall be made in Local Control Cubicles and Unit Control Boards / Local Control Boards.

If the system consists of redundant subsystems, the priority of operation of such subsystems shall be selectable, either from SCADA system or locally.

3.10.3 Power supply for control and monitoring

A reliable surge protected power supply shall be provided for powering the electronic circuits of the equipment component. The power supply shall be from two independent DC station battery source, one as primary and other as secondary. Switchover from primary to secondary will follow automatically on failure of primary and return to the primary source automatically following restoration of primary supply. The primary source of supply and the charger of the battery should be protected with surge protection device. The surge arrester should be pluggable type and should have indication to show its life.

The power supply shall include redundant converter (dc-dc) connected to station battery source such that failure of any regulated output voltage shall cause instantaneous transfer to a redundant converter without affecting normal operation of the equipment component in any

way. Contacts shall be provided to alarm on power supply failure and local indication shall be provided to identify the failed functional block, The Contractor shall provide full details of the proposed power supply system for approval by the Employer.

In case AC supply is required for any control function, same shall be sourced from two on line UPS, with one main and other standby and with automatic change over facility.

3.10.4 Colour Schedule

Colour standard references to major equipment/ system shall be as mentioned in Annexure. The interior of all cubicle and panels shall preferably have a matt white finish unless specified otherwise.

3.11 Electrical equipment enclosures

3.11.1 General

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

The cubicles and enclosures shall be of protection class IP 40 or higher according to their location. For outside installation and area which are humid, corrosive, and prone to dripping and/ or spray of water, the protection class of cubicles shall be IP 65. Cubicles housing electronic cards/modules such as of unit control boards/local control boards, digital governors, static excitation equipment shall be of Protection class of IP 5X.

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

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 wire ways accessible from the front door. The wire ways 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.

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 Employer' identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.

3.11.2 Terminal blocks

Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks.

The screw type modular Terminal Block should be manufactured as per IEC-60947-7-1. The insulating material of Terminal Block should be of polyamide 6.6 meeting VO/V2 in flammability Class as per UL94. All metal parts including screws should be of copper alloy. The Terminal Block should be suitable for mounting on both 'DIN' as well as 'G' Type rail. All the metal parts should be captive and touch proof. The Terminal Block should have screw locking design so that it can withstand vibration level up to 59 and also prevent accidental loosening of conductors. The terminal blocks shall also have necessary accessories like end clamp, separation plates etc. Terminal block for CT shall be provided with shorting and disconnecting arrangement. Test terminal block for CT and PT with plug shall also be provided in all protection and measuring circuit also provided in panel.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT/ PT circuits	Minimum of two of 2.5 sq. mm copper flexible
All CT/ PT Circuits	Minimum of 2 nos. of 6 sq. mm copper flexible

At least 20 % spare terminals shall be provided on each panel/ cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

3.11.2.1 Protection requirement

For short circuit and overload protection of power and control circuits, air circuit breakers, moulded case circuit breakers or MCBs shall be used. Outlets from AC (and DC) distribution panels are protected in their respective panels.

3.11.2.2 Switches, Lamps & Instruments

General

Control switches, indicating lamps and instruments shall be arranged so that all parts are readily accessible for servicing without the necessity to remove other devices, terminal blocks or excessive amount of wiring.

All control switches and indicating devices mounted in cabinets and enclosures shall be visible with the doors closed.

Identification nameplates shall be provided for all control switches, indicating instruments and lamps, in accordance with clause "Nameplates".

Instruments and controls shall be located so that their dials, indicators and nameplates are clearly readable. Data for all instruments to be provided, including type, size, scale range, electrical ratings, nameplate and name of manufacturer, shall be furnished. Steel panels shall be provided for group mounting of the instruments.

All instruments shall be of an approved type and shall match, insofar as practicable, the other instruments with which they are associated; their dial type, scaled markings and units, type of connection and mounting, shall be co-coordinated. All piping and tubing required for

instruments shall be furnished and installed. All instruments and control switches shall be furnished with necessary auxiliaries, i.e. resistors, shunts etc.

3.11.2.3 Control and Selector switches

The switches and push buttons shall be provided with ample contact ratings, suitable cam or block arrangements necessary for the control functions on 230 V AC or 220V DC circuits. The control switches used in mimic diagrams shall be of discrepancy type with built in lamp indication.

Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be provided.

Circuit breaker control switches shall have three positions and shall be spring return to "NEUTRAL" from "CLOSE" and "TRIP" positions and shall have pistol grip handles. They shall have at least two (2) contacts closing in close position, and two (2) contacts closing in trip position unless specified otherwise.

Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries. Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

3.11.2.4 Push buttons

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 230V AC and 0.5A at 220V DC.

All push buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push buttons shall be provided with integral escutcheon plates marked with its function. The colour of the button shall be as follows:

- Green : Breaker Close
- Red : Breaker Open
- Black : For overload reset

3.11.2.5 Indicating and signalling lamps

Each indicating and signaling lamp shall have a removable cap, which can be inscribed with wording and shall not be affected with the heat of the lamp.

Indicating lamps are preferably of LED type & low watt consumption and shall be replaceable from the front of the panel. The indicating and signaling lamps shall be of the same size and type.

Lamps shall be provided with series resistors, preferably built-in the lamps assembly.

The lamps shall have escutcheon plates marked with its function, wherever necessary.

Lamps shall have translucent lamp-covers of the following colours, as warranted by the application.

Red : ACB's/MCCB's close

Green : ACB's/MCCB's open

White : Auto trip

Amber : For all healthy conditions e.g. control supply

Voilet : Circuit breaker spring charged

Blue : For all alarm conditions (e.g. overload) Also for "SERVICE" & "TEST" positions indicators

Indication lamps should be located just above the associated push buttons/control switches. All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.

3.11.2.6 HRC Fuses

HRC-Fuses shall have visible operation indicators.

HRC-Fuses shall be mounted on fuses carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

HRC-Fuse rating shall be chosen by the tenderer depending upon the circuit requirements.

3.11.2.7 Indicating instruments and Meters

Instruments mounted on panels, shall be of the semi flush type back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient locations.

The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits.

The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale. The dials pointer etc. shall be designed to facilitate accurate reading by minimizing parallax and glare from instrument window and by providing clear bold dial markings. The size of dial and length of the scales of the indicating instruments shall be large enough to suit the requirements. The scale plates of panel mounted indicating instruments shall have a permanent white mat finish with black graduations and the pointer shall also be of the black colour. Instruments mounted on panels shall be of flush type and shall be back connected. All

instruments on a switchgear panel shall be of matching pattern, shape and finish so as to present a pleasing appearance consistent with the functional requirements.

All instruments shall conform to relevant International or national applicable standards. These shall be subjected to tests prior to dispatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 V RMS to ground for one (1) minute as per standards.

The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be coordinated with those of the associated instrument transformers (i.e. CTs, PTs, etc.) by the supplier. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.

Energy meter shall be suitable for 3-phase, 4-wire unbalanced system and shall comply generally with the relevant standard. All instruments shall be tested in accordance with the requirements of relevant standards.

3.11.2.8 Integrating instruments

The Wh and VARh meters shall be of the semi-flush-mounted type. Each meter shall be connected to terminal blocks suitable for opening and short-circuiting for testing purposes. The meter cases shall be dust-tight and with removable covers. The meters shall be three-phase, three elements, equipped with an impulse contact mechanism, potential free for remote metering purposes, and shall be suitable for continuous operation from secondary of potential transformers and from secondary of current transformers, with transformer ratios and connections indicated on the contract drawings.

The meters shall be provided with primary-rated, direct reading registers, with five or more digits and a suitable multiplier. The meters for the outgoing lines shall be of the two-way type and all meters shall have mechanism to prevent negative registration.

The meters shall have built in over-voltage protection and isolation according to IEC Publication 60521. The tolerance ambient temperature range of the meters shall be 0 to 45 degrees C.

The protection class of the Wh meters shall be 0.2 and the VARh meters 0.2 according to IEC Publication 60687.

3.11.2.9 Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide an output signal of 4-20 mA, filtered DC.

For the measuring converters the following minimum requirements shall be fulfilled:

- Current transducers shall be single-phase, of accuracy class 0.2 or better.
- Voltage transducers shall be single-phase of accuracy class 0.2 or better.
- W and VAR transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.2 or better.

3.11.2.10 Measuring transformers

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the distribution board is operating at its rated condition and the outside ambient temperature is 40 deg.C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides. The class of insulation should be E or better.

The parameter & rating of CTs & PTs are minimum requirement & tentative only. Contactor shall submit the calculations for selection of CT/PT for approval to purchaser. Potential transformer secondary windings shall be rated 110 / V3 V Current transformer secondary windings shall have a rated current of 1A / 2.5A / 5A.

3.11.2.11 Nameplates Labels and Cautionary signs

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.

The module identification plate shall clearly give the feeder number and feeder designation wherever applicable. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

All name plates shall be of non-rusting metal or 3-ply lamicaid with white engraved lettering on black back-ground, inscriptions and lettering sizes shall be as per their standard practice. Suitable plastic sticker labels shall be provided for easy identification of all equipment, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the module wiring drawings.

Caution and warning signs must be displayed in English, Hindi and local language. Identification plates and instruction plates shall preferably be bilingual i.e. English and Hindi/ local language.

3.11.2.12 Motors

All electric motors for driving various equipment shall conform to relevant standards viz. IEC, BS or IS as applicable. The motor rating, torque characteristics, speed etc. shall be selected to suit the duty requirements.

Type of starter for motors shall be duly approved by the purchaser during detailed engineering. The detailed design calculation for selection of type of starters is to be submitted for approval. The priority for type of starters shall be in the following order:

1. Variable frequency drive

-
2. Soft starter
 3. Star delta/ auto –transformer
 4. Direct on-line starter

The enclosure of each motor shall be of the type best suited for the service conditions of the motor. The motor insulation shall be resistant to moisture, oil or oil vapour and the motors in general shall be so designed as to suit the tropical climate. Varnished cambric or glass insulation class F shall be used for connection from the windings to the terminals.

The terminal box shall be closed conduit box type conveniently located, and shall have means for terminating the external wiring for outdoor use. The motor terminals shall be of the stud type totally enclosed. Eye bolts or lugs shall be provided for lifting.

Space heaters to avoid condensation shall also be provided. Special type of motors, not adequately covered by these specifications, shall be offered for any special application, but these shall be subject to the approval of purchaser.

3.11.2.13 Space heaters

Space heater shall be provided in the Distribution Boards, Control & Protection panels, Motor Control panels etc. The space heaters shall be suitable for continuous operation on 240V AC, 50 HZ single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

3.11.2.14 Auxiliary relay, contacts and devices

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a draw out construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

All AC auxiliary relays shall be suitable for operation with VTs and CTs secondaries.

DC auxiliary relays shall be designed for 220V DC unless otherwise specified and shall operate satisfactorily between 80% and 110% of the rated voltage. Relays shall have adequate thermal capacity for continuous operation in circuits in which they are used.

All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

Suitable number of auxiliary contacts or auxiliary relays shall be provided with each VCB's / ACB's for indication, remote indication, annunciation and automatic changeover and interlocking scheme.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flag) for analysing the cause of operation.

3.11.2.15 Welding & NDT

Preparation of base material

Members to be joined by welding may be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. Edges shall be shaped according to ASME requirements. Design of welded joints and selection of weld filler metal shall be in accordance with approved standards and shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces to be welded shall be sound metal free of visible defects such as laminations or defects caused by cutting operation at least 30 mm back from the edge of the weld, and free from rust, oil, grease, and other foreign matter.

The establishment of welding procedures, welder's qualifications shall conform to the requirements of the ASME Boiler and Pressure Vessel Code Section VIII and IX. The approved copy of the WPS & WPQR in accordance with the ASME requirements shall be submitted to the purchaser for review and record.

3.11.2.16 Field welding

Filler material required for field-welded joints shall be furnished by the Contractor. The Contractor shall perform all welding work at site in accordance with the applicable WPS. Only qualified welders shall be used for undertaking welding as per the applicable WPS. NDT shall be performed as per the approved drawings.

Preparation for field welding

All cutting, chamfering, and other shaping of metals necessary for the field connection shall be done as far as possible in the shop. Adequate temporary bolted field connections shall be provided to hold the assemblies rigidly and in proper alignment during shop and field assembly.

To ensure proper alignment during field erection, a minimum of two dowels shall be provided for each field connection between subassemblies. The holes shall be drilled and the dowels fitted at shop assembly after the subassemblies have been satisfactorily aligned. All stipulations for welding, structural work and other, shall be applied to fieldwork as well as to shop work, except where otherwise stated.

3.11.2.17 Painting

All the equipment furnished and installed by the Contractor shall be completely painted for final use, with the exception of those parts or surfaces that are expressly designated as unpainted. Surfaces to be painted shall receive the preparatory treatment and required number of coats. The Contractor shall perform all painting work in the shop, before shipment, followed by a final coat of paint at site after installation as per the standard procedure.

All materials, supplies, and articles furnished shall be the standard products of recognized reputable manufacturers. Colour schedule of equipment supplied shall be finalized during detailed design stage.

3.11.2.18 Galvanization

Unless otherwise specified, all structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts

associated with galvanised parts shall be hot-dip galvanised, electrolytically galvanised or sherardized, as may be appropriate to the particular case.

A) Material:

For galvanising, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%. The thickness of the zinc coat shall be:

- i) For bolts and nuts, approx. 60 micrometre.
- ii) For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 70 micrometre.

B) Galvanising of hardware:

Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards. Excess smelter shall be removed by centrifugal spinning.

C) Straightening after galvanising:

All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

D) Repair of galvanising:

Material on which galvanising has been damaged shall be re-dipped unless the damage is local and can be repaired by soldering or by applying a galvanising repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions. Soldering shall be done with a soldering iron using 50/500/o solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself, Any member on which the galvanised coating becomes damaged after having been dipped twice shall be rejected.

3.11.2.19 Pumps

All pumps forming part of the generating units and other plant and equipment shall be of high performance requisite type (viz. centrifugal, rotary etc.) and rating, of reputed make, and shall be directly coupled to their driving motors. The pumps shall be of self-priming type and with proper sealing systems and protection.

The materials of construction of pumps in general shall suit the service conditions. The materials of construction of the pumps handling water, such as drainage & dewatering pumps, turbine top cover drainage pumps etc. shall be resistant to abrasive effects of silt in such water. The pumps shall operate quietly without undue noise and vibration in their full operating range of head and flow. They shall be easy to maintain.

3.11.2.20 Embedded parts, Anchor Bolts and Fasteners

All embedded anchor bolts, rods, pipes, welding plates and support plates shall be provided by contractor. Anchor bolts shall consist of a threaded steel rod installed inside a pipe sleeve

to provide lateral adjustment after the sleeve is embedded. The threaded end of the rod shall be provided with two steel nuts and two steel washers to permit leveling and anchoring the equipment prior to grouting.

Approved types of expansion or chemical anchors shall be used where practicable for small equipment.

3.11.2.21 Rust Prevention and Protection during Transit: -

Bright steel parts including all machined surfaces shall be given a thick coat of tar or tallow or any other approved rust resisting paint in plain colour to prevent rusting during shipment and transport.

3.11.2.22 Civil Works

Civil foundations for equipment of the generating units and other plant and equipment will be prepared by the Purchaser in accordance with the basic design data to be supplied by the Contractor.

The Contractor shall provide design for foundations and install the concrete inserts/embedment; support steels and/or components for foundation /supports purpose, shall do any chipping / levelling works, denting / painting etc.

3.11.3 Erection, Testing, Commissioning and performance of Guarantee Tests

3.11.3.1 Testing and inspection

Materials used for construction of major & important sub-assemblies shall be thoroughly shop tested and inspected by the Contractor at his own expense prior to dispatch. Shop test shall comprise of routine test & type tests.

The shop tests and inspections shall be as spelt out in individual equipment specifications as dealt in succeeding sections but shall not be limited to the same. Any other tests and inspection not specifically listed but are otherwise considered essential and advisable shall also be conducted.

The Bidders shall furnish schedule of the shop tests and inspections on materials and equipment. Important tests/inspections shall be subject to witness by the purchaser for which the Contractor shall give sufficient advance notice. In case purchaser is unable to witness shop tests/inspections, the Contractor shall be so intimated and the tests/inspections may then be carried out in the absence of the Purchaser.

Equipment on which tests and inspections have been duly witnessed and approved by the Purchaser may be dispatched by the Contractor. Equipment on which tests and inspections have not been witnessed by the purchaser shall be dispatched only after the shop tests and inspection Certificates have been approved by the Purchaser.

3.11.3.2 Dimensional Checks and Visual Inspection

Dimensional checks shall be performed on all major parts, components and partial assemblies, especially when close tolerances and fits are involved (tolerance of shafts,

between stationary and moving parts, connecting dimensions for the assembly with other supplies, etc.). If the dimensional checks show discrepancies in measurement, which may affect the fit, assembly or dismantling of the respective part or component, the same have to be corrected correspondingly. Such correction or modification shall, however, in no way lead to sacrifices with respect to reliability of operation or inter-changeability, and shall be performed only after the agreement of the Owner has been obtained. If the correction or modification cannot be carried out in accordance with the terms mentioned above, the part or component concerned may be subject to rejection. Faulty machine parts or equipment shall by no means be delivered.

3.11.3.3 Functional Tests

Functional tests on partial assemblies and/or complete assemblies shall be carried out as much as possible already in the manufacturer's workshops. Such tests shall be performed as far as possible under operation-like conditions.

When requested by the Owner, the functional tests shall be repeated until full proof has been obtained that the functioning of the assemblies will comply with the requirements of the Contract Documents.

3.11.3.4 Erection, commissioning & field tests

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance. The Contractor shall provide and install the concrete inserts/embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Minor Chipping of concrete is permitted. However, taking support from reinforcement bars shall not be allowed.

3.11.3.5 Installation procedure

The Contractor shall submit six copies of all detailed programs and the procedures to be adopted for erection / installation, testing and commissioning well in advance, before start of erection activities/ installation.

The installation procedure shall also have a section "site quality assurance plan" containing erection data sheets / site protocols for various components. These sheets should specify site measurements/ inspections required to be made for ensuring proper installation.

3.11.3.6 Cable laying

Wiring between equipment enclosures shall be made with cables, laid in trenches and/or cable trays and in cable conduits. The Contractor shall submit for review to the Engineer a cable route layout-showing location of trenches, conduits and trays. All material for cable laying such as cable trays supports and fastening material shall be furnished and placed by the Contractor. Cables shall be properly fastened and marked where they enter enclosures by either cable clamps or nipples.

Cables in horizontal cable trays shall be fastened properly with clamps or plastic strips. Power and control cables shall be placed in separate trays or conduits. Cables shall be clearly marked at each terminal point and appropriate intermediate locations as per Standard.

Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square reamed, threaded and screwed tight at all joints.

Conduit entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.11.3.7 Field inspection

The Contractor shall permit Engineer to perform inspections of the assembly which will include a complete verification of the assembly of all parts as to their levels, clearances, pertinent fits, alignments and quality of workmanship. The field supervisor of the Contractor shall provide Engineer with three (3) copies of all the clearances, tolerances and data of all pertinent fits, alignments and levels, so that the latter may repeat the Contractor's measurement, if desired.

Unless otherwise specified, any rejection based on the inspection will be reported to Contractor within fifteen (15) days.

3.11.3.8 Field tests

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer. Procedure to be adopted for conducting these tests shall be submitted well in advance, before start of relevant testing, for approval of the Employer.

The equipment / system shall be deemed to be commissioned and ready for trial run only after successful operation for a test service period specified in sub clause "Performance Testing". In the event of any failure this period shall be repeated for any number of times till the successful operation as described above is achieved.

All test equipment and instruments shall be furnished by the Contractor and will remain the Contractor's property after the fulfilment of all field tests.

Any defects or leaks disclosed in the tests shall be duly mended/ repaired to meet the desired function and retested. All necessary materials and labour for performing all the above tests shall be provided by the Contractor.

The Contractor shall prepare written test certificates in a form agreed upon by the Contractor and Employer of all tests results and hand them over to the Employer in due time.

The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling of equipment and plant accessories shall be the responsibility of the Contractor.

3.11.3.9 Taking over of facilities

Taking over” means that the Facilities (or a specific part thereof where specified) have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of pre-commissioning of the Facilities or such specific part thereof has been completed and commissioning has been attained as per Technical Specifications. The contractor shall make formal request for taking over the facility to the EIC.

3.11.3.10 Operation acceptance

The operational acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor’s fulfilment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of Specification.

3.11.3.11 Consumables, oils and Lubricant

The Contractor shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, transformer oil, Nitrogen, SF6 gas and other used gases in non-returnable drums / containers and replace any quantity used up or lost during installation and testing. The oil used for the lubrication and oil pressure systems for the turbine, governor, shutoff valve and generator shall be preferably of the same type.

Supply

The Contractor shall furnish the following:

- (i) All oil for initial filling of all equipment supplied, plus additional oil equivalent to the first filling requirement of one unit.
- (ii) Grease if required for initial filling of all of the equipment, plus 10% additional.
- (iii) Gases for initial filling of all equipment supplied, plus 10 % additional quantity.
- (iv) Flushing fluids to flush and clean all systems.

3.11.3.12 Submission of Drawings, Documents, Manual, software, Calculations, Safety Margin Details etc.

All drawings and documents shall be submitted to purchaser in hard form as well as in editable soft form. Bidder shall submit Six (6) number hard copies along with copy in electronic form media of the documents & drawings to purchaser for reference / review / approval. A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand to the purchaser.

At the time of completion of contract, the Contractor shall submit ten (10) copies along with five (5) copies in electronic form in DVD media, of approved and as built drawings together with operation and maintenance manual.

Loading drawings

For all larger pieces of Works which, due to their dimensions and/or weight and transport limitations, will require special means for their transportation, the Contractor shall submit binding loading drawings indicating dimensions, weights, etc., of the respective pieces of Works and the necessary trailer for its transportation to the site.

Foundation drawings

If a piece of works requires its own foundation or needs a special area for installation, the contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

If conduits are to be installed in the foundations, the relevant information such as diameter, length, and purpose shall be indicated on the drawings.

Arrangement drawings

All arrangement drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works (constructions, machines, complete switchgears, control panels, instrument cubicles, etc.), civil constructions (buildings, rooms, foundations, ducts, etc.) and reserved areas (for pipes, cables, lines, etc.) in relation to each other and to agreed co-ordinates and boundaries. Such drawings shall be prepared for the whole plot, for separate plots and for each building (building, hall, room, ducts and trenches, etc.).

Outline drawings

The Outline Drawing shall show all elements and the main dimensions of individual components where necessary in plan view, cross-section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

Design drawings

The Design Drawings shall include the shop drawings, assembly drawings, erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract. The drawings shall - where applicable - substantially conform to the Contract Drawings and shall show:

- 3-D Assembly drawings for major components in hard and soft form.
- Details of manufacturing and treatment of major single work pieces specially manufactured for this Contract
- Assembly of the Works in plan and elevation with main dimensions Sub-assembly of the principal components of the Works with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings
- Sub-assemblies in which the Contractor proposes to ship the Works
- All necessary details of the parts connecting to the Works supplied by others

-
- Location and sizes of auxiliary connections for oil, grease, water, air, electrical power etc.
 - Location and size of the instruments and accessories provided
 - Methods of lubrication and sealing
 - Instructions for heat treatment, pressure tests, surface preparation and anticorrosive protection
 - Full details of parts for which adjustment is provided or which are subject to wear
 - Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

Installation drawings

The construction, mechanical, electrical and I & C Installation Drawings shall provide detailed information on the disposition of the various items of a system (e.g. lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, pipes, valves, pumps, compressors, etc.) and of the piping and wiring respectively included in the installation or assembly. They shall be based on dimension drawings of cubicles, rooms, buildings or areas containing the Works.

Diagrams

Single-line diagrams

This is a simplified diagram of the essential electrical Works and their interconnections. Each circuit shall be represented by a single line only. It shall contain all required technical information of the Works represented, e.g. voltage, current, capacity, short-circuit level, ratios, voltage variations, positive and zero sequence impedances, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc. as applicable.

Circuit diagrams

The Circuit Diagrams shall show the power circuits in all the phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Works or circuits with all required technical details.

Block diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter - relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

Logic diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realisation. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

Terminal diagrams

Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.

The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

Protection co-ordination diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

- A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays
- Co-ordinated tripping curves of related protection devices
- Setting of the protection devices.

Emergency shutdown diagram

This diagram shall show the sequential steps and interdependencies during emergency closure.

Flow Charts

Flow charts shall be used for representing sequence of events for start / stop / shut down of the machine including associated equipment and auxiliaries.

Manuals

The following manuals covering all equipment of EM works shall be supplied as per the time schedule in both editable soft and hard form: -

Sr.No.	Manual Description
1.	Storage and preservation manual
2.	Safety manual
3.	Erection Manual
4.	Testing and commissioning manual
5.	Operation manual
6.	Maintenance manual
7.	Long term storage manual for Generator Transformer
8.	Long term storage manual for boxed up component / equipment.
9.	Repair process / procedure manual for equipment / system

As built drawing to be provided incorporating changes made during erection, testing and commissioning.

Drawing & Document Submission Schedule

Drawings & documents submission schedule of the EM package with the categorization (i.e. Approval / reference) & tentative submission date shall be submitted to purchaser.

Preliminary list of drawings under various categories have been prepared and appended at Section 1 of the Technical Specification.

3.12 DRAWINGS & DOCUMENTS TO BE SUBMITTED BY THE SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT

One set of soft copies of all the approved drawings, documents including as built drawings shall be furnished by the Bidder to the Owner / Consultant in compact discs.

White prints or other non-reproducible drawings can be mailed folded. Blue prints shall generally not be used.

All drawings, prepared by the Bidder shall be as per IS: 696. Supplier's standard drawings are exempted from the above size limitation, unless his "standard" includes drawings of very large size or length. There shall be sufficient reference notes on the drawings to permit identification of all the drawings which are required for a proper understanding.

Bills of material and drawings shall be cross-referenced for easy identification.

All drawings shall be dimensioned in the metric system. Where drawings are usually made in the British (or other) system, they shall also have metric system dimensions in parentheses or below dimension line. Titles and written notations shall be in English. If the original is in another language it shall carry English translation. The translations will appear immediately on the drawings. Attached lists of translated words shall not be accepted.

Drawings and bills of material shall be identified by a numbering system to be mutually agreed later on. Any additional identification numbers or symbols that the Bidder selects to use for his own purposes are permissible so long as Owner's number is the prime means of identification.

The scale of the drawing shall be shown clearly in the title block of the drawing. Wherever possible, scales of drawings shall be:-

1:1	1 : 2.5	1 : 5	1 : 10	1 : 20	1 : 25
1:50	1 : 100	1 : 200	1 : 300	1 : 500	
1: 1000	1 : 2000	1 : 5000			

All reproducible must be made from original drawings.

All revised drawing shall clearly indicate the number, date and subject to each revision. All the revisions carried out in the drawings shall be clearly identified and marked.

Drawing list shall be kept up-to-date, incorporating all new additions, cancellations and changes, and will be reissued periodically with Progress Report.

General arrangement drawings shall be submitted for approval to the Owner/ Consultant prior to the commencement of detail engineering by the Bidder. These drawings shall show to scale all major equipment including electrical equipment and building outlines and overall dimensions as well as tie-in dimensions and clearances shall be clearly indicated. Approved arrangement drawings shall be used as basis for design and preparation of detail drawing to be prepared by the Bidder. The Bidder shall furnish all the necessary drawings, data etc., of the plant/equipment with appropriate "Status" stamp in adequate no. of copies as indicated below:

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	6	10	05
2	Drawings "As Built"	-	-	10	05
3	Type Test Reports	1	6	10	05
4	Erection Manuals	-	6	10	05
5	Operation and Maintenance Manuals	-	6	05	08
6	Manufacturing Quality Plan	1	6	10	-
7	Field Quality Plan	1	6	10	-
8	Inspection Test Reports	-	-	10	-

3.12.1.1 QUALITY ASSURANCE PROGRAMME

The Bidder shall follow Quality Assurance Programme to ensure that the equipment and services under the scope of contract whether manufactured or performed at the Bidder's works or at his sub-vendor's premises or at the project site or at any other place of work are in accordance with the technical specifications. Such programme shall be outlined by the Bidder and be submitted along with the bid. The QA programme shall be generally in line with IS/ISO- 9001 and generally cover the following:

- ORGANISATION STRUCTURE FOR THE MANAGEMENT AND IMPLEMENTATION OF THE PROPOSED QUALITY ASSURANCE PROGRAMME
- QUALITY SYSTEM MANUAL
- DESIGN CONTROL SYSTEMS
- DOCUMENTATION AND DATA CONTROL SYSTEMS
- QUALIFICATION/EXPERIENCE OF BIDDER'S KEY PERSONNEL.
- PROCEDURE FOR PURCHASE OF MATERIAL, PARTS, COMPONENTS AND SELECTION OF SUB-VENDOR'S SERVICES INCLUDING VENDOR ANALYSIS, SOURCE INSPECTION, INCOMING RAW-MATERIAL INSPECTION, VERIFICATION OF MATERIALS PURCHASED, ETC.
- SYSTEM FOR SHOP MANUFACTURING AND SITE ERECTION CONTROLS INCLUDING PROCESS, FABRICATION AND ASSEMBLY.
- CONTROL OF NON-CONFORMING ITEMS AND SYSTEM FOR CORRECTIVE ACTIONS AND RESOLUTION OF DEVIATIONS.
- CONTROL OF CALIBRATION AND TESTING OF MEASURING / TESTING EQUIPMENT.
- SYSTEM FOR QUALITY AUDITS.
- SYSTEM FOR IDENTIFICATION AND APPRAISAL OF INSPECTION STATUS.
- SYSTEM FOR AUTHORISING RELEASE OF MANUFACTURED PRODUCT TO THE PURCHASER.
- SYSTEM FOR TRANSPORTATION /DELIVERY, HANDLING, STORAGE AND PRESERVATION.
- SYSTEM FOR MAINTENANCE OF RECORDS.

GENERAL REQUIREMENTS - QUALITY ASSURANCE

All materials, components and equipment covered under scope and its technical specifications shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme agreed mutually.

Minimum Quality Assurance Test Requirement (QATR) to be followed during Manufacturing and Field erection indicating requirement of various tests / inspections, on major equipment / items, to be carried out as stipulated in technical specification and standards mentioned therein, are attached hereto and are part of bidding documents.

Clarification, if any, on these quality assurance test requirement, raised by bidder shall be discussed and resolved during pre-bid meeting.

After the award of contract, the contractor shall submit the detailed Manufacturing & Field Quality Assurance Plans for complete equipment / material during detailed engineering for approval and acceptance by LTHP Ltd./Consultant in line with technical specification, Quality Assurance – General & Test Requirements and detailed engineering.

Manufacturing Quality Assurance Plans shall detail out for all the components and equipment & various tests/inspection, to be carried out in conformity with relevant latest IEC/IS/ISO etc., quality practices and procedures to be followed by Contractor's / Sub vendor's Quality Control Organization, the relevant reference documents, standards and acceptance norms etc. during all stages of material procurement, manufacture, assembly and final testing / factory acceptance tests.

The Field Quality Assurance Plans shall detail out the various tests/inspection to be carried out in conformity with relevant latest IEC/IS/ISO, quality practices and procedures etc. to be followed by the contractor's / sub-contractor's site Quality Control Organisation during various stages of site activities from receipt of material/equipment at site till final commissioning/ acceptance/handover.

All major items/ equipment/ components to be manufactured in house as well as procured from sub-vendors (Bought out Items, BOI) to be listed in the bid. Bidder shall submit Quality Assurance Plan submission schedule in the bid for above listed items in attached Format (duly filled in the format F-060-05 Issue 2.0 Rev. 00, Total 1 Page) in line with L2 Schedule.

For components / equipment / Bought out Items procured by the contractor for the purpose of the contract, the Contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the sub-vendors.

The quality plans called for from the sub-vendors shall detail out, during the various stages of manufacture and installation, the quality practices and procedures followed by the sub-vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

Such quality plans of the successful sub-vendors shall be finalized with the LTHP Ltd./Consultant in line with requirement mentioned above and such approved Quality Plans shall form a part of the purchase order/contract between the contractor and his sub-vendor.

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 and other related documents such as data sheet, drawings, quality plans and delivery conditions shall be furnished to the LTHP Ltd./Consultant by contractor along with a report of the Purchase Orders placed, on the monthly basis, so far for the contract.

The Quality Plans shall be submitted on electronic media e.g. CD or E-mail in addition to hard copy, for review and approval of LTHP Ltd./Consultant. After approval, the same shall be submitted in compiled form on CD-ROM by contractor.

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

All material of construction shall be as per technical specification / approved drawings / GTP.

Contractor's Plant internal standards must be traceable to acceptable International / National standards & salient points of difference (if any) shall be clearly stated with submission of plant standards. The contractor shall furnish copies of reference documents, plant standards, acceptance norms, test and inspection procedure etc. as referred in Quality Plans along with Quality Plan to LTHP Ltd./Consultant. These Quality Plans and reference documents/standards etc. will be subject to approval of LTHP Ltd. without which manufacturer shall not proceed. These documents shall form a part of the contract.

Tests on components and sub-assemblies shall be carried out at various stages of manufacturing, till the product undergoes the final tests in conformity with the relevant standards.

The Customer Hold Points (CHPs), identified in approved quality plan, i.e. testing checks which shall be carried out in the presence of the LTHP Ltd./NHPC, beyond which the work will not proceed without written consent of LTHP Ltd.'s authorized representative.

The contractor / sub-vendor shall carry out routine test on 100% items at his works. The quantum of check / test for routine and acceptance test by LTHP Ltd./Consultant shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned, quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering.

The quantum of check when specified in percentage (%) / sampling basis shall be treated as per lot per sub-vendor. When the quantum of check is indicated to in whole no., then same quantum of check shall be applicable to each sub-vendor supplying the same equipment.

For sub-vendors identified during pre-award stage for submission of vendor details/ credentials (category "DR"), contractor shall submit documents in format F-060-01 after

placement of award in the manner as specified as under prior to any procurement and within a month after placement of award or a period as agreed at the time of pre-award discussions.

The proposed sub-vendors should be registered vendors of the bidder and must have proven experience for successful operation for similar equipment / items / processes as mentioned elsewhere in technical specification.

Before assigning any portion of work to the sub-vendor, other than one specified and duly accepted in the contract, the contractor will take prior approval of BHEL/ LTHP Ltd./NHPC.

Normally no request for change of sub-vendors or inclusion shall be entertained by LTHP Ltd./NHPC. But in exceptional circumstances, if the request for change of sub-vendors or inclusion is found reasonable and justified, then the same shall be entertained and the decision of LTHP Ltd./NHPC in this respect shall be final and binding. The time consumed for the change / inclusion of sub-vendors shall not be excluded from the stipulated time of the completion of the contract. This change shall not relieve the contractor from the responsibility to complete the work within stipulated time in any manner.

The contractor's proposal shall include sub-vendor's facilities established at the respective works, the process capability, process stabilization, Q.C. system followed, experience list etc. along with his own technical evaluation of sub-vendor. (Format F- 060-01 issue 2.0 rev. 01, Supplier / Sub-vendor Assessment Sheet, Total 14 pages).

However, whenever felt necessary, sub-vendor assessment will also be carried out by LTHP Ltd./Consultant in accordance with the above procedure and by factory visits; for existing/proposed vendors/sub-vendors. This approval shall not relieve the contractor from any obligation, duty or responsibility under the contract & LTHP Ltd./NHPC shall not be responsible for any complications arising between the contractor and his subcontractor(s) / sub-vendor (s) and / or any other liabilities.

LTHP Ltd./Consultant reserves the right to carry out quality audit and quality surveillance of the system and procedures of the contractor / or their sub-vendor. The contractor shall provide all necessary assistance to enable LTHP Ltd./Consultant to carry out such details & surveillance including Quality Manuals, if required by LTHP Ltd./Consultant.

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirement of ASME section-VIII/IX or other International equivalent standard acceptable to LTHP Ltd./Consultant. All welding/brazing procedures shall be submitted to LTHP Ltd./Consultant/BHEL for review / verification prior to carrying out the welding/brazing. However, wherever required by the LTHP Ltd./Consultant, tests shall be conducted in presence of LTHP Ltd.'s authorized representative.

All Brazers, Welders and welding operators employed on any part of the contract either in Contractor/his sub-vendor's works or at site or elsewhere shall be qualified as per ASME section-VIII/IX or other equivalent Standards acceptable to LTHP Ltd./Consultant.

Unless otherwise proven and specifically agreed with LTHP Ltd./Consultant, welding of dissimilar material and high alloy materials shall be carried out at shop only.

All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American or Indian Society of non-destructive examination). NDT shall be recorded in a report, which include detail of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of correlation of the test report with the job.

All material used for equipment manufacture including castings and forgings, 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.

Contractor shall submit Field Welding Schedule for field welding activities like field welding location, numbers, welding procedure to be used, requirements, codes and NDT requirement along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures, etc. to LTHP Ltd./Consultant for review at least ninety days before schedule start of erection work at site.

Any other statutory requirements as applicable for the equipment / systems shall also be complied with.

The inspection calls shall be placed at least 06 weeks in advance for overseas inspections excluding India and 15 days in advance for inspections within India.

Before submitting the inspection call to LTHP Ltd./NHPC for witnessing the Customer Hold Points (CHP's) and/or requesting LTHP Ltd./NHPC for issuance of Material Dispatch Clearance Certificate (MDCC) based on Test Certificate (TC) review / Certificate of Conformance (COC), the contractor shall ensure that all Drawings / documents / GTP / technical data sheet, relevant to respective CHP / MDCC requirement, has been duly approved /accepted / noted by LTHP Ltd./NHPC.

Contractor shall ensure readiness of offered equipment by all means, before raising such call to LTHP Ltd./NHPC to attend CHP inspections. In case, LTHP Ltd./NHPC engineer (s) on reaching at a place of inspection found that material is not ready for inspection due to whatsoever reason, the complete inspection expenditure of LTHP Ltd./NHPC engineer(s) as per actual shall be chargeable to the contractor.

Only calibrated testing & measuring instruments shall be used while performing tests during manufacturing and erection, testing & commissioning at site by the contractor. Copy of the calibration certificates will be submitted to LTHP Ltd./Consultant by the contractor during inspection as an evidence.

Non-conformities observed during manufacturing, shop testing, handling, packaging, transportation, storage, preservation, erection, testing & commissioning are required to be

intimated by the contractor. The acceptance/rejection of the non-conformities will be at the discretion of LTHP Ltd./NHPC.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the acceptance of LTHP Ltd./NHPC. Action taken in accordance with decision of disposal of non-conformity for repair / rework / modification of the item / equipment and to prevent re-occurrence. The corrective and preventive action may involve modification of item / equipment, change in procedure and system etc. to achieve quality improvement at all stages and levels.

Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the LTHP Ltd./NHPC 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 Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings etc.

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

The test reports of type tests conducted as per contract, in line with requirement stipulated in the technical specification / quality plan should be got accepted from LTHP Ltd./Consultant before final inspection / issuance of MDCC.

All materials used or supplied shall be accompanied by valid and approved material certificates and tests and inspection reports. These certificates and reports shall indicate the heat numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it to ensure physical correlation and traceability of material vis-a-vis test certificate. Such identification no. shall remain same and verifiable for all stages of manufacturing and installation.

3.12.1.2 QA DOCUMENTATION

The contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan.

Each QA Documentation shall have a project specific Cover Sheet bearing name and identification number of equipment including index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Contractor/sub-vendor to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, CD-ROM may be issued not later than three weeks.

Before dispatch / commissioning of any equipment, the Contractor shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The Contractor will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

The contractor shall be required to submit copies of the following quality assurance documents in original duly reviewed and accepted by contractor along with the request letter for issuance of MDCC (Material Dispatch Clearance Certificate):

- QUALITY PLAN CHECK LIST.
- MATERIAL MILL TEST REPORTS ON COMPONENTS AS SPECIFIED IN QUALITY PLAN.
- SKETCHES AND DRAWINGS USED FOR INDICATING THE METHOD OF TRACEABILITY OF THE
- RADIOGRAPHS TO THE LOCATION ON THE EQUIPMENT.
- NON-DESTRUCTIVE EXAMINATION RESULTS REPORTS INCLUDING INTERPRETATION REPORTS.
- CALIBRATION CERTIFICATE OF ALL METERS & MEASURING INSTRUMENTS PROPOSED TO
- BE SUPPLIED AS PART OF RELEVANT BILLING BREAKUP ITEM.
- ROUTINE TEST REPORTS FOR TESTING REQUIRED AS PER APPLICABLE CODES AND
- STANDARDS REFERRED IN THE SPECIFICATIONS.
- INSPECTION REPORTS DULY SIGNED BY AUTHORIZED REPRESENTATIVE OF LTHP Ltd./NHPC AND CONTRACTOR FOR THE AGREED CUSTOMER HOLD POINTS.
- ALL THE ACCEPTED DEVIATIONS SHALL BE INCLUDED WITH COMPLETE TECHNICAL DETAILS.
- LIST OF BALANCE POINTS IF ANY.
- CERTIFICATES IN RESPECT OF CALIBRATION, WELDERS & BRAZERS QUALIFICATION ETC.
- COPY OF ALL REFERENCE DRAWINGS AND REFERENCE TECHNICAL DOCUMENTS
- ACCEPTANCE OF TYPE TEST REPORTS BY LTHP Ltd./CONSULTANT.

Similarly, the Contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/procedures, within 2 weeks after commissioning of individual system.

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Consultant and other set to LTHP Ltd. For the particular case of phased deliveries, the complete quality document to the LTHP Ltd./Consultant shall be issued not later than 3 weeks after the date of the last delivery of equipment.

3.12.1.3 Safety

Safety of personnel

All equipment and services provided under this contract shall abide by international standards commonly accepted in the hydroelectric utility industry for safety of personnel whether involved with operation or maintenance.

Safety of operation

All equipment and services provided under this contract shall abide by commonly accepted standards for safety of operation.

The various system and sub-systems supplied under this contract shall be designed to follow and operate under a clear hierarchical structure:

- Plant control level,
- Unit control level,
- Functional control level, functional drive group level,
- Local drive level.

Each hierarchical control level shall perform its specific tasks and always depend on the subordinate lower control levels. In general, should a higher control level failure occur, the lower control level shall not be affected and shall be able to control the power plant with full safety.

The Contractor shall accordingly build into the "Electrical & Mechanical System" adequate levels of autonomy, independence, redundancy and functional distribution to insure that safety is maintained at all times.

3.12.1.4 Earthing

Earthing terminals for equipment of these specifications shall form part of equipment supplies. The contractor shall connect the earthing conductors to these terminals as required.

Risers from earthing bus shall be in the scope of purchaser. However, extension from these risers to the equipment shall be in the scope of supplier in the Power House, Transformer Hall, Switchyard.

However, overall earthing arrangement required for HT panel, LT panel, DG set, motor & motor control panels etc. at isolated location such as Dam Site, TRT Outfall area and Surge Shaft either by pit earthing or counter poise etc. shall be in the scope of supplier including civil works, design, material supply (for main earthing risers, interconnection, charcoal, salt, Bentonite etc.), erection, testing & commissioning etc.

A copper ground bus, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid (50 X 6 mm G.I. flat).

Tests

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

Special Cables

Special cables for specific purpose, as required, shall be supplied and installed by the Bidder.

3.12.1.5 Completeness of the specification

Any fittings, accessories, equipment or any other things required for successful commissioning of Project, though may not have been specifically mentioned in the specification but are usually necessary for the completeness of the equipment shall be deemed to be included in the specification and shall be supplied by the contractor without any extra cost to the Employer.

3.12.1.6 Packaging and Shipment

The Contractor shall provide such packing of the Goods as it is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the final destination of Goods and the absence of heavy handling facilities at all points in transit.

The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract.

After unpacking of Goods the packing material shall become the property of Employer

The contractor shall wrap, pack and crate all plant included in the work or part thereof, suitable for shipment to a tropical location, facilitating proper handling and protection from damage in rail, truck, ocean or air shipment as applicable. An approved drying agent, such as Silica Gel, shall be packed in containers or packages holding plant which may be adversely affected by moisture or excessive humidity.

All packing crates shall be clearly marked before shipping to indicate the contract number, shipping address, volume, weight, name, number and unit number of the contents, slinging and weight bearing points.

All plant parts shall be marked to facilitate erection. Each packing crate shall contain a packing list in a waterproof envelope. Parts shall be described and also identified by their numbered marking in the packing list.

Three copies of the packing list shall be forwarded to the purchaser prior to dispatch. The ownership of packaging materials shall be of Employer. All wooden packaging crates and steel support structures shall be dumped to the designated area within 5kms of the power house as per the direction of Engineer in charge.

The supplier shall be entirely responsible for the insurance, shipment, handling and transportation.

The equipment shall not be dispatched by the Bidder from the place of manufacture to the site until the dispatch instructions are issued by the Owner.

3.12.1.7 PACKAGING, HANDLING AND SITE STORAGE

The Contractor shall follow the general requirement of packaging, Handling and Storage elaborated in "section 8 - Transport and installation" of "General Technical Specification (GTS)". The Contractor shall pack all the consignment in sea worthy packaging, wherever required, strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage.

The packaging and storage of electronic equipment shall be strictly in accordance with internationally accepted standards. Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

If required, dehumidifiers shall be deployed by Contractor to control the condition of storage space. Storage of the equipment till commissioning is responsibility of the Contractor.

3.13 SPECIAL INSTRUCTIONS TO BIDDERS

General

The Bidder shall base the equipment design on the information given in this specification. The equipment shall be complete in all respects. Any item which is not specifically mentioned herein but found essential for safe and efficient operation and maintenance and satisfactory performance of the system shall be deemed to have been included in the scope of the Bidder. It shall be presumed that the Bidder has studied the site, all the drawings, tender documents and is fully aware of the scope of work involved and the site conditions prevailing.

3.14 Codes and Standards

- a) All equipment, systems and works covered under this specification shall comply, in all respect, with requirements of applicable latest statutes and that of latest editions of codes and standards. Latest regulations and safety & environmental requirements as applicable in India / state of installation shall also be complied with.
- b) All codes and standards mentioned shall mean as relevant and applicable to a particular equipment / system.
- c) All other codes/standards not covered in Section 1 / Section 2 but required for the plant and system offered shall also be referred / followed by the Bidder. The Bidder, along with the bid, shall submit a comprehensive list of codes and standards to be followed for various equipment / system.
- d) In all cases where IBR does not govern, German, American, British, ISO or other international standards established to be equivalent or superior to the codes specified are also acceptable. In the event of any conflict between the requirements of equivalent codes and standards and the requirements of Indian standards / regulations, the latter will govern unless specified otherwise in the specifications.

- e) The Bidder shall be responsible to be in possession of all the specified Codes / Standards and ensure reference to the same before submitting the offer/ bid.
- f) Mandatory codes / local regulations to be followed for safety, design, fabrication and operation of the switchyard shall be, followed:
- g) If the equipment supplied does not conform to the codes and standards mentioned in this specification, but is manufactured to the Bidder's own standard, developed as a result of his experience, is also acceptable provided the same is found to be superior to the above mentioned codes and standards. The Bidder shall identify such equipment and shall also present sufficient data to the Owner / Consultant to support his design and to establish the superiority. The design may be accepted by Owner/ his Consultants only if the Purchase / his consultant is satisfied that sufficient experience exists with the design proposed.
- h) Design not meeting the stipulations of the codes and standards will not be acceptable.
- i) Apart from various codes and standards mentioned in Section 1/2, the Manufacturer shall comply with other requirements of codes and standards mentioned in this Specification for detailed design, manufacture, testing, erection, construction etc.

Control System	IEEE – 122 , 1992
Metering / Dosing pumps	API 675 – 1987 (Positive displacement pumps – controlled volume) API 676 – 1987 (Positive displacement pumps – Rotary).
Centrifugal pumps	API 610 – 1990, ASME PTC 8.2 – 1965
Gear Box	API 613 – 1993 & AGMA 420 & 421
Coupling	API 671 – 1993
Structural	IS 1893 – 1991, IS 875-1992 & IS 800 – 1991
Pressure Vessel	ASME Sec. VIII, Div. 1 – 1995
Piping	ANSI B 31.1-1995 / 31.3 – 1993, IBR
Valve	API
Instrument	ISA, API
Electrical	As per specification attached & relevant
	IS/IEC
Tanks	API 650- 1993
Electrodes	AWS, IS
Painting	IS Standards
Performances Tests	
Overload test of crane and hoists	IS 3177

3.15 Deviations and Assumptions

Bidders requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the condition of contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Owner in writing before the award of contract, based on written request from the bidder for such a clarification.

In the event of conflict between requirements of any two clauses of the specification documents, the more stringent requirements shall apply, unless otherwise confirmed by the Owner in writing before the award of this contract, based on a written request from the Bidder for such clarification.

The Bidders are advised that while making their Bid Proposals and quoting prices, all terms and conditions of bidding documents may appropriately be taken into consideration. Bidders are required to furnish a certificate indicating their full compliance to the terms and conditions of the bidding documents.

3.16 Limit of Contract

Equipment furnished shall be complete in all respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

This review by the Owner's Engineer / Consultant may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicative of the accuracy of the information submitted. This review and/ or approval by the Engineer shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements specified under these specifications and documents.

3.17 Latent Defects

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.18 Defect Liability

The Contractor warrants that all the facilities or any part thereof are new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.

The Contractor further warrants that the Plant and equipment shall be free from defects arising from any act or omission of the Contractor or arising from design, materials, and workmanship, under normal use in the conditions prevailing in the, If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and equipment supplied or part thereof, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:

- (a) Improper operation or maintenance of the Plant and equipment by the Employer
- (b) Operation of the Facilities outside specifications provided in the Contract
- (c) Normal wear and tear.

3.19 Completion Schedule

The Bidder shall submit Time Bar chart indicating completion date of major activities such as submission of design data / calculations and drawings for approval, manufacturing of components / units, supply, inspection etc. without which the Tender shall not be considered. Time Bar Chart furnished shall afterwards form part of the contract and cannot be altered arbitrarily except Force Majeure conditions as may be agreed with the Owner.

3.20 Drawings & Documents for Owner's use and Archives

The Bidder shall submit all final drawings, documents, manuals for Owner's use and for reference / record required during course of operation and maintenance of the plant. Numbers of copies and their form (hard copy, electronic form, reproducible) to be submitted and the details of the documents, drawings, manual etc. to be furnished by the Bidder are described elsewhere in the specification.

Drawings, documents, calculation, data & Information to be submitted by the Bidder along with the offer:

Technical Data to be submitted with the Tender

- 1) List of performance tests proposed by the Bidder to demonstrate the guaranteed parameters for generator and other electrical equipment.
- 2) Specific energy consumption.
- 3) Type test certificates for major categories of equipment, issued by independent testing authority.
- 4) Guaranteed Technical Parameters.
- 5) Technical catalogues.

6) Manufacturing Quality Plan

Operation & Maintenance Manuals

Instruction manuals, presenting the basic categories of information for the operating and/or maintenance personnel, as detailed herein below shall be furnished by Bidder.

The instruction manuals shall present the following basic categories of information in particular complete and comprehensive manner and prepared for the use by operating and/or maintenance personnel.

- i. Instructions for initial commissioning, short duration and long duration shut down.
- ii. Instruction for operation, routine inspection and maintenance including preventive maintenance.
- iii. Recommendation for inspection points, method of inspection and period of inspection.
- iv. Information on detection, cause and rectification of troubles and faults.
- v. Instructions on normal repairs and overhaul.
- vi. Complete parts list with proper and complete identification (Tag nos./Serial nos. as shown in the respective approved drawings) and ordering information for all replaceable parts. The identification details of equivalent and alternative makes for these spare parts which are not manufacturer's own product shall also be listed.
- vii. List of all special tools and tackle & spares and instructions for use of such tools and tackle & spares.
- viii. One complete set of as built drawings of the entire systems.
- ix. The information shall be organized in a logical and orderly sequence. A general description of equipment including significant technical characteristics shall be included to familiarize operating and maintenance personnel with the equipment. Such description and technical characteristics shall not differ from the approved data.
- x. Necessary drawings, curves and other illustrations shall be included or copies of appropriate approved drawings shall be bound in the manuals. Tests, adjustment and calibration information, as appropriate, shall be included. Safety and other warning notices and installation, maintenance and operating cautions shall be emphasized.
- xi. Write-up, figures, part list etc., shall be clearly legible. The manuals shall be prepared on good quality paper securely bound in durable folders.
- xii. The instruction manuals shall be subject to Consultant's approval in the same fashion as that for drawings.
- xiii. Instruction manual shall give step by step procedure for Erection, testing and commissioning
- xiv. Operation, Maintenance and Repair Instruction manual shall also contain:
- xv. List of spare parts with ordering specifications and manufacturer's catalogues
- xvi. List of consumables, lubricants, chemicals with specifications, brand names and annual consumption figures.
- xvii. Drawings relevant for erection, operation, maintenance and repair of the equipment.
- xviii. Procedure for ordering spares.
- xix. Maintenance Manual shall also include:
- xx. Diagnostic trouble shooting / fault location charts
- xxi. Tests for checking of proper functioning.

Drawings / documents for approval

- Quality Control & Quality Assurance plan.
- G.A. and Cross Sectional drawings of all equipment indicating weights, material of construction, bill of material, dimension, specification etc.
- Final design calculations and assumptions.
- Actual performance data and characteristic curves based on the testing at site.
- Technical specification of all equipment, motors, for all system and all other accessories.
- Final list of drawings.
- As built drawings.

Miscellaneous

- i. General arrangement and cross sectional drawings of all major components with bill of material.
- ii. Foundation drawings, load data & design calculation for all equipment.
- iii. Erection drawings for all equipment and structures showing complete erection details.
- iv. Engineering and design calculations of installations and units.
- v. QAPs
- vi. Detailed procedures of shop testing of all the items applicable shall be submitted to the Owner/ Consultant for approval before conducting tests.
- vii. Following shop test certificates/test curves/data, shall be furnished.
 - Materials and components test certificates.
 - Performance test results and characteristic curves of all fans, pumps, and electric drive motors etc.
 - Non-destructive test results as applicable.
 - Reports and test certificates of shop tests.
 - Type test & routine test certificates.
- viii. Detailed quality assurance program along with quality plan shall be submitted.

Following data shall be furnished: -

- a) Technical data of all the plant, equipment, drive motors, instruments, panels, etc. shall be furnished.
- b) Following lists/tables / write ups shall be furnished, complete with tag nos. and brief specification. Proper numbering system as approved by Consultant/Owner shall be adopted.
 - i) Instrument schedule (with service, range, make of instrument).
 - ii) Flow element schedule.

-
- iii) Valve schedule.
 - iv) Pipe schedule.
 - v) Cable schedule (Power & Control).
 - vi) Schedule of actuators (electric/pneumatic)

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 finalized 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.

Note: The 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.

3.21 Workmanship and Quality Control




All moving parts of equipment, which can conceivably cause injury to the operator and otherwise authorized personnel within the vicinity of working area shall be suitably guarded and warning displays shall be put at prominent places.

The Bidder shall clearly indicate and identify the plans and procedures, which shall be followed in the design, manufacture and installation of plant and equipment to control and assure to the Owner of the desired quality.

FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

3.22 Title Block:

Project	Teesta-VI H.E. Project (4x125 MW)		
Customer	 LTHP LTD. (A wholly owned subsidiary of NHPC Ltd.) <small>(A wholly owned Subsidiary of NHPC LTD.)</small>		
Consultant	 NHPC Ltd.		
	BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		Name
		Drawn	
		Checked	
		Approved	
Title	Drawing Number :		Rev

-----XXXX-----

SECTION-4
GUARANTEED TECHNICAL PARTICULARS-PLCC

COUPLING DEVICES

1. Name of Manufacturer and Country
2. Type, Model and Catalogue Number
3. Whether suitable for mounting Outdoor in Switchyard & Type of mounting
4. Maximum temperature limit for satisfactory operation of coupling device mounted outdoor
5. Net weight
6. Nominal Primary Side Impedance
7. Nominal secondary Side Impedance
8. Composite loss within Passband
9. Return loss within Passband
10. Available Bandwidth (with 4400/6600/ 8800 pF CVTs)
11. Nominal Peak Envelope Power (with Distortion and Intermodulation Products 80 dB Down)
12. Maximum number of PLC terminals that can be connected in parallel:
 - (a) 20 W (P.E.P.) PLC terminals
 - (b) 40 W (P.E.P.) PLC terminals
 - (c) 100 W (P.E.P.) PLC terminals
13. Power Frequency Impedance between primary terminal and Earth Terminals of Coupling Device.
14. 1 Minute Power Frequency Insulation level between Primary and Secondary Terminals of Coupling Device
15. Impulse (1.2/50 micro-sec.) Withstand Level between Primary and Secondary Terminals

- of Coupling Device
16. Power Frequency Current Carrying Capacity of Drain Coil (or Primary Winding of Matching Transformer).
- (a) Continuous current
 - (b) Short time current for 0.2 sec.
 - (c) Inductance of drain coil with Tolerances (at 50 Hz)
17. Surge Arrester in Primary Side of Coupling Device:
- (a) Type model & catalogue number
 - (b) Power frequency sparkover voltage
 - (c) Type of construction
 - (d) Maximum permissible arrester Discharge current with 8/20 micro Sec. impulse discharge
 - (e) Maximum permissible short time Current (2.2 micro sec.)
 - (f) Power frequency discharge current For 0.2 sec.
 - (g) Impulse spark over voltage 1.2/50 Micro sec.
 - (h) Rated voltage
 - (i) Whether Site tunable
18. Surge arrester in Secondary Side of Coupling Device
- (a) Type model & catalogue number
 - (b) Power frequency spark over voltage
 - (c) Impulse spark over voltage (1.2/50 Micro sec.
19. Details of interlock provided with cover enclosed -
20. Overall dimensions

21. No of H.F. terminals provided for carrier equipment. connection

HIGH FREQUENCY CABLE

1. Name of Manufacturer and Country
2. Type, Model and Catalogue No.
3. Applicable standards
4. Characteristic Impedance
5. Rated Capacitance
6. Service Voltage
7. Attenuation per km. of cable at various Carrier Frequencies in the Range of 50 to 500 KHz. (Typically at 50,100,200,300, 400,500 KHz)
8. Withstand Test Voltage (RMS) between conductor and Sheath
9. Details and particulars of Insulation
10. Loop Resistance per Km (Typical at 20°C)
11. Details of Armouring
12. Number and Diameter of Stranded Conductor
13. Overall Diameter of Cable
14. Net weight per Km.
15. Minimum bending radius
16. Earthing detail of H. F. Cable
17. Packing length per drum
18. Construction drawing, type test & performance reports enclosed or not

POWER LINE CARRIER TERMINAL FOR SPEECH & DATA TRANSMISSION

1. Name of Manufacturer and Country

2. Type, Model and Catalogue No.
3. Type of Modulation
4. Mode of transmission
5. Carrier Frequency Range
6. Nominal Carrier Frequency Band in either direction of transmission
7. Return loss within the Nominal Carrier Frequency Band
8. Effectively Transmitted V.F Band
9. Return Loss within the Effectively Transmitted Voice Frequency Band.
10. H. F. Oscillator Details
11. I. F. Oscillator Details
12. Frequency Difference between the V.F. Input and V.F. Output of a pair of terminals connected back to back for permissible Ambient Temperature and supply voltage variations.
13. Maximum H. F. Amplifier output with Single/Multiple tone keying (Peak Envelope Power).
14. Nominal carrier frequency Power (Peak Envelop Power) at output terminals.
15. H. F. Impedance at output of carrier terminals.
16. Stability of the carrier frequency.
17. Improvement in S/N due to compander
18. Whether carrier is suppressed or reduced during transmission of signal
19. Whether frequency locking between Tx/Rx provided.

- 20 Automatic gain control range and regulation
- 21 Level of spurious emission at
 - (a) Edge of nominal Carrier Frequency Band
 - (b) 4.0 KHz away from nominal carrier Frequency band.
 - (c) 8.0 KHz away from nominal carrier Frequency band.
- 22 Relative level at V. F. 4 wire terminating points:
 - (a) Send leg
 - (b) Receive leg
23. Permissible limits for level variation with frequency relative to 800 Hz in a speech channel (without companders) transmitted over a pair of terminals connected back to back
24. Level of telephone signalling channel:
 - a. Input level
 - b. Output level
25. Near and far end cross talk due to telephone signalling channel in a pair of PLC Terminals (without companders) connected back to back.
26. Pulse distortion of telephone signalling channel when operated at a signalling speed of 10 pps and with a mark to space ratio of 40/60 in PLC terminals connected back to back.
27. Psophometric Noise contribution of a pair of PLC terminals connected back to back
28. Group delay distortion in the frequency band relevant to the transmission of protection signals.

29. Performance Under Noise condition:
 - a. Noise generated within terminal
 - b. Additional noise introduced when terminals are connected back to back at repeater station
 - c. Noise Bandwidth.
30. Power supply requirements:
 - (a) Voltage
 - (b) Permissible voltage variation
 - (c) Maximum current
 - (d) Quiescent Current
31. Installation details
32. Insulation level
33. Meters provided on Test Panel, their range and purpose.
34. Is the equipment suitable to work in Dust laden atmosphere?
35. Whether interior lamps with door switch is provided in cabinets
36. Over all dimensions (Cabinet)
 - (a) Length mm
 - (b) Width mm
 - (c) Height mm
37. Weight
38. Earthing detail of PLC Cabinet
39. Whether Tx/Rx loop-back facility is available for testing locally
40. Whether site tunable

POWER LINE CARRIER TERMINAL FOR NETWORK PROTECTION

1. Name of Manufacturer and country
2. Type, Model and Catalogue No.

3. Type of Modulation
4. Mode of transmission
5. Carrier Frequency Range
6. Nominal Carrier Frequency Band in either direction of transmission
7. Return loss within the Nominal Carrier Frequency Band
8. Effectively Transmitted V.F Band
9. Return Loss within the Effectively Transmitted Voice Frequency Band.
10. H. F. Oscillator Details
11. I. F. Oscillator Details
12. Frequency Difference between the V.F. Input and V.F. Output of a pair of terminals connected back to back for permissible Ambient Temperature and supply voltage variations.
13. Maximum H. F. Amplifier output with Single/Multiple tone keying (Peak Envelope Power).
14. Nominal carrier frequency Power (Peak Envelop Power) at output terminals.
15. H. F. Impedance at output of carrier terminals.
16. Stability of the carrier frequency.
17. Improvement in S/N due to compander
18. Whether carrier is suppressed or reduced during transmission of signal
19. Whether frequency locking between Tx/Rx provided
20. Level of spurious emission at
 - (a) Edge of nominal Carrier Frequency

Band

- (b) 4.0 KHz away from nominal carrier
Frequency band
 - (c) 8.0 KHz away from nominal carrier
frequency band.
21. Whether frequency locking between Tx/Rx provided
 22. Relative level at V. F. 4 wire terminating points:
 - (a) Send leg
 - (b) Receive leg
 23. Permissible limits for level variation with frequency relative to 800 Hz in a speech channel (without companders) transmitted over a pair of terminals connected back to back
 24. Variation in overall loss of speech circuit with a pair to PLC terminals connected back (without Companders & limiters) when voice frequency input level changes from 10 to 0 dBm
 25. Psophometric Noise contribution of a pair of PLC terminals connected back to back
 26. Noise frequency Band width
 27. Group delay distortion in the frequency band relevant to the transmission of protection signals.
 28. Signal Delay with Two PLC Terminals connected back to back
 29. Power supply requirements:
 - (a) Voltage
 - (b) Permissible voltage variation

(c) Maximum current

30. Installation details
31. Meters provided on Test Panel, their range and purpose.
32. Is the equipment suitable to work in Dust laden atmosphere without air conditioning?
33. Whether interior lamps with door switch is provided in cabinets
34. Over all dimensions
 - (a) Length mm
 - (b) Width mm
 - (c) Height mm
35. Weight
36. Insulation level
37. Cabinet earthing details
38. Whether indication is available in sending end panel for receipt/execution of trip signal/command at remote end.
39. Whether Tx/Rx loop-back facility is available for testing locally

40. Whether site tunable

**VF TRANSMISSION TERMINAL FOR NETWORK PROTECTION SIGNALS
(PROTECTION COUPLER)**

1. Name of Manufacturer and Country
2. Type, Model and Catalogue Number
3. Whether equipment works on frequency shift principle of coded signal principle

4. Whether Equipment is suitable for Independently Protecting Two Circuits
5. Frequencies used in the equipment for transmission of signal for coded Signal transmission
 - (a) Guard frequency
 - (b) Working frequency (Trip System - I)
 - (c) Working frequency (Trip System - II)
 - (d) Working frequency (Trip System I&II)
6. Criteria used for command Transmission
7. Whether equipment is protected against Tripping by Spurious Signals.
8. Transmission time corresponding to telegraph speed for transmission on PLCC channel of coded signal
 - (a) 600 Bds.
 - (b) 400 Bds.
 - (c) 200 Bds.
9. Whether in the presence of spurious signals as well as Protection Signals simultaneously, the equipment will initiate a Trip Command.
10. Mode of Transmission of guard signal
11. Whether equipment is suitable for Direct Circuit Breaker tripping.
12. Maximum number of Noises Impulses pps in Presence of which the equipment will satisfactorily perform its duty.
13. Signal Delay with Two Terminals connected back to back
14. Whether the Command Signal is acknowledged at receiving end and in the event of non-receipt of the correct signal, the command is repeated or not by the

- transmitter?
15. Whether it is possible to alter the priority of commands of various codes at site.
 16. What are the performance based results under severe line noise conditions for
 - (a) False trip probability
 - (b) Fail to trip probability
 17. Transmitter Input Requirements (Contact Ratings)
 - (a) Voltage
 - (b) Current
 - (c) Power
 - (d) No. of Contacts
 18. Receiver Output (Contact Rating)
 - (a) Voltage
 - (b) Current
 - (c) Power
 - (d) No. of Contracts
 19. Additional facilities provided in Receiver output
 20. Supervisory and Alarm Contact Facilities
 - (a) Current
 - (b) Voltage
 - (c) No. of contacts
 21. Installation
 22. Power Supply
 - (a) Voltage
 - (b) Current
 - (c) Power
 23. Type and number of counters for recording the number of Trip Commands sent and number of Trip Commands received
 24. Whether loop test is possible

25. Insulation Level
26. Whether the equipment is suitable for transmitting and receiving more than two independent commands (please give full details)

EPAX

- 1 Name of manufacturer
- 2 Type of Model
- 3 Number of subscriber lines
 - (a) Wired for
 - (b) Equipped for
- 4 Number of trunk lines provided
 - (a) Wired for
 - (b) Equipped for
- 5 Whether the facility to bar subscriber's access to the carrier lines is provided during maintenance?
- 6 Whether P.G. lockout facility provided along with alarm?
- 7 Whether alarm type fuse provided for audio and visual indications?
- 8 Whether suitable for satisfactory operation in conjunction with PLCC system
- 9 Signalling Pulse Width
 - (a) Engage Pulse
 - (B) Priority Pulse
 - (C) Digit pulse
 - (D) Inter digit pause
 - (E) Release Pulse
- 10 Operating voltage
- 11 Power requirement
- 12 Overall dimensions (W x D x H)
- 13 Mounting arrangement
- 14 Weight

- 15 Type of switching

- 16 Whether four-wire interfaces are built-in

- 17 In case four-wire interfaces are built-in maximum number of PLC terminals which can be connected to a single EPAX

- 18 Whether self-diagnostics and monitoring features are built-in

- 19 Whether the following facilities are built-in
 - (a) Priority cutting
 - (b) Conference
 - (c) Alternate routing
 - (d) Call transfer

- 20 Maximum loop resistance permissible
 - (a) For trunk line
 - (b) subscriber lines

- 21 Whether suitable to work in conjunction with electromechanical PAX

- 22 Whether suitable to work with DOT leased lines as per specification

SECTION 5
CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS
CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER: OFFER REFERENCE:

I. A) CARRIER EQUIPMENT

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60495	Yes / No	
2.	Type			
3	Type of Modulation	Amplitude Modulation	Yes / No	
3	Mode of Transmission	Single Side band (SSB)	Yes / No	
4	Carrier frequency range	40 - 500 kHz	Yes / No	
5	Nominal carrier frequency band in either direction of transmission	4 kHz	Yes / No	
6	Return Loss within the nominal carrier frequency band	10 dBmin	Yes / No	
7	Return Loss within the effectively transmitted voice frequency band	Not more than 14 dB	Yes / No	
8	Frequency difference between the V.F. input and V.F. output of a pair of terminals connected back to back for permissible ambient temperature and supply voltage variation	Will not exceed 2 Hz	Yes / No	
9	Power Output at HF terminal	20W/40 W / 80W for S/C	Yes / No	
10	Nominal carrier frequency power (peak envelope power) at output terminal	40 watt / 80W	Yes / No	
11	H.F. Impedance at output of carrier terminals	75 ohms (unbalanced) or 150 ohms (balanced)	Yes / No	
12	Stability of carrier frequency	< ±10 Hz	Yes / No	
13	Whether compander is provided	Provided		
14	Compression and expansion ratio of compander	At least 2:1 compression ratio with a corresponding expansion ratio of 1:2.	Yes / No	
15	Improvement in S/N due to compander	15 dB	Yes / No	
16	Whether carrier is suppressed during transmission of signal	Yes	Yes / No	
17	Whether frequency locking between Tx/Rx provided	Yes	Yes / No	

18	Automatic gain control range and regulation	For 40 dB change in carrier frequency signal level within the regulation range change in VF receive levels of both speech and other signals shall be less than 1 dB.	Yes / No	
19	Level of spurious emission at			
(a)	Edge of nominal carrier frequency	As per IEC 495	Yes / No	
(b)	4.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes / No	
(c)	8.0 kHz away from nominal carrier frequency band	As per IEC 495	Yes / No	
20	Near and far end cross talk due to telephone signaling channel in a pair of PLC terminals (without companders) connected back to back	Less than or equal to - 55 dBmop	Yes / No	
21	Psophometric noise contribution of a pair of PLC terminals connected back to back	Less than or equal to - 55 dBmop	Yes / No	
22	Group delay distortion in the frequency band relevant to the transmission of protection signals	As per CCITT recommendation G.232	Yes / No	
23	Performance under noise condition			
(a)	Noise generated within terminal	As per IEC 495	Yes / No	
(b)	Additional noise introduced when terminals are connected back to back at repeater station	As per IEC 495	Yes / No	
(c)	Noise bandwidth	As per IEC 495	Yes / No	
24	Power supply requirements			
(a)	Voltage	48 V DC	Yes / No	
(b)	Permissible voltage requirement	15 %, - 10% (positive pole earthed)	Yes / No	
25	Insulation level	2 kV for all AC circuits 500 V DC for all signal points	Yes / No	
26	All solid state equipment /system panels subjected to heat soaking		Yes / No	
27	LTHP/NHPC approved standard drawing/Type test reports/GTP are available for approval extension		YES	

II. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier as per IEC 495 on identical or similar material are available (test reports are of the test conducted not earlier than 5 (five) years prior to the date of bid opening).
 (YES / NO)

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost. (YES / NO)

III. A) PROTECTION COUPLER

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60834	Yes / No	
2.	Type			
3	Principle of working for transmission / reception of protection signal	Frequency shift keying / coded signal	Yes / No	
4	Each protection signaling equipment shall provide	Transmission facilities for minimum three protection signals and reception facilities for minimum three protection signals.	Yes / No	
5	The equipment shall be suitable for	Transmission of direct and permissive trip signal as well as blocking signals	Yes / No	
6	The overall time of PLC,VFT and transmission path for permissive trip / blocking	20 msec.or less	Yes / No	
7	The overall time of PLC,VFT and transmission path for direct trip	30 msec.or less	Yes / No	
8	Under no circumstances protection channel should share power	Yes	Yes / No	
9	Whether loop facilities is provided for operational reliability	Yes	Yes / No	
10	Whether built in counters for counting the number of trip command sent and number of trip command received is provided	Yes	Yes / No	
11	Whether equipment is suitable for direct circuit breaker	Yes	Yes / No	
12	Transmitter input requirements (contact requirements)			
(a)	Voltage	660 volts	Yes / No	
(b)	Current	5 amps	Yes / No	
(c)	Power	1250 W/VA	Yes / No	
(d)	No. of contacts	2 No. potential free NO contact	Yes / No	
13	Receiver output requirements (contact requirements)			
(a)	Voltage	250 V (DC)	Yes / No	

(b)	Current	0.1 A (DC)	Yes / No	
(c)	Power	As per IEC-255--25	Yes / No	
(d)	No. of contacts	2 No. potential free NO contact	Yes / No	
14	Supervisory and alarm contact facilities			
(a)	Current	0.1A(DC)	Yes / No	
(b)	Voltage	250 V(DC)	Yes / No	
(c)	No of contacts	2 number potential free change over contact	Yes / No	
15	Power Supply			
(a)	Voltage	48 V DC , + 15 % - 10% (Positive pole earthed)	Yes / No	
16	Whether loop test is possible	Yes	Yes / No	
17	Insulation level	As per IEC 60834	Yes / No	
18.	LTHP/NHPC approved standard drawings available for approval extension		Yes	

III. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier as per IEC 60834-1 on identical or similar material are available (test reports are of the test conducted not earlier than 5 (five) years prior to the date of bid opening).
(YES / NO)

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost.
(YES / NO)

IV. A) COUPLING DEVICE

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 481, IS 8998	Yes / No	
2.	Type, Model Number			
	Type of Coupling device (indenter to tick)	Phase to Phase V	Phase to earth	Yes / No

3	Type of mounting	Outdoor	Yes / No	
4	Maximum temperature limit for satisfactory operation	50 °C (Satisfactory operation upto 65 °C)	Yes / No	
5	Nominal line side Impedance	240 ohms for 765kV and 400kV Quad bundle conductor line	Yes / No	
6	Nominal equipment side impedance	75 ohm (unbalanced)	Yes / No	
7	Composite loss within passband	Not more than 2 dB	Yes / No	
8	Return loss within passband	Not less than 12 dB	Yes / No	
9	Available bandwidth	30 to 500 kHz	Yes / No	
10	Nominal peak Envelope Power (with distortion and inter modulation products 80 dB down)	Not less than 650 watt	Yes / No	
11	Power frequency impedance between primary terminal and Earth terminals of coupling device	Less than 20 ohms	Yes / No	
12	1 Minute power frequency insulation level between primary and secondary terminals of coupling device	5 kVrms	Yes / No	
13	Impulse (1.2/50 micro-sec.) withstand level between primary and secondary terminals of coupling device	As per IEC 481	Yes / No	
14	Power frequency current carrying capacity of drain coil (or primary winding of matching transformer)	As per IEC 481	Yes / No	
15	Whether Surge arrester in primary side of coupling device as per IEC 481 provided	Provided	Yes / No	
16	No. of H.F terminals provided for carrier equipment	At least 2	Yes / No	

IV. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier on identical or similar material are available (test reports are of the test conducted not earlier than 5 (five) years prior to the date of bid opening).
(YES / NO)

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost.
(YES / NO)

V. A) H.F.CABLE

S.No.	Parameters	Data	Yes / No	Remarks
1.	Applicable Standard	IEC 60096-2,BS:2316, IS:5082	Yes / No	
2.	Type			
3.	Characteristic Impedance	75ohm unbalanced	Yes / No	
4.	Attenuation constant at 200MHz	0.1dB/m	Yes / No	
5.	Details and particulars of insulation	8kV (rms)		
6.	Rated Capacitance per meter	67pFapprox.		
7.	Dielectric strength of core			
8.	Withstand test voltage (rms) between conductor and outer sheath	4 kV for 1 min.	Yes / No	
9.	Conductor resistance of cable	Not exceed 16 ohms /Km at 20 °C Cent	Yes / No	
10.	Minimum bending radius	15 cms	Yes / No	
11.	Packing length per drum	500 meter.	Yes / No	

V. B) TYPE TESTS

i) Whether type test reports of the following test conducted earlier on identical or similar material are available (test reports are of the test conducted not earlier than 5 (five) years prior to the date of bid opening).
(YES / NO)

ii) If type test reports are not acceptable to BHEL/Customer then above tests shall be conducted by the bidder free of cost .
(YES / NO)

VI. A) Electronic Private Automatic Exchange (EPAX)

S.No.	Parameters	Data	Yes / No	Remarks
1.	Type			
2.	Construction feature	Solid state and fully automatic	Yes / No	
3.	Number of subscriber lines (Indentor to tick)	4 8 24 48 v	Yes / No	
4.	Number of trunk lines (Indentor to tick)	4 8 v 12	Yes / No	
5.	Type of Switching	PCM/TDM	Yes / No	

6	Operating voltage	48 V DC with + ve pole earthed	Yes / No	
7	Whether four wire E/M interfaces unit is provided.	Yes	Yes / No	
7	Whether suitable to work in conjunction with Electro - mechanical PAX	Yes	Yes / No	
9	Whether suitable to work with DOT leased lines	Yes	Yes / No	

V. ADDITIONAL REQUIREMENTS:

1.	Training shall be imparted to employer's personnel as per Section-I , of this Technical Specification		Yes/No	
2.	Valid Type test reports as per Section-II , is attached along with this offer.		Yes/No	
3	Confirmation to Section –III pertaining to TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE		Yes/No	
4	List of Deviations if any , is attached along with offer		Yes/No	
5	List of all special tools and tackles as per Clause 13.9 of Section-II of this technical Specification and scope thereof of BHEL/Supplier is attached along with offer .		Yes/No	
7	Bidder to submit details of freq. planning done (including computer studies carried out and facilities available) for PLCC links on EHV lines in the past along with this offer		Yes/No	
8	One copy of computer study result done in past attached along with this offer.		Yes/No	
9	Following Documents are attached along with the offer :			
	a. Filled Checklist.		Yes/No	
	b. Filled GTP		Yes/No	
	c. Drawings & technical Literature		Yes/No	
11	Construction drawing of HF cable with		Yes/No	

	Mechanical & Electrical parameters, enclosed with offer			
12	Details as per cl. 6 (6) of Section I shall be furnished at contract stage		Yes/No	
13	All terminals for speech shall be with transit band pass filter, tunable at site & wired for addition of VFT's in future		Yes/No	
15	Mandatory testing & maintenance equipment as per cl. 13.11 , section II , included in offer		Yes/No	

Date:

Signature of the authorized representative of Bidder

Company Seal

SCHEDULE OF TECHNICAL DEVIATIONS

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

<u>Sl. No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
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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-B:
COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing/ 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 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 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