BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP, (MATERIALS MANAGEMENT)
Integrated Office Complex, 3rd Floor,
Lodhi Road, New Delhi – 110 003, INDIA
Phone: 011 – 41793299, Fax: 011 - 24365869
Email :smmittal@bhelindustry.com

TENDER ENQUIRY NO.:	**E - 4583196**	**DATE**	**:**	**20/10/2008**
DUE ON DATE	**:**	**19/12/2008**	**TIME :**	**10.15 Hrs. (IST)**
PROJECT	:	220 KV SWITCHYARD FOR SIKKA TPS UNITS 3 & 4 DIST. JAMNAGAR, GUJARAT, INDIA		
ITEM	:	420 KV XLPE POWER CABLES WITH ACCESSORIES AS PER CLAUSE 1.2 OF TECHNICAL SPECIFICATION NO. TB-301-316-022		

Please find herewith enclosed above mentioned tender enquiry along with following enclosures:

√1.	Tender Enquiry	√5.	Checklist (BHEL/TBG/SOI/01)
√2.	Our Terms and conditions	√6.	Schedule of commercial & technical deviations
√3.	Schedule of prices (BHEL/TBG/SP/01)	√7.	Technical Specification
√4.	Activity schedule (BHEL/TBG/ATS/01)	√8.	Packing and other erection marks

You are requested to submit your most competitive offer so as to reach us positively by the tender opening date and time. THE TENDERS NOT RECEIVED WITHIN SCHEDULED DATE AND TIME ARE LIKELY TO BE IGNORED. BHEL shall not be responsible for any postal delay.

IN YOUR OWN INTEREST YOU ARE ADVISED TO CAREFULLY READ "TERMS AND CONDITIONS FOR INDIGENOUS TENDER ENQUIRY". INCOMPLETE BIDS AND / OR BIDS NOT COMPLYING WITH TENDER CONDITIONS SHALL BE TREATED AS NON RESPONSIVE & ARE LIKELY TO BE IGNORED.

In case Tender Documents are not received within 7 days of this Fax message, intimate BHEL accordingly. If no intimation is received, it will be considered that you have received tender enquiry & delay in submission due to late receipt of tender documents will not be entertained.

Please acknowledge the receipt of tender enquiry and fax back this letter by ticking the appropriate item below:

EXECUTIVE (TBMM) :
NAME : S.P. SINHA
DESIGNATION : DY. MANAGER / TBMM

ACKNOWLEDGEMENT BY TENDERER

We acknowledge the receipt of tender:

a) The offer against subject enquiry shall be submitted by the scheduled date & time.

b) We regret to quote. The item in reference is out of our manufacturing range.

c) We regret because of our prior commitments.

d) Any other reason.

(Signature and Seal of Tenderer)

TENDER ENQUIRY NO.: E – 4583196, DATE 20/10/2008

TO
MR. S.M. MITTAL, AGM / TBMM
Fax No. 011 – 24365869

BHARAT HEAVY ELECTRICALS LTD.

(TRANSMISSION BUSINESS GROUP)

GENERAL TERMS AND CONDITIONS FOR ENQUIRY

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.

Sr. No	ENQUIRY NO. E-4583196, DATE 20/10/2008
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, otherwise offer may be rejected. 2. Bidder must ensure that their quotation is received / dropped in the tender box on or before 10.15 AM 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- 41793299, Fax :091-11-24365869,** **Email: smmittal@bhelindustry.com** 3. The same shall be opened at 10.30 AM on the same day. Tenders received late may be rejected. Bidders sending tenders by courier or post, to ensure that it is delivered one day before as same day delivery may not reach above office by due time. 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. 5. For any Technical clarification, please contact **Shri S.K. Shukla, Dy. Manager / TBEM** **BHEL, Integrated Office Complex,** **Lodhi Road, New Delhi – 110 003, India** **Phone : 091-11- 41793345, Fax :091-11-24369509,** **Email: skshukla@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.

Sr. No	ENQUIRY NO. E-4583196, DATE 20/10/2008
	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 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** 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 part –II are firm through out the currency of contract. **B**. The break-up of price shall be as under:- ***i)* Ex-works Price:** FOB price including seaworthy packing and forwarding charges. **ii) Freight & Insurance:** Freight and insurance charges from works and up to site must be quoted separately. ***iii)* Erection / Commissioning supervision charges:** If asked in the technical specification, to be quoted separately along with taxes and duties applicable on them. Note : The purchase order shall be placed on Ex-works basis.
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.
4.	**GUARANTEE:** The equipment / material shall be guaranteed for 18 months from the date of delivery or 12 months from the date of commissioning, which ever is earlier. The defective material / component shall be replaced free of cost at site.

Sr. No	ENQUIRY NO. E-4583196, DATE 20/10/2008
5.	**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).
6.	**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.
7.	**DISPATCH DOCUMENTS:** Dispatch documents (Negotiable 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.
8.	**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.
9.	**DELAYED DELIVERY:** In case of delay in execution of order beyond the lot wise contractual delivery, an amount of ½ % of total Ex-Works Value per week or part there-of subject to maximum of 5% of total Ex-Works value of P.O. will be withheld.
10.	**VALIDITY:** The offer shall be valid for 120 days from the due date of opening.
11.	**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.
12.	**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.
13.	**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.
14.	**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 contract 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.
15.	**LEGAL SETTLEMENT**: All suits/claims in respect of this contract shall be in the courts having jurisdiction at New Delhi.

Sr. No	ENQUIRY NO. E-4583196, DATE 20/10/2008
16.	**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.
17.	**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.
18.	**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.
19.	**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.

Signature of Bidder
Seal

SCHEDULE OF PRICE

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

TENDER ENQUIRY NO. : E-

SL. NO.	DESCRIPTION OF ITEM	UNIT	QUANTITY	UNIT FOB PRICE	TOTAL FOB PRICE	UNIT FREIGHT AND INSURANCE UP TO SITE	TOTAL FREIGHT AND INSURANCE UP TO SITE	UNIT SUPERVISION / ETC PRICE (*)	TOTAL SUPERVISION / ETC PRICE
1	2	3	4	5	6	7	8	9	10
	TOTAL PRICE								

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.

(*) ETC PRICE: ERECTION, TESTING & COMMISSIONING

ACTIVITY SCHEDULE

(To be filled – up by the supplier)

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.**

ENQUIRY NO. E-4583196, DATE 20/10/2008

SL. NO.	ACTIVITY	ACTIVITY TIME IN WEEKS	CUMULATIVE TIME IN WEEKS FROM LOI/PO DATE	REMARKS IF ANY
1.	Submission of documents necessary for getting manufacturing clearance like Drawings, date sheet etc.			
2.	Approval of documents in Cat-I from BHEL / Customer *			
3.	Manufacturing time			
4.	Inspection call			
5.	Customer Inspection and Despatch Clearance			
6.	Transportation to destination.			
7.	Installation Services			

Note : 1) * Supplier must ensure the completeness and correctness of the requisite documents before submission for approval. Delay in approval on account of incomplete / inadequate information shall be the responsibility of supplier.

2) Inspection call should be given in the prescribed format only. Inspection calls not in the prescribed format shall not be entertained.

3) Qty to be offered for inspection should be in accordance within Delivery-schedule – lot. BHEL reserves the right not to entertain multiple inspection calls for a Delivery – lot and delay on this account shall be the responsibility of Supplier.

Signature & Seal of Supplier

Date:

ENQUIRY NO. E-4583196, DATE 20/10/2008

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. E-4583196, DATE 20/10/2008

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. E-4583196, DATE 20/10/2008

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 .....

BHARAT HEAVY ELECTRICALS LTD.
(TRANSMISSION BUSINESS GROUP)

TERMS & CONDITIONS FOR SUPERVISION / INSTALLATION SERVICES

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.

Sl. No.	Terms & Conditions
1.0	**SCOPE OF WORK:** As per our Technical Specification No. TB-301-316-022.
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.

SL. No.	Terms & Conditions
10.0	**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.
11.0	**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 half percent (½%) of the contract price, per calendar week or part thereof by which the commissioning is delayed, subject to a ceiling of 5% of the contract price.
12.0	**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.
13.0	**REGULATION OF LOCAL AUTHORITIES AND STATUS :** The contractor shall adhere to the regulation of local authorities and status.
14.0	**DISCIPLINE OF WORKMEN:** The contractor shall adhere to the disciplinary procedure set by the owner in respect of his employees and workman at site.
15.0	**FORCE MAJEURE:** The force majeure shall be as specified under Clause 19 of General Terms and Conditions of Overseas Enquiry.
16.0	**ARBITRATION:** The arbitration shall be as specified under Clause 14 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

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-301-316-022	Rev no.-00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	SKS	MK	SN
TITLE		SIGN			
SPECIFICATION FOR 220kV HT POWER CABLES & CABLE TERMINATION KITS		DATE	24.09.08	24.09.08	
		GROUP	TBEM	W.O. No	87004
CUSTOMER/ CONSULTANT	GUJARAT STATE ELECTRICITY CORPORATION LTD. VADODARA/ TCE CONSULTING ENGINEERS LTD. BANGALORE				
PROJECT	220KV SWITCHYARD FOR SIKKA TPS UNITS 3 & 4, DIST. JAMNAGAR				

CONTENTS

Sec. No.	Description	No. of Sheets
1.	Scope , Specific Technical requirement and Quantities	6
2.	Equipment Specification	14
3.	General Technical Requirements	14
4.	Guaranteed Technical Particulars	4
5.	Schedule of technical deviations	1

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	To Copies				

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 220kV XLPE Cables , termination etc complete in all respect along with accessories .

Name of Customer	: Gujarat State Electricity Corporation Ltd., Vadodara
Name of Consultant	: TCE Consulting Engineers Ltd., Bangalore
Name of the Project	: 220KV SWITCHYARD FOR SIKKA TPS UNITS 3 & 4, DIST. JAMNAGAR

The specification comprise of following sections:

Section-1: Scope & Bill of Quantities.
Section-2: Specific technical requirements for the equipment under scope of supplies.
Section-3: General technical requirements for all equipments under the project.
Section-4: Equipment Data Sheet

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

A. SUPPLIES

I. Supply of power cable, single core, Copper conductor compacted circular stranded, XLPE-insulated, corrugated Aluminium /laminated Aluminium sheathed, HDPE outer sheathed with outer conductive layer. Other configurations can also be considered if technically superior subject to approval by BHEL/GSECL.
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, 220kV CABLE SYSTEM and the scope includes all materials and service necessary to execute the job to satisfaction of GSECL 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 Installation 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	220kV
1.	Rated System Voltage	kV	220
2.	Highest System Voltage	kV	245
3.	Number of phases	Nos.	3
4.	System Frequency	Hz	50
5.	System earthing		Effectively earthed (solidly grounded)
6.	Rated peak withstand current	kA	100
7.	System fault current for one second	kA	40
8.	One minute power frequency withstand voltage	kV	460
9.	Rated lightning impulse withstand voltage (1.2/50μs)	kVp	1050
10.	Conductor area	mm^2	1200 for 220kV GT and 300 for 220kV ST
11.	Type of conductor		Copper
12.	Insulation		XLPE
13.	Transformer rating to which the cables are proposed to be connected		For 220kV GT- 3 Phase 320MVA, 220/16.5kV For 220kV ST- 3 phase 40MVA, 220/6.6kV

14.	Continuous Current rating considering 10% overloading of Transformer	A	924 for 220kV GT, 115.5 for 220kV ST
15.	Metallic sheath	-	Corrugated Aluminium /laminated Aluminium
16.	Outer sheath	-	HDPE with outer conductive layer
17.	Creepage distance for termination	mm/kV	31
18.	Maximum permissible operating temperature of the conductor under (a) Rated continuous current (b) Short circuit	 °C °C	 90 250
19.	Daily load	Hours	24
20.	Sheath voltage	V/Km	Sheath voltage to ground under normal operating condition shall not exceed 65
21.	Laying method	-	In separate RCC trench supported on rack with removable cover (one circuit in one trench with partition)
22.	Cable configuration	-	Trefoil
23.	Screen earthing method	-	Single point bonding
24.	Design ambient temperature	°C	50
25.	Minimum ambient temperature	°C	8

1.2 QUANTITIES

Material and Services required for the execution of the job are listed below. All items 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

37

respect and shall cover completely the requirements of Section 1 and Section 2.

SUPPLY ITEMS

(1) 220kV Cables: GT yard to GT bay

Sl. no.	Description	Unit	Quantities
1.	220kV 1C X 1200mm^2 Copper conductor corrugated Aluminium /laminated Aluminium sheath, XLPE cable complete with necessary auxiliary equipment	M	1000
2.	220kV outdoor type cable termination kit complete with porcelain terminal bushing for GT bays	Nos.	12
3.	Single pole link box without SVL at GT side including the cable/cable accessories required for the connection	Nos.	06
4.	Single pole link box with SVL at switchyard side including the cable/cable accessories required for the connection	Nos.	06
5.	Trefoil clamps for 220kV cables as above	Nos.	300

(2) 220kV Cables: ST yard to ST bay

Sl. no.	Description	Unit	Quantities
1.	220kV 1C X 300mm^2 Copper conductor corrugated Aluminium /laminated Aluminium sheath, XLPE cable complete with necessary auxiliary equipment	M	1000
2.	220kV outdoor type cable termination kit complete with porcelain terminal bushing for ST bay	Nos.	12
3.	Single pole link box without SVL at ST side including the cable/cable accessories required for the connection	Nos.	06
4.	Single pole link box with SVL at switchyard site including the cable/cable accessories required for the connection	Nos.	06
5.	Trefoil clamps for 220kV cables as above	Nos.	300

36

Note:

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

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

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

(4) Supplier will submit detailed cable sizing calculation for justifying the size of the cable.

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

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

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

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

(3) Other services for cables

Sl. no.	Description	Unit
1.	Laying , erection, testing and supervision of following cables	
(i)	220kV 1C X1200 mm^2 Cables	1000 m
(ii)	220kV 1C X300 mm^2 Cables	1000 m
2.	Erection of 220kV outdoor cable termination kit	24 nos.
3.	Erection of single pole link box without SVL for 220kV	12 nos.
4.	Erection of single pole link box with SVL for 220kV	12 nos.
5.	Training	1 lot

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 from the date of LOA (**i.e. 10.05.2007)** . 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 (from the date of LOA) 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

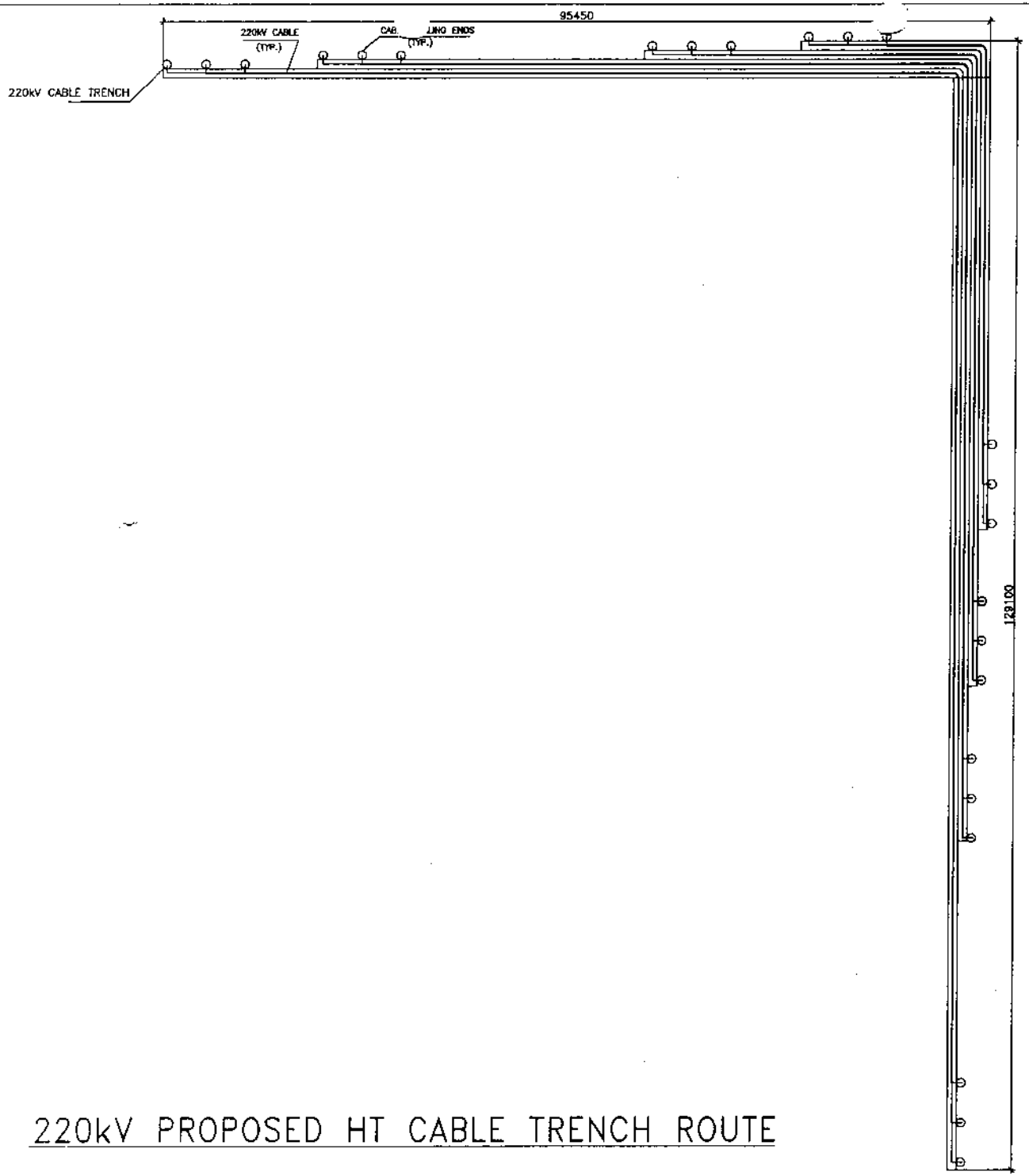
Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, provided by the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

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 GSECL 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.



220kV PROPOSED HT CABLE TRENCH ROUTE

ANNEXURE-A

SECTION
EQUIPMENT SPECIFICATION

1.0 GENERAL

The section covers the broad technical specifications of 400kV and 220 kV single core Copper conductor XLPE insulated, Aluminium corrugated /laminated Aluminium sheathed cable system complete with accessories and spares etc.,

2.0 GENERAL REQUIREMENTS

The design and workmanship of the cable and accessories covered under this specification shall be in accordance with the best engineering practices to ensure satisfactory performance and service life of 50 years. The cable accessories shall also be designed for maximum reliability and acceptability.

Unless brought out clearly, the offer shall be deemed to confirm to be this specification. Any deviation between this specifications and bid offered, if not clearly brought out and accepted by BHEL/GSECL will not be considered as invalid deviation.

The vendor shall bring out clearly any additional feature which they deem to include to give a complete and comprehensive offer. The vendor shall, however sustain his reasons for offering such additional feature/item in his proposal.

3.0 STANDARDS

The XLPE Cables and the associated accessories shall conform to the following International standards, as amended/ revised till date, as appropriate:

IEC 62067(2001)	Power cables with extruded insulation and their accessories for rated voltage above 150 kV up to 500kV – Test methods and requirements.
IEC 60060 Part-1	High voltage test techniques
IEC 60187	General definitions & test requirements
IEC 60068	Seismic test methods for the equipment
IEC 60183	Guide to the selection of High Voltage Cables

IEC 60228	Conductors for insulated cables
IEC 60229	Tests on cable over sheaths
IEC 60230	Impulse test on cables and their accessories
IEC 60270	Partial Discharge Measurements
IEC 60287	Calculation of continuous current carrying capacity & losses
IEC 60332 Part-1	Test on Electric Cables under fire conditions
IEC 60502	Power Cables with extruded insulation and their accessories
IEC 60506	Switching Impulse test on EHV Insulators
IEC 60540	Test methods for insulations and sheaths of electric cables and cords
IEC 60811 Part-1 to Part-4	Common test methods for insulating and sheathing materials of electric cables
IEC 60840	Tests for power cables with extruded insulation
IEC 60859	Cable connections for gas insulated metal enclosed cwitchgear
IEC -60885 Part-3	Electrical test methods for electric cables
IEC 62087	
CIGRE WG21.03 (Electra 151) (Dec 1993)	Recommendation for electrical tests on extruded cables and accessories
IEEE 48	Test procedures and requirements for high voltage cable terminations
IEEE 404	Joints for use with solid dielectric cables
IEEE 635	Guide for selection and design of aluminium sheath

4.0 TECHNICAL PARAMETERS OF CABLES

The rating and electrical characteristics of the single core, XLPE cables shall be as follows:

a) **TYPE OF CABLE:**
220 kV single core, stranded, annealed, copper conductor, segmental compacted, circular, XLPE insulated, corrugated Alumimium /laminated Aluminium sheath , High Density Polyethylene outer sheathed cable .

The tests shall be as per IEC-62067- 2001 with latest amendments.

Voltage Grade	As per section-1
Maximum operating conductor temperature	90° C
Maximum conductor temperature under short Circuit for 1 Sec.	250° C

b) Construction — Single core stranded, annealed, copper conductor, segmental, compacted, circular, conductor screen, cross linked polyethylene (XLPE) insulation, core screen of semi-conducting water swellable layer, Corrugated Aluminium/laminated Aluminium sheathed, semi-conducting bedding tapes, helically applied plain round copper wire, plain copper tape in open helix, water swellable tape with overall extruded High-Density Polyethylene sheath coated with graphite along with outer conductive layer.

c) Conductor : — Plain, annealed, high conductivity copper wires stranded, segmental conductor

d) Conductor Screen : — Extruded semi-conducting layer with adequate capacity

e)	Insulation :	Dry cured cross linked polyethylene. In any particular point, the thickness may differ from the nominal thickness, however, the measured thickness shall be within the limits.
f)	Core/Insulation Screen	Extruded semi-conducting layer.
g)	Longitudinal Water barrier	Semi-conducting water swellable tape/s
h)	Radial Moisture Barrier	Corrugated Aluminium /laminated Aluminium sheath
i)	Bedding	Semi-conducting tape/s.
j)	Armour Screen	Helically applied non-magnetic plain copper wires
k)	Contact Tape	Annealed plain copper tape in open helix.
l)	Water swellable tape	Non-conducting water swellable tape.
m)	Outer Sheath	Extruded High Density Polyethylene type ST 7 (black), anti-termite treated. Extruded outer conducting layer coated with graphite. Nominal thickness 3.5 mm (approx).

5.0 GENERAL TECHNICAL REQUIREMENTS OF CABLE

5.1 The cable and all its accessories shall conform in all respects, to the requirement of the latest standards of IEC/IS except in so far as they are modified in these specifications. Whenever a standard is specifically mentioned in the specification, it is understood that the corresponding standard or standard from amongst the source mentioned above shall also apply. It is, however, understood that the cable and accessories etc., supplied shall conform to one consistent set of standards except in so far as they are modified by the requirement of these specifications.

5.2 Cables/Cable accessories satisfying the quality requirements of other

National/International standards, which ensure equal or better quality than the standards mentioned above shall also be acceptable. Where the equipment offered by the supplier conforms to other standards, salient points of difference between the standards preferred and the specified standards shall be informed. Four (4) copies of the reference standards in English language shall be furnished for reference.

5.3 The general principle on which these specifications are drawn up, is to permit the adaptation of modern manufacturing standards. The Contractor shall supply his own standard equipment as far as possible, provided they comply with the requirements of these specifications. However, should the Contractor wish to depart from the provisions of these specifications either on account of manufacturing practice or for any other reasons, he shall draw the attention of the Corporation to the proposed items of departure and shall submit such full information, drawings and specifications, full justification as will enable the relative merits.

5.4 In the event of these specifications or part thereof and of the Contractor's drawings, specifications, forms, tables etc., being found to disagree during the execution of the contract, these specifications shall be held as binding unless, the departures have been duly approved in writing by the Corporation.

5.5 All similar component parts of similar equipment supplied shall be interchangeable with one another.

5.6 The size of the conductors of the cable shall be sufficient to carry continuously Current at a maximum temperature of 90° C under site conditions.

5.7 Insulation Curing: Dry curing process should be adopted in cross-linking the insulation.

5.8 Triple Extrusion:

The conductor screen, insulation and insulation screen shall be extruded in

single process (triple extrusion) and cross linked by continuous vulcanization process or MDCV process (Mitsubishi Dainichi Continuous Vulcanization process) or any other equivalent process using dry curing technology to ensure homogeneity and absence of micro voids.

5.9 The cable shall be designed to have a minimum useful life of not less than fifty years.

5.10 Each cable length shall be provided with a pulling socket, pulling eye, which shall be fitted to pulling end to withstand the maximum pulling force.

5.11 The contractor shall furnish the details of any specific construction features which will be provided to ensure specific water tightness of cable both transversely and longitudinally.

6.0 MECHANICAL CHARACTERISTICS OF CABLE

The cable shall withstand the electro-mechanical forces due to short circuit current of 40 kA and shall withstand the stresses in the insulation due to faults. The cable shall withstand the mechanical stress during installation.

6.1 TEMPERATURE RISE:

The maximum conductor temperature shall not exceed 90°C during continuous operation of current. The temperature after a short circuit for one second shall not exceed 250° C, with initial conductor temperature of 90° C.

6.2 CABLE MATERIAL:

a) Conductor :The conductor shall be of plain annealed high conductivity copper wires, stranded, segmental conductor conforming to IEC-60228. The Copper used for the conductor shall be of highest purity. The minimum number of wires and conductors and DC resistance of conductor shall be as per IEC-60228.

b) Conductor Screen :The conductor screen shall be provided over the conductor by extrusion of semi-conducting compound or by a combination of semi-conducting tape/s and extruded semi-conducting compound.

c) Insulation :Cross-linked polyethylene insulation by dry curing process shall be provided over the conductor screen. The insulation shall be of high quality and shall be as far as possible free from contaminants, moisture and voids. The size of voids and contaminants shall be within limits of recognised Standards.

The insulation shall be suitable for operation in wet or dry locations at conductor temperature not exceeding 90o C for normal operation and 250o C for short

circuit conditions.

d) Insulation Screen: Shall be by extruded semi-conducting compound .The semi-conducting screen shall be suitable for the operating temperatures of the cable and compatible with the insulation.

e) Moisture Barrier (Longitudinal): This shall be semi-conducting synthetic non-woven tape with suitable swellable absorbent for longitudinal water sealing covering the whole surface area of the non-metallic part of insulation screening. This barrier shall restrict longitudinal water penetration under the metallic sheath.

f) Metal Sheath/Moisture Barrier (Radial): This shall be Corrugated Aluminium/laminated Aluminium sheath.The nominal thickness of sheath shall meet the Electrical and Mechanical properties as per standards. The minimum thickness shall be as per IEC-62067.

g) Bedding Tapes: Suitable semi-conducting bedding tapes shall be used under metallic screen .

h) Metallic Screen (Armour): The metallic screen shall be of non-magnetic SS316 stainless steel tapes or 1% bronze tapes/ plain copper round wires, helically applied over the semi-conducting bedding tape/s.

A binder tape of suitable material/annealed plain copper shall be applied in the form of an open helix, over the metallic screen.

Note: Requirement of Metallic Sheath/Screen:

The cross section of the metallic sheath that is corrugated Aluminium /laminated Aluminium sheath in combination with stainless steel tapes/bronze tapes/plain copper round wire screen shall be designed to meet the following requirements:

i) Sustaining the system short circuit rating of 40 KA for 1 Sec. The temperature of metallic sheath at the time of short circuit (cable operating at maximum conductor temperature) shall be indicated in the short circuit calculations of the design of metallic screen/sheath.

ii) Ensuring mechanical protection of the cable.

iii) Ensuring radial water tightness of the cable.

Test report ensuring the above compliance shall be furnished by the contractor.

i) Outer Sheath: The outer sheath shall be extruded black colour, High Density

Polyethylene, type ST7 conforming to requirement of IEC. The High Density Polyethylene compound used shall be brand new from a reputed manufacturer and in no case shall recycled material be used.

The Corporation reserves the right to seek documentary proof of the source of material (insulation, outer sheath and other cable components) and to cross check with the supplier.

The outer sheath shall be designed for protecting against termite and rodent attack by adding suitable additives, which are harmless to operating personnel to High Density Polyethylene (HDPE) compound.

j) Coating: A hard baked one layer of graphite shall be applied over the outer sheath as outer electrode for testing sheath.

7.0 IDENTIFICATION

The following information shall be embossed on the outer sheath of the cable continuously repeated through out the length of the cable.

i) Brand Name of Manufacturer

ii) Year of Manufacture

iii) Voltage rating/conductor cross Section

iv) Customer:

v) XLPE

vi) Running length of cables

The embossed letters and figures shall be raised and consist of upright block characters along one or more lines.

The maximum size of the characteristics shall be 20 mm and the minimum size not less than 15 percent of the nominal or specified external dia of cable or 3 mm whichever is greater

The gap between the end of one set of embossed characters and the beginning of the next shall not exceed 1 m. Any additional information embossed on the sheath shall not affect the spacing between repetitions of the legend.

Further as a safety if any additional ground wire is required for grounding all clamping equipment at ground potential shall also be supplied.

8.0 CABLE END TERMINATIONS

a) The cable end termination shall be outdoor type on both end suitable for cable size as specified in section-1 and shall confirm to the relevant IEC.

b) The outdoor termination should have a device for electrical stress control at the end of screen/shield. It should avoid partial discharges and surface Corona under the service conditions. It should seal any ingress of atmospheric elements. The total creepage distance shall not be less than 31 mm/kV.

c) The terminations shall be suitable for insulation voltage, conductor size and current rating of the cable.

d) Cable terminations (Sealing end pre-moulded type) – The sealing ends shall conform to the latest International Standards and shall be of thoroughly proven design. The internal electric stress by the pre-moulded cone epoxy resin unit arrangement preferably with epoxy bell mouth and all other accessories. The cable terminations shall be outdoor type. The outdoor type sealing end shall be suitable for installation in polluted atmosphere and shall be completely weather proof. Each outdoor type sealing end shall be supplied complete with mounting plate insulators to insulate the sealing end from the supporting structures and to control the sheath current. The required terminal connectors and bimetallic clamps shall also be supplied. Each sealing end shall be provided with consumable materials such as viper and cleanant for cleaning. The power cable leading to sealing end shall be provided with proper sunshield cover.

e) The material for the housing of the termination should be resistant to tracking, ultra violet radiation (U-V exposure) weathering and should have stable hydrophobic properties.

f) The contractor shall provide necessary arrangement to limit flow of current in the structure supporting the sealing end.

g) The sealing ends shall withstand the power frequency, impulse and cable testing voltage after installation as specified.

h) The cable and accessories shall withstand all thermal and mechanical stresses under steady state and transient operating conditions.

9.0 SUPPORTS, HARDWARES AND ACCESSORIES

(a) The supporting structure (in BHEL scope) for the outdoor shall be fabricated from lattice steel material and the detailed drawing showing foundation particulars shall be furnished by the successful bidder. The Contractor shall also arrange the required foundation area ready for erection of the support structure. The Contractor shall furnish necessary information such as foundation load and mounting details to the Corporation.

(b) Cable cleats, clamps, fire barriers, fixing bandage, miscellaneous accessories and hardware required for the assembly of the cable support system shall be supplied. The complete detailed fixing arrangement/ installation drawings of the cables shall be furnished.

10.0 PROTECTION AGAINST EARTHQUAKE

Cable system shall be so designed as to be secured to the foundation clamps to withstand earthquake forces of the above.

11.0 CABLE DRUMS

Immediately after the inspection, both ends of each cable length shall be sealed by means of end caps in the presence of the inspector. Cable drums shall be of rugged construction, with a drum diameter of ample dimensions to accommodate the single- conductor cables. The drum cable length shall be chosen considering the lengths to be laid at site. No negative tolerance on the required lengths may be adopted.

Each drum shall be marked, by stenciling thereon, with an arrow the direction in which the drum should be rolled. The cable shall be wound on non-returnable strong steel drums. The dimensional drawings of steel drums shall be furnished. The drum shall be provided with circumferential lagging of strong wooden planks. The ends of the cable shall be sealed with good quality heat shrink sealing caps. The required additional sealing caps of sufficient quantity shall be

supplied for use for testing during laying at site and to seal spare lengths of cable.

The cable drums shall be supplied with definite cable length (to be informed before start of manufacturing) within +/- 2 m tolerance. Contractor shall not be reimbursed for excess lengths supplied. Cable drums with shorter lengths shall not be accepted.

12.0 INSTALLATION & COMMISSIONING

Cable drum shall be unloaded, handled and stored on hard and well drained surface so that they may not sink. In no case , the drum shall be stored flat i.e. with horizontal. Rolling of drums shall be avoided as far as possible. For un-reeling the cable, drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that the cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall always be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.

While laying the cable, power rollers shall be used at required interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangement. Pulling tension shall not exceed recommended values. Selection of cable drum for each run shall be planned so as to avoid using straight through joint. Cable splices will not be allowed unless approved by customer.

The cables shall be laid and terminations installed by skilled and experienced workers, fully qualified to carry out the work. The supplier shall also be responsible for providing clamps, required to support cables on racks for cable laying in trenches.

In surface trench, cable will be laid in trefoil arrangement on support angle and will be fixed with angle by clamps made of non-magnetic material. These surface trenches will be covered by suitable trench covers.

The sheath voltage under full load conditions shall be within safe limits. The value of sheath voltage shall be furnished for approval. Sheath shall be solidly grounded at both end. The connection to earth shall be as short as possible to prevent HV impulses and spikes. A sheath voltage limiter shall be provided as per section-1 to control the sheath voltage. These voltage limiters shall be without boxes.

13.0 TESTS

The cables and cable terminations shall be subjected to tests as per applicable standards in the presence of GSECL and/ or his authorized representative. After

installation the cables shall also be subjected to tests at sites. All tests shall be carried out generally as per the different standards listed in Cl. 3 above. Following test but not limited to this as mentioned below shall be submitted as per latest IEC.

14.1 TYPE TESTS (IEC 62067)

In lieu of conducting the fresh type tests, supplier should submit the valid type test reports for BHEL/GSECL approval. In absence of valid type test reports (Type test reports more than 5 years old will not be valid), supplier shall conduct the type tests as per relevant IEC standards at no extra cost to customer. The supplier shall offer material for selection of samples for type testing, only after getting quality assurance plans approved. The sample shall be manufactured strictly in accordance with the approved Quality Assurance Plan.

Following type tests shall be carried out.

a) **Electrical type test on complete cable system (Cl 12.4)**

i) Check for insulation thickness of cable for electrical type test (Cl 12.4.1)
ii) Bending test (Cl 12.4.4)
iii) Partial discharge test (Cl 12.4.5)
iv) Tan δ measurement (Cl 12.4.6)
v) Heating cycle voltage test (Cl 12.4.7)
vi) Lightning impulse voltage test followed by a.c. voltage test (Cl 12.4.9)
vii) Examination (Cl 12.4.10)
viii) Resistivity of semi-conducting screens (Cl 12.4.11)

b) Non electrical type test on cable components and on complete cable (Cl 12.5)

i) Check of cable construction (Cl 12.5.1)
ii) Tests for determining the mechanical properties of insulation before and after ageing (Cl 12.5.2)
iii) Tests for determining the mechanical properties of oversheaths before and after ageing (Cl 12.5.3)
iv) Ageing tests on pieces of completed cable to check compatibility of materials (Cl 12.5.4)
v) Loss of mass test on PVC sheaths of type ST2 (Cl 12.5.5)
vi) Pressure test at high temperature on oversheaths (Cl 12.5.6)
vii) Test on PVC oversheath ST2 at low temperature (Cl 12.5.7)
viii) Heat shock test on PVC oversheath ST2 (Cl 12.5.8)
ix) Hot set test for XLPE insulation (Cl 12.5.10)
x) Test under fire conditions (Cl 12.5.13)
xi) Water penetration test (Cl 12.5.14)

14.2 Acceptance Tests (Sample Tests) on Cables (Cl. 10 of IEC 62067)

Following tests shall be carried out on minimum 10% of the drums subject to minimum one sample in each lot:

a) Tests on conductor (Cl 10.4 & 10.5)
b) Measurement of thickness of insulation and oversheaths (Cl 10.6)
c) Measurement of thickness of metallic sheath (Cl 10.7)
d) Measurement of diameters (Cl 10.8)
e) Hot set test for XLPE insulation (Cl 10.9)
f) Measurement of capacitance (Cl 10.10)
g) Lightning impulse voltage test followed by power frequency voltage test (Cl 10.12)

14.3 SAMPLE TESTS ON ACCESSORIES

Tests and its procedure to be proposed by the supplier for GSECL/BHEL's approval.

14.4 ROUTINE TESTS

Following routine test shall be carried out as per Clause 9 of IEC 62067 on samples drawn from each drum and each accessory.

a) Partial discharge test (Cl 9.2)
b) Voltage test (Cl 9.3)
c) Electrical test on non metallic sheath of the cable (Cl 9.4)
d) Voltage test on outer sheath as per Clause 3.1 of IEC 60229

14.5 SITE TESTS

The suppliers shall furnish field quality assurance plans giving different checks and tests, including high voltage tests, to be carried out at site to ensure a maintenance-free installation. Atleast following site test shall be carried out as detailed in Clause 14 of IEC 62067.

a) DC voltage test of the oversheath (Cl 14.1)
b) AC voltage test of the insulation by applying a voltage U_0 to be applied for 24 hours (Cl 14.2)

14.0 DESIGN REQUIREMENTS

Supplier of the cable system shall furnish the details calculations along with technical data sheet for verification/approval of design parameters elected. Detail design calculations/documents will be submitted for approval to GSECL/BHEL:

a) Calculation of continuous current capacity for specified cable laying conditions

b) Adequacy of XLPE insulation thickness.
c) Calculation for short circuit currents for metal sheath or screen.
d) Calculation for adequacy of metallic sheath/ screen for short circuit current carrying capability.
e) Calculation of sheath induced voltage for single end bounding/ double end bounding.
f) Manufacturing Quality plan
g) Field quality plan for site installation, commissioning and testing
h) Instruction manual for jointing and cable laying.

15.0 PACKING AND MARKING

The packing should be able to withstand the rigors of transport.

The following information in bold letters in English shall be painted on the flanges.

(i) Name and address of the Manufacturer, Trade name/Trade Mark/Brand.
(ii) Size of cable (cross section) rated voltage, standard, insulation, cable code, drum number, year of manufacture.
(iii) Length of cable (metres)
(iv) Direction of Rolling
(v) Net weight (in Kg)
(vi) Gross weight (in Kg)
(vii) Purchase order reference.

19

SECTION - 3
GENERAL TECHNICAL REQUIREMENTS

3.0 Foreword

The provision under this section is intended to supplement general requirements for the materials, equipment and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a) Customer : GUJARAT STATE ELECTRICITY CORPORATION LIMITED

b) Consultant : TCE Consulting Engineers Limited

c) Project Title : 220KV SWITCHYARD FOR SIKKA TPS UNITS 3 & 4, DIST. JAMNAGAR

d) Transport facilities : ROAD/RAIL

e) Site location : The Sikka substation is located in Jamnagar Distt. of Gujarat

f) Postal Address : Chief Engineer – Generation
Gujarat State Electricity Corporation Limited,
Sikka Thermal Power Station,
Sikka -361141
Distt- Jamnagar (Gujarat)

The following system parameters shall prevail:

Nominal system voltage	**220 kV**
Highest system voltage	245 kV
Frequency	50 Hz
Rated short time current	40 kA for 1 sec
Dry and wet one minute power frequency withstand voltage (rms)	460 kV
Dry and wet impulse withstand voltage positive and negative	1050 kVp
Minimum total creepage	31mm /kV (7595 mm)
System Earthing	Effectively Earthed

SITE CONDITIONS

3.1.1 Ambient Temperature
a) Ambient air temp. (max.) : 45 deg C
b) Ambient air temp. (min.) : 1.7 deg C
c) Design ambient temp. : 50 deg C

3.1.2 Relative humidity : 100% Max.

3.1.3	Altitude	: 242 M from Mean Sea level
3.1.4	Wind speed	: 50 m/s

3.1.4 Earth quake data

a) Seismic zone	: Zone IV as per IS: 1893 (latest)
b) Seismic acceleration	: 0.3g horizontal
3.1.5 Average Annual rainfall	: 1119.6 mm
3.1.6 Lowest rainfall	: 78.2 mm

3.2 GENERAL REQUIREMENT

3.2.1 The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification.

3.2.2 It is recognised that the Supplier may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

3.2.3 Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

3.2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

3.3 STANDARDS

3.3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.3.2 The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards , unless specifically mentioned in the specification.

3.3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

3.3.4 The Supplier shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

3.3.5 When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3.6 Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards specified under individual sections for various equipments shall also be accepted, however the salient points of difference shall be clearly brought out in the offer along with English language version of such standard. The equipment conforming to standards other than specified under individual sections for various equipments shall be subject to Purchaser's approval.

3.3.7 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

3.4.1 All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

3.4.2 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

3.4.3 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

3.4.4 The equipment shall also comply with the following:

a) All outdoor EHV equipment except marshalling kiosks shall be suitable for hot line washing.

b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

c) All Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

3.4.5 Operating times of circuit breakers, protective relays have been specified in respective sections. However, the bidder is allowed to have minor variations on the individual equipment timings subject to the condition that overall fault clearing time remains within 160 milli seconds at 220 kV level under comparable conditions.

3.5 ENGINEERING DATA & DRAWINGS

3.5.1 The engineering data shall be furnished by the Supplier in accordance with the Schedule for each set of equipment as specified in the Technical Specification.

3.5.2 The list of drawings/documents which are to be submitted to the purchaser shall be discussed and finalised by the purchaser at the time of award.
The supplier shall necessarily submit all the drawings/documents unless any thing is waived. The supplier shall submit 11 (eleven) sets of drawings/ design documents/ data/ test reports as may be required for the approval of purchaser.

3.5.3 Drawings

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

3.5.3.2 Each drawing submitted by the Supplier shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

3.5.3.3 Further work by the Supplier shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

3.5.4 The review of these data by the Owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. Owner may not indicate a thorough review of all dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and /or approval by the Owner shall not be considered by the Supplier, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

3.5.6 All engineering data submitted by the Supplier after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

3.5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/ information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

	Stage	No. of copies	Submission Schedule
i)	Initial Submission	11	As per agreed schedule
ii)	Approval/comments/ by Purchaser on initial submission		Within 3(three) weeks
iii)	Resubmission, if required	11	Within 3(three) weeks from date of comments including both ways postal time).
iii)	Approval or comments		Within 3 weeks of receipt
iv)	Furnishing of distribution copies of drawings in bound volume	14	2 Weeks from the date of final approval
v)	Furnishing of distribution copies of type test reports in bound volumes	11	
vi)	Furnishing of distribution copies of Routine test reports	11	
vii)	Furnishing of instruction/ operation manuals	14	As per agreed schedule
viii)	As-built drawings	4	On completion of entire works
ix)	CD-ROM/ Optical Disc of all drawings/ design documents	4	----------do----------

Notes:

a) The supplier may please note that all resubmissions must incorporate all comments given in the prior submission by the Purchaser. Adequate justification for not incorporating the same must be submitted, failing which the submitted documents may be returned.

b) The drawings, which are required to be frequently referred during execution, should be submitted on cloth-lined paper. The list of such drawings shall be finalised with the Supplier at the time of Award.

c) All major drawings shall be submitted in AUTOCAD Version 2002 or better.

d) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

e) If after the commissioning and initial operation of the installation, the instruction manuals require any modifications/ additions/ changes, the same

shall be incorporated and the Supplier shall submit the updated final instruction manuals to the Purchaser.

f) The Supplier shall furnish to the Purchaser catalogues of spare parts.

3.6 DESIGN IMPROVEMENTS / COORDINATION

3.6.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the purchaser or the Supplier may propose changes in the specification of the equipment or quality thereof and if the purchaser & supplier agree upon any such changes, the specification shall be modified accordingly.

3.6.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and / or schedule of completion before the supplier proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

3.6.3 The Supplier shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in this specification. The design of various components, subassembly and assemblies shall be so done that it facilities easy field assembly and maintenance.

3.6.4 The Supplier has to coordinate design and terminations with the agencies (if any) who are Consultants/Supplier for the purchaser. The name of agencies shall be intimated to the successful bidders.

3.6.5 The Supplier will be called upon to attend design co-ordination meetings with the Engineer, other Supplier's and the consultant of the Purchaser (if any) during the period of Contract. The supplier shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.7 QUALITY ASSURANCE PROGRAMME

3.7.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Supplier's Works or at his Sub-supplier's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Supplier shall adopt a suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be broadly outlined by the Supplier and shall be submitted by the supplier after the award of contract finally accepted by the Purchaser after discussions. However, in case detailed valid programme approved by purchaser for the equipment already exist, same would be followed till its validity. A quality assurance programme of the supplier shall generally cover the following:

(a) Supplier's organisation structure for the management and implementation of the proposed quality assurance programme;
(b) Documentation control system;
(c) Qualification data of bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Supplier's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
(f) Control of non-conforming items and system for corrective actions;
(g) Inspection and test procedure both for manufacture and field activities;
(h) Control of calibration and testing of measuring instruments and field activities;
(i) System for indication and appraisal of inspection status;
(j) System for quality audits;
(k) System for authorising release of manufactured product to the Purchaser
(1) System for maintenance of records;
(m) System for handling storage and delivery; and
(n) A quality plan, detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and Procedure of the Supplier/ his vendors' quality management and control activities.

3.7.2 Quality Assurance Documents

The Supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of purchaser's inspection of equipment/ material.

3.8 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

3.8.1 All equipment being supplied shall conform to type tests including additional type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the type tests. The supplier shal intimate the purchaser the detailed program about the tests atleast three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

3.8.2 The reports for all type tests and additional type tests as per technical specification shall be furnished by the Supplier along with equipment/material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO/IEC Guide 25/17025 or EN 45001 by the national accredition body of the country where laboratory is located) or witnessed by the representative(s) of POWERGRID/BHEL or Utility. The test-reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the supplier shall repeat these test(s) at no extra cost to the purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the technical specification

or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

3.8.3 The purchaser intends to repeat the type tests and additional type tests on transformers, reactors, cables and battery chargers for which test charges shall be payable as per provision of contract. The price of conducting type tests and additional type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal sheets. These type tests charges would be considered in bid evaluation. In case the bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

3.8.4 The purchaser, his duly authorized representative and / or outside inspection agency on behalf of the purchaser shall / have at all reasonable times free access to the Supplier's / Subvendors premises or Works and shall have the power at all reasonable times to inspection and examine the materials and workmanship of the works during it's manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Supplier shall obtain for the Engineer and for his duly authorized representative permission to inspect as it the works were manufactured or assembled on the Supplier's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

3.8.5 The Supplier shall give the Purchaser/inspector thirty (30) days written notice of any material being ready for joint testing including supplier and POWERGRID/BHEL. Such tests shall be to the Supplier's account except for the expenses of the inspector. The purchaser / inspector unless witnessing of the tests is virtually waived, the Purchaser/ inspector will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Supplier may proceed with the test which shall be deemed to have been made in the Inspector's presence and the Supplier shall forthwith forward duly certified copies of test reports in triplicate.

3.8.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Supplier, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Supplier shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser/ inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

3.8.7 When the factory tests have been completed at the Supplier's or Sub-Supplier's works, the Purchaser/ inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser/inspector, the certificate shall be issued within fifteen (15) days of receipt of the Supplier's Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Supplier from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should it, on further tests/ after erection, be found not to comply with the Contract. The equipment shall

be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.

3.8.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Supplier or of any Sub-Supplier, the Supplier except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser Inspector or to his authorised representative to accomplish testing.

3.8.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Supplier in respect of the agreed quality assurance programme forming a part of the Contract.

3.8.10 The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carved out at Supplier's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

3.8.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Purchaser.

3.9 PACKAGING & PROTECTION

3.9.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Owner / Purchaser, the supplier shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the supplier. The purchaser takes no resonsibility of the availability of the wagons.

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

3.10 FINISHING OF METAL SURFACES

3.10.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & 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.

3.10.2 Hot Dip Galvanising

3.10.2.1 The minimum weight of the zinc coating shall be 610g/ m^2 and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface, which shall be embedded in concrete, the zinc coating shall not be less than 610 g/ m^2.

3.10.2.2 The galvanised surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. 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 surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

3.10.2.3 After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment except that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

3.10.2.4 The galvanized steel shall be subjected to six one-minute dips in copper sulphate solution as per IS-2633.

3.10.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard *Preece test*. All other coatings shall withstand six immersions. The Following galvanizing tests shall essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

3.10.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

3.10.3 Painting

3.10.3.1 All sheet steelwork shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

3.10.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving-type zinc chromate primer. The first coat may be 'flash dried" while the second coat shall be stoved.

3.10.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

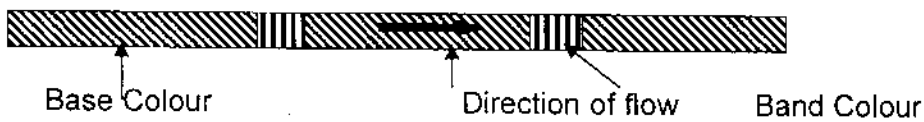
3.10.3.4 The exterior colour of the paint shall be as per shade no. 697 of IS -5 and inside shall be glossy white for all equipment, marshalling boxes, junction boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.

3.10.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted along with the Bids for Purchaser's review & approval.

3.10.3.6 The colour scheme as given below shall be followed for Fire Protection/Air Conditioning System:

S.No.	Pipe line	Base Colour	Band Colour
Fire Protection System			
1	Hydrant and Emulsifier System Pipeline	FIRE RED	-
2	Emulsifier System detection line-water	FIRE RED	Sea Green
3	Emulsifier System detection line-Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline - at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline - at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	
9	Condenser Water pipeline	Sea Green	Dark blue

The direction of flow shall be marked by → (arrow) in black colour



3.11 TOOLS AND TACKLES

The supplier shall supply with equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

3.12 AUXILIARY SUPPLY

3.12.1 The sub-station auxiliary supply is normally met through a system indicated below. 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 shall also conform to the parameters as indicated in the following:

Normal Voltage	*Variation in Voltage*	*Frequency in Hz*	*Phases*	*Neutral Connection*
415V	± 10%	50 ± 5%	3ph-3Wire	Resistance Earthed
240 V	± 10%	50 ± 5%	1 ph	Solidly Earthed
220V	190-240 V	DC	-	Isolated 2 wire system
48 V	-	DC	-	Isolated 2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

3.13 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.13.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below-

a)	For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all test as per IS: 617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic Connectors made from Al alloy casting, conforming to designation A6 of IS 617 with 2-mm thick bimetallic liner and all tests shall conform to IS 617.
c)	For connecting G.I. Shield wire	Galvanised mild steel shield
d)	i) Bolts, nuts & Plain washers	Electro-galvanised for sizes below M12, for others hot dip galvanized
	ii) Spring washers for items 'a' to 'c'	Electro-galvanised mild steel suitable for at least service condition-3 as per IS 1573

3.13.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type suitable for 4" IPS (O.D. : 114.2 mm, ID: 97.18 mm) aluminium tube or suitable for Quad/Twin ACSR/AAAC Conductor (250 mm Sub-Conductor spacing for 220 kV). The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

3.13.3 Where copper to aluminium connections are required, bimetallic clamps shall be used, which shall be properly designed to ensure that any deterioration of -the connection is kept to a minimum and restricted to parts which are not current carrying

or subjected to stress. The design details of the joints shall be furnished to the Purchaser by the Supplier.

3.13.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

3.13.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised.

3.13.6 All casting shall be free blowholes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

3.13.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/ sliding) type connection of 4" IPS Al tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

3.13.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current, for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

3.13.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

3.13.10 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 220kV class clamps shall not be less than 156KV (rms) and R.I.V. level shall not be more than 1000 micro volts at the test voltage specified in respective sections.

3.13.11 **Tests**

3.13.11.1 Clamps and connectors should be type tested as per IS: 5561 and shall also be subjected to routine tests as per IS: 5561. Following Type tests/special tests reports on three samples shall be submitted for approval as per clause 9.2 above except for S. No. (ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last five years shall not be applicable):

- Temperature rise test (max. temp. rise allowed is 35°C over 50°C ambient)
- Short time current test,
- Corona (dry) and RIV (dry) test (for 220 kV and above voltage level clamps),
- Resistance test and tensile test

6

ANNEXURE – 1 – Title Block of BHEL

CUSTOMER: **GUJARAT STATE ELECTRICITY CORPORATION LIMITED**
PROJECT: **220KV SWITCHYARD FOR SIKKA TPS UNITS 3 & 4, DIST JAMNAGAR**
LOI NO.: **PP/SE(P-I)/EE-IV/SIKKA 3&4/BHEL/1322 DATED 10.05.2007**

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP

P.O. No. : Dated:

Attach your Title block below this block.

Section-4

Guaranteed Technical Particulars for the 220kV XLPE Insulated Cable

SL.NO.			Item Description	Unit	Data
1			Manufacturer's Name & Address		
2			Country of Manufacture		
3			Type of Cable		
4			Applicable Standards for manufacturing		
5			Applicable Standards for testing		
6			Rated Voltage	kV	
	i)		Normal		
	ii)		Highest	kV	
7			Conductor		
		i)	Material & Grade		
		ii)	Nominal cross sectional area	mm^2	
		iii)	No. Of strands		
		iv)	Nominal Diameter of each strand (before stranding)	mm	
8			Conductor Screen (conductor screen, insulation and extruded layer of insulated screen shall be extruded in a single process)		
		i)	Material		
		ii)	Thickness	mm	
9			XLPE Insulation (conductor screen, insulation and extruded layer of insulated screen shall be extruded in a single process)		
		i)	Composition		
		ii)	Type of Curing		
		iii)	Thickness of insulation	mm	
		iv)	Tolerance on thickness	%	
10			12/50μs Impulse wave withstand voltage	kVp	
11			1-min Power-frequency withstand voltage	kV	
12			Insulation Screen (conductor screen, insulation and extruded layer of insulated screen shall be extruded in a single process)		
		i)	Material / composition		
		ii)	Extruded/ wrapped		
		iii)	Thickness	mm	
13			Metal sheath		
		i)	Material/composition		
		ii)	Minimum radial thickness	mm	
		iii)	Nominal diameter over metallic sheath		
14			Copper Wire Screen		
		i)	Bedding over metal sheath		
		a.	Material		
		b.	Approx. Thickness	mm	
		ii)	Metallic Cu. Screen over bedding		
		a.	Material		
		b.	Min. Area of copper wire screen		
		c.	Nominal thickness of open helix Cu tapes (for each tape)	Sq.mm	
		d.	Nominal width of copper tape	mm mm	

		e.	Nominal Diameter over metallic sheath		
		iii)	Earth fault current rating of metallic Cu screen & lead sheath (Combined) for 1 second duration	KA	
		iv)	Screen current corresponding to the rated current of the cable with both ends of screen earthed	A	
15		Protective Outer Covering			
		i)	Type & Composition		
		ii)	Colour of sheath		
		iii)	Nominal thickness	mm	
		iv)	Test Voltage at Works	kV	
16		Nominal overall diameter of completed single-core cable		mm	
		Nominal weight of completed cable		kg/m	
17		Short circuit capacities with a conductor temperature of 90°C at the commencement			
		i)	0.5 s duration		
		ii)	1.0-s duration		
		iii)	2.0-s duration		
		iv)	3.0 -s duration		
18		Min bending radius of the cable		mm	
19		Max. DC Resistance of conductor at 20°C		Ω/km	
20		Max. AC Resistance of conductor at 20°C		Ω/km	
21		Equivalent star reactance of 3- φ circuit at 50 Hz		Ω/km	
22		Max. Continuous current carrying capacity per cable when laid in ground in flat formation , with 500 mm center to center spacing between phase, at a depth of 1.0-m (Ground Temp. 40°C and soil thermal resistivity of 150°C/watt/cm, Max conductor temp. 90°C (with both end bonding)			
		i)	Only one 3-φ circuit loaded	A	
		ii)	Three circuits loaded	A	
23		Max. continuous current carrying capacity per cable when drawn into duct/pipes (conditions same as in 22 above)			
		i)	Only one 3-φ circuit loaded	A	
		ii)	Three circuits loaded	A	
24		Max. Continuous current carrying capacity per cable when laid in covered RCC trenches at an ambient air temperature of 50°C.(Considering cables laid in ventilated trench on tray with minimum one cable dia spacing)			
		i)	Only one 3-φ circuit loaded	A	
		ii)	Three circuits loaded	A	
25		Continuous current carrying capacity which will permit a further 10% overload for two hours without exceeding the max. conductor temp. 90°C, as in 22 above			
		i)	Only one 3-φ circuit loaded	A	
		ii)	Three circuits loaded	A	
26		Continuous current carrying capacity which will permit a further 10% overload for two hours without exceeding the max. conductor temp. 90°C, as in 23 above			
		i)	Only one 3-φ circuit loaded	A	
		ii)	Three circuits loaded	A	

27		Continuous current carrying capacity which will permit a further 10% overload for two hours without exceeding the max. conductor temp. 90°C, as in 23 above			
		iii)	Only one 3-φ circuit loaded	A	
		iv)	Three circuits loaded	A	
28		Max. power factor of charging current of the cable when laid direct in ground at normal voltage and frequency at conductor temperature of 15,30,45,65 and 90°C			
29		Max. power factor of charging current of the cable when laid in trench at normal voltage and frequency at conductor temperature of 15,30,45,65 and 90°C			
30		Max. dielectric power loss of the cable per km of three-phase circuit, laid direct in ground, at normal voltage and frequency at max. Conductor temperature.		W/km	
31		Max. dielectric power loss of the cable per km of three-phase circuit, laid direct in trench, at normal voltage and frequency at max. conductor temperature.		W/km	
32		Max. power factor of charging current of the cable when laid direct in ground at normal frequency at 20°C conductor temperature and 0.5, 1.0,1.5 and 2.0 times nominal voltage			
33		Max. power factor of charging current of the cable when laid direct in trench at normal frequency at 20°C conductor temperature and 0.5, 1.0,1.5 and 2.0 times nominal voltage			
34		Sheath loss of cable per km of three-phase circuit, at normal voltage and frequency at max. Conductor temperature.			
		i)	laid direct in ground (S.No.27 above)	W	
		ii)	Drawn into ducts (S.No. 28 above)	W	
		iii)	laid in air (S.No. 29 above)	W	
35		Impedance per km of three-phase circuit, at 50 Hz and max. Conductor temperature			
		i)	Positive and negative sequence	Ω	
		ii)	Zero sequence	Ω	
36		Attenuation to carrier current signals operating over a frequency range of 50 Hz to 200 kHz			
37	a)	Phase-to-ground characteristics impedance at 50Hz to 200 kHz		Ω	
	b)	Screen Factor		Ω	
38	Max. Drum length of cable			m	
39	Approx. Shipping weight and size of drums			m	
40	Details of recommended method of laying of single-core cables in ground and in trench to be enclosed				
41	Details of warning tape				
	a)	Width		mm	
	b)	Thickness		mm	
	c)	Colour			
	d)	Tensile Strength		kg/mm^2	
	e)	Breaking load		kg	
42	Details of RCC Cable Covers				
	a)	Dimensions		mm	
	b)	Design			
	c)	Drawing			
43	Details of Cable Markers				

	a)	Size	mm	
	b)	Design		
	c)	Drawing		
44	Safe pulling force when pulled by pulling eye		N/mm^2	
45	Maximum capacitance		MicroF/ kM	
46	Volume resistivity			
	a)	Insulation (at 27 deg C)	Ohm-cm	
	b)	Conductor screen (at 90 deg C)	Ohm-m	
	c)	Insulation screen (at 90 deg C)	Ohm-m	
47	Eccentricity of insulation			
48	Ovality of core			

CABLE TERMINATION KIT FOR 220kV XLPE INSULATED CABLE

S. No.	Item Description	Unit	Data
			Termination Kit
1.	Manufacturer's Name & Address		
2.	Country of Manufacture		
3.	Type of Cable Termination		
4.	Applicable Standards for manufacturing		
5.	Applicable Standards for testing		
6.	Rated Voltage	kV	
7.	Maximum service voltage	kV	
8.	Type & Material of bushing		
9.	Creepage Distance	mm	
10.	Whether full details of termination and BOQ furnished with offer		
11.	Whether cable sealing end is complete with all accessories		
12.	Whether descriptive pamphlet enclosed		
13.	Whether full details of tests to be carried out furnished with offer		
14.	Copies of type test reports enclosed		

SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

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

Date:

Tenderer's Stamp & Signature