SCHEDULE OF PRICE(Supply Items)

'(BIDDERS TO STRICTLY ENSURE SUBMITTING THE PRICE BIDS IN THIS FORMAT)

TENDER ENQUIRY NO 429E192 . DATE 11/9/19
CURRENCY

SL. NO.	DESCRIPTION OF ITEM	UNIT	QUANTITY	UNIT FOB/EX WORKS PRICE	TOTAL FOB/EX WORKS PRICE	UNIT FREIGHT AND INSURANCE UP TO PORT OF DISCHARGE (FOREIGN BIDDER)	UNIT FREIGHT AND INSURANCE FROM PORT OF DISCHARGE(FOREIGN BIDDER) /EX WORKS (INDIAN BIDDER) UP TO SITE	TOTAL FREIGHT AND INSURANCE	TAXES AND DUTIES IF ANY	TOTAL F.O.R (DESTINATION) PRICE
	2	3	4	5	6	7	7	8	9	10
1	400kV 1C X 2500mm^2 Copper conductor corrugated Aluminium/copper/welded Aluminium sheath. XLPE cable complete with necessary auxiliary equipment	M	3600							
2	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	Nos	7							
3	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	Nos	7							
4	Set of Sealing Arrangement for sealing the above spare cable at both ends	SET	1							
5	Set of bonding arrangement for the connection for the sheath of above cables(Detailed Description and bill of material shall be furnished)	SET	1							
6	Non-magnetic clamps with necessary hardware for fixing above cables to the Cable support system	LOT	1							
7	Cable Straight through joints for the above cable	NOS	2							
8	Sheath voltage limiter	NOS	3							
9	Link Box, single phase	NOS	2							
10	Training for BHEL/NHPC personnel at supplier s works (14 man days	LOT	1							
		TOTAL								

NOTE 1 PLEASE NOTE THAT UNPRICED COPY OF PRICE BID (i.e WITH ALL PRICES BLANKED) SHALL BE FURNISHED ALONG WITH TECHNO-COMMERCIAL BID
2 REQUIRED COPIES OF FORMAT BE MADE & DETAILS MAY BE ANNEXED
3 THE PRICES MUST BE QUOTED IN THE PRESCRIBED UNIT ONLY
4 SEAWORTHY PACKING CHARGES ARE INCLUSIVE
5 MENTION PORT OF LOADING

SIGNATURE AND SEAL OF BIDDER

SCHEDULE OF PRICE(Installation Services)

'(BIDDERS TO STRICTLY ENSURE SUBMITTING THE PRICE BIDS IN THIS FORMAT)

Sl. No.	Item Description	QTY./Unit	Laying / Erection (A)	Supervision of Laying / Erection (B)	Testing and Commissioning (C)	Taxes and Duties (D)	Total sum of services (E=A+B+C+D)
1	400 kV 1C X2500 mm^2 Cable (7lengths)	M	3600				
2	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	NOS	7				
3	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	NOS	7				
4	Set of bonding arrangement for the connection for the sheath of above cables. (Detailed description and bill of material should be submitted along with the offer)	SET	1				
5	Non-magnetic clamps with necessary hardwares for fixing above cables to the Cable support system	LOT	1				

Mention currrency of the rates quoted

TOTAL

BHEL/TBG/GTC02-07

BHARAT HEAVY ELECTRICALS LTD.

(TRANSMISSION BUSINESS GROUP)

GENERAL TERMS AND CONDITIONS FOR ENQUIRY

Sr. No	ENQUIRY NO. 429E192 DATE 11/9/01	Supplier Reply / Remark
1.	1.Sealed quotations are invited for the items mentioned in the enquiry. Quotations should be typed and free from over writing and erasures, corrections or additions must be clearly written both in words and figures and attested and otherwise offer may be rejected. 2. Bidder must ensure that their quotation is received / dropped in the tender box on or before 2 PM of the due date of opening in **Material Management Division,** **Transmission Business Group,** **BHEL, Integrated Office Complex,** **Lodhi Road, New Delhi – 110 003, India.** **Phone : 091-11- 41793463, Fax :091-11-24365869,** Email: rky@bhelindustry.com swayam@bhelindustry.com 3. The same shall be opened at 2.30 PM on the same day. Tenders received late shall be rejected. Bidders must ensure that tender documents are deposited on or before due date. Bidders are required to submit the **credential** along with Techno commercial bid to substantiate the qualifying requirement . 4. Bids are to be submitted in Two parts: i) Techno-commercial bid (Part I) – To be submitted in duplicate. A copy of price bid (Part II) (without prices) is also to be enclosed in Part I bid. ii) Price bid (Part II) – To be submitted only in one copy in a separate sealed envelope. This should not contain any Technical or Commercial Terms. The rates should be quoted both in figures and words. In case of any difference between figures and words, the quoted rate in words will prevail over figure. If there is a calculation mistake in multiplication of unit rate with quantity, then the unit rate quoted will be considered for calculation. Both Part I and Part II bids are to be sealed in separate envelope and both envelops to be kept in another common envelope. Each envelope should be sealed and super scribed with enquiry no., item / package name, project name and due date of opening. Note:1 Representative deputed to witness tender opening must produce an authority letter from the signatory of offer at the time of tender opening. 5. For any Technical clarification, please contact **Shri Vijay Kumar, Engineer / TBEM** **BHEL, Integrated Office Complex,** **Lodhi Road, New Delhi – 110 003, India** **Phone : 091-11- 41793459, Fax :091-11-24369509,** **Email: vijaykumar@bhelindustry.com** For any commercial clarification please contact person issuing enquiry. 6. Price bid should not contain any information / description / terms & condition other than given in Part-I of the bid except prices, otherwise bid is liable for rejection. 7. Price bid submitted along with the bid shall remain valid up to validity of offer. Unsolicited Supplementary / Revised price bid submitted during validity period of offer, unless asked by BHEL, shall not be considered. Withdrawal of quotation by the	

	offer, unless asked by BHEL, shall not be considered. Withdrawal of quotation by the bidder, at any stage after its opening, may entail blacklisting of vendor. 8. Enquiry condition for where the scope against this tender includes Installation and Commissioning of the equipment / material 9. Authorized signatory should authenticate tender documents. There will be separate contract awarded for Supply portion and Site execution portion. For Supply portion General Terms and Conditions mentioned here shall be applicable for Site execution portion, Terms and conditions for Installation services shall be applicable. However, any breach in either of the contract shall be deemed as the breach of other contract also.	
2.	**PRICES:** **A.** The prices as quoted in price schedule remain firm after adjustment by the PVC adjustment formula attached with the enquiry. **B**. The break-up of price shall be as under:- • Ex-Works price for Indian vendors • FOB (mention port) / CIF- destination port (Mumbai) for foreign **ii) Freight & Insurance:** Indian vendors to quote Freight and insurance from works to site. Foreign vendors to quote Freight and Insurance charges from port of loading to port of discharge . **iii)Type Test charges** is to be quoted separately for each Test along with taxes and duties if such test is specified . **iii) Erection / Commissioning supervision charges** to be quoted separately along with applicable taxes and duties . Note: i) The purchase order shall be placed on Ex-works/ FOB/ CIF basis. ii) Evaluation shall be on landed cost at site to buyer.For foreign vendor, BHEL transport contract rates / freight charges from port to site will be added for evaluation. However foreign vendor can also quote for inland transport.(from port to site) iii) Price offer should clearly mention breakup of FREIGHT and INSURANCE up to DISCHARGE PORT – MUMBAI (iv) BHEL reserves right to exercise option of "REVERSE AUCTION" to obtain best price. (v) Price expressed in any currency will be converted to Indian rupee at the sailing exchange rate in India on the date of Bid opening.	Supplier reply / Remark
3.	**TERMS OF PAYMENT:** - a) **FOR SUPPLY PORTION**:- By irrevocable LC which will be opened after placement of order and receipt of performance bank guarantee for 10% of order value. All bank charges to supplier's account. **90%** against original invoice, original bill of lading, packing list, MICC (dispatch clearance given by BHEL quality group), guarantee certificate, certificate of origin, Transit Insurance Certificate. **10%** against material receipt at site against material receipt certificate by BHEL Site Incharge. b) **FOR INSTALLATION SERVICES:**- 100% direct payment within 15 days after acceptance of the installation services work. **INTEREST LIABILITY** In case of any delay in payment due to any reason, BHEL shall not pay any interest on delayed payment.	Supplier Reply/Remark

4.	**SECURITY CUM PERFORMANCE BANK GUARANTEE**: In the event of an order, tenderer shall furnish BG towards Security Cum Performance for 10% of total value of P.O., within two weeks of placement of P.O. valid till 60 days beyond the guarantee period, from a reputed Bank of the bidder's country, subject to Purchaser's approval, in our prescribed format. The original BG shall be sent by issuing bank directly to AGM - FINANCE, INDUSTRY SECTOR, BHARAT HEAVY ELECTRICALS LIMITED, INTEGRATED OFFICE COMPLEX, LODHI ROAD, NEW DELHI – 110 003, (INDIA).	Supplier Reply/Remark
5	**INSPECTION:** BHEL and / or customer may inspect the Equipment/Material before dispatch. In the event BHEL / Customer waives off inspection, certified TEST REPORTS and RESULTS shall be submitted for approval. Supplier shall obtain approval on Test reports and MICC (Material Inspection Clearance Certificate), before dispatch of equipment. BHEL / Customer may also carry out stage inspection during manufacturing of the ordered item. Supplier shall send inspection call on prescribed format only, with an advance notice of 15 days.	
6	**DISPATCH DOCUMENTS:** Dispatch documents shall normally comprise Original Invoice, AWB / Bill of Lading, Shipping / Packing lists (case wise), Transit Insurance certificate, Certificate of country of origin, Material Inspection Clearance certificate (MICC), Test Certificates & approval of acceptance & routine test certificates and manufacturer's guarantee certificate.	
7	**DELIVERY PERIOD:** Bidder to specify delivery period in weeks from the date of LOI / PO in the activity schedule format enclosed with enquiry. Time for conduction of type test, if required, is to be separately indicated. Note: BOL/AWB date or Invoice date whichever is later shall be considered as delivery date for supply portion and date of completion of installation work shall be considered as delivery date for installation work.	
8	**DELAYED DELIVERY:** In case of delay in execution of order beyond the lot wise contractual delivery, an amount of .65 % of total Ex-Works Value per week or part there-of subject to maximum of 10 % of total Ex-Works value of P.O. will be withheld.	
9.	**VALIDITY:** The offer shall be valid for 120 days from the due date of opening.	
10.	**ACCEPTANCE / REJECTION OF TENDER**: BHEL reserves the right to reject in full or part, any or all tender without assigning any reason thereof. BHEL also reserves right to vary the quantities mentioned in the tender.	
11.	**EVALUATION:** Comparative statement shall be prepared based on overall quantity basis unless otherwise indicated in the enquiry. Evaluation of offers shall be done on the basis of delivered cost to BHEL.	
12.	**DEVIATION:** The bids having deviation(s) w.r.to tender are liable for rejection. However, BHEL, at its discretion, may load the prices for evaluation of offer with prior intimation to bidder.	
13.	**ARBITRATION**: All cases of disputes emanating from and relating to this contract, the matter shall be referred to the sole arbitration of Unit Head / GM, BHEL or any other person (including an employee of BHEL, even though he had to deal with the matter relating to this contract in any manner) nominated by him to act as sole arbitrator. The arbitration shall be under 'The arbitration and conciliation act 1996' and the rules there under as amended from time to time. The arbitrator may from time to time with the consent of the parties enlarge the time for making and publishing the award. The venue of arbitration shall be any Indian city as decided by BHEL.	
14.	**LEGAL SETTLEMENT:** All suits/claims in respect of this contract shall be in the courts having jurisdiction at New Delhi.	

15.	**SUBCONTRACTING:** In case further subcontracting of BHEL order or part thereof is envisaged by supplier, the same can be done after written permission is obtained from BHEL. However it shall not absolve the supplier of the responsibility of fulfilling BHEL purchase order requirements.	Supplier Reply/Remark
16.	**RISK PURCHASE:** In case the successful bidder fails to supply or fails to comply with the terms & conditions of the purchase order, BHEL reserves the right to source such material/ component / equipment/ system from any other agency at the risk and cost of the successful bidder.	
17.	**ADJUSTMENT OF RECOVERY:** Any amount payable by the supplier under any of the condition of this contract shall be liable to be adjusted against any amount payable to the supplier under any other works/contract awarded to him by any BHEL unit. This is without prejudice to any other action as may be deemed fit by BHEL.	
18.	**FORCE MAJEURE CONDITION:** If by reason of war, civil commotion, act of god, Government restrictions, strike, lockout which are not in control of supplier the deliveries are delayed, supplier shall not be held responsible.	
19	**Demurrage/ Wharfage:** For the reasons of delay in receipt of documents from suppliers or due to the same being found to be incomplete, and/or faulty, the suppliers shall be responsible to reimburse in all demurrages / wharfages, if any, paid by BHEL (for stated reasons).	
20	Procurement will be from manufacturers only. Manufacturers should submit offers directly. However in case of involvement of any representative the details of the same along with the copy of the agreement should be submitted in the first part of the offer. Principal manufactures must ensure that the nominated representative do not represent any other manufacture for the same item.	

Signature of Bidder

Seal

BHARAT HEAVY ELECTRICALS LTD.
(TRANSMISSION BUSINESS GROUP)

TERMS & CONDITIONS FOR SUPERVISION / INSTALLATION SERVICES

Sl. No.	Terms & Conditions	Supplier Reply/Remark
1.0	**Scope of Work:** As per our Technical Specification No. TB-300-316-002. REV 01	
2.0	**COMMENCEMENT OF WORK**: Project start / zero date for this work shall be intimated by BHEL.	
3.0	**COMPLETION SCHEDULE**: Bidder to specify delivery period in weeks from the date of Project start / zero date in the activity schedule format enclosed with enquiry.	
4.0	**OVER RUN CHARGES**: No over run charges are payable.	
5.0	**IDLE LABOUR CHARGES:** No idle labour charges will be admissible in the event of any stoppage of work resulting in the contractor's workmen being rendered idle due to any reason at any time.	
6.0	**SECURITY-CUM-PERFORMANCE GUARANTEE:** The contractor shall furnish security-cum-performance BG for 10% of total contract value within two weeks of placement of work order valid till guarantee period from a reputed Bank of the bidder's country, subject to Purchaser's approval n the prescribed format . The BG should be sent directly by your banker to AGM - FINANCE, INDUSTRY SECTOR, BHARAT HEAVY ELECTRICALS LIMITED, INTEGRATED OFFICE COMPLEX, LODHI ROAD, NEW DELHI – 110 003, (INDIA).	
7.0	**INSURANCE:** The Contractor shall take insurance cover(s) to cover his Tools and Plant assets, workman compensation and third party liability. The contractor shall make available the original insurance cover(s) to the Engineer for necessary verification before commencement of work.	
8.0	**GUARANTEE:** Though the work will be carried out under the supervision of BHEL Engineers, the contractor shall be responsible for the quality of the workmanship and shall guarantee the work done for a period of 15 months from the date of putting the complete system into commercial operation or 18 months from the date the system is declared completely erected, duly tested and accepted by customer, whichever is later and shall rectify free of cost all defects due to faulty erection detected during the guarantee period starting from the date of the	

	completion of rectification. In the event of the contractor failing to repair the defective works within the time specified by the engineer, BHEL may proceed to undertake the repairs of such defective works at the contractor's risk and cost without prejudice to any other rights under the contract and recover the same from security deposit/ other dues of this project or any other project executed by the contractor.	
9.0	**TERMS OF PAYMENT:** The terms of payment shall be as specified under Clause 3 of General Terms and Conditions of Overseas Enquiry.	
10	**ESCALATION / PRICE VARIATION:** Prices shall be firm for total contract period and extended period, if any, and no price escalation / price variation will be applicable.	
11	**COMPENSATION FOR DELAY IN EXECUTION:** In case the contractor fails to complete the work within the time specified or any extension thereof subject to force major condition, the contractor shall be liable to pay by way of compensation, a sum equal to .65 % of the contract price, per calendar week or part thereof by which the commissioning is delayed, subject to a ceiling of 10% of the contract price.	
12	**ADDITIONAL EXPENDITURE:** In case any additional expenditure is incurred in the works arising out of the faulty execution of the works by the contractor, such additional expenditure shall be borne by the contractor.	
13	**REGULATION OF LOCAL AUTHORITIES AND STATUS :** The contractor shall adhere to the regulation of local authorities and status.	
14	**Discipline of Workmen:** The contractor shall adhere to the disciplinary procedure set by the owner in respect of his employees and workman at site.	
15	**FORCE MAJEURE:** The force majeure shall be as specified under Clause 18 of General Terms and Conditions of Overseas Enquiry.	
16	**ARBITRATION:** The arbitration shall be as specified under Clause 13 of General Terms and Conditions of Overseas Enquiry.	

We understand that the bids having deviation (s) w.r.t tender are to be out rightly rejected. BHEL, however at their discretion, if consider the bid, have undisputable right to load the prices for price comparison as they deem fit.

Signature of Supplier
With seal

PRICE ADJUSTMENT FORMULA

(400/220KV XLPE CABLE)

The prices of cables shall be adjusted to the official LME (Cash) price ruling on following working day from the issue date of our Purchase Order.

The offered price of cable shall be increased or decreased by the following formula for rise or fall respectively in the basic cash price of Cu and Al :

$P1 = P_0 + [(Cu_1 - Cu_0)^* VFc] + [(Al_1 - Al_0)^* VFa]$

where :

P1 = The final contract price of cable (USD/kM)

Po = The initial order price of Cable (USD/kM)

Cu_1 = The official LME Copper Cash price of the next LME working day of our Purchase Order issue date. (USD/MT)

Cu_0 = The base copper price (LME Rate of Enquiry floating Date i.e.).

VFc = Copper weight per cable KM (MT/kM) – To be Quoted

AL_1 = The official LME Aluminum price of the next LME working day of our Purchase Order issue date.

Al_0 = The base Aluminum price (LME Rate of Enquiry floating Date

i.e.).

VFa = Aluminum weight per cable kM (MT/kM) - To be Quoted

Initial Price (P_0) quoted in any currency will be converted to USD on the exchange rate of Bid opening date between currency of quotation and USD.

P1 will be converted back to currency quoted on same exchange rate.

TRANSMISSION BUSSINESS GROUP
MATERIAL MANGEMENT
BHEL LODI ROAD NEW DELHI

86

ACTIVITY SCHEDULE

Please submit this format duly filled in along with offer. Time indicated will be used for calculating contractual delivery period.

ENQUIRY NO. 4296192 Date: 1/3/07

PROJECT: Haydro Electric Project Parbati ITEM: CABLE

VENDOR : OFFER REF.

SL. NO.	ACTIVITY	ACTIVITY TIME IN WEEKS	REMARKS IF ANY
1.	Receipt of P.O		
2.	P.O Acceptance	ONE WEEK	Vendor must Submit Po acceptance with in one week
3.	Submission of documents necessary for getting manufacturing clearance like Drawings, date sheet etc.		Documents complete in all respect are to be Submitted. Delay in approval on account of incomplete / inadequate information shall be the responsibility of supplier
4.	Review and Approval of documents and issue of manufacturing clearance	BHEL ACTIVITY	Vendor must ensure to reply all queries within 3 working days.
5.	Manufacturing Time		Manufacturing time be indicated considering all constrains & must include time required for internal inspections etc.
6	Raise inspection call	-VE 2 WEEKS TO SL NO 5	Call for inspection must be raised atleast two weeks in advance in the prescribed format. Non availability of offered material for inspection to the inspector will be viewed very seriously & may result in financial implications. The date of inspection must be with in the period indicated in 5 above.
7	Inspection	BHEL	
8	Issue of MICC, MDCC & other documents like EDEC , Road permits etc	BHEL	Vendor must indicate requirement well in advance.
9	Dispatch	ONE WEEK	Vendor must ensure to dispatch with in one Week of receiving all documents rquired
10	Installation Services(Laying/Erection/Testing /Commisioning		

Total time in vendor's scope.

Please mention constraints if any. For multiple lot delivery activity landmark for each lot should be mentioned. Multiple inspection calls for one lot are to be avoided & delay on this account shall be vendor's responsibility

SIGNATURE AND SEAL

ENQUIRY NO. 429192 Date: 11/9/04 85

CHECKLIST

SCHEDULE OF INFORMATION TO BE FURNISHED WITH THE OFFER

NOTE: This format is to be submitted in original only, duly filled in. Reproduction of this format on bidder's letter head or on other paper is not acceptable.

Put a tick mark on "YES" if the information is enclosed with the offer or put a tick mark on "NO" if the information is not enclosed or write "NOT APPLICABLE" if the information is not applicable.

1.	Technical offer with detailed schedule of equipment / material and spares enclosed.	YES / NO
2.	Guaranteed Technical Particulars as per Section – 4 enclosed.	YES / NO
3.	Schedule of deviation, if any, clause wise with respect to Technical Specification enclosed.	YES / NO
4.	Standard Manufacturing Quality Plan enclosed.	YES / NO
5.	GA Drawings with dimensions and weights & foundation / fixing details enclosed.	YES / NO
6.	Drawing and Data submission schedule enclosed.	YES / NO
7.	Type Test Reports enclosed.	YES / NO
8.	Bar Chart showing the schedule indicating time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning enclosed.	YES / NO
9.	Makes of all components as per technical Specification enclosed.	YES / NO
10.	Schedule of commercial deviation exception from the General Terms and Conditions	YES / NO

The above checklist is verified for:-

Offer Ref. :

Equipment :

Submitted by : M/s

Project Reference. :

Signed with Seal .....

Date .....

ENQUIRY NO. 4298192 Date: 11/9/09 84

SCHEDULE OF COMMERCIAL DEVIATION

The following are the deviations / variations exception from the General Terms and Conditions:-

SL. NO.	CLAUSE NO. OF GENERAL TERMS & CONDITIONS	STATEMENT OF DEVIATION

Incase, this schedule is not submitted, it will be presumed that the equipment / material to be supplied under this contract is deemed to be in compliance with the General terms and Conditions.

If there is NIL deviation, even then the format to be filled as NIL DEVIATION.

NOTE: Continuation sheets of like size and format may be used as per the Bidder's requirement and shall be annexed to this schedule.

Place .....

Date .....

Signature of the authorized representative of

Bidder's Name .....

Designation .....

Company seal .....

ENQUIRY NO. 02E192 Date: 11/5/09

83

SCHEDULE OF TECHNICAL DEVIATION

The following are the deviations / variations exception from the Technical Specifications:-

SL. NO.	CLAUSE NO. OF TECHNICAL SPECIFICATIONS	STATEMENT OF DEVIATION

Incase, this schedule is not submitted, it will be presumed that the equipment / material to be supplied under this contract is deemed to be in compliance with the Technical Specifications.

If there is NIL deviation, even then the format to be filled as NIL DEVIATION.

NOTE: Continuation sheets of like size and format may be used as per the Bidder's requirement and shall be annexed to this schedule.

Place .....

Date .....

Signature of the authorized representative of

Bidder's Name .....

Designation .....

Company seal .....

Annexure-1

Bill of Quantities

SUPPLY ITEMS

S. No	Description	Unit	Main Quantities	Spare quantities
1.	400kV 1C X 2500mm^2 Copper conductor corrugated Aluminium/copper/welded Aluminium sheath, XLPE cable complete with necessary auxiliary equipment	M	3070 (Six lengths)	530 (One length)
2.	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	Nos.	06	01
3.	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	Nos.	06	01
4.	Set of Sealing Arrangement for sealing the above spare cable at both ends	Set.	01	00
5.	Set of bonding arrangement for the connection for the sheath of above cables (Detailed description and bill of material shall be furnished)	Set.	01	00
6.	Non-magnetic clamps with necessary hardware for fixing above cables to the Cable support system	Lot	01	10 % of the total quantity
7.	Cable Straight through joints for the above cable	Nos.	00	02
8.	Sheath voltage limiter	Nos.	00	03
9.	Link Box, single phase	Nos.	00	02
10.	Training for BHEL/NHPC personnel at supplier's works (14 man days)	Lot	01	00

Notes: Exact length of the cable may vary +/- 20%. Final length shall be decided after joint visit of BHEL, NHPC and successful bidder.

ERECTION ITEMS

S. no.	Description	Main Quantities
1	400 kV 1C X2500 mm^2 Cable (7lengths)	3600M (Total)
2	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	07 Nos.
3	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	07 Nos.
4	Set of bonding arrangement for the connection for the sheath of above cables. (Detailed description and bill of material should be submitted along with the offer)	1 Set
5	Non-magnetic clamps with necessary hardwares for fixing above cables to the Cable support system	1 lot

M. Vijay Kumar

ANNEXURE - A

Specific terms & conditions

PI No.342290242 dated 20.08.09 for 400 KV XLPE Cables for Parbati – III project

1. Delivery requirement - March, 2010
2. Taxes & Duties :
   The project is accorded mega project status and hence taxes and duties as applicable are as under :

   2.a. Customs Duty / CVD - Nil

   2.b. Service Tax - Applicable towards Erection, Testing & Commissioning as per the prevailing rate.

   - Mega Project Certification for availing tax exemption for Customs Duty & CVD shall be made available.
3. Following documents to be arranged / provided by vendor for realization of payment by BHEL from M/s NHPC :
   - Original Invoice
   - Clean on Board Bill of Lading /AWB
   - Insurance Declaration
   - Material Despatch Clearance Certificates
   - Packing List
   - Certificate of Origin of Goods issued by chamber of commerce of that country or any other authorized organization of that country.

4. Special terms & Conditions :

4.1. **GUARANTEE PERIOD**

- Defect liability & Period : The Supplier warrants that the item supplied shall be free from defects in the design, engineering, materials and workmanship. The period shall be Four & half years from date of its receipt at site or four years from its commissioning or three years from the date of issue of Taking Over Certificate of the Generating Unit first commissioned (Scheduled date : 16.10.10) or Twenty Four months from the date of issue of Taking Over Certificate of the generating unit which is commissioned last (scheduled date : 28.02.2011) whichever happens earlier. Liability for latent defects warranty shall be limited to 5 years commencing from the end of defect liability period.

4.2. **LIQUIDATED DAMAGES**

The rate of levy of Liquidated damages for delayed delivery / completion of work shall be at the rate of 0.65% of the contract price per week with a maximum ceiling of 10% of the contract value.

4.3. **TRANSFER OF OWNERSHIP**

Ownership of the Equipment / Material (including spare parts) to be imported into the country where the Site is located shall transferred to the Purchaser / Purchaser's Customer upon loading on to the mode of transport to be used to convey the equipment / material from the country of origin to that country and upon endorsement of the dispatch documents in favour of the Purchaser / Purchaser;s Customer.

4.4. SITE REGULATIONS & SAFETY

The Supplier shall be responsible for the complete laying and termination, testing and commissioning of Cables and as such all site regulations and safety regulations prevailing shall be followed.

4.5. **LOSS OR DAMAGE TO PROPERTY, ACCIDENT etc.**

1) Supplier to assist BHEL for assessing the extent of damage for claim settlement.
2) Accident or injury to persons of supplier during erection, testing & commissioning : To be in the account of supplier.

5. **Responsibility indicator :**

a. Customs clearance - By BHEL. Any taxes to be paid at the discharge port for clearing the material is in BHEL's scope.
b. Inland Transportation – By BHEL.
c. Inland Insurance - By BHEL
d. Site storage - By BHEL.
e. Cable Laying, Termination - By supplier.
f. Testing & Commissioning – By supplier
g. Performance Guarantee Test – By supplier
h. Handing over to customer after PG test – By BHEL & Supplier

6..Port of discharge for imported consignment - Mumbai, India.

7..**Pre-qualifying criteria** :

1. Please refer attached sheet for Qualifying Criteria & Format for letter of authorization which is to be furnished by Contractor / Supplier. Refer – Annexure-B (2 pages)
2. Approved vendors list for the project. Refer – Annexure-C

8. **Consignee Address** : The Manager(Stores)
NHPC Parbati-III HEP
Village & PO : Panarsa
Dist. Mandi. Himachal Pradesh
PIN : 175121

PRE-QUALIFICATION CRITERIA

PARBATI-III

SL.NO	Item	Specific qualification Criteria
1.0	XLPE CABLES	The Sub-Contractor/vendor i) Should have successful experience in last 15 yrs in designing, manufacturing, supply, installation,testing & commissioning of 420kV XLPE Cables with Minimum 100 Cer t KM length having rated voltage 420kV that are under successful operation. ii) Should attach a copy (ies) of the following as evidence a) Successful Commissioning Certificate issued by the respective Project Authorities/ Owner. b) Detailed Communication address of the concerned Project Authority / Owner (iii) Letter of authorisation as per Annex-I enclosed to this Attachment. iv) Should be as ISO certificated company Documentary evidence along with the complete details of the company profile be furnished.

Annex-I

LETTER OF AUTHORISATION

No. ____ . _____ ___ Dated : _ _____

To,

National Hydroelectric Power Corporation
NHPC Office Complex
Sector-33, Faridabad
Haryana

Subject: Lot-IV: Electro-Mechanical Works of Parbati HE Project (Stage-III).

Dear Sirs

We, M/s_____, who are established and reputed manufacturers of ___ _____, having factories at ____ _____ (address of factory) do hereby agree to supply ____. _____ (item (s) of equipment) manufactured by us to M/s _____ _____ (Name and address of Contractor) under the contract agreement No. ____ -- _____ dt _____ _____.

We further undertake that we shall be directly responsible to the Employer for guarantees & warrantees for the item (s) of equipment manufactured by us and shall be jointly and severally responsible with M/s _ _____ ____ (Name of the Contractor) for the performance of the Contract(s), for the items of equipment mentioned above.

Yours faithfully,
For & on behalf of M/s
___ ___ _____

Station: .
(Office Seal)

Signature.
Name

Date.

Note: This Letter of Authorisation should be on the letterhead of the subcontractor / manufacturer and be signed by a person competent to bind the subcontractor /manufacturer. Power of attorney in favour of this person to do so may be enclosed with this Letter of Authorisation

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NEW DELHI

DOCUMENT No.	TB-300-316-002	Rev No.-00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MK	MK	SN
TITLE		SIGN	Sd/-	Sd/-	Sd/-
TECHNICAL SPECIFICATION FOR 420 KV XLPE CABLE		DATE	12.01.09	12.01.09	12.01.09
		GROUP	TBEM	W.O. No	87016
CUSTOMER/ CONSULTANT	***NHPC Limited***				
PROJECT	4×130 MW Parbati-III Hydroelectric Project				

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS
01	20.08.09	VK	MK	SN	Revised to increase max. sheath voltage & incorporate metallic sheah of laminated aluminium type also.

Distribution	To		O/C	TBMM		
	Copies	-	1	4		

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacturing, testing at works, packing and dispatch, transporting, laying of cable at site in BHEL provided trenches, testing and commissioning at site of 400kV XLPE Cables , Termination etc complete in all respect along with accessories .

Name of the Customer : NHPC Limited

Name of the Project : Parbati Hydroelectric Project Stage-III(H.P.) India

A. SUPPLIES

I. Supply of power cable, Single core, Copper conductor compacted circular stranded, XLPE-insulated, corrugated Aluminium sheathed, PE with HFFR outer layer.
II. Supply of cable accessories, essential spares, tools and tackles.

B. INSTALLATION SERVICES

Complete cable installation services including laying , termination, clamping , testing and commissioning of the cable system, point to point.

The Specification envisages turnkey execution of a COMPLETE, POINT TO POINT, 400 kV CABLE SYSTEM and the scope includes all materials and service necessary to execute the job to the satisfaction of NHPC and BHEL. Any other item /service required for the execution for the complete job shall be included in the offer , Whether specifically mentioned in the specification or not, The Bill of quantities included in the offer shall clearly reflect such items along with their respective quantities.

The Payment of cables length will be as per actual measurement at site jointly.

Bidder shall offer both Supplies and Installtion Services as per this Technical Specification. Bids in which only Supplies or only Installation Services are offered shall be rejected.

1.1 SPECIFIC TECHNICAL REQUIREMENTS-

Sl. no.	Particulars	Unit	400kV
1.	Rated System Voltage	kV	400
2.	Highest System Voltage	kV	440
3.	Number of phases	Nos.	3
4.	System Frequency	Hz	50 ± 5 %
5.	System earthing		Solidly grounded

6.	Rated Normal Current at nominal system voltage (400 kV)	A(rms)	2400
7.	Rated peak withstand current	kA	100
8.	System fault current for one second	kA	40
9.	Rated withstand voltage to earth of cable and cable sealing		
	- One minute power frequency	kV	520
	- Lightning Impulse	kVp	1425
	- Switching Impulse	kV	1050
10.	Nominal cross section area of Conductor	mm^2	2500 (Minimum)
11.	Type of conductor		Copper
12.	Internal semiconductor		XLPE semi-conducting shield
13.	Insulation		XLPE
14.	External semiconductor		XLPE semi-conducting shield
15.	Metallic sheath		Corrugated Aluminium/ corrugated copper / welded aluminium/ Laminated Aluminium
16.	Outer sheath		PE with HFFR layer
17.	Creepage distance for termination	mm/kV	31
18.	Maximum permissible operating temperature of the conductor at Rated continuous current	°C	90
19.	Short circuit Temperature (5 seconds max.)	°C	250
20.	Daily load	Hours	24
21.	Sheath voltage under full load condition to ground	V	180 (Max.)
22.	Laying method	-	Flat formation, laying in tunnel
23.	Design ambient temperature	°C	40
24.	Minimum ambient temperature	°C	-4

1.2 QUANTITIES

Material and Services required for the execution of the job are listed below. All item listed in the following BOQs shall be offered. Any item not appearing herein but clearly mentioned in Section 2 shall be included in the offer. The BOQs included in the offer to be submitted by the Bidder shall be exhaustive in this respect and shall cover completely the requirements of Section 1 and Section 2.

SUPPLY ITEMS

Sl. no.	Description	Unit	Main Quantities	Spare quantities
1.	400kV 1C X 2500*mm^2 Copper conductor corrugated Aluminium/copper/welded Aluminium sheath, XLPE cable complete with necessary auxiliary equipment	M	3070 (Six lengths)	530 (One length)
2.	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	Nos.	06	01
3.	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	Nos.	06	01
4.	Set of Sealing Arrangement for sealing the above spare cable at both ends	Set.	01	00
5.	Set of bonding arrangement for the connection for the sheath of above cables (Detailed description and bill of material shall be furnished)	Set.	01	00
6.	Non-magnetic clamps with necessary hardwares for fixing above cables to the Cable support system	Lot	01	10 % of the total quantity
7.	Cable Straight through joints for the above cable	Nos.	00	02
8.	Sheath voltage limiter	Nos.	00	03
9.	Link Box, single phase	Nos.	00	02
10.	Training for BHEL/NHPC personnel at supplier's works (14 man days)	Lot	01	00

* Bidder to confirm the suitability of size of the cable

ERECTION ITEMS

S. no.	Description	Main Quantities
1	400 kV 1C X2500 mm^2 Cable (7lengths)	3600M (Total)
2	400kV outdoor type cable termination kit complete suitable for terminating the above cable in Potyard	07 Nos.
3	400kV cable termination kit complete suitable for interconnection of above cable in GIS with necessary hardware	07 Nos.
4	Set of bonding arrangement for the connection for the	1 Set

	sheath of above cables. (Detailed description and bill of material should be submitted along with the offer)	
5	Non-magnetic clamps with necessary hardwares for fixing above cables to the Cable support system	1 lot

Note

(1) Manufacturing lengths and drum length shall be determined as per the joint route survey with NHPC, BHEL and the Supplier.

(2) Refer Annexure -A for cable proposed trench rout.

(3) The exact length may vary by ±20% .

(4) Spare cables shall be laid as a spares run. Both the end of spare cable shall be sealed.

(5) Supplier will submit detailed cable design memorandum for justifying the size of the cable.

(6) Supplier will submit detailed bar chart indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.

(7) Earthing of HT cables shall be in supplier scope.

(8) The cable trench and support angles in the trenches will be supplied by BHEL as per supplier's recommendation.

(9) Support structure for cable sealing end shall be provided by BHEL based on the input provided by supplier.

(10) The spare 400kV cable will be used to replace any one of the cables of 400kV Line.

1.3 TYPE TESTS

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years. The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.4 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, provided by the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on cables and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL and NHPC in accordance with agreed quality plan with 3 weeks advance information.

Type test reports on identical rating cables and accessories shall be submitted for approval.

In event of non-acceptability of submitted test reports on technical grounds at the contract stage, the type tests shall be conducted at no additional cost.

1.5 QUALITY PLAN

The contractor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

Section - 2

CUSTOMER'S EQUIPMENT SPECIFICATION

9.0 XLPE CABLES

9.1 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, training of Employer's personnel, handing over to NHPC and guarantee for two years of XLPE cables as per the specifications hereunder, each 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:

9.1.1 XLPE cables

i) Seven (7) Single-phase, 400-kV, copper conductor, XLPE cables for the interconnection of 420 KV Gas Insulated Switchgear to outdoor pothead yard, each complete with all necessary auxiliary equipment and hardware,
ii) Six (6) cable sealing end suitable for terminating the cables for interconnection with GIS including necessary hardware,
iii) Six (6) cable sealing end suitable for terminating the cables in the outdoor Pot yard including necessary hardware,
iv) One (1) set of sealing arrangement for sealing the one (1) spare cable at both ends,
v) One (1) set of bonding arrangement for the connection of the cable sheath to the grounding system,
vi) One (1) set of cable support system including cable trays / hangers, fixtures, hardware etc. for supporting all the cables along the entire length of cable,
vii) Coordination and provision of necessary contacts and/or ports integration with plant SCADA system,
iii) One (1) set of spare parts in accordance to clause 9.8 "Spare Parts" of this section,
ix) One (1) set of tools and instruments in accordance to clause 9.9 "Tools and Instruments" 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.

9.2. Specific Parameters and Layout Conditions

9.2.1. Layout and General Arrangement

For the interconnection between the 420 kV GIS and the Outdoor pot yard six (6) nos. of single-phase 400 kV XLPE cables shall be provided. The XLPE Cables shall take off from the bottom of GIS and terminate to the pot yard through the cable tunnel. The laying of cable in cable tunnel shall be decided during the detail engineering.

One (1) cable of largest length shall be kept as spare and laid to connected any phase of two (2) outgoing line bays of the 420 kV GIS switchgear and any of the cable terminals in the outdoor pot yard. Both the ends of spare cable shall be sealed suitably to prevent ingress of moisture. The laying of spare cable shall be designed so as be used in any equipment without cutting and without exceeding the specified bending radius.

9.2.2. Operating conditions

Normal operation shall be defined as operation with operating parameters within the following ranges:

Grid parameter	Normal range
Voltage	90 % to 110 % of rated value
Frequency	47.5 Hz to 52.5 Hz

9.2.3. Design considerations

The power evacuation system of the Parbati H.E. Project, Stage-III shall be designed to cater the combined power generation of Parbati H.E. Project, Stage-II and Parbati H.E. Project, Stage-III i.e., 1620 MVA of power. For evacuation of this power two nos. of transmission line shall be provided. Each line shall be capable to handle the entire power.

The cables shall be capable of carrying the specified rated current continuously without exceeding the specified temperature limitations. The sheath voltage under full load conditions shall not exceed 180 V to ground at the terminations. Sheath shall be solidly ground at the switchgear end. The charging current of the cable shall be as low as possible.

The 400 kV systems will be solidly grounded. Cables will be protected from over voltages caused by lightning strikes or switching surges by means of station type lightning arresters located in the pot yard / GIS. The pot yard equipment and all outgoing 400 kV transmission lines will be shielded against direct lightning strokes.

The manufactured length of each cable shall be the responsibility of the contractor who shall determine exact requirements to enable installation of the cables from terminal to terminal without resorting to cable splices and other corrective measures in order to ensure a satisfactory installation.

Contractor shall satisfy itself before commencing manufacture as to the exact lengths of cables required.

Additional cable lengths required for test samples shall be provided by the contractor.

9.3. Rating and Functional Characteristics 9.4. Performance Guarantee

Nominal system voltage ,kV rms	400
Highest voltage for system ,kV rms	440
Rated normal current at nominal system voltage (400 kV), A, rms	2400
frequency, Hz	50 ± 5 %

No. of phase	Three
System Earthing	solidly grounded
Rated withstand voltage to earth of cable and cable sealing	
- Power frequency	520 kV
- Lightening Impulse (peak value)	1425 kV
- Switching Impulse	1050 kV
Rated short time withstand current (r.m.s) for 1 Sec	40 kA
Rated Peak withstand current	100 kA
Maximum permissible operating temperature of conductor at rated continuous current	90o C
Short circuit temperature (5 seconds max.)	250°C
Daily load	24 hours
Cable Construction	
- Type of Conductor	Copper
- Nominal cross section area of Conductor	2500 mm2 (Minimum)
- Internal semi-conductor	XLPE semi-conducting shield
- Insulation	XLPE
- External semi-conductor	XLPE semi-conducting shield
- Metallic sheath	Corrugated Aluminium sheath / Corrugated Copper sheath/Welded Aluminium sheath/Laminated Aluminium
- Outer Sheath	PE with HFFR layer
- Laying condition	Flat formation, laying in tunnel

The 400 kV XLPE cable along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

9.5. Design and Construction

9.5.1. 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:

Standards	Description
IEC 62067	Power cable with extruded insulation and their accessories for related voltage above 150 KV up to 500 KV"
IEC 60228(1978)	Conductor for insulated cables
IEC 60229(1982)	Tests on cable over sheaths
IEC 60230(1966)	Impulse tests on cables and their accessories
IEC 60270(1981)	Partial discharge measurements
IEC 60287 (1994)	Calculation of continuous current carrying capacity and losses
IEC 60502 (1998)	All cables with extruded insulation and their accessories
IEEE 48-1996	Test procedure and requirement for high voltage cable termination
IEEE 404-1993	Joint for use with solid dielectric cables
IEE 635-1989(R 1994)	Guide for selection and design of aluminium's sheaths
IS 5216	Guide for safety procedure and practices in electrical works

9.5.2. Cable construction

The cable shall be designed and manufactured to withstand the mechanical forces caused by the specified short circuit current, and the insulation stresses caused by an earth fault current.

No splice shall be made in the conductor as a whole, or in any wire comprising the conductor throughout its entire length.

9.5.3. Terminal Accessories

Sealing end shall be rated at 400 kV. Ambient temperature will be 40°C maximum, in the GIS and pot yard.

Field tests of sealing end terminals shall be made in conjunction with the 400 kV cables after installation of the cables and terminals.

9.5.4. Supports and Hardware

All support structures shall be either galvanised steel or aluminium structural sections.

9.6. Drawings, Documents and Design Calculations

9.6.1. Design memorandum

The Contractor shall submit to Employer a design memorandum.

9.6.2. Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements specified elsewhere.

These drawings and documents shall include at least the following:

Cable routing arrangement,
Supporting arrangement details,
Large scale general assembly drawings of the GIS end terminal,
Large scale general assembly drawings of the transformer end terminal,
Large scale general assembly drawings of the pot yard end terminal,
Cable installation procedures.

9.6.3. Design calculation

The Contractor shall submit the design calculation covering at least the following, for review / acceptance.

Calculation for selecting the cable size and losses for XLPE cables with de-rating capacity with temperatures and other conditions,

Foundation loads for support structures at end terminals.

9.7. Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning.

9.7.1. Specific packaging, handling and storage requirements

Cable reels shall be of rugged construction, with a drum diameter of ample dimensions to accommodate the single-conductor cables.

A label shall be attached to each reel, giving the Employer's order number, length of cable, size of conductor, thickness of insulation, cable designation in accordance with these specifications, shipping weight dimensions as well as project particulars.

Each reel shall be stencilled with an arrow and suitable wording to indicate the direction in which the reel should be rolled.

Changes in the shape of the cable during transit shall not result in deformation.

Cable drums shall be suitably protected by metallic enclosures of adequate thickness and strength to avoid damage to cable during transit and handling.

9.7.2. Construction methodology

The Contractor shall follow the construction methodology and installation procedure recommended by the cable manufacturer and shall arrange all the necessary erection tools/devices required for installation of cables such as cable rollers, cable pullers, motorized winches, power packs, two-way communications and safety devices etc., as per manufacturer's standard practices for installation of the cables.

9.8. Spare Parts

Recommended spare parts shall be quoted other then the specified spare parts given below :

S. No.	Description	Quantity
1	Cable sealing end arrangement for use at GIS terminal complete with gasket.	1 no.
2	Cable sealing end arrangement for use at Pot yard terminal complete with gasket.	1 no.
3	Link box, single phase	2 nos.
4	Sheath voltage limiter	3 nos.
5	Cable straight joint	2 nos.

9.9. Tools and Instruments

The bidder shall supply all necessary tools and instruments etc. for installation, repair and maintenance.

9.9.1. Special tools

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

9.10. Quality Assurance and Testing

The bidder shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)" which is given below :

"Quality assurance and Testing Specifications (QTS)".

1. INSPECTIONS AND TESTS

1.1. General

In addition to the provisions established in the Conditions of Contract regarding general procedure of inspections and tests, terms and definitions, and time schedules for inspections and tests the following stipulations shall apply:

Approval of assemblies, tests, inspections, related procedures etc. and acceptance of pertinent test and inspection certificates, or waiving of inspections or tests, shall in no way relieve the Contractor of his contractual obligations for finishing the Works in accordance with the provisions of the Specifications.

Three (3) sets of all test records, test certificates, performance curves, tables etc. of all inspections and tests, whether or not attended by the Engineer shall be supplied soonest after performance of each inspection or test. After completion of all testing two (2) sets of the above-mentioned documents shall be supplied properly bound in books.

All test certificates shall be endorsed with sufficient information for identification of the equipment and material to which the certificates refer.
In addition, the following references shall be entered in the top right-hand corner:

i) Employer's name
ii) Project title
iii) Plant's (stage's) name
iv) Number of Contractor's drawing
v) Date

1.2. Manufacture and Supply

All material furnished shall be of tested quality and all work performed shall be subjected to rigid inspection as specified in relevant International or Indian Standards and no articles or material or supplies shall be dispatched until the dispatch instructions are issued by the Employer, which shall be issued only after all test's analysis and shop inspection have been completed or certified copies of reports or, results of tests and analysis have been accepted by the Employer. Duplicate copies of manufacturer tests certificate shall be submitted to the engineer in charge as soon as the tests are completed. In case test certificates are not available for any of materials, the same shall be tested if requested by the employer and only those materials, which fulfil the requirements of the specifications, shall be used.

1.2.1. Steel Casting

Castings shall be sound and free from blowholes, porosities, shrinkage holes, cracks or any other defects, Surfaces of castings which do not undergo machining and which are exposed to view in the installation shall be dressed for good appearance and for painting. The location of existing defects shall be determined, and all defects, which impair the strength or utility of the casting, shall be removed to sound metal. The structure of the castings shall be homogeneous and free from excessive non-metallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a casting will be a cause for its rejection.

1.2.2. Welding

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 DIN 8551. 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 qualification of welding procedures, welders, and welding operators for all welding, including weld repairs, shall conform to DIN 8560, DIN 8563, EN 287, or to the requirements of the ASME Boiler and Pressure Vessel Code Section VIII and IX The Contractor shall perform qualification tests of his welders and welding operators and submit evidence of this to the Engineer in-charge.

Weld-fabricated pressure-containing parts shall be designed, fabricated, inspected and tested, unless otherwise specified, in accordance with approved standards and shall be stress relieved as a unit prior to final machining.

1.2.3. Workmanship

i) Electric Welding

All welds shall be made continuous and watertight. The minimum size of fillet welds shall be 6 mm measured on the leg. All butt welds shall be full penetration welds welded from both sides.

Welds shall in general be treated so that they will display good appearance and a surface suitable for painting. Structural welds shall be ground and blended to avoid stress raisers. All welds, which require nondestructive examination, shall be dressed by chipping and grinding as required for good interpretation by the selected weld examination method. All butt welds in the flanges and webs of beams and girders shall be radio-graphically inspected. The fillet welds between flanges and webs shall be tested by the magnetic particle method.

ii) Machine work

All tolerances, allowances, and gauges for metal fits between plain (nonthreaded) cylindrical parts shall be indicated. Sufficient machining stock shall be allowed on parts to be machined to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal and sliding surfaces shall be polished, and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. No machining shall be done on working surfaces of self-lubricating bushings or washers.

iii) Finished Surfaces

All surfaces that are so indicated on the drawings or those that require machining for their intended function, or those that are usually machined according to good workshop practice shall be machined. Surface finish qualities shall be adequate for the intended use and shall be indicated on the Contractor's Drawings. Suitable measuring device such as Scatter meter or other acceptable measuring device will be used to determine compliance with specified surface.

iv) Unfinished Surfaces

So far as practicable, all work shall be laid out to secure proper matching of adjoining unfinished surfaces. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth, or machined, to secure proper alignment. If surfaces not designated as finished in the Contract Documents require machining to obtain the tolerances or straightness specified or needed for correct function, such machining shall be performed by the Contractor.

1.2.4. 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 Engineer in-charge 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.

Castings shall be inspected visually at the foundry after they are cleaned and while defects are being removed. Castings shall also be inspected after repairs and after heat treatment. Radiographic or other nondestructive tests will be required as specified under non-destructive testing and as directed by Engineer in-charge when granting permission to repair major defects. The Engineer in-charge reserves the right to require conducting non-destructive tests at the Contractor's expense to determine: the full extent of defects; that area is properly prepared for welding that the repairs are satisfactory.

1.2.5. Impact and Bend Tests

Steel products for all principal turbine and shut-off valve parts shall be tested for impact resistance using the ISO V-notch specimen. Both longitudinal and transverse impact tests shall be performed on plate steel. Bend tests shall be performed on specimens of all major steel castings and forgings in accordance with the applicable DIN standards. The nil ductility transition temperature shall be the temperature at which the impact resistance is at the values specified above.

1.2.6. Non-Destructive Testing

1.2.6.1. Examination of Welds

Unless otherwise indicated in these Contract Documents, non-destructive tests shall be in accordance with approved standards. Radiographic examination of welds shall be in accordance with the technique and acceptance standards of IIW (International Institute of Welding). The Contractor's Drawings shall indicate the type and extent of nondestructive examination as it applies to each component or weld.

Weld examination shall be by the ultrasonic, dye penetrant, or magnetic particle methods, supplemented by radiographic examination. Supplemental radiographic examination shall include examination of critical high-stressed areas where interpretation of other methods is unclear, or where the integrity of the weld is doubtful. The Employer shall have the right to request the Contractor to make random spot-check examination of welds, including radiographic examination, as part of his inspection of the equipment. The Contractor's detailed program for nondestructive examination of welds shall be submitted for review.

1.2.6.2. Examination of Casting

The turbine runner casting shall be given complete non-destructive examination including radiographic examination of the most critical areas. The Contractor shall submit Quality Sheets (Specification for inspection of steel casting for hydraulic machines), with his recommendation and specify special precautions to be taken for the casting of the turbine runner and other important casting components. The Quality Sheets submitted shall define the area and extent of the various non-destructive examinations to be performed on castings.

1.2.6.3. Examination of Forging

Shafts, stems and coupling bolts made of forgings shall be given complete ultrasonic examination and other applicable non-destructive test, to determine that they are sound. Non-destructive examination of other forgings shall be in accordance with accepted good practice to assure their soundness. The structure of forgings shall be homogeneous and free from excessive non-metallic inclusions. An excessive concentration of impurities or separation of alloying elements at critical points in a forging will be a cause for its rejection.

1.2.7. Pressure Tests

Unless specifically mentioned otherwise in the Contract Documents, equipment, vessels and tanks under internal pressure during service shall be subject to hydrostatic pressure testing. The test pressure shall be 1.5 times the maximum design pressure of the respective equipment, vessel or tank.

Unless otherwise specified, the test pressure shall be applied for a period of 1/2 hour without showing leaks or drop in pressure.

1.3. Workshop Inspections and Shop Tests

As far as practicable, quality of materials, workmanship and performance of all items of the Works to be furnished under this Contract shall be inspected at the places of manufacture.

Free and unrestricted access to the Contractor's factory and shops (including those of his Subcontractors) shall be granted to the Engineer also and upon reasonable notice by the Engineer if deemed necessary by the same for additional witnessing of assembly work or inspections and tests.

Should an agreed inspection not be carried out as proposed because of lack of preparation, obvious negligence or material and/or equipment being presented in a state, which does not corresponds to the proposed procedure or is clearly not acceptable such an inspection shall be repeated. The cost incurred by the Employer for repeated inspections shall be fully borne by the Contractor.

The Contractor shall state the plan of manufacture, testing and inspection of the various works in the contract, and the representative of engineer in-charge shall also be entitled to access to manufacturer's or, subcontractor's work at any time during working hours for the purpose of inspecting the manufacture of equipment and materials.

All the required tests as per standard/specifications shall be carried out at Contractor's expenses. If any component of the equipment fails in the specified test, the same shall be replaced/ rectified and again offered for inspection.

Shop Tests specified in respective section shall be carried out in Employer's presence. The tests not specifically mentioned but recommended in the relevant standards for such equipment and/or good engineering practice shall also be carried out.

The factory test equipment and the test methods used shall conform to the

recommendations of the relevant IEC Publications and shall be subject to approval of the Engineer in-charge.

1.3.1. Material Tests

Unless otherwise specified, the quality of materials shall be verified generally by:

i) Chemical analysis

ii) Mechanical tests (yield point, tensile strength, elongation, Transverse Contraction and notch impact.)

iii) Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reversed bend test, etc.)

iv) Non-destructive tests (X-rays, Ultrasonic, Magnetic Particle tests, Liquid Penetration inspection, etc.).

v) Electrical tests (voltage, losses, tan delta, insulation, magnetic properties etc.) For the notched bar impact test, the impact value shall be obtained at plus (+) 20°C ambient temperature unless mentioned otherwise. The material tests shall be performed as per relevant ASTM unless approved otherwise. Certified mill test reports of plates will be acceptable when these comply with the requirement of specifications. Test specimen and samples for analysis shall be plainly marked to indicate the materials they represent. Castings and forgings shall be tested in the rough state in order to detect flaws in good time thus avoiding delays. Magnetic particle inspection of important castings shall cover the whole surface of the casting. After partial machining further tests can be conducted. Load tests on crane hooks, steel wire ropes, chains and other lifting devices, etc. shall be considered as material tests.

1.3.2. Checking of Dimensions

The dimensions, especially clearances and fits, which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

i) Run out and roundness tolerances of shafts, pistons, etc., to be measured on single parts as well as (wherever possible) on the assembled components,

ii) Fits and clearances of bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc.,

iii) Accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc.,

iv) Dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other contractors.

1.3.3. Workshop Assembly

In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.

Works to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the Specifications, that the delivery is complete, and that no work remains to be done at Site, which reasonably can or should be done in the shop.

Where applicable, each item of the Works shall be assembled completely prior to painting.

Field joints shall be temporarily connected.

All parts shall be properly match marked, identified and doweled where practicable, to facilitate correct and quick field assembly and alignment. Where necessary, suitable dowels shall be provided for insertion after field assembly and drilling. The holes for any fitted bolt shall be accurately reamed.

During workshop assembly all instruments, control devices and piping shall be fitted.

If the assembly shows defects in the design or manufacture or unforeseen difficulties in assembling and dismantling, these shall be eliminated. If required, design alterations or corrective measures can be executed provided that reliability of operation or interchangeability are not reduced and provided that the agreement of the Engineer has been obtained.

If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Engineer. Faulty parts or Works shall by no means be delivered.

The assembled parts shall subsequently be subject to tests as per applicable standards or required by the Engineer.

1.3.4. Pressure and Leakage Tests

All parts subject to internal or external pressure or containing any liquids or gases temporarily or permanently during operation shall be tested prior to painting. As far as practicable, these tests shall be done in the shop but can be repeated at site.

Parts exposed during operation to hydraulic pressure, to gas pressure or to any liquid without pressure, shall be treated distinctively.

As far as practicable and required, the influences of temperatures and temperature differences to which the part will be exposed during operation shall be considered in the performance of the tests.

1.3.4.1. Parts Exposed to Hydraulic Pressure

Unless otherwise specified or required, the following shall apply: the hydraulic pressure tests shall be carried out using the liquid to be used during operation or a liquid with less viscosity.

The hydraulic test pressure shall be 1.5 times the maximum operating pressure (except for spiral distributor) and shall be maintained for a period of eight hours or longer if required by the applicable standards. Afterwards the test pressure shall be reduced to the operating pressure.

1.3.4.2. Parts Exposed to Gas Pressure

Parts which will be subjected to gas pressure during operation for example pressure tanks, pressure air tanks and others, shall be inspected and tested according to the official regulations with respect to design, construction, fittings, etc.

The pressure test shall be executed by applying the test pressure in accordance with the relevant standards and specifications.

1.3.4.3. Parts Exposed to Liquids without Overpressure

Parts which shall not be closed and which are exposed to only small pressures of any liquid during operation e.g., bearing housings, oil containers, etc.) Shall be subjected to a tightness test with a suitable liquid of low viscosity. The testing-period shall not be less than 8 hours, unless otherwise agreed.

1.3.5. Functional Tests

Functional tests shall be defined as tests of the function of assemblies, sub-assemblies or parts of the Works under no load conditions. Functional tests shall be performed on all Works prior to the execution of operational tests.

1.3.6. Operational Tests

As far as practicable operational tests shall be carried out on all Works, simulating operating conditions.

Parts to be delivered by sub suppliers shall be tested either at the premises of the sub supplier or of the Contractor, as agreed by the Engineer.

Before testing the Contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the Works to be tested and on the test facilities and equipment.

Testing of the electrical Works shall be performed in accordance with applicable Standards; they shall include but not be limited to tests of heating, loading, overloading, losses.

Operational tests of lifting equipment and other machinery shall include tests under nominal load and 125 % of nominal load unless otherwise specified.

1.3.7. Electric Tests

Electrical Works shall be tested in accordance with applicable Standards and agreed test programs and procedures.

1.3.8. Model Tests

Model tests for certain parts of the work or Works shall be carried out as specified or agreed between Contractor and Engineer.

1.4. Quality Control and Assurance

To ensure quality during each stage of work, the Contractor shall establish a system defining quality assurance plan/procedures during various stages of work.

The Contractor shall maintain quality control during manufacturing of equipment as per the approved quality assurance plan. The model quality assurance plan for equipment / components for each section are given hereafter. Final quality assurance

plan (QAP) for manufacturing shall be approved during detailed engineering.

The Bidder shall submit the detailed Quality Assurance Plan for the complete equipment/materials along with the bid for approval and acceptance by the Employer. This shall form integral part of the contract. The QAP shall include inspection and tests proposed to be conducted on raw material/bought out items at the time of induction in the process of manufacturing and at final stage of assembly.

Based on the test certificate, inspection report dispatch clearance shall be issued by the employer. The materials/equipment/items shall only be dispatched after issue of material dispatch clearance certificate (MDCC).

Detail Model Quality Assurance Plan is attached here with of each and every equipment/ auxiliaries. These are to be strictly observed /followed by the Manufacturer / Contractor/ Sub – Vendor.

Inspections and tests shall be carried out by the Contractor as per approved QAP with due regard to stipulations in "Section 3 - Inspection and Tests" of "General Technical Requirements" at various stages of manufacturing for assuring the full compliance of supply with the requirements of specification.

The Contractor shall follow approved site quality assurance plan and installation procedures. The Contractor shall maintain the quality records during site installation and commissioning which shall be produced to engineer in charge for approval at defined stages.

Inspection and tests shall be carried out at site by contractor during installation and commissioning as described in relevant clauses.

1.4.1. Type Tests

Type tests shall verify that all components of the equipment perform satisfactorily, both electrically and mechanically, at the rating assigned. All equipment proposed according to the specification shall be type tested at typical units in accordance with the relevant standards specified in respective sections.

The type tests for equipment, except wherever mentioned specifically as mandatory in respective section, may not be mandatory if similar typical units of equipment have been type tested and test certificate(s) for relevant tests are accepted by the Employer.

The Contractor shall prepare written documents, in a form agreed upon by the Contractor and the Employer, of all test certificates/ results and hand over these documents to the Employer in due time for review and acceptance as required.

All cost associated with the mandatory type tests shall be included in contract price Also, the Contractor shall conduct the type test(s) at his own cost for which certificate(s) are not acceptable.

1.4.2. Routine Tests

Routine tests shall be conducted on various equipment/components as elaborated in respective section and/or approved quality assurance plan. (QAP).

1.5. Field Tests

During erection, commissioning and trial operation, the Contractor shall perform at suitable intervals all inspections and tests in the presence of the Engineer in order to prove the orderly execution of the works in accordance with the Contract.

Unless otherwise specified, all costs for testing at site and of the works and charges associated with it shall be borne by the Contractor. This includes the measuring devices, properly calibrated, and any pertinent accessories, which shall be made available by the Contractor for the entire duration of the tests. The Contractor shall delegate his experts to perform the tests at site.

The Engineer reserves the right to have checked at his own expenses the Contractor's instruments to be used or having been used for any tests by an independent, officially acknowledged institution.

The Contractor's testing at Site shall be complete in every respect to prove the successful performance and operation of all the works and Works supplied and erected under the Contract.

For the procedure of inspections and test at site, notice to the Engineer, reports, commissioning, trial runs and trial operation, and acceptance tests refer to General Conditions of Contract.

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.
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.
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.

1.5.1. Tests During Installation, Pre Commissioning And Commissioning

Immediately upon termination of commissioning of a part or section of the Permanent Works, which can operate as an independent unit a "Certificate of Suitability for Operation", shall be issued by the Engineer.

This document shall be signed by an authorised representative of the Employer, the Engineer and the Contractor.

This Certificate shall state:

i) The supplier of the Works concerned,
ii) The quantity and type of Works concerned,
iii) The conditions of commissioning,
iv) The names of the participants,
v) The date of commencement of trial run,
vi) The list of minor defects, if any, which has to be corrected by the Contractor.

During the trial run the Contractor shall make familiar the Employer's personnel with

the equipment, the operation and maintenance of the Works and its auxiliaries to such an extent that thereafter the duties can be assigned to the Employer's trained personnel.

If any defects or irregularities affecting the safety or reliability of the Works should arise during the trial run, the trial run shall be interrupted and started again after such defects or irregularities have been corrected by the Contractor.

The tests during installation, pre-commissioning and commissioning shall be conducted at site in accordance with provision in respective sections and/or in applicable Indian/International testing standards for the system and system components. However, following generic tests shall be essentially performed on all installation/system:

Visual inspection of the equipment/components,

Pressure test of all field installed piping at 1.5 times of the design pressure,

Operational and functional tests of components, sub-assemblies, auxiliaries, piping system etc,

Control logic field tests to prove control logic scheme for operation and interlocks of system components, including annunciation and shutdown scheme,

Calibration Test - All instruments, gauges, sensors, switches, relays, and similar equipment shall be calibrated and adjusted after installation, wherever practical. Where not practical, the calibration and adjusting shall be done just prior to installation,

Operational Tests For Protection - Field tests for verification of correct operation of protective relays shall be conducted,

Dielectric and insulation resistance test, continuity test, starting current measurement of each motor,

Any other checks/tests to ensure that requirements of the specifications are being met.

1.5.2. Performance Testing

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period.

During this test service period, all the system/installations must perform satisfactorily.

The Contractor shall be responsible for the equipment during test service and also for the way it is operated. However, Employer will operate the equipment under the Contractor's guidance during test service period.

1.5.2.1. Field Acceptance Tests

The taking-over testing of any part or section of the Permanent Works which can operate as an independent unit, shall be performed in accordance with the standards and regulations laid down in the " General Conditions of contract, and as per the test procedure agreed upon between Engineer and Contractor.

Immediately upon termination of any such testing of a part or section of the permanent Works a "Protocol of Acceptance" which shall be deemed to be the Test Certificate required by General Conditions of Contract shall be issued by the Engineer.

This document shall be signed by an authorised representative of the Employer, the Engineer and the Contractor and shall form an integral part of the later "Taking-Over Certificate".

This "Protocol of Acceptance" shall state:

i) The date of testing,

ii) The quantity and type of Works concerned,

iii) Statement of all minor defects and/or irregularities, which have to be corrected by the Contractor,

iv) Confirmation that the guaranteed data have been proven,

v) Confirmation that all contractual documents have been submitted,

vi) Confirmation that the Employer's personnel have been familiarised with the Works and that they will be able to operate and maintain the Works. If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the Contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.

9.0 XLPE CABLES

9.1. Type Tests

The contractor is required to carry out all type tests as per relevant IEC / International Standards on 400 kV XLPE Cable and its Accessories 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 certificates for relevant tests are accepted by the employer.

Following Type Tests shall be done:

- Bending Test,
- Tan δ measurement,
- Heating Cycle Voltage Test,
- Partial Discharge Tests,
- At Ambient Temperature and
- At High Temperature.
- Switching Impulse Voltage Test,
- Lightning Impulse Voltage Test,
- Test of Outer Protection for Buried Joints,

- Examination of Cable System with Cable and Accessories.

9.2. Shop Tests

The 400 KV XLPE Cable shall be tested as per relevant IEC with latest amendments. Following Shop Tests shall be carried out by the manufacturer at their works as per IEC: 62067 as follows:-

- Partial Discharge Test,
- Voltage Test,
- Electrical Tests on Oversheath,
- Conductor Examination (no. of strands, lay direction, lay length),
- Electrical Resistance of Conductor,
- Measurement of Thickness of Insulation and Oversheath,
- Measurement of Thickness of Metallic Sheath,
- Measurement of Diameter of core and overall diameter of cable,
- Hot Set Test for XLPE Insulation,
- Measurement of Capacitance,
- Water Content on XLPE insulation,
- Measurement of External Diameter,
- Lightning Impulse Test followed by a Power Frequency Voltage Test.

Following Shop Tests shall be carried out on Terminations at the manufacturer works as per IEEE Std 48:-

- Power Frequency Voltage 1 min Dry Withstand Test,
- Power Frequency Voltage 6 hrs Dry Withstand Test,
- Power Frequency Partial Discharge (Corona) Extinction Voltage Test,
- Lightning Impulse Voltage Withstand Test,
- Direct Voltage 15 min Dry Withstand Test,
- Cycle aging test,
- Dielectric Tests,
- Partial Discharge Tests,
- Pressure Leak Tests.

The following FRLS Tests are to be conducted as per the referred standards:

- HCL Gas Evolution Test (IEC - 754.1),
- Oxygen Index (ASTM-D-2863),
- Temperature Index (ASTM-D-2863),
- Smoke Density Test (ASTM-D-2863),
- Flammability Test (IEC-332.1),
- Swedish Chimney Test (SS-424 14 75),
- Ladder Test (IEEE-383),
- Heat Shock Test (IS:1554) and
- Anti Rodent and Termite Test.

The Contractor shall submit the routine test report for Accessories of Cable System.

The details of tests are given in Model Quality Assurance Plan of 400 kV XLPE Cable.

9.3. Field Tests

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

Before commissioning of complete system, all cabling system shall be checked as per cable schedule and complete report shall be prepared by Contractor and shall be submitted.

Field Test shall include:

- Cable checking,
- Continuity checking,
- Meggar Testing in accordance with the applicable codes and standards,
- AC Voltage Test of insulation with voltage of U_o for 24 hours,
- DC Voltage Test of over-sheath,
- Resistance checking,
- Verification of phase order.

SECTION - 3

GENERAL TECHNICAL REQUIREMENTS

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, equipments and services covered under other sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 SITE INFORMATION

	Particular	
a)	Customer/ Owner	NHPC LIMITED
b)	Purchaser	Bharat Heavy Electricals Limited
c)	Project Title	Parbati Hydroelectric Project Stage-III(H.P.) India
d)	Location	Located in Kullu District of Himachal Pradesh. Project Headquarter is proposed at Sainj which is about 258 kM from Chandigarh on Chandigarh-Manali National Highway NH-21.
e)	Transport Facilities	The nearest broad gauge railhead is at Kiratpur, which is 190 kM away. The nearest Airport is located at Bhuntar. The approximate distance of Sainj (Project Headquarter) from different important towns is as follows: From Bhuntar(Airport) 36 kM From Delhi 508 kM From Chandigarh 258 kM From Kiratpur 190 kM From Shimla 208 kM Parbati H.E.Project, Stage-III is connected by 172 kMs long National Highway(NH-21) from nearest broad gauge railhead Kiratpur sahib upto Aut and thereafter by the existing 3/5 M wide state PWD road 21 kMs in length upto dam proposed at village Suind and other components of the project. The maximum permitted size of bulkiest package for transportation upto project site is as under: Length - 6.0 M Width - 4.5 M Height (including trailer bed Height above ground) - 5.5 M
f)	Postal Address	To follow

SITE CONDITIONS		
a)	Mean Max. Ambient air temp.	46°C
b)	Mean Min. ambient air temp.	-4°C
c)	Design Ambient Temperature	50°C
d)	Maximum Relative Humidity	98.8%
e)	Minimum Relative Humidity	4.40%
f)	Maximum height above sea level	1000 M for GIS and 1087 for Potyard
g)	Pollution Severity	Heavily Polluted (Creepage 25 mm/kV)
h)	Basic horizontal Seismic Co-efficient	Zone V Peak ground acceleration 0.36g for Maximum Credible Earthquake(MCE) and 0.18g for Design Basis Earthquake(DBE)
i)	Average number of thunder strom days per annum	
j)	Average Soil resistivity	
k)	Average rainfall	
l)	Maximum wind speed	
m)	Prevailing Wind Direction	

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 GENERAL

This part covers technical conditions which form integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and the requirements brought out in the various sections of this specification.

3.2.2 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

The equipment are also to comply with latest and revised Indian electricity act and electricity rules and any other electrical statutory and provisional rules and regulations. In the event of supply of equipment conforming to any international or internationally recognised standard which will ensure equal or better than those standards specified for each equipment in this specification, salient features of comparison shall be brought out and furnish along with bid in English language. However, in case of standard other than IS & IEC or CBIP, if requested by the Engineer the supplier shall supply at his own expense three copies of the adopted standard in English language and one in original language. Brief detail of relevant standards has been given in section 2 for reference.

3.2.3 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type.

The Bidder / Contractor shall furnish the reports of all the type tests carried out in within last five years as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/similar components/equipment/systems to those offered/proposed to be supplied under this contract.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer, and reports shall be submitted for approval. No charges shall be paid under this contract.

Irrespective of the Contractor furnishing valid test report as indicated above, Employer will get some type test conducted under this contract specified as Mandatory Tests in other sections of this specification. The charges for each of these type tests shall be given in the offer.

All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.4 DOCUMENTATION TO BE FURNISHED BY THE BIDDER

The number of copies/ prints/ reproducibles, manuals, computer CD-ROM's/ manuals to be furnished for various types of document is given in ANNEXURE-A.

The documentation shall include but not limited to the following as applicable, in addition to the documents if specified in Sections 1 and 2.

3.2.4.1 DETAILED ENGINEERING

1. Layout, General Arrangements, Elevations and Cross Section drawings of all equipment and facilities of the plant.
2. Flow diagram. Process & Instrumentation Diagrams
3. Technical data Sheets.
4. Detail design calculations for components, system, piping etc. wherever applicable including sizing calculations.
5. Characteristic Curves/ Performance Correction Curves.
6. Power Supply Single Line Diagram, Block logic, Control Schematics, Electrical Schematics etc.
7. Protection System Diagrams and Relay Settings.
8. Cable Schedules and interconnection diagrams
9. Cable Routing Plan
10. Instrumentation schedule, measuring point list, functional write ups, installation

drawings for field mounted instruments, wiring and tubing diagrams of the panels and enclosures etc. Drawings for open and closed loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

11. Alarm and annunciation/ Sequence of Event (SOE) list and trip set points.
12. Sequence and protection interlock schemes.
13. Type test reports (of tests conducted within 5 years)
14. Control system configuration diagrams and card circuit diagrams and maintenance details.
15. Detailed software manuals and software listing.
16. Detailed flow chart for digital control system.
17. Mimic diagram Layout
18. Civil drawings consisting of foundation and structural work, civil calculation sheets including structural analysis and design.
19. Model study reports wherever applicable
20. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

3.2.4.2 INSTRUCTION MANUALS

The instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically complied for this project. The instruction manual shall comprise of the following-

ERECTION MANUALS

The minimum contents of Erection Manual shall be as follows -

1. Erection Strategy
2. Sequence of Erection
3. Erection Instructions
4. Critical checks and permissible deviations/tolerances.
5. List of tool, tackles, heavy equipment like cranes, dozers etc.
6. Bill of Material
7. Procedure for erection
8. Procedure for initial checking after erection.
9. Procedure for testing and acceptance norms.
10. Procedure / Check List for pre-commissioning activities.
11. Procedure / Check List for commissioning of the system.
12. Safety precautions to be followed in electrical supply distribution during erection.

OPERATION AND MAINTENANCE MANUALS

The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give step by step procedure for all operations likely to be carried out during the life of the plant/equipment including operation, maintenance, dismantling and repair. Each manual shall also include a complete set of drawings together with performance / rating curves of the equipment and test certificates wherever applicable.

If after the commissioning and initial operation of the plant, the manuals require any modification/ additions/ changes the same shall be incorporated and the updated instruction manuals shall be submitted to the Owners for records.

A separate section of the manual shall be for each size / type of the equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.

The manuals shall include the following -

1. List of spare parts along with their drawings and catalogues and procedure for ordering spares.
2. Lubrication Schedules including charts showing lubrication checking, testing and replacement procedure to be carried out daily, weekly, monthly and at longer interval to ensure trouble free operation.
3. Wherever applicable, fault location charts shall be included to facilitate finding the cause of the mal-operation or break down.

Detailed specifications for the consumables including lubricant oils, greases, chemicals etc. shall be required for the complete plant.

3.2.4.3 DRAWINGS

1. All drawings shall be made in Autocad 2006 or latest Version. All drawings shall be plotted in ink. All dimensions and data shall be in SI metric units. All items of the equipment should be clearly identified by proper part numbers in the contract drawings. Such parts which are to be dispatched to site from works in dispatchable units and are re-assembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. All the items of the shipping list should be identified in the drawing. The language for all inscriptions shall be English.
2. All drawings submitted by the contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials clearances and spaces required between various portions of equipment.
3. Each drawing shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, the System designation, specifications title, specifications number the name of the Projects drawing number and the revisions.

If standard catalogue pages are submitted the applicable items shall be indicated there. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be metric units. **The title block for the drawings and documents and the numbering system shall be furnished to the successful bidder, which has to be strictly followed.**

4. The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the Project. The review of these documents /data/ drawings by the Owner will cover only general conformance of the data/ drawings/documents to the specifications and contract, interfaces with the equipment provided by others and external connections of the dimensions which might affect plant layout. The review by the Owner should not be construed to be thorough review of all dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the Owner shall not relieve the Contractor of any of his responsibilities and liabilities under the contract.

5. After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.

6. All manufacturing, fabrication and execution of the work in connection with the equipment/system, prior to the approval of the drawings shall be at Contractor's risk. The Contractor is not expected to make any change in the design of the equipment/system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/ system at a later date, the contractor may do so, but such change shall be promptly be brought to the notice of Owner indicating the reasons for the change and get the revised drawing approved again.

7. Drawing shall include all installation and detailed piping drawings. All piping of 100 mm and larger diameter shall be routed in detail and smaller pipe shall be shown schematically or by isometric drawing.

8. As Built Drawings - After final acceptance of individual equipment/ system by the Owner the contractor will update all original drawings and documents for the equipment /system to "As Built" conditions.

9. Drawings must be checked by the contractor prior to submission to the Owner. In case drawings are found to be submitted without proper checking by the contractor, the same shall not be reviewed and returned to the contractor for re-submission.

10. The Bidder shall submit the specified number of prints of drawings /data/ document **along with soft copy** for Owner's review and approval. The Owner shall review the drawings and return one (1) copy to the contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be resubmitted promptly, with revisions clearly marked for the final review. Any delays arising out of the failure of the contractor to submit /rectify in time shall not be accepted as a reason for delay in the contract schedule.

11. The Bidder shall submit to the employer for approval within the time given in the contract or in the Program such drawing , samples , models or information as may be called for therein , and in the number therein required .During the progress of the works , such drawings of the general arrangements and details of the works as

specified in the Contract. The Employer shall signify his approval or disapproval within 30 days. Approve drawings samples and models shall be signed or otherwise identified by the employer. The Contractor shall supply additional copies of drawings in the form and number stated in the contract.

12. The following Schedule and procedure of drawing approval to be followed:

Sl. No.	Steps	Action/Approved status Duration
1.	First Submission by Bidder (as per approved program)	COMMENTED 1- "Approved"' 2- "Approved- Except As Noted" 3- "not Approved" 4- "For Information Only" .....**21 Days**.....
2.	Second submission by Bidder within 10 days	For '1' –Approved drawings Resubmitted with incorporation of comments/modifications with revision no. For '3' –Returned with corrections/changes with Revision no. .....**15 Days**.....
3.	third submission by Bidder within 07 days	For '1' Approved .....**15 Days**.....

Note-

Resubmission of '2' category and '3' category shall be within 7 days 10 days respectively to be recorded from the date of return of such drawings.

Approval of any drawing by the Employer shall not relieve the Bidder of his responsibility for the accuracy thereof or modification required during actual execution or for any deviation in scheme from Technical specification with accepted deviation if there by any.

3.2.5 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the Scope of Contract, whether manufactured or performed within the Contractor's works or at his Sub-Contractor's premises or at the Owners' site or at the other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be outlined by the Contractor and finally accepted by the Owner/ Authorized representative after discussions before the award of Contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality programme shall be generally cover the following :

1. His Organization structure for the management and implementation of the proposed quality assurance programme.
2. Quality System Manual

3. Design Control System
4. Documentation Control System
5. Qualification data for Bidder's key personnel
6. The procedure for purchase of materials, parts, components, and selection of Subcontractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchased etc.
7. System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
8. Control of non-conforming items and system for corrective actions.
9. Inspection and test procedure both for manufacture and field activities.
10. Control of Calibration and testing of measuring, testing equipment.
11. System for quality audits.
12. System for indication and appraisal of inspection status.
13. System for authorizing release of manufactured product to the Owner.
14. System for handling, stores and delivery
15. System for maintenance of records.
16. Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of the equipment/ component as per format enclosed in SCHEDULE-4 & 5 of section -5.

QUALITY ASSURANCE DOCUMENTS

The Contractor shall submit the following Quality Assurance documents within three weeks after dispatch of the equipment.

1. Material mill test reports on components as specified by the specification and approved Quality Plans.
2. The inspection plan with verification, inspection plan check points verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
3. Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
4. Non-destructive examination results reports including radiography interpretation reports.
5. Factory tests results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
6. Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed customer hold points

During the course of inspection, the following will also be recorded.

(A) When some important repair work is involved to make the job acceptable and

(B) The repair work remains part of the accepted product quality

7. All the accepted deviations shall be included with complete technical details.

ENGINEER'S SUPERVISION

To eliminate delays and avoid disputes and litigation all matters and questions shall be referred to the Owner and Contractor shall proceed to comply with the Owner's decision

The work shall be performed under the supervision of the Owner. The scope of the duties of the Owner pursuant to the Contract will include but not be limited to the following.

1. Interpretation of all the terms and conditions of these documents and specifications.
2. Review and interpretation of all the Contractor's drawings, engineering data etc.
3. Witness or his authorized representative to witness tests and trials either at the manufacturer's work or at site, or at any place where work is performed under the contract.
4. Inspect, accept or reject any equipment, material and work under the contract.
5. Issue certificate of acceptance and/or progressive payment and final payment certificates
6. Review and suggest modifications and improvement in completion schedules from time to time and
7. Supervise the quality assurance programme implementation at all stages of the work.

INSPECTION, TESTING AND INSPECTION CERTIFICATES

1. The word 'Inspector' shall mean the Owner and/or his authorized representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship or the works during its manufacture or erection.
2. The Owner, his duly authorized representative and or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the contractor shall obtain for the Owner and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the contractors own premises or works.
3. The contractor shall give the Owner/inspector fifteen (21) days written notice of any material being ready for testing. Such tests shall be to the contractor's account except for the expenses of the inspector's. The Owner/inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for tests/inspection and he shall forthwith forward to the inspector duly certified copies of test reports.
4. The Owner or inspector shall within fifteen (15) days from the date of inspection

as defined herein give notice in writing to the contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner/inspector giving reasons therein, that no modifications are necessary to comply with the contract.

5. When the factory tests have been completed at the contractor's or subcontractors works the Owner/inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/inspectors the certificates shall be issued within fifteen (15) days of the receipt of the contractor's test certificate by the Owner/inspector. Failure of Owner /inspector to issue such a certificate shall not prevent the contractor from proceedings with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

6. In all cases where the contract provides for tests whether at the premises or works of the contractor or any sub contractor, the contractor except where otherwise specified shall provide free of charges such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Owner/inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the contractor and shall give facilities to the Owner/inspector or to his authorized representative to accomplish testing.

7. The inspection by Owner and issue of inspection certificate there on shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed quality assurance programme forming a part of the contract.

8. To facilitate advance planning of inspection in a addition to giving inspection notice as per clause 3 of 3.2.8, the contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

9. All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The contractor shall maintain all the relevant records of periodic calibration and instrument identification and shall produce the same for inspection by Owner. Wherever asked specifically the contractor shall recalibrate the measuring test equipment in the presence of Owner engineer.

GENERAL REQUIREMENTS QUALITY ASSURANCE

1. All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the contractor responsibility to draw up and implement such programme duly approved by the Owner. The detailed quality plans for manufacturing and field activities should be drawn by the Bidder, separately in the format attached at Section 5 and will be submitted to Owner for

approval. Schedule of finalization of such quality plans will be finalized before award.

2. Manufacturing quality plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing performance testing.

3. Field quality plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the contractors site quality control organization, during various stages of site activities from receipt of materials/equipment at site. Format for field Quality Plan is given in Section 5.

4. However if Owners/ Purchasers Standard Manufacturing Quality Plan OR the Standard Check List is furnished at Section 5 of this specification or at contract stage separately, the Bidder shall give his concurrence to the same. In case Owners Standard Manufacturing Quality Plan OR the Standard Check List is furnished then Contractor's Manufacturing Quality Plan is not required.

5. The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in quality plans along-with quality plans. These quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans Owner shall identify Customer Hold Points (CHP), i.e test/checks which shall be carried out in presence of the Owner's engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and disposition.

6. The contractor shall submit to the Owner field welding schedule for field welding activities if applicable. The field welding schedules shall be submitted to the Owner along with all supporting procedures, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The format for the welding schedules shall be furnished at contract stage, if applicable.

7. No material shall be dispatched from the manufacturer's work before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspection by Owner's engineer/ authorized representative, and duly authorized for dispatch issuance of MDCC.

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

9. WELDING AND BRAZING

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

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

All brazers, welders and welding operators employed on any part of the contract either in contractors/his subcontractors works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner

Test results of qualification tests and specimen testing shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorized representative.

For all pressure parts and high pressure piping welding the latest applicable requirements of the IBR(Indian Boiler regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment /systems shall also be complied with.

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

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

Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials 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 Standard. The NDT operator shall be qualified as per SNT-TC-IA(of the American Society of Non-destructive Examination). NDT shall be recorded in report which includes details of methods and equipment used, result evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

10. SUB-VENDORS

All the sub-vendors proposed by the contractor for procurement of major bought out item including castings, forging, semi-finished and finished components/equipment, list of which shall be drawn up by the contractor and finalized with the Owner shall be subject to Owners approval. The contractors proposal shall include vendors facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. alongwith his own technical evaluation and shall be submitted to the Owner for approval prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation duty or responsibility under the contract.

For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the contractors, purchaser, specification , and engineering shall call for quality plans to be

submitted by the suppliers alongwith their proposals. The quality plans called for from the vendors shall set out, during the various stages of manufacture and installation, the quality practice and procedures followed by the vendor's quality control organization, the relevant reference documents/standards used, acceptance level, inspection of documentation raised etc.

Such quality plans of the successful vendors shall be finalized with the Owner and such approved quality plans shall form a part of the purchase order/contract between the contractor and vendor. Within three weeks of the release of the purchase order/contracts for such bought out items/components, a copy of the same without price details but together with the quality plans and delivery conditions shall be furnished to the Owner by the contractor.

11. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the contractors or their sub-vendors quality management and control activities. The contractor shall provide all necessary assistance to enable the Owner to carry out such audit and surveillance.

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

12. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner 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.

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

13. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/authorized representative

FIELD INSPECTION & TESTS

The following field inspections and tests will be carried out in the sequence detailed below, and the successful performance and completion of all the tests taken together shall constitute the OWNER ACCEPTANCE TESTS -

1. On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the contractor for correctness and completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the contractor's quality assurance programme.
2. The contractor's commissioning/start-up engineers, specially identified as far as

possible shall be responsible for carrying out all the pre-commissioning tests at site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over the complete equipment shall be placed on initial operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

3. All piping system shall be flushed steam blown as required and cleanliness demonstrated using acceptable industry standards procedures to accomplish this work shall be submitted for approval to the Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.

4. The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

5. The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owners commissioning (start-up) Engineer(s) should be checked out and cleaned. The checking and inspection of individual system should then follow a prescribed schedule to be agreed by Owner.

6. The contractor during trial operation and performance testing conduct vibration testing to determine the base line of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

MATERIAL AND WORKMANSHIP

All material used for the construction of equipment shall be new and shall be in accordance with the requirement of this specification. Material utilized for various components shall be those which have established themselves for use in such applications.

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings, which do not undergo machining, shall be free from foundry irregularities. The casting shall be tested for NDT, chemical, mechanical and metallographic tests. This shall be specified in quality plan for the specific equipment. All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM. Structural steel rolled shapes, bars, etc. shall comply with the latest ASTM.

All or a representative number of such components shall be subjected to one or more of the tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiograph. These tests shall be in accordance with the ASTM. The acceptance shall be as per ASTM Specifications.

All joints and fastening shall be so designed, constructed and registered that the component part may be accurately positioned and restrained to fulfil their required function. The heads of all bolts shall register flush on the surfaces, which they fasten.

All the information concerning materials or components to be used in manufacture, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the Contractor shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall

be borne by the Contractor.

All components exposed to rain shall be designed with sloped upper surface to avoid water pools.

AUXILIARY SUPPLY

The sub-station auxiliary supply is normally met through a system indicated under section-5 having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform to the parameters as indicated in the following.

Normal Voltage	*Variation in Voltage*	*Frequency in HZ*	*Phases*	*Neutral connection*
415V	*+/- 1 0%*	*50 +I- 5%*	*3/4-Wire*	*Solidly*
24OV	*+/- 1 0%*	*50 +/- 5%*	*1 /2-wire*	*Earthed.*
22OV	*+/- 1 0%*	*DC*	*2-wire*	*Isolated*
50 V	*+/-1 0%*	*DC*	*2-wire*	*Isolated*

Combined variation of voltage and frequency shall be limited to +/- 10%.

RATING PLATES, NAME PLATES AND LABELS

1. General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder:

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

2. Equipment Labels and Instruction Plates

Labels written in the contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the device in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit(cubicle, panel,desk, box, etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. Overall designation of each unit shall be given in the Contract language and – if required – also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscription, arranged at the top section of the units. Manufacturer's trade label shall – if desired –

appear in the bottom section of the units.

All works inside cubicles, panels, boxes, etc. shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagram, Works list, etc.)

Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

3. Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the contract and selected local language, where required in particular cases.

For indoor circuit breakers, starters, etc. transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

4. Labels for conduits, etc.

The material shall be non-corrosive and the description be done with 4 mm high letters/figures.

5. Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, non-corrosive labels detailing identification number of the cable, voltage, and conductor size. The cable identification number shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

6. Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitabley protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.

7. Single Line Diagram

Each Switchgear room shall be furnished with a copy of the final as built single line diagram detailing all electrical data and denominations, separate for each individual switchgear/distribution board/MCC, placed under glas and frame/wall mounted at an approved location.

8. Key System for Electric Boards

Key interlocked switches shall be provided with Yale or other approved locks for locking in the neutral position. Similar locks shall be provided for selector switches for

locking the switches in any of the positions.

The locks or padlocks shall be co-ordinated for the different applications and shall be supplied with three keys. A key cabinet at the end of each board (distribution board, MCC, control cubicles, etc.) shall be provided for storing the keys of that board. All keys shall have six master keys to open any lock or padlock supplied. Each key shall have one identification label fixed above the key-hanging hook inside cabinet.

The cabinet door keys shall be similar and shall be six(6) in number.

GROUND TERMINAL

Each equipment shall be provided with two grounding pads, each with two holes for M12 bolts and spring washers suitable for connection to 75mm x 12mm galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment.

BOLTS, NUTS AND WASHERS

Bolts, nuts and plain washers of size M12 and above shall be hot-dip galvanized, while sizes below M12 shall be electro-galvanized or stainless steel. Bolts and nuts shall be hexagonal or socket headed. All spring washers shall be electro-galvanized mild steel suitable for at least service condition. The shall supply the net quantities plus 5 percent of all permanent bolts, screws and other similar items and materials required for installation at site.

In general, screw threads shall be standard ISO metric threads. The use of other thread form will be used only after prior approval. The Contractor shall furnish locking devices for threaded fasteners, which will lock them in such a manner so as to prevent them from coming loose in transport and in service.

NOISE LEVEL

The noise level caused by the installed Works shall not exceed the following values if not otherwise stated in the particular technical specification:

- Machine hall, workshop, etc. max. 85 dB (A) at any place 1 M distant from operating equipment.
- Offices, control rooms, first aid max. 55 dB (A) rooms, canteens, etc.
- Residential areas, daytime max. 50 dB (A) night time max. 35 dB(A)

The noise level definition and measurement shall be in accordance with ISO and IEC. The values stated shall be adhered to taking a normal civil construction into account.

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

CONTROL CABINETS/ BOXES/ PANELS

Cubicles and control panel enclosures shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5mm and non load bearing as 2 mm, of rigid,

self-supporting construction and supplied with channel bases made to ensure no bulging takes place.

Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm^2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

Alarm contacts

Where applicable, all alarm contacts shall be of galvanically isolated type and provide inputs to the following devices.

Local annunciator
Station annunciator
Supervisory control and sequence of events / fault recorder system.

All alarm contacts shall be changeover type. Where required, relays shall be provided as contact multiplier.

All types of panels shall generally conform to IS5039, IS8623 and IEC 439 as applicable.

Suitable 240 V, single phase, 50 Hz heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10 deg. Above the ambient. The heaters shall be suitably designed to prevent any contact between the heater wire and air. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

The size of the enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/Kiosk/panel shall be provided with 15 A 240 V AC, 2 pole, 3 pin, industrial grade receptacle with switch. For incoming supply MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be rotary switch type.

Each box shall be provided with two earthing pads to receive GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire.

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

The labels etc. on these panels shall be as per clause 3.2.13 above.

Electric Motors

1. General

All motors shall be of approved manufacture and shall comply with the requirements of this Chapter. Motors of the same type and size shall be fully interchangeable and shall comply - as far as applicable - to IEC standard motor dimensions.

The general construction shall be stiff and rigid; no light metal alloy casings will be accepted. All precautions shall be taken to avoid any type of corrosion.

All motors shall be fitted with approved types of lifting hooks or eyebolts as suitable.

AC motors shall have squirrel cage type rotors.

Motor Voltages and Power Ratings

The service voltages and corresponding power ratings for electric motors to be used in

the Project shall be as follows:

Motors up to 100 kW

• Service voltage :	3-phase a.c. 415/240 V,50 HZ
• Mode of starting :	direct-on-line up to 50 kW above 50 kW with suitable starters

Motors up to 0.75 kW

• Service voltage :	single-phase a.c. 240 V, 50 HZ
• Mode of starting :	condenser

Motors intended to work on the d.c. System

Service voltage : 220 V D.C.
Mode of starting : resistor

2. Rating

The rating of the motors shall be adequate to meet the requirements of its associated equipment. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:
Power Demand of Driven Machine Service Factor

Up to 5 kW 1.2

More than 5 kW 1.1

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 95% and 105% of the rated frequency and/or with any voltage variation between 90% and 110% of the nominal voltage. A transient overvoltage of 130% of the nominal voltage shall as well be sustained.

Further, the motors shall be capable of maintaining stable operation when running at 70% nominal voltage for a period of 10 seconds. The pullout torque for continuously loaded motors shall be at least 160% of the rated torque and for intermittently loaded motors 200% of the rated torque.

D.C. motors shall be capable of operating continuously under rated output conditions at any voltage between 90% and 110% of the nominal voltage with a fixed brush setting for all loads. Unless otherwise approved, the speed drop between no-load and full-load shall not exceed 10% of no-load speed.

3. Starting

A.C. motors shall be designed for direct on-line starting. They shall be capable of being switched on without damage to an infinite busbar at 110% of the nominal voltage with an inherent residual voltage of 100% even in phase opposition. For starting the motors from the individual main and auxiliary busbars, a momentary voltage drop of 20% referred to nominal voltage should be taken into consideration. With 85% of the nominal voltage applied to the motor terminals, each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

The maximum starting currents (without any tolerance) shall not exceed the following values: -

5 times of rated current for L.V. motors rated 100 kW or above
2 times of rated current for D.C. motors (by means of starting resistors)

Generally, all motors shall be able to withstand three cold starts per hour, equally spaced. In addition, each M.V. motor shall be capable of enduring two successive starts with the motor initially at operating temperature. Each L.V. motor shall be capable of withstanding three successive starts under the same conditions or once every twenty minutes without detrimental heating.

Motors for frequent automatic starting shall have an adequate rating. In the motor list the Contractor shall state the frequency of starts permitted in compliance with the motor design.

4. Windings and Insulation Class

The insulation of all motors shall be of class F but maintain in operation the temperature limits of class B materials. It shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapors and for considerable fluctuations in temperature.

The stator winding shall be suitably braced to withstand the forces due to direct-on-line starting and transfer conditions as mentioned before. The winding envelopment and tails shall be non-hygroscopic. The stator winding shall withstand the maximum fault current for the period determined by the associated protective devices.

The rotor winding (if applicable) shall be designed to give trouble-free continuous service including repeated direct-on-line starting. The rotor shall be subjected to a 120% over speed test for 2 minutes without showing any winding dislocation.

5. Ventilation and Type of Enclosure

All motors shall be of the totally enclosed fan-cooled type, protection class IP 54 according to IEC Recommendation 144. Cable termination points shall be of class IP55.

They shall have a closed internal cooling air circuit recooled by an external cooling air circuit drawn from the opposite side of the driving end.

Where motors are installed outdoors, a weatherproof design shall be chosen. L.V. motors of IEC size 132 and above shall be equipped with automatically controlled heating elements for protection against internal condensation of moisture during standstill periods. Such A.C. heater shall be suitably fixed inside the motor casing; the leads shall be led to a separate L.V. terminal box.

Motors installed outdoors and directly subjected to solar radiation shall be rated such as not to exceed a maximum metal temperature of 85°C. Where necessary, such motors shall be provided with sun shields.

Vertical motors shall be provided with a top cover to prevent the ingress of dirt, etc.

6. Bearings

As far as possible, the motors shall have sealed ball or roller bearings lubricated for live. All other motors with ratings of about 1 kW and above shall be equipped with lubricators permitting greasing while the motor is running and preventing over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Vertical motors shall have approved thrust bearings.

Where sleeve bearings are being used, they shall be of the self or forced lubricating type. If forced lubrication is required, it shall be arranged common to both the motor and the driven machine and provisions shall be made to ensure lubrication during start-up and shutdown operations without the necessity to start an auxiliary lube oil pump. Self-lubricated bearings shall be equipped with an easily accessible oil reservoir with overflow pipe and oil collecting vessel.
All bearings shall be easily controllable during operation or standstill without dismantling the bearings. The bearings shall further be protected and sealed against dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

For the transport of motors equipped with ball or roller bearings, special bearing inserts shall be provided to prevent transport damage.

Service hour meters shall be installed in the motor control centres if maintenance work such as regreasing, oil change etc. depend on the operation time of the motors.

7. Shafts and Couplings

The motors shall be provided with a free shaft extension of cylindrical shape with key and keyway according to IEC Recommendation 72-1 and with the motorside-coupling, which shall be pressed on the motor shaft and be balanced together with it. A coupling guard shall be provided.

8. Brushgear and Commutators

Brushgear for D.C. motors shall be designed to ensure constant brush pressure. Carbon brushes shall be provided which stand at least 6 months of operation without replacement. Each brush shall be independently adjustable but should not require adjustment throughout its life. A design of brushgear which permits the brush holder to touch the commutator as the brushes wear or which passes current through the pressure fingers will not be accepted.

A sufficient number of brushes, not less than two per pole, shall be fitted to ensure that vibrations do not affect the commutation.

The minimum safe wearing margin of commutators shall not be less than 20 (twenty) per cent of the total thickness of the commutator bars and the minimum safe diameter shall be clearly marked on it.

9. Terminal Boxes and Earthing

The terminal leads, terminals, terminal boxes and associated equipment shall be suitable for terminating the respective type of cables as specified in these General Technical Specifications and in the Particular Technical Specifications.

The terminal boxes shall be of ample size to enable connections to be made in a satisfactory manner. Supports shall be provided at terminal boxes as required for proper guidance and fixing of the incoming cable.

The terminal boxes with the cables installed shall be suitable for connection to supply systems with the short-circuit current and the fault clearance time determined by the motor protective devices.

A permanently attached connection diagram shall be mounted inside the terminal box cover. If motors are provided for only one direction of rotation, this shall be clearly indicated.

Terminal boxes shall be totally enclosed and designed to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW, the terminal box shall be sealed from the internal air circuit of the motor.

Depending on the size, the terminal box of L.V. motors shall be fitted either with an approved cable sealing-end or with a gland plate drilled as required and provided with suitable fittings for cable fixing and sealing. Such openings shall be temporarily plugged or sealed during transportation.

For earthing purposes, each motor shall have adequately sized bolts with washers at the lower part of the frame. In addition, each terminal box shall contain one earthing screw. Each equipment/panel shall be earthed by at least two separate earthing strips.

The cable termination philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field-mounted group. JB'S at stategic locations (where large concentration of signals are available, e.g switchgear) is done. Termination / Junction boxes shall have either maxi- terminal or cage clamp type terminals

10. Noise-Level and Vibrations

Under all operating conditions, the noise level of motors shall not exceed 85 dB (A).

In order to prevent undue and harmful vibrations, all motors shall be statically and dynamically balanced.

Vibration displacements or velocity shall be measured in accordance with relevant IS for IEC motor sizes 80 to 315. The results for all motors shall be within the "R" (reduced) limits.

11. Tests

Each motor shall be factory tested and shall undergo a test at site. The following tests shall be performed under full responsibility of the Contractor.

Workshop Tests:
Measurement of winding resistances
No-load and short-circuit measurements
Measurement of starting current and torque
Efficiency measurement (type test)
Heat test run
Dielectric test
Measurement of insulating resistance

Overspeed test

Site Tests:

Measurement of insulation resistance
Measurement of motor vibrations
Measurement of starting time.

PROTECTION CLASS OF CABINETS/PANELS, ENCLOSURES, MOTORS ETC.

All panels desk cabinets and enclosures furnished shall at least comply with the requirements of protection classes as indicated below unless otherwise specified in Section 1 or 2 :

1. Indoor air conditioned (AC) areas IP22
2. Indoor Non AC areas
   - b. Ventilated enclosures IP42
   - c. Non Ventilated enclosures IP54
3. Outdoor IP55

SURGE PROTECTION FOR SOLID STATE EQUIPMENT

All solid state systems/equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protections as defined in ANSI C37.90.1-1989 or its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates etc. shall be submitted by the Contractor.

INSTRUMENT AIR SYSTEM

The instrument air supply system shall be supplied by the Contractor for various pneumatic control and instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping/tubing etc.

Each pneumatic instrument shall have an individual air shut-off valve. The pressure regulating valve shall be equipped with an internal filter, a 50mm pressure gauge and a built-in filter housing blow down valve.

Tapping points shall include probes, wherever applicable, for analytical measurements and samplings.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

1. Temperature test pockets with stub and thermo-well.
2. Pressure test pockets.

LUBRICATION

Equipment shall be lubricated by the systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

LUBRICANTS, SERVO FLUIDS AND CHEMICALS

The Bidder's scope includes first fill of all lubricants, servo fluids, gases and chemicals. Consumption of all these consumables during the trial operation and final filling after the trail operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity one year topping requirement of each variety of lubricants, servo fluids and the chemicals used unless specially excluded under Exclusion in the specification. As far as possible, lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

COLOUR CODE FOR ALL EQUIPMENT/ PIPING/ PIPE SERVICES

All equipment / piping/ pipe services are to be painted by the Contractor in accordance with Owner's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from the damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/ paints / shall take into account the hot humid, corrosive and saline atmospheric conditions applicable for a coastal area.

All exposed metallic surfaces subject to corrosion shall be protected by the shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to finish painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Owner regarding quality of the primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.

All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Owner.

All piping shall be cleaned after shop assembly by shot blasting or other ,means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

All metal surfaces shall be treated to provide anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High Tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition 4. All steel conductors including those used for earthing / grounding (above ground level) shall also be galvanized according to IS- 2629.

FUNGISTATIC VARNISH -Special moisture and fungus resistant varnish shall be applied to 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 or 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.

All Switchgear panels and Control / Relay Panels shall be painted by powder coating. Paint shade for electrical equipment shall be 692 for indoor and 631 of IS : 5 for outdoor equipment. However paint shade has to be matched with existing equipments, which shall be furnished at the detailed design engineering stage.

GALVANIZING

The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the steel by dry process. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking and peeling off, etc.

Unless otherwise specified in Section 1 or 2, the minimum weight of the zinc coating shall be as follows –

It shall be 610 gm/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. The average coating thickness shall be 95 microns. For items less than 6 mm, requirements of coating thickness shall be as per clause 4.1 of IS 4759, 1984. For surfaces which will be embedded in concrete, the zinc coating shall be 900 gm/sq.m minimum. Galvanizing of each member shall be carried out in one complete immersion.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment.

1. All bolts, nuts, lock nuts, washers, etc. shall be hot dip galvanized. Nuts, however, may be tapped, but not to cause
2. Adhesion test as per IS 2629 :1985
3. Mass of zinc coating as per IS 6745 :1972

3.2.27 Terminal Blocks

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

Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals. The terminal blocks shall be cage clamp

type (Wago or equivalent) or non-disconnecting stud type (Elmex type CAT-M4 or equivalent). The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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

The terminal blocks shall be of expandable design.

The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

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

The arrangements shall be made in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

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.

There shall be minimum clearance of 250 mm between the first/ bottom row of terminal block and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150 mm

3.3 SEISMIC WITHSTAND TEST

The seismic withstand test on complete equipment shall be carried out along with the supporting structure.

The Contractor shall arrange to transport the structure from the structure Contractor's works/ project site or alternatively arrange the structure as per approved drawings for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pads of the equipment and any other point as agreed by the Owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Owner.

3.4 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling, jigs and fixtures for maintenance and calibration/ readjustment. Checking and measurement aids etc. A list

of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The prices of each tool/ tackle shall be deemed to have been included in the total bid price. The tolls and tackles shall be separately packed and sent to site. This set of tools and tackles shall not used by during erection and trial operation. For this purpose a separate set of tools and tackles shall be brought/ supplied by the Contractor. In case the above mentioned set is used during erection, commissioning or trial operation the same shall be refurbished repaired/ replaced as required to the satisfaction of the Owner before handing over. All tools and tackles shall be of reputed make acceptable to the Owner.

3.5 PACKING AND TRANSPORTATION

All the equipment shall be suitably protected coated covered or boxed and crated to prevent damage of deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

PACKING IN CRATES

For the equipment packed in crates, the packing wood shall be as per relevant Indian/ International standards. The base of the crate shall be made of wooden batons and planks giving necessary reinforcement, so that the bottom of the equipment is at a height of 100mm minimum from the ground level. The size of the plank shall be decided by the sub-contractor to suit the weight of equipment. Minimum thickness of the plank shall be 25mm and minimum width shall be 150mm. Crate shall be made while keeping the gap from 25mm to 200mm depending upon the size of equipment and weight. However, the responsibility of proper packing and safe delivery of the equipment to site lies with the supplier

3.6 DEVIATIONS FROM SPECIFICATIONS

Deviation, if any, from any of these specifications shall be listed out separately. Bidder shall attach a separate sheet titled as "DEVIATIONS FROM SPECIFICATIONS" and list all deviations details of each deviation Section wise and Clause wise. In absence of any deviation listed out separately, adherence to the specifications shall be assumed.

3.7 Training

The Contractor shall arrange training to familiarize the customer's personnel about constructional and O&M aspects of equipment wherever need of specialized training is felt during detail engineering. Cost of such training shall be borne by the Contractor. Traveling and living expenses, of the personnel deputed on such training, however, shall be borne by the Employer.

Besides above, the Contractor shall hold training sessions to familiarize the Employer's personnel with all aspects of operation and maintenance of the plant and sub-systems before the beginning of the dry tests on site. The technical documentation used in the training sessions shall include the Contractor's draft operation and maintenance manuals and test procedure descriptions approved by the Employer.

The Contractor shall provide training for each phase of work as per details agreed at the time of award.

1. General requirements of training

The Contractor shall provide suitable instructors, training material and facilities (instruments, apparatus, simulators, documents, drawings, protective clothing, rooms, office supplies, etc.) for the personnel made available by the Employer for training.

One month before the training start, the Employer will send the list of the trainees and any comments on the training program proposed by the Contractor. This program shall be adapted to the design and nature of the Works, and the needs of trainees. Trainees shall be suitably trained in the various aspects of design, manufacture, installation/erection, operation and maintenance, relevant to the training, of works similar to the Works

The Contractor shall supervise and provide direction to, and be liable for the acts or omissions, other than negligent or willful misconduct of such personnel, of the Employer's trainees.

The Contractor shall provide the training described hereafter in accordance with any further specific requirements stated in the Employer's Requirements.

The Contractor shall assist the Employer in obtaining any visas and other formalities for entering or leaving the territory on which the training is being provided.

The Contractor shall bear responsibility for ensuring the safety of the trainees during their stay in the country of the training. On their part, the trainees shall comply with the laws, regulations and customs of the country in which training is being provided.

In the event of illness or accident, the Contractor shall take all steps to provide the trainees with the appropriate medical care.

2. Training of Employer's personnel

The scope of service under training of Employer's engineers shall include a training module covering the following:

2.1. Training during engineering/ manufacturing phase

This shall cover all the related areas like design familiarisation, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. The training in areas of Operation and Maintenance shall take place preferably during end of manufacture/ tests.

2.2. Training during the erection / installation / site work

Independently from the supervision and inspection functions of the Employer's Representative, the Contractor shall authorize the Employer's Personnel to follow the erection / installation / site work at his site.

The Employer's Start-up Personnel shall take no part in the equipment erection and/or installation operations, which shall be exclusively carried out by the Contractor and

under his entire responsibility.

This on site training shall cover each phase of erection / installation / site work and shall be of sufficient duration.

The Contractor shall supply the information or measurements concerning the erection requested by the Employer's Representative or/and by the Employer's personnel.

2.3. Training during the tests on completion phase

The Contractor shall provide on the-job training in the operation and maintenance of the Works to the Employer's Operating Personnel. Such training shall start at least 30 days prior to commencement of Tests on Completion and continue until Taking Over. Its scope and quality shall be such as to provide the trainees with comprehensive understanding of all operational and maintenance aspects of the work. Such training shall also include safety and environmental protection aspects applicable to the work.

3.8 INFORMATION TO BE FURNISHED BY THE CONTRACTOR/ SUB CONTRACTOR

Information/ documents to be furnished at the TENDER / CONTRACT STAGE shall be as given below: (marked 'X' in the appropriate column)

DETAILS OF DOCUMENTATION TO BE FURNISHED	At Tender Stage	At Contract Stage
Technical offer with details of equipment, scope etc	X	
Guaranteed Technical particulars	X	X
Schedule of Tests to be conducted	X	
Schedule of deviations, if any, Section wise, clause wise, with respect to technical specifications	X	
List of past supplies complete with purchase & project ref., quantity, order ref., etc. where identical equipment have been supplied.	X	-
Manufacturing Quality Plan/ Standard Check List	X	X
Field Quality Plan	X	X
GA drg with dimensions & weight and foundation/ fixing details	X	X
Drg & Data submission schedule (to be furnished at contract stage shall be specified date-wise here).	X	X
Type test Reports.	X	X
Bar chart showing the time schedule indicating the timer required for design submission of drawing, manufacture of eqpt, test and inspection.	X	
Routine / Acceptance test reports.		X
Installation , Operation & Maintenance Manual	X	X
Field Quality Plan for receipt and storage, installation, testing and commissioning with details of test equipment, tests to be conducted and acceptance values	X	X

ANNEXURE-A

NUMBER OF COPIES AND MODES OF DOCUMENTATION TO BE SUBMITTED

Sl. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE		
		PRINTS	PRINTS	CD-ROM	MANUALS
1.	Drawings & GTP data sheets for approval	2	7		
2.	Drawings & GTP data sheets after revision for approval		7		
3.	Drawings & GTP data sheets after revision for approval (Final)		12		
4.	Drawings and GTP-data sheets as build		12	6	
5.	RTFs of approved drawings		3		
6.	Test Procedures for approval	1	7		
7.	Type Test & Routine test Reports for approval	1	7		
8.	Type Test & Routine test Reports for after approval		12		
9.	Draft copies of the following for approval				
9.1	Erection Manual		7		
9.2	O & M Manual		7		
9.3	Commissioning and Performance procedure manual		7		
10.	Approved final copies of the following				
10.1	Erection Manual			6	12
10.2	O & M Manual			6	12
10.3	Commissioning and Performance procedure manual			6	12
11.	Draft copies of the following for approval				
11.1	Manufacturing Quality Plan		7		
11.2	Field Quality Plan		7		
12.	Approved final copies of the following				
12.1	Manufacturing Quality Plan				12
12.2	Field Quality Plan				12
13.	Inspection and Test Reports		7		12

NOTE:
Quality Documentation shall be arranged in plastic folders in the same order as they appear in the QP, with cover sheet and index with QP itself as the first document at the top.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top .

9.1 Guaranteed Technical Particulars

Item / Clause No.	Parameter	Units	Contractor's Data
1	Type designation	-	
2	Rated system voltage	kV	
3	Highest voltage for equipment U_m	kV	
4	Rated frequency		
4.1	normal condition	Hz	
4.2	exceptional condition	Hz	
5	Rated power frequency withstand voltage	kV_{rms}	
6	Rated lightning impulse withstand voltage (1.2/50ms)	kV_{peak}	
7	Rated switching impulse withstand voltage	kV_{peak}	
8	15 minute dry power frequency withstand test voltage (conductor-sheet)	kV_{rms}	
9	Maximum partial discharge	pC	
9.1	at test voltage	kV_{rms}	
10	Test voltage after laying, applied on complete installation (cable and cable end seals)	kV	
11	Maximum permissible operating temperatures at		
11.1	continuous rated operation	°C	
11.1.1	short time emergency (overload) operation	°C	
11.1.2	short-circuit condition	°C	
12	Cable construction		

Item / Clause No.	Parameter	Units	Contractor's Data
12.1	conductor cross section	mm_2	
12.2	conductor design	-	
12.3	conductor material	-	
12.4	type of screen	-	
12.5	screen cross-section	mm_2	
12.6	screen material	-	
12.7	thickness of XLPE insulation	mm	
12.8	thickness of outer PE-sheath	mm	
12.9	outer diameter of cable	mm	
12.10	minimum bending radius	mm	
12.11	weight of cable	kg/m	
13	Cablel rating		
13.1	Rated continuous current considering specified cable laying	A	
13.2	short time withstand current 1s		
13.2.1	of conductor	kA_{rms}	
13.2.2	of screen	kA_{rms}	
13.3	Dynamic short circuit withstand current	kA_{peak}	
13.4	DC resistance at 20°C		
13.4.1	of conductor	Ohm/km	
13.4.2	screen	Ohm/km	
13.5	AC resistance of conductor at 60°C	Ohm/km	
13.6	Capacitance per phase	nF/km	

9.1 Guaranteed Technical Particulars

Item / Clause No.	Parameter	Units	Contractor's Data
13.7	Total cable losses at rated current, considering proposed screen earthing		
13.7.1	per phase	kW/km	
13.7.2	complete three phase system	kW/km	
14	GIS cable sealing ends		
14.1	Type designation	-	
14.2	Number of sealing ends		
15	Outdoor cable sealing ends		
15.1	Type designation	-	
15.2	Material of screens	-	
15.3	Number of sealing ends	-	

9.2 Informative Data

Item / Clause No.	Parameter	Units	Contractor's Data
1	Manufacturer		
2	Place of manufacture		
3	Applicable standards		
4	Maximum electric field strength at the conductor at 440 kV (highest system voltage)	kV/mm	
5	Charging current per phase at 440 kV	A/km	
6	Inductance per phase	mH/km	
7	Induced voltage on screen		
7.1	at rated current	V/km	
7.2	at short circuit current	V/km	
8	Proposed cable laying		
8.1	laying in	-	
8.2	maximum ambient temperature	°C	
8.3	arrangement of single phase cables	-	
8.5	axial distance	mm	
8.6	number of parallel circuits	-	
8.7	joints required	yes/ no	
9	Total estimated length of single phase cable	m	
10	Maximum weight of complete cable drum for transportation	kg	
11	Maximum dimension of cable drum		
11.1	diameter of drum	mm	
11.2	width of drum	mm	

9.2 Informative Data

Item / Clause No.	Parameter	Units	Contractor's Data
11.3	max. cable length per drum	m	
12	Manufacturer		
12.1	GIS cable sealing ends		
12.2	Outdoor cable sealing ends		

Information to be supplied together with the bid

At least the information listed hereunder shall be given by the Bidder. The Bidder may submit additional documents /descriptions to describe special technical features of offered equipments / system:

1 Drawing with cross-section of each cable type, showing construction and dimension.

2 Dimensional drawing of cable sealing ends of each type.
3 Propose applicable methods of cable testing after laying.
4 Describe proposed cable laying and fixing method including cross bending, if applicable.
5 Propose method of earthing of cable screens including sheath overvoltage protection measure, if applicable.

SECTION – 5

ENCLOSURES

S.No.	Description	Drawing/Document No.
1.	Model QAP for 420 kV XLPE Cables	F/IQA/740/01/01
2.	Power House Transformer Cavern-Equipment Arrangement Plan at EL. 984.00 & 981.00M	NH/DEM/PBT-III/PH/11
3.	Pothead Yard Layout Plan	NH/DEM/PBT-III/PY/01
4.	Power House Complex Drainage System	NH/DEM/PBT-III/DD/01

9. MODEL QUALITY ASSURANCE PLAN (QAP) FOR 420 KV XLPE CABLE

Special instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments /equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Raw Material**								
1.1	**Copper wires**								
a)	Diameter	Measurement	100% Coils	Tech. Spec./ IS:5484	TC	2/3	-	1	TC
b)	Surface Condition	Visual	Sample plan	-do-	TC	2/3	-	1	TC
c)	T S and E.B	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Chemical Composition	Chemical	-do-	-do-	TC	2/3	-	1	TC
1.2	**Copper Conductor**								
a)	Diameter	Measurement	100% Drum	Tech.Spec / IS:8130,613 & 2982	TC	2/3	-	1	TC
b)	Weight	-do-	-do-	-do-	TC	2/3	-	1	TC
1.3	**Insulating Paper (As Applicable)**								
a)	Thickness	Measurement	Sampling Plan	As per Tech Spec./Appd.Drg./ Relavent IS/IEC	TC	2/3	-	1	TC
b)	Tensile Strength	Mechanical	-do-	-do-	TC	2/3	-	1	TC
c)	Elongation	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Diameter	Measurement	-do-	-do-	TC	2/3	-	1	TC
1.4	**Internal & External Semiconductive**								
a)	Viscosity	Physical	1Bag/Lot	Tech Spec & IEC 540	TC	2/3	-	1	TC
b)	Scroch Time	-do-	-do-	Tech Spec / IS 5831	TC	2/3	-	1	
c)	Rheometer	Chemical	-do-	-do-	TC	2/3	-	1	TC
d)	Transversal Resistivity	Mechanical	-do-	-do-	TC	2/3	-	1	TC
e)	Density	Physical	-do-	-do-	TC	2/3	-	1	TC

Note a In 'Inspection Agency'column figure 1,2,or 3 to be filled 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate sub-supplier'
b In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C - Test Certificate Submission & CHP - Customer Hold Point
c Test certificates shall be submitted at the time of final inspection

6

Signature
NHPC (I&QA DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1.5	**XLPE Compound**								
a)	Tensile strength	Mechanical	Sampling Plan	As per Tech Spec./Appd.Drg./ IEC:62067	TC	2/3	-	1	TC
b)	Permittivity	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	Dielectric loss angle	Electrical	-do-	-do-	TC	2/3	-	1	TC
1.6	**Aluminium Wires**								
a)	Surface Condition	Visual	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	Mechanical Strength	Mechanical	-do-	-do-	TC	2/3	-	1	TC
c)	Elongation	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Diameter	Measurement	-do-	-do-	TC	2/3	-	1	TC
1.7	**Semi Conductive tape**								
a)	Dimension	Measurement	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	Mechanical Strength	Mechanical	-do-	-do-	TC	2/3	-	1	TC
c)	Elongation	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Resistivity	Electrical	-do-	-do-	TC	2/3	-	1	TC
1.8	**Aluminium Tape**								
a)	Dimension	Measurement	Sampling Plan	-do-	TC	2/3	-	1	TC
b)	Mechanical Strength	Mechanical	-do-	-do-	TC	2/3	-	1	TC
c)	Elongation	Mechanical	-do-	-do-	TC	2/3	-	1	TC
1.9	**PE**								
a)	Melt Index	Physical	-do-	-do-	TC	2/3	-	1	TC
1.10	**PE Semiconductive Layer**								
a)	Hardness Shore	Mechanical	-do-	-do-	TC	2/3	-	1	TC
b)	Density	Physical	-do-	-do-	TC	2/3	-	1	TC
c)	Mechanical Strength	Mechanical	-do-	-do-	TC	2/3	-	1	TC
d)	Elongation	Mechanical	-do-	-do-	TC	2/3	-	1	TC

Note. a In 'Inspection Agency' column figure 1,2,or 3 to be filled 1- will indicate NHPC', 2- will indicate 'supplier' & 3- will indicate sub-supplier
b In Remarks' column following abbreviations shall be used - RR-Review of Records, T C - Test Certificate Submission & CHP - Customer Hold Point.
c Test certificates shall be submitted at the time of final inspection

Signature
NHPC (I&QA DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
2	**Electrical Type Test on Cables**								
a)	Bending Test	Physical	1 Sample	As per Tech Spec./Appd.Drg / IEC:62067	TC	2/3	-	1	TC
b)	Dielectric Loss Angle Test	Envi.	-do-	-do-	TC	2/3	-	1	TC
c)	Heating Cycle Test	Thermal	-do-	-do-	TC	2/3	-	1	TC
d)	Partial Discharge Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
e)	Impulse Withstand Test	-do-	-do-	-do-	TC	2/3	-	1	TC
f)	Power frequency AC Voltage Withstand Test	-do-	-do-	-do-	TC	2/3	-	1	TC
g)	High Voltage Test								
	i) At Room Temperature	-do-	-do-	-do-	TC	2/3	-	1	TC
	ii) Water Immersion	-do-	-do-	-do-	TC	2/3	-	1	TC
h)	Insulation Resistance	-do-	-do-	-do-	TC	2/3	-	1	TC
3	**Non-Electrical Type Test on Cables**								
a)	Check of Cable Construction	Measurement	100%	-do-	TC	2/3	-	1	TC
b)	Mechanical Properties of Insulation(before & after ageing)	Physical	1sample/lot/size	-do-	TC	2/3	-	1	TC
c)	Mechanical Properties of Oversheath(before & after ageing)	-do-	-do-	-do-	TC	2/3	-	1	TC
d)	Ageing Test on Complete Cable	-do-	-do-	-do-	TC	2/2	-	0	TC
e)	Hot Set Test for XLPE Insulation.	Measurement	-do-	-do-	TC	2/3	-	1	TC

Note a. In 'Inspection Agency' column figure 1,2,or 3 to be filled 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
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NHPC (I&QA DEPT.)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
4	**Routine Tests**								
a)	Conductor Resistance Test	Electrical	100% Durm	Tech.Spec./IEC:62067	TC	2/3	-	1	TC
b)	High Voltage Test	-do-	-do-	-do-	TC	2/3	-	1	TC
c)	Electrical Test on Oversheath	-do-	-do-	-do-	TC	2/3	-	1	TC
5	**Acceptance Test**								
a)	Conductor Examination (no of strands,lay direction,lay length)	Measurement	1lot /size	-do-	JIR	2/3	1	-	
b)	Electrical Resistamce of Conductor	Electrical	-do-	-do-	JIR	2/3	1	-	
c)	Measurement of Thickness of Insulation and Oversheath	Measurement	-do-	-do-	JIR	2/3	1	-	
d)	Measurement of Thickness of Metallic Sheath	Measurement	-do-	-do-	JIR	2/3	1	-	CHP
e)	Measurement of Diameter of core and overall daimeter of cable	-do-	-do-		JIR	2/3	1	-	
f)	Hot Set Test for XLPE Insulation	-do-	-do-	-do-	JIR	2/3	1	-	
g)	Measurement of Capacitance	Electrical	-do-	-do-	JIR	2/3	1	-	
h)	Water Content on XLPE insulation	Chemical	-do-	-do-	JIR	2/3	1	-	
i)	Measurement of External Diameter	Measurement	-do-	-do-	JIR	2/3	1	-	
j)	Lightning Impulse Test followed by a power frequency voltage Test	Electrical	-do-	-do-	JIR	2/3	1	-	

Note a In Inspection Agency column figure 1,2,or 3 to be filled 1- will indicate 'NHPC , 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'
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c. Test certificates shall be submitted at the time of final inspection

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NHPC (I&QA DEPT.)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
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SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
6	**FRLS Tests**								
a)	HCL Gas Generation Test	Chem.	1lot /size	Tech.Spec./IS:7098 part-1/IEC 502	JIR	2/3	1	-	
b)	Oxygen Index Test	Thermal	-do-	-do-	JIR	2/3	1	-	
c)	Temperature Index Test	-do-	-do-	-do-	JIR	2/3	1	-	
d)	Smoke Density Test	-do-	-do-	Tech.Spec./ASTM D 2843	JIR	2/3	1	-	
e)	Flammability Test	Flam	-do-	Tech.Spec./IS.1554/IEC:502	JIR	2/3	1	-	
f)	Swidish Chimney Test	-do-	-do-	Tech.Spec./SS-424 14 75	JIR	2/3	1	-	
g)	Ladder Test	-do-	-do-	Tech.Spec./IEEE-383	JIR	2/3	1	-	
h)	Heat Shock Test	Ther.	-do-	Tech.Spec./IS.1554 & 10810/ IEC:502	JIR	2/3	1	-	CHP
i)	Anti Rodent & Termite Test	Chem.	-do-	Tech Spec/Appd Drg	JIR	2/3	1	-	
7	**Check for Embossing and Colour coding, etc.**	Visual	-do-	Tech Spec /Appd.drg./IS Code	JIR	3/2	1	-	
8	**Packing, Marking & End Sealing**								
a)	Marking on Cable Drum	Visual	Each Drum	-do-	JIR	2/3	1	-	
b)	End Sealing	-do-	-do-	-do-	JIR	2/3	1	-	

Note a In 'Inspection Agency column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier & 3- will indicate 'sub-supplier'
b In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T C - Test Certificate Submission & CHP - Customer Hold Point
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NHPC (I&QA DEPT.)

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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : PARBATI - III H.E. PROJECT
NAME OF
EQUIPMENT : 420 kV XLPE Cable

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	**Transformer Oil Immersed Sealing End**								
a)	Appearance & Dimensional Check.	Visual / Measurement	100%	Tech.Spec /Appd Drg /IEEE std.48	TC	3/2	-	1	TC
b)	Dielectric Tests.	Electrical	-do-	-do-	TC	3/2	-	1	TC
c)	Pressure Leak Test	-do-	-do-	-do-	TC	3/2	-	1	TC
d)	Partial Discharge Test.	-do-	-do-	-do-	TC	3/2	-	1	TC
2	**SF^6 Sealing End**								
a)	Appearance & Dimensional check.	Visual / Measurement	-do-	-do-	TC	3/2	-	1	TC
b)	Dielectric Tests.	Electrical	-do-	-do-	TC	3/2	-	1	TC
c)	Pressure Leak Test	-do-	-do-	-do-	TC	3/2	-	1	TC
d)	Partial Discharge Test	-do-	-do-	-do-	TC	3/2	-	1	TC
3	**Pothead Yard Sealing End**								
a)	Appearance & Dimensional check	Visual / Measurement	-do-	-do-	TC	3/2	-	1	TC
b)	Dielectric Tests.	Electrical	-do-	-do-	TC	3/2	-	1	TC
c)	Pressure Leak Test	-do-	-do-	-do-	TC	3/2	-	1	TC
d)	Partial Discharge Test	-do-	-do-	-do-	TC	3/2	-	1	TC
4	**Joints**								
a)	Appearance & Dimensional Check	Visual / Measurement	-do-	-do-	TC	3/2	-	1	TC
b)	Dielectric Tests.	Electrical	-do-	-do-	TC	3/2	-	1	TC
c)	Pressure Leak Test	-do-	-do-	-do-	TC	3/2	-	1	TC
d)	Partial Discharge Test	-do-	-do-	-do-	TC	3/2	-	1	TC

Note a In Inspection Agency'column figure 1 2.or 3 to be filled 1- will indicate NHPC', 2- will indicate supplier & 3- will indicate 'sub-supplier'
b In Remarks column following abbreviations shall be used - RR-Review of Records T C - Test Certificate Submission & CHP - Customer Hold Point
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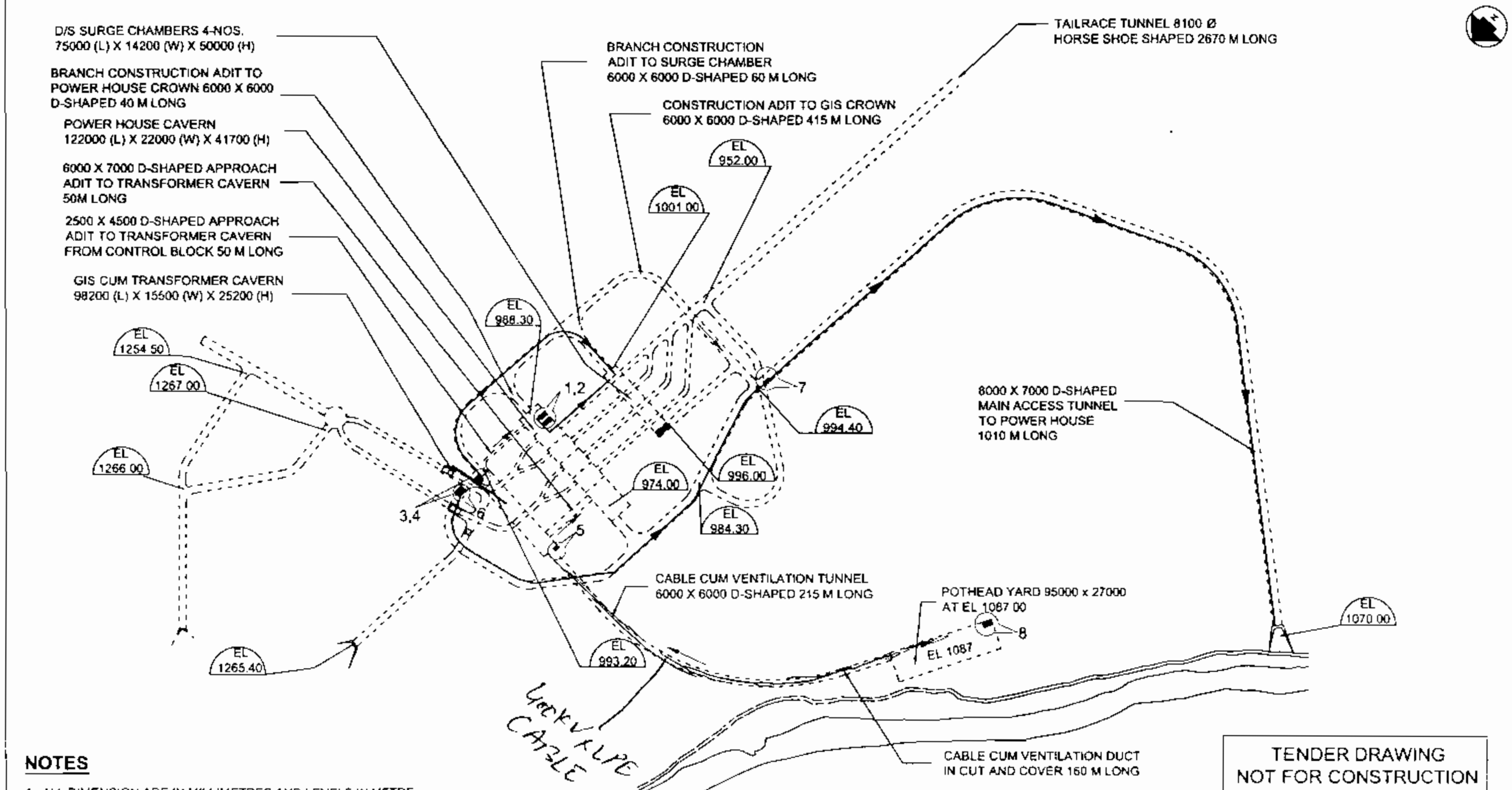
4

Signature
NHPC (I&QA DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



TENDER DRAWING
NOT FOR CONSTRUCTION

NOTES

1 ALL DIMENSION ARE IN MILLIMETRES AND LEVELS IN METRE
2 THE LAYOUT, SHAPE, SIZE AND GRADIENT OF ADITS ACCESS TUNNELS MAY BE MODIFIED DURING DETAIL DESIGN
3 THE LAYOUT OF THE POWERHOUSE CAVERNS MAY BE MODIFIED AS PER SITE CONDITIONS
4 DIMENSIONS OF SUMPS SHALL BE FINALISED DURING DETAIL DESIGN

REFERENCE DRG.

1 SURGE SHAFT PRESSURE SHAFT, POWER HOUSE COMPLEX LAYOUT PLAN
NHPB III-4AT2-41-GA-005

LEGENDS

1 POWER HOUSE DRAINAGE SUMP
2. DEWATERING SUMP
3 DRAINAGE SUMP IN GIS-CUM-TRANSFORMER CAVERN
4 TRANSFORMER OIL WATER SUMP
5 SUMP IN CABLE CUM VENTILATION TUNNEL
6 SUMP NEAR PENSTOCK PLUG IN MAT
7 SUMP NEAR TERMINATION OF CONSTRUCTION ADIT TO GIS CROWN IN MAT
8 SUMP IN POTHEAD YARD

NATIONAL HYDROELECTRIC POWER CORPORATION LTD

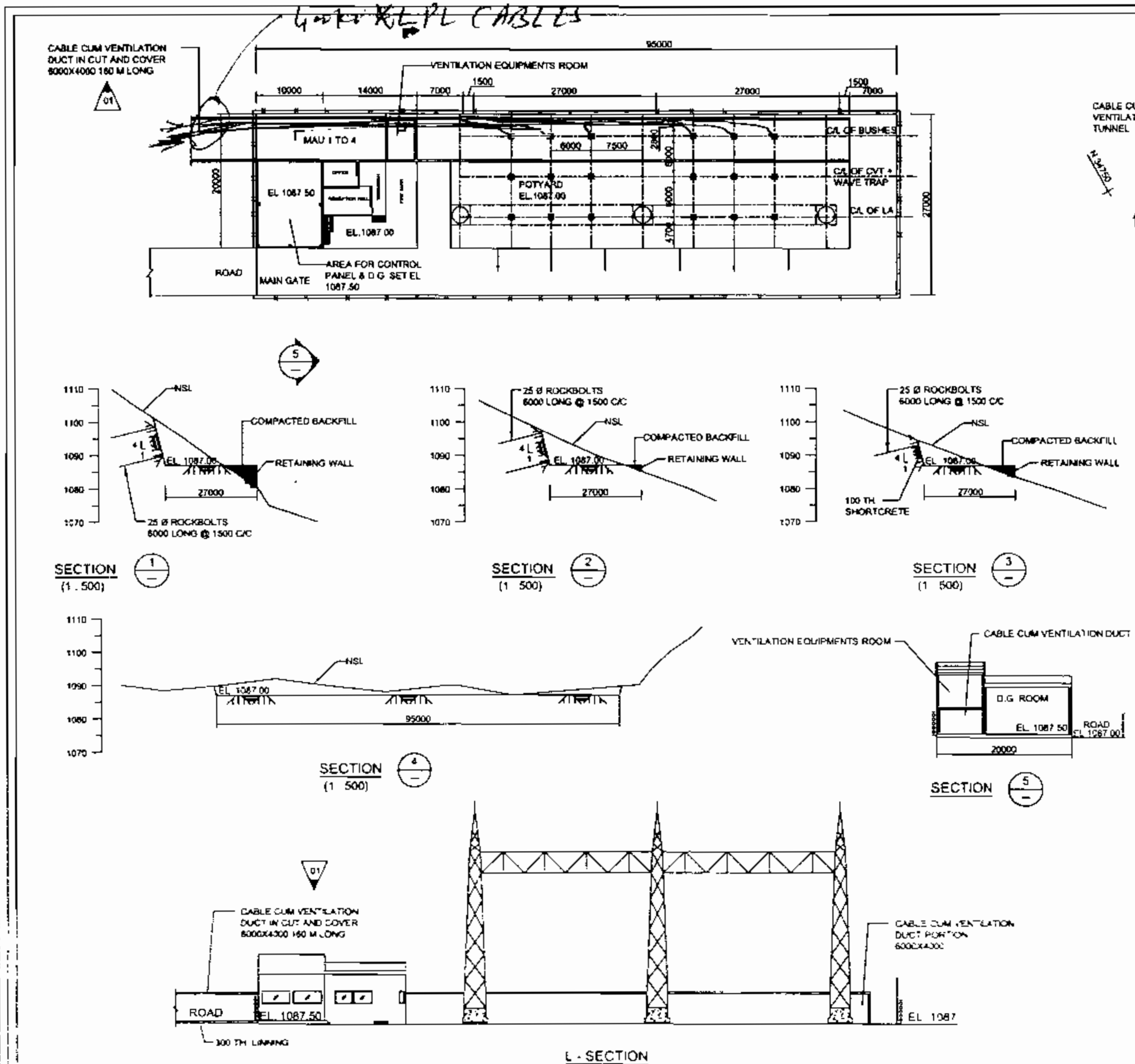
PARBATI HYDROELECTRIC PROJECT STAGE-III (H P)

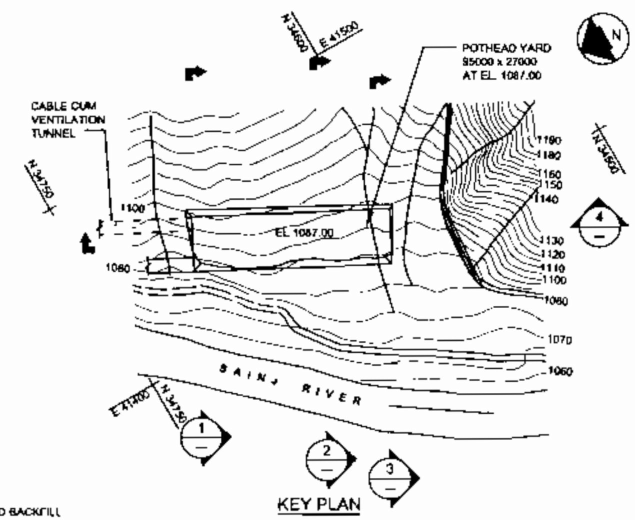
POWER HOUSE COMPLEX
DRAINAGE SYSTEM

SHEET 1 OF 2

DRAWN	SUBMITTED	RECOMMENDED	APPROVED
C B SHARMA	PRAVEEN	S RAY	M ANANTHA

DATE	DRG NO	
NOV 2005	NHDEM PBT ..00 01	00





KEY PLAN

NOTES

1. ALL DIMENSION ARE IN MILLIMETRES AND LEVELS IN METRE
2. M-20 GRADE CONCRETE SHALL BE USED UNLESS OTHER WISE SPECIFIED
3. THE LEVELS OF FLOORS & WALLS IN DG SET AND OFFICE BUILDING SHOWN ARE TYPICAL ONLY & MAY BE CHANGED DURING DETAIL DESIGN TO SUIT THE ACTUAL REQUIREMENTS
4. FOR FINISHING WORKS REFER TECHNICAL SPECIFICATION

REFERENCE DRAWING

1. POTHEAD YARD LAYOUT PLAN NH-PB III-4ET2-41-GA-036

TENDER DRAWING
NOT FOR CONSTRUCTION

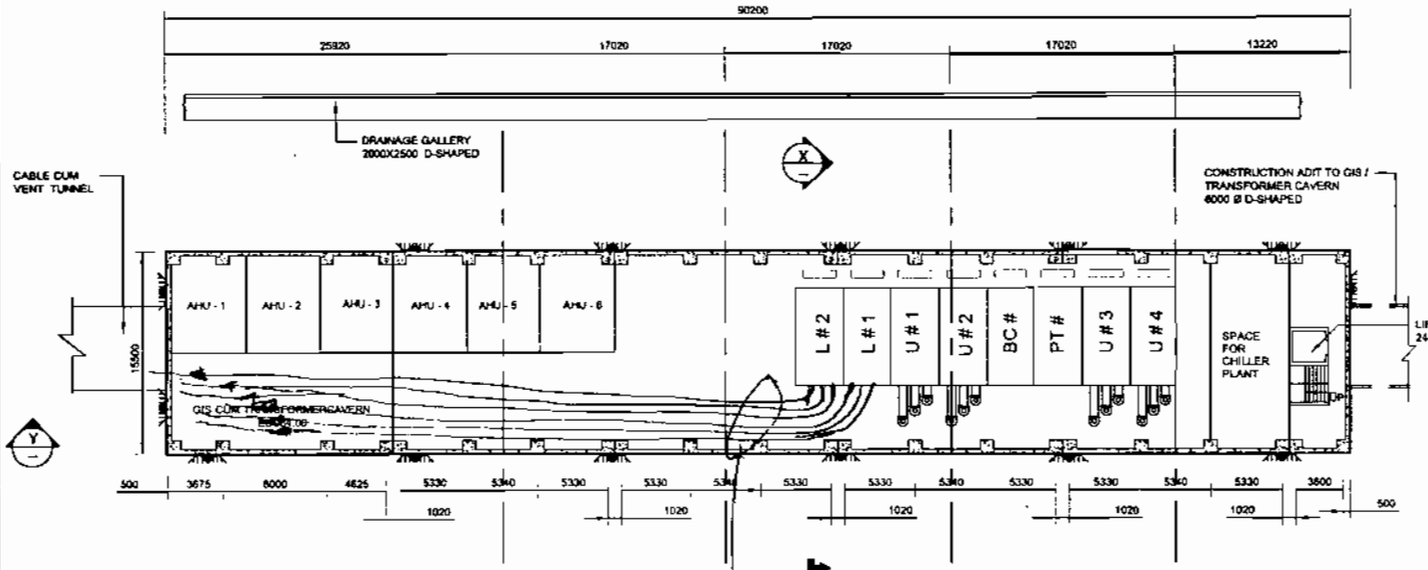
SCALE
10 0 10 40 METRE

नेशनल हाइड्रोइलैक्ट्रिक पावर कारपोरेशन लि.
NATIONAL HYDROELECTRIC POWER CORPORATION LTD
पार्बती जलविद्युत परियोजना चरण -३ (हि.प्र.)
PARBATI HYDROELECTRIC PROJECT STAGE-III (H.P)

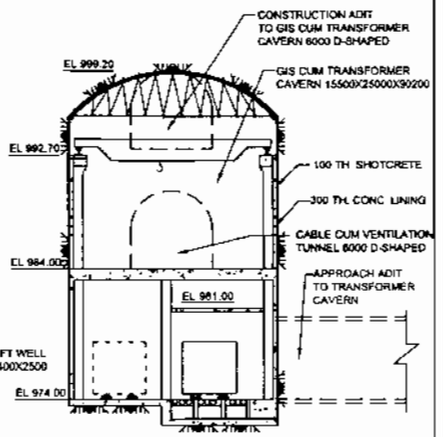
POTHEAD YARD

LAYOUT PLAN

DRAWN	SUBMITTED	RECOMMENDED	APPROVED
C.S.SHARMA	ARVIND	H.K.SHARMA	N. ANANTHA
DATE NOV 2005	DRG. NO.	NH/DEM/PBT-III/PY/01	00

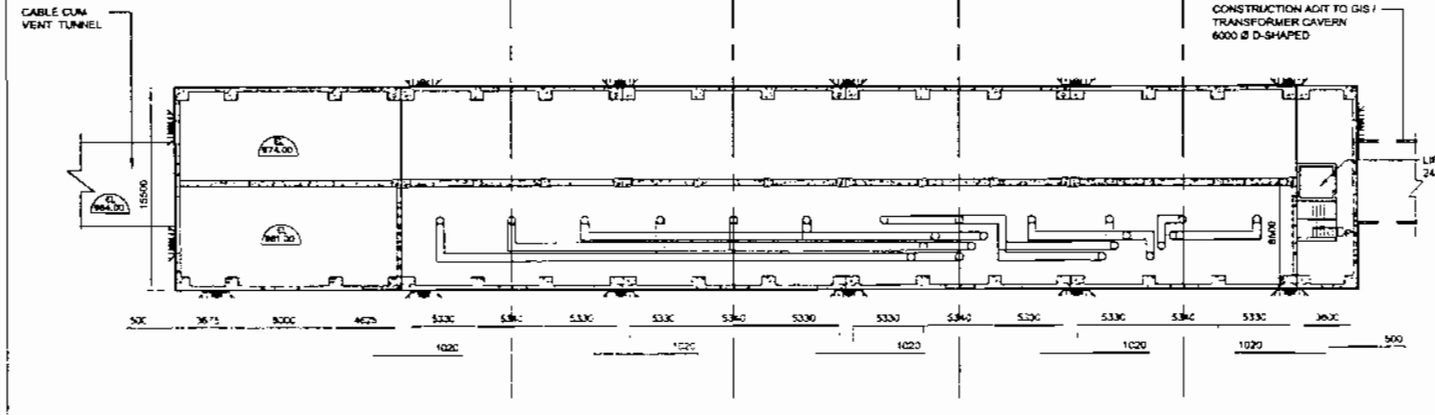


PLAN AT EL. 984.00 M



SECTION (X)

400kV XLPE CABLES



PLAN AT EL. 981.00 M

NOTES

1 ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS IN METRE
2 THIS DRAWING SHALL BE READ ALONGWITH DRG NO
NHPB III-4CT2-41-GA-010

REFERENCE DRAWING

1. POWER HOUSE TRANSFORMER CAVERN PLAN AT EL 974.00 & SECTIONS NHPB III-4CT2-41 GA 020

TENDER DRAWING
NOT FOR CONSTRUCTION

SCALE
1.5 0 1.5 5 METRE

नेशनल हाइड्रोइलेक्ट्रिक पावर कॉरपोरेशन लि.
NATIONAL HYDROELECTRIC POWER CORPORATION LTD
पार्वती जलविद्युत परियोजना चरण – 3 (हि.प्र.)
PARBATI HYDROELECTRIC PROJECT STAGE-III (H.P.)

POWER HOUSE
TRANSFORMER CAVERN- EQUIPMENT ARRANGEMENT
PLAN AT EL. 984.00 & 981.00M

DRAWN	SUBMITTED	RECOMMENDED	APPROVED
C.B.SHARMA	ARVIND	H.K.SHARMA	M.ANANTHA
DATE NOV - 2005	DRG NO NH/DEM/PBT-III/PH-11		00