Enquiry

Bharat Heavy Electricals Limited
Transmission Business Group
Materials Management

Project : PGCIL CHARIKAR AND DOSHI

Enquiry No	Enquiry Dt	Rev No	Rev Dt	PI No	Enquiry Type	Inspection by	Due Dt	Commercial Comments	Technical Comments	Signing Authority
142E097	08-Jun-12	0		342210477	Package	Customer	29-Jun-12	Arvind Kumar (Engineer/TBMM)	Mr. Sanjeev Shrivastava (Manager/TBEM)	

Document Enclosed

, # Technical Specifications
, # Terms & Conditions for Indigenous Enquiry
, # Activity Schedule
, # Schedule of Information (checklist) to be furnished
, # Schedule of Commercial Deviation
, # Schedule of Technical Deviation

SN	Equipment	Phy Unit	Qty	Plan Dt	Comments
1	DIGITAL PROTECTION COUPLER (DPC), OPGW AND SDH EQUIPMENT COMPLETE WITH ACCESSORIES AS PER TECHNICAL SPEC.	LOT	1	30-Sep-12	BOQ AS PER TECHNICAL SPECIFICATION DOC NO. TB-351-510-034 REV 00
2	Digital Protection Coupler for 220 KV lines	Nos.	8		
3	24 Fibre(DWSM) OPGW fibre optic cable	Km	1.5		
4	OPGW Cable Accessories - Tension Assembly at dead end location	Nos.	1		
5	OPGW Cable Accessories - Tension Assembly at pass through location	Nos.	3		
6	OPGW Cable Accessories - Tension Assembly at joint box location	Nos.	1		
7	OPGW Cable Accessories - Splice Enclosure	Nos.	3		
8	OPGW Cable Accessories - Vibration Damper	Nos.	8		
9	FODP 24 F, indoor type, rack mounted including pigtails and FCPC coupling	Nos.	1		

SN	Equipment	Phy Unit	Qty	Plan Dt	Comments
10	24 fibre (DWSM) Underground fibre optic approach cable	Km	1		
11	Installation hardware set including ties/clips/cleats, conduits, ducts, supports, fittings, accessories etc for approach cable	Set	1		
12	SDH Equipment (ADM) with Digital Cross-connect FC coupled, single mode - Base equipment (common cards, Power supply cards, power cabling, other hardware & accessories including sub-racks etc. fully equipped	Nos.	2		
13	SDH Equipment (ADM) with Digital Cross-connect FC coupled, single mode - Optical Cards - L 1.2 @	Nos.	12		
14	SDH Equipment (ADM) with Digital Cross-connect FC coupled, single mode - Tributary Cards - E1 interface card (minimum 4 interfaces per card)	Nos.	4		
15	SDH Equipment (ADM) with Digital Cross-connect FC coupled, single mode - Tributary Cards - Ethernet interfaces 10 Base T with Layer-2 switching (Minimum 4 interfaces per card)	Nos.	4		
16	Multiplexer Equipment - Drop & insert : Fully Equipped excluding subscriber line interface cards	Nos.	2		
17	Multiplexer Equipment - Subscriber line interface cards - Voice channel cards: 2 wire	Nos.	2		
18	Multiplexer Equipment - Subscriber line interface cards - Synchronous data cards (64 kbps) V.35 and/or X.21	Nos.	2		
19	Equipment Cabinets - For SDH equipment	Nos.	2		
20	Equipment Cabinets - For Multiplexer Equipment (Drop-insert)	Nos.	2		
21	Pre-connectorized optical fibre Patch cords-pack of 6 patch cords of 10 meter each	Pack	4		
22	Network Management System - Portable Craft Terminal (Lap-top PC) including all hardware & software for SDH and Multiplexer equipment	Set	2		
23	Network Management System - Laser Printer (color)	Nos.	2		
24	EPAX (24/8) with 24 telephone sets, cables etc.	Set	2		
25	Spares for OPGW Cable System as per clause 1.2.2.1 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
26	Spares for SDH System as per clause 1.2.2.2 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
27	Test Equipments for Fibre Optic Cables as per Clause 1.2.3.1 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
28	Test Equipments for Terminal Equipment System as per Clause 1.2.3.2 of Section-1 of Technical Specification document No. TB-335-510-035	Lot	1		
29	Services for Digital Protection Coupler as per Cl;ause 1.2.4.1 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
30	Services for OPGW Cable System as per Cl;ause 1.2.4.2 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
31	Services for SDH System as per Cl;ause 1.2.4.3 of Section-1 of Technical Specification	Lot	1		

SN	Equipment	Phy Unit	Qty	Plan Dt	Comments
	document No. TB-335-510-034				
32	Training and Suppor Services on Overhead Fibre Optic Cabling System as per clause 1.2.5.1 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
33	Training and Suppor Services on Terminal Equipment as per clause 1.2.5.2 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
34	Annual Maintenance Contract (AMC) for Fibre Optic Cable System as per clause 1.2.6.1 of Section-1 of Technical Specification document No. TB-335-510-034	Year	1		
35	Annual Maintenance Contract (AMC) for Terminal Equipment as per clause 1.2.6.2 of Section-1 of Technical Specification document No. TB-335-510-034	Year	1		
36	Type Test Charges for Type Test to be conducted on Optical Fibre as per Clause 1.2.7.1 of Section-1 of Technical Specification document No. TB-335-510-034	Lot	1		
37	Type Test Charges for Type Test to be conducted on OPGW Cable as per Clause 1.2.7.2 of Section-1 of Technical Specification document No. TB-335-510-035	Lot	1		
38	Type Test Charges for Type Test to be conducted on Underground Fibre Optice approach Cable as per Clause 1.2.7.3 of Section-1 of Technical Specification document No. TB-335-510-036	Lot	1		
39	Any other item required for completion of project and not covered above as per Clause 1.2.8 of Section-1 of Technical Specification document No. TB-335-510-036	Lot	1		

You are requested to submit your most competitive offer so as to reach us positively by the tender opening date & 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 "THE INSTRUCTIONS TO BIDDERS". INCOMPLETE BIDS AND/OR BIDS NOT COMPLYING WITH TENDER CONDITIONS SHALL BE TREATED AS NON RESPONSIVE AND ARE LIKELY TO BE IGNORED.

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

YOU ARE REQUESTED TO SUBMIT YOUR MOST COMPETITIVE OFFER SO AS TO REACH US POSITIVELY BY 2 PM ON THE TENDER OPENING DATE AND TENDER WILL BE OPENED AT 2:30 PM WITH EFFECT FROM 15-SEP-09.

BHEL RESERVES THE RIGHT TO OPT FOR REVERSE AUCTION FOR OBTAINING BEST PRICES.

OFFERS THROUGH E-MAIL / FAX:

WHOSOEVER DESIRES TO SEND OFFERS ON THEIR OWN RISK (COMPLETE IN ALL RESPECTS) VIA E-MAIL or FAX HAVE TO SEND THE OFFERS TO THE COMMON E-MAIL ADDRESS tenderbox@bhelindustry.com or 011-24365869 FAX .

THE RECEIVED EMAIL OFFERS WILL BE PRINTED BY PURCHASE COORDINATOR AND PUT THEM INTO COVERS AS PER CONVENTIONAL METHOD FOR TENDER OPENING I.E., TECHNO COMMERCIAL & PRICE OFFER SHALL BE PUT INTO TWO SEPARATE COVERS AND BOTH THE COVERS ARE KEPT IN THIRD COVER DULY SUPER SCRIBING ENQY. NO. AND DUE DATE.

OFFERS SENT TO ANY OTHER E-MAIL ID or FAX NO AND INCOMPLETE OFFERS SHALL NOT BE CONSIDERED FOR EVALUATION PURPOSE.

It is suggested that the bidders are advised to send the files with 'password protection'. procedure for giving a password to a file has been given below:

For saving Excel file with password

Steps to be followed:

1. Click on the FILE option in XP system and Start sign in Vista system then go to SAVE AS option.
2. Select the location to save and Click on the TOOLS box and go to GENERAL OPTION.
3. It will ask for the password, type the password into open or modify box or both as required.
4. Then click on the OK button it will ask for reenter of the password.
5. After reentering the password click on the save box.

For saving Word file with password

Steps to be followed:

1. Click on the FILE option in XP and Start sign in Vista then go to SAVE AS option.
2. Select the location to save and Click on the TOOLS box and go to SECURITY OPTION in XP system and GENERAL OPTION in Vista system.
3. It will ask for the password, type the password into open or modify box or both as required.
4. Then click on the OK button it will ask for reenter of the password.
5. After reentering the password click on the save box.

The venders who has sent offers with password,the passwords are to be forwarded to another email id:supplierinfo@bhelindustry.com

MSME STATUS

"THOSE INDUSTRIES WHO HAVE FILED A MEMORANDUM WITH THE CONCERNED AUTHORITIES AND REGISTERED AS MICRO & SMALL ENTERPRISE UNDER MICRO, SMALL AND MEDIUM ENTERPRISES DEVELOPMENT ACT 2006, HAVE TO SUBMIT A COPY OF SUCH REGISTRATION CERTIFICATE / MEMORANDUM TO BHEL FOR NECESSARY COMPLIANCES OF THE ABOVE ACT".

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

for BHARAT HEAVY ELECTRICALS LTD

We acknowledge the receipt of tender.

(a) The offer against subject enquiry shall be submitted by the scheduled date and 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.

To
Mr D K Prasad

Manager (TBMM)
TBG, Industry Sector,
Integrated Office Complex,
Lodhi Road,
New Delhi-110003

Ph: 011-41793110 / 24302110
Fax: 011-24365869

Signature and Seal of Tenderer

Enquiry No : 142E097 **Enquiry Dt :** 08-Jun-12

BHARAT HEAVY ELECTRICALS LTD.
(TRANSMISSION BUSINESS GROUP)
TERMS AND CONDITIONS FOR INDIGENOUS TENDER ENQUIRY

This Format is to be submitted in original duly signed by bidder. Deviation, if any, is to be brought out clearly in Schedule of Commercial deviation giving clause wise deviation. Any condition / clarification / deviation mentioned elsewhere may not be accepted.

Sr. No	Terms & Conditions
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 2.00 PM of the due date of opening in **Material Management Division,** **Transmission Business Group,** **BHEL, Industry Sector,** **Integrated Office Complex,** **Lodhi Road, New Delhi – 110 003.** 3. The same shall be opened at 2.30 PM 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. 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 Mr. Sanjeev Shrivastava (Manager) BHEL, Integrated Office Complex, Lodhi Road, New Delhi – 110 003 Phone : 011-41793272 Fax : 011-41793221 e-mail : sks@bhelindustry.com For any commercial clarification please contact person issuing enquiry. 6. Price bid should not contain any information / description / terms & condition other than given in Part-I of the bid except prices, otherwise bid is liable for rejection. **7. Price bid submitted along with the bid shall remain valid up to validity of offer. Unsolicited Supplementary / Revised price bid submitted during validity period**

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	of offer, unless asked by BHEL, shall not be considered. With-drawl 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:** **<RELEVANT OPTION TO BE SELECTED BEFORE ISSUE OF ENQUIRY>** **A.1.** Unless specifically indicated, all prices shall be **FIRM.** No enhancement of rate for whatever cause unless and until asked by BHEL will be allowed. **A.2. PVC (if indicated)** The prices to be quoted are with **PVC** with following formula. *<Formula>* The base indices in the formula shall be of first notification of ---------- of the --------- month. The date of delivery shall be PO delivery date or date of actual despatch, whichever is earlier. **B** The prices shall be quoted by the vendors considering following. **B.1.** Unless specifically indicated, the prices shall be on **Domestic basis.** **B.2. Deemed export (if indicated)** i) Prices are to be quoted considering following benefits: 1. ---------- 2. ---------- 3. ---------- ii) For availing above benefits, BHEL shall provide following documents. 1. ---------- 2. ---------- iii) In case of import benefit in deemed export projects, bidder to indicate import content (CIF value) in the price bid.
	B.3. Physical export (if indicated) i) Prices are to be quoted considering following benefits 1. ---------- 2. ---------- ii) For availing above benefits BHEL shall provide following documents 1. 2.

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	C. The prices are to be quoted on FOR (Destination) basis. The break-up of price shall be as under:- **a) Ex-works Price:** Ex- works price including packing & forwarding charges. **b) Excise duty:** ED as applicable is to be quoted as percentage in both un-price and price bid. **c) Sales Tax:** ST / VAT /CST (against C-form) to be quoted as percentage in un-price and price bid. In case of interstate sale-in-transit supplier have to provide E1/E2 form. **e) Entry tax / Octroi Charges:** Any Entry tax / Octroi applicable at destination / destination state shall be paid extra on proof of such payment. **f) Freight & Insurance:** Freight and Transit Insurance for door delivery up to destination/store is to be quoted. **g) Type Test charges:** If asked in the technical specification, is to be quoted separately for each Test along with taxes and duties applicable on them. **h) 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 :** **<RELEVANT OPTION TO BE SELECTED BEFORE ISSUE OF ENQUIRY>** For BOIs (non package items) 100% payment along with taxes, duties, Freight & Insurance within 60 days from the date of receipt of complete invoice containing following documents in 3 sets (Original + 2 copies). - Receipted LR - Excise invoice (where ED re-imbursement is required) - Delivery Challan / Packing list (casewise) - Transit insurance certificate from under writers or Copy of Intimation of Transit Insurance duly endorsed by under writers, - Despatch Clearance given by BHEL, - Guarantee certificate, - All Test reports and inspection reports, - Performance Bank Guarantee copy. For BOPs : Air-Conditioning & Ventilation, Fire Protection, Illumination, Oil handling system where ETC is in scope of bidder a. 90% of Ex-works value alongwith 100% taxes, duties, Freight & Insurance within 60 days from the date of receipt of invoice. The invoice must contain following documents in 3 sets (Original + 2 copies) - Receipted LR / RR - Excise invoice (where ED re-imbursement is required) - Delivery Challan / Packing list (casewise) - Transit insurance certificate from under writers or Copy of Intimation of Transit

Sr. No	Terms & Conditions
	Insurance duly endorsed by under writers, - Despatch Clearance given by BHEL, - Guarantee certificate, - All Test reports and inspection reports, - Performance Bank Guarantee copy. b. 5% of Ex-works value on completion of supplies as per billing breakup. c. 5% of Ex-works value on successful completion of Erection, Testing, Commissioning (To be certified by BHEL site) and final documentation (Against proof of submission to Engineering) Note: When ETC is not in scope last 5% as per (c) above shall be paid alongwith (b). Terms of payment for Type test charges: 100% payment with taxes and duties on acceptance of test reports by BHEL on certification by BHEL engineering within 60 days from the date of receipt of clear invoice. Terms of payment for Supervision charges: 100% payment against completion with taxes and duties on certification by BHEL site within 60 days from the date of receipt of clear invoice.
4.	**INTEREST LIABILITY** In case of any delay in payment due to any reason, BHEL shall not pay any interest on delayed payment.
5.	**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.
6.	**PERFORMANCE BANK GUARANTEE :** Bidder shall furnish along with first invoice Performance BG / deposit as per one of following 3 options. Option A: A single rolling Bank Guarantee of Rs 20 lakhs initially valid for one year for all the orders being executed for Transmission Business Group, BHEL. Option B: BG for 10% of the total Ex-works PO value, valid for 18 months from the date of PO delivery. PO value at the time of first invoice for the particular order shall be considered for calculation of BG amount. The PBG is to be kept valid for 18 months from the last item's delivery date of the PO. Note: The claim period of the BG should be 3 months over and above the validity of the BG as above. Option C: Retention of 10% of the total Ex-works PO value by BHEL from the first bill in lieu of Performance Bank Guarantee, to be released after expiry of 24 months from the date of first delivery. Note : For Shield wire, Earthing material, Cable gland, Cable Trench material, GI/PVC pipe, Hardwares, Al tube, MS Rod, Lable & phase colour disc, HG Fuse, Ferrule, Lug,

Sr. No	Terms & Conditions
	Marker, Stationary, Office eqpt. and any petty / sundry purchase no Performance bank guarantee is required. The Bank guarantee shall be from State Bank of India / State bank of Hyderabad / State Bank of Travancore / State Bank of Mysore / Canara Bank / Bank of Baroda / Punjab National Bank / Deutsche Bank / HDFC Bank / Standard Chartered Bank / CITI Bank / ICICI Bank / IDBI Bank / HSBC / any other Nationalised Bank. The original BG should be sent by issuing Bank directly to AGM (Finance), TBG-BHEL.
7.	**FINAL ENGINEERING DOCUMENTATION:** Final documentation as called in the specification is to be submitted within 3 months from the date of despatch of material. In case of default, the Performance BG is liable to be en-cashed.
8.	**INSPECTION :** BHEL / customer / third party shall inspect equipment / material before despatch. Stage inspection during manufacturing may also be carried out. Material to be despatched only after getting Despatch Clearance from BHEL. Supplier shall send inspection call on prescribed format (web site) only, with an advance notice of 15 days.
9.	**DESPATCH DOCUMENTS :** Following despatch documents are to be immediately sent to purchaser on despatch. - Copy of LR - Copy of delivery challan / packing list - Insurance certificate - Guarantee certificate
10.	**DELIVERY PERIOD:** Bidder to specify delivery period in weeks from the date of LOI / PO. Time for conduction of type test, if required, is to be separately indicated. Note: LR date or Invoice date whichever is later shall be considered as delivery date.
11.	**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.
12.	**VALIDITY :** The offer shall be valid for 120 days from the due date of opening.
13.	**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.
14.	**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.
15.	**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.
16.	**ARBITRATION :** All cases of disputes emanating from and relating to this contract, the matter shall be

Sr. No	Terms & Conditions
	referred to the sole arbitration of Unit Head / GM, BHEL or any other person (including an employee of BHEL, even though he had to deal with the matter relating to this contract in any manner) nominated by him to act as sole arbitrator. The arbitration shall be under **'The Arbitration and Conciliation act 1996'** and the rules there under as amended from time to time. The arbitrator may from time to time with the consent of the parties enlarge the time for making and publishing the award. The venue of arbitration shall be any Indian city as decided by BHEL.
17.	**LEGAL SETTLEMENT :** All suits/claims in respect of this contract shall be in the courts having jurisdiction at New Delhi
18.	**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.
19.	**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.
20.	**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.
21.	**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.
22.	**REVERSE AUCTION :** BHEL shall reserve the right to exercise an option for "reverse auctioning" if required

Signature of Bidder
Seal

Mentioned clauses of General Terms and Conditions are to be read as follows:

Clause 1:

2. Bid submission time: upto 02:00 PM of the due date of opening
3. Bid opening time: 02:00 PM on the same day.

Clause 2: PRICES

A.1.: Applicable

A.2.: Not applicable

B.1.: Not applicable.

B.2. Not applicable.

B.3. Applicable

a) ED is exempted against ARE-1/CT-1 form.

b) CST exempted against 'H' form.

Clause 3: TERMS OF PAYMENT

Terms for BOP is not applicable

Terms for BOI is applicable

Documents for payment:

1. Excise Invoice 2.Proof of material receipt (Receipted LR or material receipt on invoice/delivery Challan/Packing list) 3.Guarantee Certificate 4.Insurance certificate 5.Packing list 6.Delivery Challan 7.BHEL MICC 8. Performance BG copy

Note: Place of delivery shall be Delhi/NCR. Material receipt shall be arranged by BHEL/BHEL authorized representative.

Clause 16: ARBITRATION

The arbitration shall be under **'The Arbitration and Conciliation act 1996'.**

All remaining terms which are not mentioned here shall remain unchanged.

Note-1. Supplier has to specifically indicate/ tick mark their preference for Performance Bank Guarantee out of the three options mentioned in clause no.6 of the General terms and conditions (BHEL/TBG/GTC/02-07).

Proposed delivery plan is 30-Sep-2012; however vendor has to quote their best delivery plan in activity schedule.

Mentioned clauses of General Terms and Conditions are to be read as follows:

Clause 1:

2. Bid submission time: up to 02:00 PM of the due date of opening

3. Bid opening time: 02:00 PM on the same day.

4. Bids are to be submitted in one part.

Clause 2: PRICES

A.2. Not applicable (Prices shall be firm as per Sl. No. A.1)

B.2. Not Applicable

B.3. Applicable

Clause 3: TERMS OF PAYMENT

LR to be read as Bill of Lading/AWB.

Note: Place of delivery shall be Delhi/NCR. Material receipt shall be arranged by BHEL/BHEL authorized representative

Terms for BOP is not applicable

Clause 15: DEVIATION

The bids having deviation(s) w.r.t tender are liable for rejection. However, BHEL, at its discretion, may load the prices for evaluation of offer with prior intimation to bidder.

Clause 16: ARBITRATION

The arbitration shall be under '**The Arbitration and Conciliation act 1996'**.

Deviations must be mentioned in deviation schedule(s) and deviation mentioned, if any, elsewhere shall not be considered.

All remaining terms which are not mentioned here shall remain unchanged.

.....Cont. to Pg. 2

.....Cont. from Pg. 1

Annexure A to GTC (BHEL/TBG/GTC/02-07) for Foreign Vendor

Enq. No. 142E097 dtd. 08.06.2012

Note : -

1- Supplier has to specifically indicate / tick mark their preference for PBG out of the three options mentioned in clause no. 6 of General Terms and Conditions (BHEL/TBG/GTC/02-07) i.e. Performance Bank Guarantee.

2- Proposed delivery plan is 30-Sep-2012; however vendor has to quote their best delivery plan in activity schedule.

3- Price Break up should consist of the following breakup :-
   a- FOB port of Loading.
   b- Marine Freight from load port to discharge port i.e. any Indian port.
   c- Marine Insurance from load port to discharge port i.e. any Indian port.

Marine Freight and Insurance to be quoted separately.

BHEL may arrange Marine Shipment or exercise option for shipment by vendor at quoted F&I rates.

Freight & Insurance from discharge port to site – BHEL's scope. Rates will be based on BHEL's applicable rate contract for arriving at landed cost to BHEL. However vendor may also quote for the same.

Freight and Insurance to be quoted separately.

Un-Priced SCHEDULE (For Indian vendors only) (Part II)

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

ENQUIRY NO: 142E097 Dtd: 08.06.2012

	S.No.	Description of Item	Unit	Quantity	Unit Price Ex-works	Total Ex-Works	Unit F & I	Total F & I	*ED @____ % of Col6 (EXEMPTED)*	CST / ST @____% of (Col 6+9) (EXEMPTED)	TOTAL (FOR Destination) PRICE (Rs.)
	1	2	3		5	6	7	8	9	10	11

NOTE: 1.VENDOR TO INDICATE APPLICABLE LOCAL TAX/VAT WITHOUT AS ANY CONCESSIONAL FORMS FOR TRANSACTION WITHIN THE STATE.LOCAL TAX/VAT_____

2. PLEASE NOTE THAT UNPRICED COPY OF PRICE BID (i.e. WITH ALL PRICE BLANKED) SHALL BE FURNISHED ALONGWITH TECHO-COMMERCIAL BID.
3. REQUIRED COPIES OF FORMAT BE MADE & DETAILS MAY BE ANNEXED.
4. THE PRICES MUST BE QUOTED IN THE PRESCRIBED UNIT ONLY.
5.IN CASE OF CST RATE AGAINST 'C' FORM SHALL BE QUOTED.

TENDERER

SCHEDULE OF PRICE (For Foreign vendors only) (Part II)

Unpriced price bid to be kept with Techno-commercial offer. **Price bid should be kept in separate sealed cover.**

TENDER ENQUIRY NO. 142E097 dtd. 08.06.12

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	Name of item	Tariff No.	Qty	Unit-CIF {Indian Sea port)}	Total -CIF {Indian Sea port)}.	Break up of CIF(Indian 'Any' Sea port) rates						Breakup of Inland Transportation			
						Unit -FOB (Load port).	Total -FOB (Load port).	Unit-Sea Freight (upto indian Discharge port)	Total-Sea Freight (upto indian Discharge port)	Unit-Insurance(upto indian Discharge port)	Total-Insurance(upto indian Discharge port)	Unit-Freight (from Indian Discharge port to site)	Unit-Insurance (from Indian Discharge port to site)	Total-Freight (from Indian Discharge port to site)	Total-Insurance (from Indian Discharge port to site)
	Total														

NOTE-

Discharge Port:- Indian Sea Port (Any Indian port)

CIF (indian port) should be equal to "FOB(load port) + Sea Freight (upto indian Sea port) +Insurance(upto Indian Sea port)"

Load port to be mentioned by bidder .

No of package with Dimensions and type of cargo(/Break Bulk/LCL/FCL) and no. of container (with type of container) required-is also to be mentioned by bidder.

Vendor has to mention tarrif no. against each item for custom duty purpose.

Bidder has to mention quoted (in each cell) in unpriced price bid

ENQUIRY NO. 142E097

Date: 08.06.12

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.

SL. NO.	ACTIVITY		ACTIVITY TIME IN WEEKS	CUMULATIVE TIME IN WEEKS FROM LOI/PO DATE	REMARKS IF ANY
1.	Receipt of P.O				
2.	Submission of P.O Acceptance	Max 1 week (7 days)			
3.	Submission of documents necessary for getting manufacturing clearance like Drawings, data sheet etc.				
4.	Review and Approval of documents and issue of manufacturing clearance				
5.	Manufacturing Time	(A)			
6.	Inspection and Issue of MICC	**'BY BHEL"**			
7.	Issue of other documents like Road Permits etc.	**'BY BHEL"**			
8.	Dispatch				
9.	Transit time upto Site.				

Note : 1) For item at Sl. No. 4) Vendor to reply to all queries within 3 days.

2) For Sl. No. 5) Inspection call for entire lot to be issued 2 weeks in advance. Date given in call for inspection should be within the period indicated in "A" for completion of activity at Sl. No. 6.

3) 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:

SCHEDULE OF COMMERCIAL DEVIATION

TENDER ENQUIRY NO. 142E097 Dtd 08.06.12

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

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

In case, 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 Gerneal 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.

This Format is to be submitted in original duly signed by bidder. Reproduction of the same in any sort is not acceptable.

Signature of the authorised representative of

Place: .....

Date : .....

Bidder's name :.....

Designation:.....

Company Seal:.....

SCHEDULE OF TECHNICAL DEVIATION

TENDER ENQUIRY NO. 142E097 **DTD. 08.06.12**

The following are the devitions/ variations exception from the Technical Specifications:

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

In case, 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.

This Format is to be submitted in original duly signed by bidder. Reproduction of the same in any sort is not acceptable.

Signature of the authorised representative of

Place: .....

Date : .....

Bidder's name :.....

Designation:.....

Company Seal:.....

Contact details of suppliers/manufacturers of OPGW cable:

1. **M/s LS Cables Ltd, Korea**
   C/o M/s Alpasso Exports Ltd
   406, Som Dutt Chambers-II
   9, Bhikaji Cama Place
   New Delhi – 110066
   Contact Person : Mr. Sandeep Puri
   011-26169170, 9811050488, Fax no. 26195485

2. **M/s VISCAS Corporation, Japan** (Earlier known as Furukawa)
   Contact Person: Mr. S.S. Bali, Vice President
   0124-4261451, 53, 54, Fax: 0124-4261452
   Mob: 9818023174
   e-mail: baliviscas@gmail.com

3. **M/s Prysmian, Italy** , earlier known as Pirelli)
   14-15, 'B' Wing, Mamta,
   A. M. Marg, Prabhadevi,
   Mumbai – 400 025
   Contact Person: Mr. Kamlesh Pokarna
   Ph. 022-24301075, 24310021, 24329660, 24329661
   Fax:022-24360473,24374287
   e-mail: kamlesh.pokarna@pransa.in

4. **M/s BGR Energy Systems Ltd.**
   443, Anna Salai, Teynampet, Chennai-600 018
   Contact Person: K. Perumal Swamy
   Mobile:9600018931, 044-2433 2314, 2435 5626, Fax no. 044-2431 1654
   e-mail: epd@bgrenergy.com

5. **M/s KEC International Ltd.**
   Telecom Division,
   The Pavilion, 3rd Floor 339/2,
   Mehrauli Road, Sector-14,
   Gurgaon – 122 001
   Contact : Mr S. Bir, Mob. 09818454825

ENQUIRY NO. 142E097

Dated: 08.06.12 **BHEL/TBG/SO1/01**

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

The above checklist is verified for:-

Offer Ref. :

Equipment :

Submitted by : M/s

Project Reference. :

Signed with Seal .....

Date .....

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

BHEL DOCUMENT No.	TB-351-510-034	Rev.	00		Prepared	Checked	Approved
Customer Doc. No.				NAME	RK	SKS	AS
TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN	Rajat	Sankar	Ashok
TITLE				DATE	21/3/12		24/03/12
Digital Protection Coupler (DPC), Overhead Optical Fibre Grounding Wire (OPGW) & SDH Equipment				GROUP	TBEM		
				W.O. No			
CUSTOMER	POWER GRID CORPORATION OF INDIA LIMITED						
PROJECT	220/20 kV Charikar (New) Substation and 220/20 KV Doshi (New) Substation associated with Consultancy services for MEW Afghanistan						

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS		
Distribution				To	TBPM	TBMM	TBQM
				Copies			

SECTION 1
SCOPE AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, supervision of erection and site testing of Digital Protection Coupler (DPC), Overhead Optical fibre Grounding Wire (OPGW) & SDH equipment complete with accessories as listed under this specification.

This section covers the specific technical requirements of Digital Protection Coupler (DPC), Overhead Optical fibre Grounding Wire (OPGW) & SDH equipment. This constitutes minimum technical parameters for the above item as specified by the customer (POWERGRID). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:
Section-1: Scope & Bill of Quantities
Section-2 :Equipment Specification
Section-3: General Technical Requirements
Section-4: Checklist
In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer	:	**Power Grid Corporation of India Limited (POWERGRID)**
Name of the project	:	**220/20KV Charikar (New) Substation and 220/22KV Doshi (New) Substation associated with Consultancy services for MEW Afghanistan**

Refer Section - 3 for Project Details and General Specifications.

1.2 BILL OF QUANTITIES

1.2.1 MAIN ITEM

S. No.	Item Description	Unit	Charikar	Doshi	Total Quantity
1	**Digital Protection Coupler for 220 KV lines**	Nos.	4	4	8
2.	**24 Fibre(DWSM) OPGW fibre optic cable**	Km.	1.5	NIL	1.5
	OPGW cable Accessories – Installation Hardware set for 12 fibre (DWSM) OPGW Cable consisting of following:				
3.	Tension assembly at dead end location	Nos.	1 **	NIL	1
4.	Tension assembly at pass through location	Nos.	3 **	NIL	3
5.	Tension assembly at joint box location	Nos.	1 **	NIL	1
6.	Splice Enclosure	Nos.	2 **	1	3
7.	Vibration Damper	Nos.	8 **	NIL	8
8.	FODP 24 F, indoor type, rack mounted including pigtails and FCPC coupling	Nos.	1	NIL	1
9.	24 fibre (DWSM) Underground fibre optic approach cable	Km.	0.5	0.5	1
10.	Installation hardware set including ties/clips/cleats, conduits, ducts, supports, fittings, accessories etc for approach cable	Set	0.5 *	0.5 *	1
	SDH Equipment (ADM) with Digital Cross-connect FC coupled, single mode -				
11	Base equipment (common cards, Power supply cards, power cabling, other hardware & accessories including sub-racks etc. fully equipped.	Nos.	1	1	2
12	Optical Cards – L 1.2 @	Nos.	6	6	12
13.	Tributary cards - E1 interface card (minimum 4 interfaces per card)	Nos.	2	2	4
14	Tributary cards - Ethernet interfaces 10 Base T with Layer-2 switching (Minimum 4 interfaces per card)	Nos.	2	2	4
	Multiplexer Equipment -				
15.	Drop & insert : Fully Equipped excluding	Nos.	1	1	2

	subscriber line interface cards				
16.	Subscriber line interface cards - Voice channel cards: 2 wire	Nos.	1	1	2
17.	Synchronous data cards (64 kbps) V.35 and/or X.21	Nos.	1	1	2
	Equipment Cabinets -				
18	For SDH equipment	Nos.	1	1	2
19	For Multiplexer Equipment (Drop-insert)	Nos.	1	1	2
20	**Pre-connectorized optical fibre Patch cords-pack of 6 patch cords of 10 meter each**	Pack	2	2	4
	NETWORK MANAGEMENT SYSTEM (NMS *)**				
21	Portable Craft Terminal (Lap-top PC) including all hardware & software for SDH and Multiplexer equipment	Set	1	1	2
22	Laser Printer (color)	Nos.	1	1	2
23	**EPAX (24/8) with 24 telephone sets, cables etc.**	Set	1	1	2

Note * - One set of installation hardware shall contain all insulation hardware fittings as may be required for 1 Km fibre optic approach cable.

Note ** - The quantity of tension assembly, suspension assembly and splice enclosures have been calculated on the basis of tower spotting data. However, the quantity shall be adjusted as per the actual requirement. Other hardware & fittings such as Earthing clamps, download clamps etc. required for installation shall also be provided as required.

Note *** - Network Management System shall be based on open system Architecture to the ITU-T recommendations M.3010 and G.784. It shall be provided as a portable system incorporating the NMS software installed on a notebook / laptop PC together with appropriate interfaces and leads to allow the system to be easily moved the areas under this contract.

Note: @ - 4 Nos. of cards has been considered for Pul-e- Khumri & Chimtala.

1.2.2 Spares:

1.2.2.1 *Spares for OPGW Cable System*:

S. No.	Item Description	Unit	Spares
A.	**OPGW Cable**		
1.	24 Fibre(DWSM) OPGW fibre optic cable	Km	1

B	**OPGW cable Accessories**		
	Installation Hardware set for 12 fibre (DWSM) OPGW Cable consisting of following:		
2	Tension assembly at dead end location	No.	1
3.	Tension assembly at pass through location	No.	1
4.	Tension assembly at joint box location	No.	1
5.	Splice Enclosure	No.	1
6.	**Underground fibre optic approach cable**	Km.	0.5
7.	**Installation hardware set including ties/clips/cleats, conduits, ducts, supports, fittings, accessories etc for 24 Fibre (DWSM)**	Set **	0.5

1.2.2.2 *Spares for SDH System*:

S. No.	Item Description	Unit	Spares
A.	**SDH Equipment**		
1.	Common Cards, power supply cards, hardware and accessories (each)	Set	1
2.	Optical cards - L 1.2 @	No.	1
3.	Tributary cards - E1 interface card (minimum 4 interfaces per card)	No.	1
4.	Tributary cards - Ethernet interfaces 10 Base T with Layer-2 switching (Minimum 4 interfaces per card)	No.	1
B	**Multiplexer -**		
5.	Drop insert: fully equipped excluding subscriber line interface cards	No.	1
6.	Subscriber line interface cards - Voice channel cards: 2 wire	No.	1
7.	Subscriber line interface cards - Voice channel cards: 4 wire(E&M)	No.	1
8	Subscriber line interface cards- Synchronous data cards (64 kbps)	No.	1
9.	**Pre-connected optical fibre patch cords – pack of 6 patch cords of 10 meter each**	Pack	1

Note ** - One set of installation hardware shall contain all insulation hardware fittings as may be required for 1 Km fibre optic approach cable.

1.2.3 **Testing Equipments for Fibre Optic Cables**

S.No.	Item Description	Unit	Quantity
1.2.3.1	**Test Equipment for Fibre Optic Cables**	Lot	1
1	OTDR (optical Time Domain Reflectometer) for 1310/1550 nm (Anritsu MW9076B1 or equivalent)	No.	1
2	Laser Light Source for OTDR (1310/1550 nm) (suitable for item no .1 above)	No	1
3	Optical Attenuators (variable 1310/1550 nm) (Anristu MN 9650C or equivalent)	No	1
4	Optical Power Meter (1310/1550 nm) (Anritsu ML9002A or equivalent)	No	1
5	Optical Loss Test Set (Anritsu MS9020D or equivalent)	No	1
6	Optical Test Set (ANDO AQ8125B or equivalent)	No	1
7	Optical Fibre Fusion Splicer incl. Fibre cleaver (Sumitomo Electric Type – 37 SE or equivalent)	No	1
8	Calibrated Fibre	No	1
9	Connectorization kit (FIS-FI-0053-U or equivalent)	No	1
10	Splice kit (FIS-FI-0053-Fi or equivalent)	No	1
11	Optical test accessory kit including all necessary connectors, adapters, cables, terminations and other items required for testing	No	1
1.2.3.2	**Test Equipment for terminal equipment system**		
1	Handheld 2mbps BER tester equipment to trend tango E1 or better	No.	2
2	Ethernet tester Acterna FST 2802 (with dual port,10/100 ports Mbps Ethernet option, layer-1 & layer-2 functionality or better	No.	2
3	Digital multimeter Equivalent to fluke 189 model or better	No.	2
4	Oscilloscope Equivalent to Tektronix 3054B or better	No.	1
5	Transmission impairment measurement system (TIMS) equivalent to trend communication ALT-2000 model or better	No.	1
6	SDH analyser (upto STM-1) with Jitter and Wander Equivalent to Acterna ANT-20 or better	No.	1

1.2.4 **Services:** Services shall include the following

1.2.4.1 **Services for Digital Protection Coupler:**

S.No.	Item Description	Unit	Quantity
1.	Supervision of Erection, commissioning & site testing of Digital Protection Coupler	Lot	1

1.2.4.2 **Services for OPGW Cable System:**

S. No.	Item Description	Unit	Quantity
A	**Erection, commissioning & site testing of OPGW system & accessories shall include the following**		
1.	Installation of hardware & fitting needed to tie OPGW to the tower / gantries.	Lot	1
2.	Termination & splicing of OPGW cable.	Lot	1
3.	Commissioning of fibre optic system	Lot	1
4.	Site acceptance tests at per specification.	Lot	1

1.2.4.3 **Services for SDH System:**

S. No.	Item Description	Unit	Quantity
1	Supervision of Erection, commissioning & site testing of SDH	Lot	1

1.2.5 **Training and support services –**

As per clause 6.1, 6.1.1, 6.1.2, 6.1.3, 6.1.4 & 6.15 of section-2 (page 57 & 58).

1.2.5.1 **Training and Support Services on Overhead Fibre Optic Cabling System:**

S. No.	Item Description	Unit	Quantity
1	Training on Overhead Fibre Optic Cabling System to be Imparted in Afghanistan for 4 Nos. of Trainees for 5 days – Total 20 mandays –	Lot	1

1.2.5.2 **Training and Support Services on Terminal Equipment:**

S. No.	**Description**	**Unit**	**Quantity**
1	Training on Terminal Equipment (SDH equipment, MUX and NMS etc.) to be Imparted at Manufacturer works / Training centre for 4 Nos. of Trainees for 5 days – Total 20 mandays	Lot	1

1.2.6 Annual Maintenance Contract (AMC) for fully installed System

1.2.6.1 **AMC of Fibre Optic Cable System:**

S. No.	**Description**	**Unit**	**Quantity**
1	AMC of Fibre optic cable for one year after warrantee period	Year	1

1.2.6.2 **AMC of Terminal Equipment:**

S. No.	Description	Unit	Quantity
1.	**AMC of Terminal equipment** including SDH, Mux etc. for one year after warrantee period	Year	1

1.2.7 TYPE TEST CHARGES

1.2.7.1 **Type Tests to be conducted on Optical Fibre** **1 Lot**

Following type tests are to be conducted on optical Fibre
a. Attenuation
b Attenuation variation with wavelength
c. Attenuation at water Peak
d. Temp. cycling (temp. dependence of attenuation)
e. Attenuation with bending (Bend performance)
f. Mode field dia.
g. Chromatic Dispersion
h. Cladding Diameter
i. Point discontinuities of Attenuation
j. Core-clad concentricity error
k. Fibre tensile proof testing

1.2.7.2 **Type Tests to be conducted on OPGW Cable** **1 Lot**

Following type tests are to be conducted on OPGW Cable
a. Water ingress Test
b. Seepage of filling compound
c. Short Circuit Test
d. Aeolian Vibration Test
f. Galloping Test
g. Cable bend Test
h. Sheave Test
i. Crush Test
j. Impact Test
k. Creep Test
l. Fibre Strain Test
m. Strain Margin Test
n. Stress strain Test
o. Cable Cut-off wavelength Test
p. Temperature Cycling Test
q. Corrosion (salt spray) Test
r. Tensile performance Test
s. Fault current/lighting Test
t. DC Resistance Test

1.2.7.3 **Type Tests to be conducted on Underground Fibre optic approach cable** **1 Lot**

Following type tests are to be conducted on Underground Fibre optic approach cable
a. Water ingress Test
b. Seepage of filling compound
c. Crush Test
d. Impact Test
e. Stress strain Test

f. Cable Cut-off wavelength Test
g. Temperature Cycling Test

1.2.8 Any other item required for completion of project and not covered above. **1 Lot**
(Complete List to be provided by bidder along with unit price)

Note:

1. All interconnecting cable between the offered systems in the bidder scope of supply.

1.3 TYPE TEST REQUIRMENTS

At contract stage, the reports for all type tests (except for type tests mentioned in clause 1.2.6, 1.2.7 & 1.2.8 of above) and additional type tests as per section -2 of technical specification shall be submitted for POWERGRID approval. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited base 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 representatives(s) of POWERGRID or Utility. The test - reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening (i.e. 11.01.2011). In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening (i.e. 11.01.2011), the bidder 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 to POWERGRID due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification on any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

1.4 INSPECTION, TESTING AND ACCEPTANCE

Bidder has to follow specification and POWERGRID approved Manufacturing Quality Plan of Power Grid Corporation of India Ltd.

1.5 DEVIATION

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

1.6 DOCUMENTATION

Final Documentation (after approval) shall be separate for each Substation. List of documents to be submitted is mentioned in section-2 of specification.
Note: It may be noted that word "contractor " wherever is referred in section-2 &4 shall be read as bidder and word " employer " wherever is referred in section – 2& 4 shall be read as " Powergrid".

SECTION-2
Equipment Specification

ANNEXURE-XI

INTRODUCTION, GENERAL INFORMATION and GENERAL REQUIREMENT

Optical Powerline Ground Wire(OPGW) & associated equipment for LILO part of 220 kV transmission Pul-e-Khumri to Chimtala(Kabul) at Charikar & Doshi. This specification describes the functional and performance requirements of the system.

The purpose of this part of the specification is to provide introduction, general information, and general requirement and define the scope of the project.

1.1 Overview

OPGW cable shall be laid on LILO line from Charikar & Doshi sub-station to Pul-e-Khumri to Chimtala line. However, the fibre optic communication link shall be established between Kabul - Charikar – Doshi - Pul-e-Khumri sub-stations. This communication link will be used for substation SCADA, Voice and protection signalling. Over LILO part of transmission line OPGW shall be used in place of the earth wire. The connection of OPGW cable from gantry tower to the communication room shall be with underground armoured fibre optic cable (also called approach cable). The communication network shall be SDH based STM-1 links supporting 10/100 Mbit/s IEEE 802.3 Ethernet data links & 2 Mbit/s G.703 E1 circuits.

1.2 Scope and General Requirements

The scope is described in following two parts:

Part-1 -: Overhead Fibre Optic Cable (OPGW)

(a) The scope of procurement of this Part shall include the planning, design, engineering, supply, installation, splicing, termination, testing, demonstration for acceptance, commissioning and documentation of:

(i) Overhead Optical fibre cabling (OPGW)
(ii) Underground Fibre Optic approach cabling and Fibre Optic Distribution Panels (FODPs)
(iii) All associated hardware & fittings and accessories (Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps, Splice Enclosure etc.) for OPGW cable.

Part-2 : Terminal Equipments

b) The scope of procurement of this Part includes the planning, design, engineering, supply, installation, termination, testing, demonstration for acceptance, commissioning and documentation of:

(i) SDH Equipment including optical & electrical interfaces, DDF, racks,

synchronization etc.

(ii) Associated Termination equipment (Multiplexer including Voice & data cards).
(iii) Telecommunication Management Network (TMN)/NMS System
(iv) All cabling, wiring, Digital Distribution Frame patch facilities and interconnections to the supplied equipment at the defined interfaces.

All other associated works/items described in the technical specifications for a viable and fully functional communication network.

Part -1 through 7 of this Section defines the survey, design, performance, test and implementation requirements for Overhead Fibre Optic cable system to be installed under this Project.

1.3 Proposed communication System

The communication network shall be based on minimum bit rate of Synchronous Transport Module –1 (STM-1). Appendix B, Figure B- 1 depicts the communications network connectivity proposed under this Project.

1.3.1 General Requirements

The Contractor is encouraged to offer standard products and designs. However, the Contractor must conform to the requirements and provide any special equipment necessary to meet the requirements stated herein.

It should be noted that preliminary design information and bill of quantity (BoQ) specified in this specifications are indicative only. The Contractor shall verify the design data during the detail engineering and finalise the BoQ as required for ultimate design & system performance. The Employer reserves the right of execution of works within the stipulated quantity variation provision at places (inside Afghanistan) other than those indicated in the appendices at the same rates, terms and conditions.

An analysis of the functional and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude that additional items are required that are not specifically mentioned in this specification. The Contractor shall be responsible for providing at no added cost to the Employer and/or Purchaser, all such additional items such that a viable and fully functional Overhead Fibre Optic Cable System is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items in their proposal.

All equipment provided shall be designed to interface with other equipment and shall be supporting all present requirements and spare capacity requirement identified in the technical specifications.

1.4 General Responsibilities and Obligations

This part describes the general responsibilities and obligations of the Contractor and the Employer.

1.4.1 Responsibilities for the Implementation Plan

The Bidder's technical proposal shall include a project implementation plan and schedule that is consistent with the implementation plan detailed in this specification. The implementation plan shall be modelled such that it provides fibre optic cabling system support for the activation of this Project. The Implementation plan shall include the activities of both the Contractor and the Employer, showing all key milestones and clearly identifying the nature of all information and project support expected from the Employer. The Employer and Contractor shall finalise the detailed Implementation plan following award of the contract.

1.4.2 Contractor's Responsibilities and Obligations

Contractor's obligations include, but are not limited to, the following:

(1) Provide a working system that meets the functional and performance requirements of this specification.

(2) Engineering and design specific to each location including review of, and conformance with local environmental and earthing requirements.

(3) Inputs for finalisation of installation and safety guidelines and procedures for the stringing, mechanical installation

(4) Development of installation and safety guidelines and procedures for the complete system.

(5) Development of procedure for splicing of all fibre optic cable, including testing and documentation.

(6) Project management, project scheduling, including monthly project reports documenting progress during the contract period.

(7) Engineering and technical assistance during the contract and warranty period and annual maintenance contract (AMC) period.

(8) Site visits and studies necessary to identify and provide all equipment needed to implement the FO cabling network.

(9) Supply, installation and termination of cables and cabling for all interconnection.

(10) Submission of source power requirements for each cabinet/ rack of equipment.

(11) An availability analysis showing MTBF (mean-time-between-failure) and MTTR (mean-time-to-repair) figures for all system components.

(12) Factory and site acceptance testing of all items including hardware, software & firmware provided.

(13) Conduct type tests or provide documented evidence of satisfactory Type Test performance to the Employer.

(14) Provide a Quality Assurance Plan ensuring the Employer/Purchaser access to the manufacturing process.

(15) Providing earthing system and extension of earthing system

(16) Supply of cable & all equipment/items required for Terminal equipment system

(17) Shipment of all equipment and documentation to the Purchaser designated locations and/or staging areas.

(18) Storing, Staging, maintenance and security of the staging area up to the operational acceptance including the full responsibility for protection from fire and theft of the supplied equipment.

(19) Installation of OPGW, Underground armoured fibre optic cable (Approach Cable) along with associated fitting, hardwares and accessories, splice enclosures, FODP etc.

(20) Installation of Terminal Equipment System (SDH, Multiplexer Equipment etc.)

(21) All Fibre Optic Distribution frame patch facilities.

(22) Installation and integration of network management software, hardware and firmware.

(23) Provide all additional Equipment necessary to ensure compatibility with the equipment to be interconnected.

(24) All hardware, software, and firmware required to satisfy the requirements of this Specification.

(25) Overall integration of communication equipments/subsystem procured under this package

(26) All documentation and drawings as specified.

(27) All required spare parts, maintenance aids, etc.

(28) Training for to the Purchaser's personnel.

(29) Maintenance and support of the items through final acceptance, and maintenance throughout the warranty period.

(30) Hardware, software, and firmware maintenance, debugging, and support of the equipment through final acceptance, and maintenance on all new equipment through the warranty period.

(31) Due diligence in properly planning and executing the work so as to minimise any physical damage.

(32) Availability of service, spare and expansion parts for the supplied items for a minimum period of fifteen (15) years from the date of operational acceptance or seven (7) years after the declaration of withdrawal of equipment from production, whichever is earlier.

(33) Notification services for field updates to the hardware, software, and firmware.

Detailed descriptions of the Contractor's obligations, in relation to individual items and services offered, are delineated in other parts of this specification.

1.4.3 The Employer Responsibilities and Obligations

The Employer will provide the following items and services as part of this Project:

(1) Review and approval of the Contractor's designs, drawings, engineering documents, test procedures and recommendations.

(2) Participation in and approval of "Type", factory and site acceptance tests.

(3) Review and approval of training plans.

(4) Providing support and access to facilities at the sites.

(5) Provide to the extent possible drawings for existing sites and facilities for which equipment installations are planned.

(6) Overall project management of the project

(7) Earthing details of sub-stations where terminal equipment is to be installed.

(8) Providing –48 Volts DCPS /220 AC Power supply for communication equipments

1.5 Supported Systems

The communication systems shall support Real time data transfer for SCADA system, voice communication & digital tele-protection signalling.

1.6 General Bidding Requirements

The Bidder shall be responsive to the technical requirements as set forth in this specification. The Bidder's proposal shall include the following:

(1) The Technical Proposal including the documents listed in the table 1-1: Bid Documents Checklist shall be provided in the bid.

(2) The bidder shall submit with their proposal, performance certificate of all the offered equipments i.e. SDH & Multiplexer from at least one customer. The performance certificates shall provide evidence of successful operation of the proposed equipment for at least two years as on date of opening of the bid.

(3) A detailed project implementation plan and schedule that is consistent with the scope of the project and Employer's specified objectives. The plan shall include the activities of both the Contractor and Employer, show all key milestones, and clearly identify the nature of all information and project support to be provided by Employer.

(4) A commitment and a clearly defined plan to develop a system support organization, based in India and capable of providing a full range of local services (including software and hardware maintenance and upgrade support) for the life of the delivered telecommunications systems.

Table 1-1;
Bid Documents Checklist

S. No.	Description:	Enclosure Reference	
1	Type Test Certificates for offered items. (As per relevant Parts of Technical Specs Volume II)	Page no. Ref no.	
2	Completed Data Requirement Sheets (As per Technical Spec Volume II)	Page no. Ref no.	
3	Performance certificate of two years of successful operation from one customer	Page no. Ref no.	
4	Quality Assurance Program	Page no. Ref no.	
5	Detailed Project Implementation Plan	Page no. Ref no.	

1.7 Table of Compliance

Bidder shall use one copy of Volume II, "Technical Specifications" to indicate compliance status with those volumes. Within the right-hand margin, Bidder shall indicate compliance status to each paragraph along with a cross-reference to its proposal and an index key for any explanation or comment.
In addition, the Bidder shall annotate the Table of Contents of each of the above stated volumes to provide a high-level summary of compliance status. In both cases, the following symbols, and no others, shall be used:

C - Bid complies with all requirements in the adjacent paragraph.

A - Bid is not compliant with the requirements in the adjacent paragraph, but a functional alternative is proposed.

X - Bid takes exception to the requirements of the adjacent paragraph and no functional alternative is proposed.

Only one symbol shall be assigned to a paragraph and shall indicate the worst case level of compliance for that paragraph. This annotation may be hand written.

Bidder shall also underline, on the compliance copy, all requirements to which exceptions have been taken (X) or to which alternatives have been proposed (A).

Each alternative shall be clearly and explicitly described. Such descriptions shall use the same paragraph numbering as the bid document parts addressed by the alternatives. All alternative descriptions shall be in one contiguous part of the Bidder's proposal, preferably in the same volume, and titled "Alternatives." A separate part titled "Exceptions" should be provided containing any discussion or explanation Bidder chooses to provide concerning exceptions taken. Alternatives which do not substantially comply with the intent of the bid documents will be considered exceptions.

The Employer will assess the merits of each alternative and exception and will be the sole judge as to their acceptance.

1.10 Organization of the Technical Specification Document

Part-2 through 7 provide the requirements of the fibre optic communication system to be provided.

Part-2 contains the specifications and functional description for the fibre optic cabling system.
Part-3 contains Network Configurations, Equipment Characteristics and Network Management System
Part- 4 contains the specification for Environment, Power Supply, Cabling and Earthing
Part-5 contains the specification for Inspection, Tests and Availability
Part-6 contains the specification for Training and Support Services
Part-7 contains the Documentation and Deliverables

The following is a list of the Volume II , Section VI Appendices:

Appendix A - Acronyms
Appendix B - ~~Bill of Quantity (BoQ)~~ Refer section-1 of Specification
Appendix C - Type Testing and Factory Acceptance Test (FAT) requirements
Appendix D - Data Requirement Sheets

1.11 Applicable Standards

The following standards and codes shall be generally applicable to the equipment and works supplied under this Contract:

(1) American Society for Testing and Materials ASTM

ASTM-B415	Standard Specification for Hard-Drawn Aluminium-Clad Steel Wire
ASTM-D1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable
ASTM D3349	Standard Test Method for Absorption Coefficient of Ethylene Polymer Material Pigmented with Carbon Black

(2) Bell Communication Research

GR-20	Generic requirements for optical fibre and optical fibre cable

(3) ITU-T/CCITT Recommendations

G.650	Definitions and test methods for the relevant parameters of single-mode fibres
G.652	Characteristics of a single-mode optical fibre cable

(4) IEEE

IEEE-524	IEEE Guide to the Installation of Overhead Transmission Line Conductors
IEEE-1138	IEEE Standard Construction of Composite Fibre Optic Ground Wire (OPGW) for Use on Electric Utility power Lines

(5) Telecommunication Industry Association EIA/TIA

EIA/TIA-455-3	Procedure to Measure Temperature Cycling Effects on Optical Fibres, Optical Cable, and Other Passive Fiber Optic Components
EIA/TIA-455-16	Salt Spray (Corrosion)Test for Fibre Optic Components
EIA/TIA-455-25	Repeated Impact Testing of Fibre Optic Cables and Cable Assemblies
EIA/TIA-455-32	Fibre Optic Circuit Discontinuities
EIA/TIA-455-33	Fibre Optic Cable Tensile Loading and Bending Test
EIA/TIA-455-41	Compressive Loading Resistance of Fibre Optic Cables
EIA/TIA-455-59	Measurement of Fibre Point Defects Using an OTDR
EIA/TIA-455-62	Measurement of Optical Fibre Macrobend Attenuation
EIA/TIA-455-80	Measurement of Cut-Off Wavelength of Single-Mode Fibre

	by Transmitted Power
EIA/TIA-455-81	Compound Flow (Drip) Test for Filled Fibre Optic Cable
EIA/TIA-455-82	Fluid Penetration Test for Fluid-Blocked Fibre optic Cable
EIA/TIA-455-91	Fibre Optic Cable Twist-Bend Test
EIA/TIA-455-164	Single-Mode Fibre, Measurement of Mode Field Diameter by Far-Field Scanning
EIA/TIA-455-168	Chromatic Dispersion Measurement of Multimode Graded Index and Single-Mode Optical Fibres by Spectral Group Delay Measurement in the Time Domain
EIA/TIA-455-169	Chromatic Dispersion Measurement of Single-Mode Optical Fibres by the Phase-Shift Method
EIA/TIA-455-170	Cable Cut-off Wavelength of Single-Mode Fibre by Transmitted Power
EIA/TIA-455-174	Mode Field Diameter Measurement
EIA/TIA-455-175	Chromatic Dispersion Measurement of Single-Mode Optical Fibres by the Differential Phase-Shift Method
EIA/TIA-598	Optical Fibre Cable Colour Coding

(6) International Electrotechnical Commission IEC standards

IEC-60068-2-18	Environmental testing - Water
IEC-60068-2-32	Environmental testing - Free fall
IEC-60304	Standard Colours for Insulation for low-frequency cables and wires
IEC-60529	Degrees of protection provided by enclosures (IP Code)
IEC-60793-1	Optical fibres – Generic specification
IEC-60793-2	Optical fibres – Product specification
IEC-60794-1	Optical fibre cables – Generic specification
IEC-60794-2	Optical fibre cables – Product specification
IEC-60794-3	Optical fibre cables – Duct, buried and aerial cables – sectional specification
IEC-61089	Round wire concentric lay overhead electrical stranded conductors
IEC-61232	Aluminium-clad steel wires for electrical purposes
IEC-61284	Overhead lines-Requirements and tests for fittings
IEC-61395	Overhead electrical conductors – Creep test procedures for stranded conductors
IEC-61396	Construction of Composite Fibre Optic Ground Wire (OPGW); Draft

(7) The following standards and codes shall be generally applicable to the equipment and works supplied under this Contract

(i) IEEE 802.3

(ii) ITU-T/CCITT Recommendations, G.652, G.701, G.702, G.703, G.711/ 12/ 14/ 35/ 36, G.721, G.742, G.811 and G.823

(iii) ITU-T/CCITT Recommendations, G.801, G.821, G.822, G.823, G.826.

(iv) ITU-T/CCITT Recommendations of the V Series

(v) ITU-T/CCITT Recommendations R35, R37, and R38A (or R38B)
(vi) ITU-T/CCITT Recommendations M3010, G771
(vii) International Electrotechnical Commission standards, IEC 801-2/3/4/5. IEC-255-4, IEC-255-5, IEC-870-2-1, IEC-721-3-3, IEC-529.
(viii) IEC publication 68, 68-2-2, 68-2-3, 68-2-14, 68-2-27, 68-2-32.
(ix) ITU-T/CCITT Recommendations K.11, K.17, K.20.
(x) International CISPR standards

---------- **End of this Part** ----------

SPECIFICATIONS AND FUNCTIONAL DESCRIPTION FOR FIBRE OPTIC CABLE SYSTEM

This Part describes the functional & technical specifications of overhead fibre optic cable (OPGW), fibre optic approach cable and associated hardware & fittings.

2.1 Fibre Optic Cabling

This Part defines the requirements for G.652 Dual-window Single mode (DWSM) telecommunications grade fibre optic cable. Bidders shall furnish with their bids, detailed descriptions of the fibres & cable(s) proposed.

All optical fibre cabling including fibre and all associated installation hardware shall have a minimum guaranteed design life span of 25 years.

2.1.1 Required Optical Fibre Characteristics

This Part describes the characteristics of optical fibre to be provided under this specification.

2.1.1.1 Physical Characteristics

12 nos. of Dual-Window Single mode (DWSM) optical fibres shall be provided in the fibre optic cables as per quantities specified in the Appendices. DWSM optical fibres shall meet the requirements defined in Table 2-1(a).

2.1.1.2 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The attenuation coefficient between 1285 nm and 1330 nm, shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 2-1 (a)shall be "guaranteed" fibre attenuation of any & every fibre reel.

The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: 0.23dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors

Maximum attenuation @ 1310nm: 0.35dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors

Table 2-1(a)
DWSM Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 μm (± 10% of the nominal value)
Cladding Diameter:	125.0 μm ± 2 μm
Mode field concentricity error	≤ 1.0μm at 1310 nm
Cladding non-circularity	≤ 2%
Cable Cut-off Wavelength λ_{cc}	≤ 1260 nm
1550 nm loss performance	As per G.652
Proof Test Level	≥ 100 kpsi
Attenuation Coefficient:	@ 1310 nm ≤ 0.35 dB/km @ 1550 nm ≤ 0.23dB/km
Chromatic Dispersion; Maximum: **Zero Dispersion Wavelength:** **Zero Dispersion Slope:**	20 ps/(nm x km) 1550 nm 3.5 ps/(nm x km) 1288-1339nm 5.3 ps/(nm x km) 1271-1360nm 1300 to 1324nm -0.093 ps/(nm^{2}xkm) maximum
Polarization mode dispersion coefficient	≤ 0.5 ps/km^½
Temperature Dependence:	Induced attenuation ≤ 0.05 dB (-60^{0}C - +85^{0}C)
Bend Performance:	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB/km @ 1550 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.10 dB/km @ 1550 nm (32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise ≤ 0.50 dB/km
End of Table	

2.1.1.3 Optical Fibre Cable Link Lengths

The estimated optical fibre link lengths are provided for each required link in Appendices. However, the Contractor shall supply the optical fibre cable as required during the project execution. The Contract price shall be adjusted accordingly.

For the purpose of payment, the optical fibre link lengths are defined as transmission line route lengths from Gantry at one terminating station to the Gantry in the other terminating station. The actual cable lengths to be delivered shall take into account various factors such as sag, service loops, splicing, working lengths & wastage etc. and no additional payment shall be payable in this regard. The unit rate for FO cable quoted in the Bid price Schedules shall take into account all such factors.

2.1.1.2 Optical Fibre Identification

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 or IEC 60304 or Bellcore GR-20 colour-coding scheme.

Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing. Each cable shall have traceability of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified number of fibres is included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

2.1.1.3 Buffer Tube

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel.

2.1.1.4 Optical Fibre Strain

The fibre optic cable shall be designed and installed such that the optical fibres experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep.

For the purpose of this specifications, the following definitions shall apply:

- *Maximum Working Tension (MWT)* is defined as the maximum cable tension at which there is *no fibre strain.*
- The *no fibre strain* condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ ETSI (FOTP) specified optical reflectometry techniques.
- The *Cable strain margin* is defined as the maximum cable strain at which there is no fibre strain.
- The cable *Maximum Allowable Tension (MAT)* is defined as the maximum tension experienced by the Cable under the worst case loading condition..

- The cable *max strain* is defined as the maximum strain experienced by the Cable under the worst case loading condition.
- The cable *Every Day Tension (EDT)* is defined as the maximum cable tension on any span under normal conditions.
- The *Ultimate /Rated Tensile Strength (UTS/* RTS/ breaking strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.

While preparing the Sag-tension charts for the OPGW cable the following conditions shall be met:

- The Max Allowable Tension (MAT) / max strain shall be less than or equal to the MWT/ Strain margin of the cable.
- The sag shall not exceed the earth wire sag in all conditions.
- The Max Allowable Tension shall also be less than or equal to 0.4 times the UTS of OPGW. However, Max Allowable Tension up to 0.5 times the UTS of OPGW may be accepted, subject to no fibre strain.
- The 25 year creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 year creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
- The everyday tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The Sag-tension chart of OPGW indicating the maximum tension, cable strain and sag shall be calculated and submitted along with the bid under various conditions mentioned below.

a) For Light/medium ice condition:

1. 25°C, no wind and no ice (Everyday Condition)
2. –5° c, full wind and no ice
3. –5° C, 25% full wind and 15 mm radial (Hard rime) ice
4. 55° C , no wind and no ice
5. –15° C, 15mm radial (Hard rime) ice no wind

The size of OPGW shall be selected such that max, tension and sag at specified temperature and wind condition remain within the limits indicated below:

S.No.	Parameter	FOR LIGHT/MEDIUM ICE ZONE (15mm Radial Ice)
1.	Design Span	300 m
2.	Design Wind Pressure	240 kg/m^2(including gust and drag)
3.	Diameter of OPGW	9-15.8 mm
4.	Tension (Max)	5300 kg
5.	Sag (Max)	6.2m (at – 5 °C, no wind and full ice)

The above cases shall be considered for the spans from 100 m to 600 m in the range of 50 m spans. The full wind load shall be considered as the design wind load for all the specified transmission lines as per relevant IS 802 version and the sag-tension chart shall be submitted for both the cases and considering all the transmission lines. The stringing chart shall be submitted by the transmission line Contractor. However. the same shall be reviewed by this package Contractor and Employer.

2.1.1.5 Cable Materials

The materials used for optical fibre cable construction, shall meet the following requirements:

2.1.1.5.1 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC-60794-1-F-5. The filling compound used shall be a non-toxic homogenous waterproofing compound that is free of dirt and foreign matter, nonhygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The filling compound shall meet the requirements of "Seepage of Filling Compound test" as per EIA/TIA 455-81. The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

2.1.1.5.2 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

2.1.1.5.3 Marking, Packaging and Shipping

This Part describes the requirements for marking, packaging and shipping the overhead fibre optic cable.

(a) Drum Markings: Each side of every reel of cable shall be permanently marked with the vendors' address, Purchaser's name, destination address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line & segment no., factory inspection stamp and date.

(b) Cable Drums: All optical fibre cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as

to prevent the escape of filling compounds and dust & moisture ingress during shipment and handling.

There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by the Contractor.

2.1.1.6 Optical Ground Wire (OPGW)

OPGW cable construction shall comply with IEEE-P1138 and IEC publication 1396. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The cable shall consist of optical fibre units as defined.

The composite fibre optic overhead ground wire shall be made up of buffered optical fibre units embedded in a water tight aluminium / aluminium alloy/stainless steel protective central fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre.

2.1.1.6.1 Central Fibre Optic Unit

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibre units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning and fault current, as well as environmental effects which may produce hydrogen. The central fibre optic unit may include an aluminium tube and/or channelled aluminium rod.

2.1.1.6.2 Basic Construction

The cable construction shall conform to the applicable clauses of IEC 61089 related to stranded conductors and Table 2.2(a) OPGW Mechanical and Electrical Characteristics. In addition, the basic construction shall include bare concentric-lay-stranded metallic wires with the outer layer having left hand lay. The wires may be of multiple layers with a combination of various metallic wires within each layer. The direction of lay for each successive layer shall be reversed.

2.1.1.6.3 Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as no more than 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength.

The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the total rated breaking strength of the composite conductor.

2.1.1.6.4 Electrical and Mechanical Requirements

Table 2-2(a) provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics. For the purposes of determining the appropriate Max Working Tension limit for the OPGW cable, IS 802:1995 and IS 875: 1987 shall be applied. However the OPGW installation sag & tension charts shall be based on IS 802 version to which the line is originally designed. For the OPGW cable design selection and preparation of sag tension charts, the limits specified in this specification shall also be satisfied. The Bidder shall submit sag-tension charts for the above cases with their bids

Table 2.2(a)
OPGW Electrical and Mechanical Requirements

(1)	**Everyday Tension**	≤ 20% of UTS of OPGW
(2)	**D.C. Resistance at 20^0C:**	< 1.0 ohm/Km
(3)	**Short Circuit Current:**	≥ 6.32 kA for 1.0 second

2.1.1.6.5 Operating conditions

Since OPGW shall be located at the top of the EHV transmission line support structure, it will be subjected to Aeolian vibration, Galloping and Lightning strikes. It will also carry ground fault currents. Therefore, its electrical and mechanical properties shall be the same or similar as those required of conventional ground conductors.

2.1.1.6.6 Installation

All hardware & fittings needed to tie the OPGW to the towers/gantries shall be provided by the contractor.

The OPGW cable sections shall normally be terminated & spliced only on tension towers. In exceptional circumstances, and on Employer specific approval, cable may be terminated on suspension towers, but in this case tower strength shall be examined to ensure that tower loads are within safe limits and if required, necessary tower strengthening shall be carried out by the Contractor.

2.1.1.6.7 Installation Hardware

The scope of supply of the optical cable includes the assessment and supply of all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps , Splice enclosure etc. To ensure their satisfactory performance, the Contractor shall determine the exact requirements of all accessories used to install and secure the OPGW.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284: 1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e.level 1 drawing and (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

(a) Suspension Assemblies: Preformed armour grip suspension clamps and aluminium alloy armour rods/ reinforcing rods shall be used. The suspension clamps shall be designed to carry a vertical load of not less than 25 kN. The suspension clamps slippage shall occur between 12kN and 17 kN.

The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, etc. The total drop of the suspension assembly shall not exceed 150 mm (measured from the centre point of attachment to the centre point of the OPGW). The design of the assembly shall be such that the direction of run of the OPGW shall be the same as that of the conductor.

(b) Dead End Clamp Assemblies: All dead end clamp assemblies shall preferably be of the performed armoured grip type and shall include all necessary hardware for attaching the assembly to the tower strain plates. Dead end clamps shall allow the OPGW to pass through continuously without cable cutting. The slip strength shall be rated not less than 95% of the rated tensile strength of the OPGW.

(c) Clamp Assembly Earthing Wire: Earthing wire consisting of a 1500 mm length of aluminium or aluminium alloy conductor equivalent in size to the OPGW shall be used to earth suspension and dead end clamp assemblies to the tower structure. The earthing wire shall be permanently fitted with lugs at each end. The lugs shall be attached to the clamp assembly at one end and the tower structure at the other.

(d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves for the OPGW, one on either side of the connecting bolt. The clamps shall be such that clamping characteristics do not alter adversely when only one OPGW is installed. The tower attachment plates shall locate the OPGW on the inside of the tower and shall be attached directly to the tower legs/cross-members without drilling or any other structural modifications.

(e) Vibration Dampers

(i) Vibration dampers of 4R-Stockbridge type with four (4) different frequencies spread within the specified aeolian frequency band-width corresponding to wind speed of 5m/s to 7 m/s shall be used for suspension and tension points on OPGW cable in each span to damp out aeolian vibrations.

(ii) One damper minimum on each side per OPGW section at suspension points and two dampers on each side per OPGW section at tension points shall be used for ruling design span of 300 meters for 220 kV line. The Contractor shall determine the exact numbers and placement(s) of vibration dampers through a detailed vibration analysis.

(iii) The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chaffing of the OPGW cable during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the OPGW cable without damaging the strands or causing premature fatigue failure of the earth wire under the clamp. The clamp groove shall be in uniform contact with the OPGW cable over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or materials which could cause damage to the earth wire when the clamp is installed. Clamping bolts shall be provided with self locking nuts designed to prevent corrosion of the threads or loosening during service.

(iv) The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 Kg/sq.mm. It shall be of preformed and post formed quality in order to prevent subsequent droop of weights and to maintain consistent flexural stiffness of the cable in service. The number of standards in the messenger cable shall be 19. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.

(v) The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkages, inclusions and blow holes etc. The inside and outside surfaces of the damper masses shall be smooth.

(vi) The vibration analysis of the system, with and without damper, dynamic characteristic of the damper as detailed under Annexure-A, shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the system are as follows

Sl. No.	Description	Technical Particulars
		220 kV
1.	Span length in meters	
(i)	Ruling design span	300 meters
(ii)	Maximum span :	1100 meters
(iii)	Minimum span :	100 meters

2.	Tensile load in OPGW at temp. of 0° C and still air	As per sag tension calculation
3.	Maximum permissible dynamic strain	±150 micro strains

(vii) The damper placement chart for spans ranging from 100 m to 1100 m shall be submitted by the Bidder. All the placement charts should be duly supported by relevant technical documents.

(viii) The damper placement charts shall include the following :

(1) Location of the dampers for various combinations of spans and line tensions clearly indicating number of dampers to be installed on OPGW cable per span.

(2) Placement distances clearly identifying the extremities between which the distances are to be measured.

(3) Placement recommendation depending upon type of suspension clamps (viz, free center type/trunion type etc.)

(4) The influence of mid span compression joints in the placement of dampers.

2.1.1.7 Fibre Optic Approach Cables

For purposes of this specification, a fibre optic approach cable is defined as the underground fibre optic cable installed between the splice enclosure on the gantry and the Fibre Optic Distribution Panel (FODP) installed within the terminal building. The estimated fibre optic approach cabling length requirements are indicated in the appendices. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly.

2.1.1.7.1 Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

2.1.1.7.2 Jacket Construction

The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring.

2.1.1.7.3 Jacket Material

The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall conform to low density, medium density and high density polyethylene standards as defined in ASTM D1248.

2.1.1.7.4 Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

2.1.2 Optical Fibre Termination and Splicing

Optical fibre terminations shall be installed in Fibre Optic Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The Contractor shall provide rack mounted Fibre Optic Distribution Panels (FODPs) sized as indicated in the appendices, and shall terminate the fibre optic cabling up to the FODPs.

2.1.2.1 Fibre Optic Distribution Panels

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

(a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to pre-connectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings.

(b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.

(c) FODPs shall be supplied in suitable cabinets/racks with locking arrangement

(d) All FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Specific selection of the entry points shall be made at the time of installation. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.

2.1.2.2 Optical Fibre Connectors

Optical fibres shall be connectorised with FC-PC type connectors. Fibre optic couplings supplied with FODPs shall be appropriate for the fibre connectors to be supported. There shall be no adapters.

2.1.2.3 Fibre Optic Splice Enclosures (Joint Box)

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. The Splice Enclosures shall comply to ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of a minimum of 12 optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures.

Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on EHV transmission towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. Contractor shall be responsible for installation of splice enclosures.

2.1.2.4 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful Contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur within facilities or on tower structures. All optical fibre splicing shall comply with the following:

(a) All fibre splices shall be accomplished through fusion splicing.

(b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.

(c) All splices and bare fibre shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.

(d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.

(e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

.1.3 Methodology for Installation and Termination

ıe transmission line contractor shall install the OPGW cable as per field proven and ISO accredited stallation practices.

tical fibre attenuation shall be measured before and after installation and before splicing. Any increase ıttenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable ıent failure. In the event of cable damage, the complete section (tension location to tension location) ' be replaced, as mid-span joints are not acceptable.

2.1.3.1 Service Loops

For purpose of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

(a) Outdoor Cable Service Loops: FODPs and in-line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.

(b) Indoor Cable Service Loops: FODPs shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius' are maintained.

(c) Fibre Units Service Loops: For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of fibre units shall provide for at least one (1) metre of fibre unit service loop between the stripped cable and the bare fibre fan-out.

(d) Pigtail Service Loops: Connectorized pigtails spliced to bare fibres shall provide at least 0.5 metre of service loop installed in the FODP fibre organizer and at least one (1) metre of service loop to the couplings neatly stored behind the FODP coupling panels.

(e) Fibre Service Loops: At least 0.5 metre of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

2.1.4 Installation of Approach Cable

A network of cable trenches and/or ducts may exist at sites and/or new construction at stations. It shall be a responsibility of the Contractor to cooperate fully with the Employer in the planning and efficient use of existing and new-construction infrastructure supporting on-station communications cabling. The Contractor shall route the cable through the existing available cable trenches to the extent possible.

It may be noted that in order to utilise the existing trenches, the approach cable may be required to be co-located with HV and LV cables. Accordingly, the approach cable shall be installed in corrosion resistant flexible conduit also across the trenches. Suitable provisions shall be made by the Contractor to ensure adequate safety earthing and insulated protection for the approach cable. Approach cables exiting from the ground or passing through floors shall be protected against mechanical damage.

Approach cables shall penetrate buildings through cable ducts. The cabling shall route within buildings in cable raceways or under raised floors. The Contractor may utilize existing ducts, building penetrations, cable trays, racks, etc., where appropriate and approved by the Employer. The cables shall be affixed to cable supports using approved ties, clips or cleats at regular intervals. On short approach cable runs for which cable supports are not required, the Contractor shall fix the cable to the structure of the building using approved fixings and cable cleats.

All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for lay and installation of approach cables shall be supplied and installed by the Contractor.

End of this Part

NETWORK CONFIGURATION, EQUIPMENT CHARCTERISTICS & NETWORK MANAGEMENT SYSTEM (NMS)

3.0 INTRODUCTION

This Part describes the functional requirements, major technical parameters for Fibre Optic Transmission Equipments, Termination Equipment System & Network Management System (NMS) to be provided under this package.

3.1 NETWORK CONFIGURATION AND TELECOM EQUIPMENT CHARACTERISTICS

The subsystems addressed are:

(1) Fibre Optic Transmission System
(2) Termination Equipment Sub-system
(3) DDF, MDF and Cabling
(4) Network Management System

The requirements described herein are applicable to and in support of network configurations depicted in Appendix B.

3.1.1 General Network Characteristics

3.1.1.1 Description

The wideband communication network for this Project is depicted in Figure 1. The communication system would support the data & voice requirements of SCADA in point to point, Point to multipoint and/or multipoint to multipoint configuration using Ethernet over SDH. In addition to this digital teleprotection circuits shall be provided on the SDH network for transmission line protection.

The fibre optic network shall be based on the lowest bit rate of the Synchronous Digital Hierarchy (SDH) i.e. STM-1. The Contractor, however can propose a system based on higher bit rate systems so as to meet the link budget requirements.

The detailed BOQ is described in Section-I

3.1.1.2 Functional Requirement

The SDH network shall provide the following services:

SCADA Data: Digital communications shall be provided to connect the SCADA Remote Terminal Unit (RTU) at each site with the Control Centre . 10/100 Mbit/s IEEE 802.3

Ethernet data links shall be provided over the SDH.

Teleprotection: Digital teleprotection circuits shall be provided on the SDH network for all transmission line protection.
In addition to this data transport supporting Network Management activities shall also be provided.

3.1.2 General Systems Requirements

Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level.

3.1.2.1 System Upgradeability and Expandability

Equipment supplied shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped sub-units, shall be terminated at appropriate patching facilities or termination blocks. Power supplies and TMN shall be sized for maximum equipped system capacity.

3.1.2.2 Equipment Availability

The calculated availability requirements are as follows:
(1) The availability of each fibre optic link (E-1 to E-1) shall be at least 99.999%.
(2) The availability of network end to end (E-1 to E-1) shall be at least 99.998%.
(3) The average subscriber to subscriber availability shall be at least 99.97%.

The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS.

In order to ensure that the equipment & configuration proposed by the bidders shall be capable of demonstrating the specified availability figures it is required that the Bidders shall include in their proposal a calculated availability analysis for the proposed equipment/ sub system. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided in the proposal. The analysis shall be based on an availability block diagram and shall include the mean-time-between failure (MTBF) and mean-time-to-repair (MTTR) of all of the components on the link. The Contractor shall indicate in the analysis the MTBF and MTTR and the resulting availability of each point-to-point link. For this analysis, an MTTR of at least 4 hours. shall be assumed

3.1.3 General Equipment Characteristics

All Contractor supplied equipment shall be new and of the finest production quality. The

Employer will not accept modules or printed-circuit boards that are modified by appending wires or components. Wired strapping options shall be incorporated in the board design to meet the above requirement.

3.1.3.1 Revision Levels and Modifications

All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most of current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by the Employer, prior to the completion of SAT.

All field modifications of the hardware, firmware and software that is required to meet installation and/or performance specifications, shall be fully documented as part of the deliverables, both as a separate field modifications record and as corrected equipment/configuration documentation.

3.1.3.2 Equipment Capacities

Equipment supplied shall be sized and equipped with sufficient capacity to support the circuit, channelization and configuration requirements, including spares, as identified in the appendices.

Data communications channelization required to support the TMN subsystems specified are not identified in the appendices. Therefore, the Contractor is required to size and equip the system to include all channelization and channel cards required to support the TMN function.

3.1.3.3 Redundancy Requirements and Protection Schemes

Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 3-1.

Table 3-1
Equipment Redundancy Requirements Summary

Fiber Optic transmission Equipment :	
SDH equipment	
Power Supply & Converters ----------	1:1, APS or distributed power supply
Common Control* Cards ----------	1:1 APS
Tributary Cards E1----------	N:1 APS

Table 3-1
Equipment Redundancy Requirements Summary

MULTIPLEX EQUIPMENT Power Supply ---------- * = Common control cards which are essentially required for operation of the equipment.	1:1 APS or distributed power supply

The offered equipment shall support at least SNCP as per standard ITU-T G.841. In case the equipment offered by the Bidder does not support the above mentioned minimum protection methods, the bidder shall have to provide all additional equipment needed to provide same level of flexibility, redundancy and functionality at no additional cost to Purchaser. The bidders shall provide details of protection schemes supported in the Bid document. The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switchover shall be provided by the Contractor.

3.1.3.4 Lost Signal Recovery

At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to the signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported if applicable.

3.1.3.5 Equipment Lifespan

All equipment supplied shall have a minimum expected life of fifteen (15) years from the date of operational acceptance.

3.1.4 Fibre Optic Link Lengths

The fiber optic route lengths (i.e. transmission line route lengths) are as specified in Section I. The lengths specified in appendices are the transmission line route lengths; however the actual fiber cable length shall exceed the route lengths on account of extra cable requirement due to sag, jointing & splicing, approach cabling etc. For bidding purposes the Contractor may assume an additional cable length of 5% of transmission line route length + 1 Km towards approach cable for calculating the link length. The exact cable lengths shall be used for final link design during the detailed engineering of the project. The contract price shall be adjusted accordingly.

3.1.5 Fibre Optic Transmission System

The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-1 and equipped with minimum 4 Ethernet interfaces (IEEE 802.3/IEEE 802.3u) supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. The Contractor may offer external Layer-2 switch to meet the functionality if Layer-2 switching is not supported within the offered SDH equipments. The SDH equipment shall also support E1 interfaces (G.703). The bidder shall provide STM-1 or higher aggregate bit rate SDH equipment as may be required to meet the link budget requirements.

The Contractor shall provide (supply and install) connectorised jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.

3.1.6.1 SDH Equipment

3.1.6.1.1 Functional Requirement

There is a requirement of SDH ADM equipment under this project. The BOQ is provided in the appendices. For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts ie. Optical cards (Line), Tributary Cards (Electrical tributaries such as E1 (2Mbit/s) and Ethernet 10/100 Mbps interface) and Base Equipment (Consisting of Common Cards, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment ie. everything besides optical cards and tributary cards). The Bidder shall list out all type of cards/items being provided, in the BOQ and identify price for each separately.

The aggregate interfaces shall be (at least) STM-1 towards at least two directions. The equipment shall support at least E1 electrical tributary interfaces and Ethernet interfaces. At present the equipment shall be equipped with a minimum 4 Ethernet 10/100 Base-T & 4 E1 electrical tributary interfaces as defined in appendices interfaces. The Equipment shall provide access to full STM-1 payload for mapping of E1s and each Ethernet interface over any single or multiple VC-12s. The ADM Equipment shall be capable of VC-12 level Cross Connection of up to 2 STM-1 equivalent.

The equipment shall be configurable either as a Terminal Multiplexer (TM) or as an Add/Drop Multiplexer (ADM) or Cross Connect (DXC) by adding or removing cards.

3.1.6.1.2 Redundancy and Protection

The protected links using 4 fibres shall be implemented. The actual protection scheme shall

be finalized during detailed engineering. The Contractor shall provide all required optical cards, protection cards (if any) and size the equipment accordingly.

3.1.6.1.3 Service Channel

Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Muldems that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and One data channel. Both omnibus and selective calling facilities shall be provided. There shall be a facility to extend the line system order-wire to any other system or exchange lines on 2W/4W basis.

3.1.6.1.4 Supervision and Alarms

ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784. Additionally, F2/Q2 interfaces for a local craftsperson terminal interface and remote equipment monitoring is required.

The Equipment shall support collection of at least four (4) external alarms for monitoring and control of station associated devices by the TMN.

3.1.6.1.5 Synchronization output

One 2MHz synchronization output from each equipment shall be reserved to be used in future by the Purchaser. The Contractor shall be responsible for providing necessary hardware required, in case the equipment doesn't support the same for providing one 2MHz synchronization output.

3.1.6.1.6 Electrical and Optical I/O Characteristics and General Parameters

Table 3-2 provides the electrical and optical characteristics as well as other general parameters for SDH equipment.

Table 3-2
Electrical and Optical I/O Characteristics and General Parameters

Optical Wavelength [NOTE (1)]	1310/1550nm
Optical Source [NOTE (2)]	Laser
Optical Source Lifespan	Better than $5 X10^5$ hours
Optical Fibre Type	G.652 and G.653
Optical Connectors	Type FC-PC

Table 3-2

Electrical and Optical I/O Characteristics and General Parameters

Transmission Quality	Per ITU-T G.821, G.823, G.826
Source Primary Power	-48 Vdc
Equipment Specifications	Per ITU-T G.783
Tributary, Electrical Interface	Per ITU-T G.703, 75Ω
Ethernet 10/100 Mbps interface	Per IEEE 802.3/802.3u
SDH Bit Rates	Per ITU-T G.703
Optical Interfaces	Per ITU-T G.957, G.958
Frame and Multiplexing Structure for SDH	Per ITU-T G.707
Synchronization	Per ITU-T G.813
Management Functions	Per ITU-T G.774, G.784
Protection Architectures	Per ITU-T G.841
Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784

NOTE (1) Optical wavelength shall be selected considering the characteristics of the optical fibre and the link budget.

NOTE (2) **Eye Safety for Laser Equipment:** To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958.

3.1.6.2.2 Optical Amplifiers

A combination of transmit power amplifier, receiver preamplifier and Wavelength Translator shall be offered to meet the link budget requirements. Both the transmitter power amplifier and the receive preamplifier shall be located at the terminal stations .The Bidders may also offer any high power interfaces to meet the link budget requirements. The Bidders shall provide detail specifications of Optical Amplifiers in the Bid.

The Bidder shall identify the type and quantity of Optical amplifiers/high power interfaces required for long link. The Bidder shall list out the different type of cards/items being provided, in the BoQ and identify price for each separately.

3.1.6.3 Optical Link Performance Requirements

The optical fibre link performance requirements are specified as follows.

3.1.6.3.1 Link Budget Calculations

The fibre optic link budget calculations shall be calculated based upon the following criteria:

(1) Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation ie 0.23 dB/Km @1550nm and 0.35 dB/km @1310nm.

(2) Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.

(3) Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.

(4) Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed "End of Life (EOL)" parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered and a similar margin shall be considered for optical amplifiers.

(5) Optical path Penalty: An optical path penalty of at least 1 dB shall be considered to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.

(6) Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.

(7) Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.

(8) Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion ie 20 ps/nm.Km @1550 nm & 6 ps/nm.km @ 1310 nm for DWSM fibres and 2.7 ps/nm.km @ 1550 nm for DSSM fibres.

(9) Bit Error Rate: The link budget calculations shall be done for a BER of 10^{-10}.

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) and BOQ for SDH Equipment Systems (including exact quantity and type of optical cards), repeaters and optical amplifier, if required, for each fibre optic link. The Bidder shall indicate and quote for the exact quantity required as per these calculations in the Bid Price Schedules. No repeater shall be used for any link.

For finalizing the FOTS system design & BOQ, similar methodology shall be adopted during the detail engineering taking into account fibre attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

3.1.6.3.2 Link Performance

The Link performance for ES, SES and BER for the fibre optic links shall correspond to National Network as defined in ITU-T G.826.

3.1.6.4 FODP to SDH Equipment/Optical Amplifier Connectivity

The Contractor shall be responsible for connectivity between the FODP and the SDH

equipment. The Contractor shall provide FC PC coupled patch cords. The patch -cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.

3.2 Termination Equipment Subsystem (Multiplexer)

The Termination Equipment Subsystem is defined to include the equipment that interfaces (adapts) the subscriber (user) to the Fibre Optic Transmission Subsystem (FOTS). The description of these equipments are as follows:

3.2.1 Functional Description

Primary Multiplexer shall be used to accomplish subscriber connectivity to the Digital Communication Network. Subscriber Line Units shall provide analog to digital and direct digital conversion to 64 Kbps or higher digital channel. In the CEPT standard hierarchy, thirty (30) such 64 Kbps digital channels shall be Time Division Multiplexed (TDM) resulting in a single 2.048 Mbps (E-1) digital bit stream.

Digital Drop-Insert and Branching Equipment shall be used to digitally interface a small number of channels at spur locations without requiring successive D/A and A/D conversions of the throughput channels.

The equipment shall also have an interface for external 2048 kHz synchronisation signal according to paragraph 10 of ITU-T Recommendation G.703.

3.2.2 First Order (Primary) Multiplexing

The Contractor shall be required to provide E-1 Drop & Insert Muldem and E-1 Channel Bank primary multiplexing in compliance with the electrical input-output characteristics provided in Table 3.3

3.2.2.1 Drop & Insert Primary Multiplexing

Drop & Insert primary multiplexing in conformance with CEPT E-1 characteristics shall be required at locations where the subscriber requirement is minimal. The drop and insertion of up to thirty 64 Kbps channels supporting subscriber line units (SLU) shall be required at locations where it is cost justified. The Drop & Insert Muxes supplied shall be performance and card compatible with the Channel Bank equipment provided so that all Subscriber Line Units (SLU) are directly interchangeable.

Table 3-3
CEPT E-1 Standard First Order Multiplexing
Electrical Input/Output Characteristics

Applicable Standards:	CEPT per CCITT Recommendation G.702, G.703, G.711 and G.712

Number of Tributaries:	30 X 64 Kbps
Alternative Sub-rate Tributaries:	n X 64 Kbps V.35/X.21 64Kb/s V.35/X.21
Output Aggregate Rate: Interface Code: Impedance: Peak Level @ 120 ohm: Peak Level @ 75 ohm: Maximum Insertion Loss:	2.048 Mb/s ± 50 ppm HDB3 75 ohm unbalanced 3.0 volts ± 10% 2.37 volts ± 10% 6 db
Signal Waveform: Frame Structure: Jitter Performance:	Per CCITT G.703 Per CCITT G.742 Per CCITT G.823
Power Supply Voltage:	-48 vdc

3.2.2.2 Primary Multiplexer

User data equipment interfacing requirements are defined at the subscriber line level. Primary multiplexing in conformance with CEPT E-1 characteristics shall be used to provide first order multiplexing of up to thirty 64 Kbps channels supporting SLUs.

3.2.2.3 Subscriber Line Units\Subscriber Line Interface Cards

Multiple configurations of SLUs shall be required to provide subscriber to primary multiplexer Bank interfacing for a variety of data communications. The Contractor shall be required to provide the exact quantity and type of interfaces required after the detailed engineering. In case there are changes in number or type of cards because of changes in channel requirements, the contract price shall be adjusted accordingly. The terms Subscriber Line Interface Cards and Subscriber Line Units have been used interchangeably throughout the specification.

The SLU interface requirements are discussed in the following subparagraphs:

(A) 2 Wire Voice

2 wire SLUs shall be DTMF/TP optioned for 2-wire loop start or 2-wire GND start. The voice cards shall utilize ITU.T A-law companded PCM G.711, 64 kbits/s encoding.

(B) Synchronous Data

The Contractor shall provide a direct DTE interface for synchronous communications at speeds of 2.4, 4.8, 9.6, 19.2, 56 and 64 kbps and compatible with CCITT G.703 Kbit/s, V.35 and/or X.21 interfaces. Data rate selection shall be switch selectable or programmable.

3.3 DDF Patching Facilities

The Contractor shall supply and install all cabling, wiring, connectors, cross connects, Digital Distribution Frames (DDF) associated with the installation and interconnection of equipments procured under this package &, equipment being procured under other packages as follows:

(I) DDFs

(II) Cables (including connectors) for E1 level connections between DDF and Terminal Equipment (FOTS as well as Termination)

(III) Cables (including connectors) required for E-1 level connections of all other equipment (provided by other Contractors or existing systems) to DDF and Terminal Equipment.

(IV) All Ethernet ports shall be terminated with RJ-45 connector. Provision for 100% expansion with connector for terminating additional ports shall be provided.

(V) Cables and connectors required to enable subscriber-to-subscriber circuits over the communication network.

(VI) Any other cables, connections etc required for a fully functional, integrated communication system.

The connections amongst various equipment such as FOTS & Multiplexer equipment etc shall always be routed through DDF.

3.4 Digital Distribution Frame Functional Requirements

The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband-quality (better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and Monitor Patch Jacks. DDFs shall provide the following basic functions:

(I) "Normally thru" circuit routing

(II) Circuit rerouting via patch cord assemblies

(III) Circuit disconnect and termination

All DDFs shall be sized and equipped to support the maximum capacity of the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.

3.5 Patch Cords

The Contractor has to supply FC PC coupled Patch cords as described in BOQ. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.

3.6 Test Equipments

The Contractor shall be responsible to supply the test equipment. The BOQ and equivalent model for test equipment has been indicated in the Appendix.

3.7 NETWORK MANAGEMENT SYSTEM

The Contractor shall provide a Network Management System (NMS) also referred as TMN to provide operational support for the FOTS and associated Termination equipment subsystems. This NMS shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network at each node of the network where equipment is located. It shall also be possible to remote login to other NE(s) through NMS system. This NMS system shall assist Purchaser in the operations and maintenance of the wideband communication resources including detection of degraded equipment, system performance, the diagnosis of problems, the implementation of remedial actions and the allocation or reallocation of telecommunications resources and addition/deletion of network elements and remote monitoring of alarms/indications.

NMS system shall be provided as a portable system incorporating the NMS software installed on a notebook/laptop PC together with appropriate interfaces and leads to allow the system to be easily moved between the areas covered under this Package. Local interfaces shall be provided at each site to allow connection of the NMS. The interface to each network shall be a Q3 interface as defined in the ITU-T recommendation G.773.

The Contractor shall supply a TMN system comprising of a single TMN for all the NEs (Network Elements) i.e. SDH equipment and Multiplexers to be supplied under this package. However, two independent TMN systems (one for SDH equipment and other for Primary Multiplexer) may also be acceptable provided both the TMN systems can run on the same hardware simultaneously on different independent windows.
The bidder shall provide details of the offered TMN in the bid supporting the above features.

3.7.1 Applicable Standards

The TMN design concept, functional and informational architecture and physical architecture, shall be in compliance with ITU-T Recommendation M.3010 and G.784.

TMN shall also include the monitoring of the Ethernet Interfaces/Switching modules of SDH equipment (or external layer-2 swiches) for configuration, alarm and performance monitoring as a minimum requirement.

3.7.2 TMN Architecture

The TMN shall provide

a. Collection of Management data from all Network Elements (NEs) supplied under this package. The minimum monitoring and control requirements for the communication equipments shall be as per this Part: Fibre Optic Transmission system

b. Processing of above management data

c. Monitoring and control of the NEs as defined below:

   i) TMN system shall support management of all equipments supplied under this package. At a minimum functions Management functions as defined in CCITT M3010 shall be supported.

d. Supervisory monitoring and control of the station associated devices to the extent supported by equipment.

e. Communication channel support.

The supplied TMN system shall be capable of handling all management functions. The Contractor shall submit for Employer's approval the TMN architecture describing in detail the following subsystems/features:

a. Database used in TMN

b. Hardware & peripheral requirements

c. Software and operating system

d. Data communication between NEs

3.7.3 Management Functions

The TMN shall support following Management functions:

3.7.3.1 Configuration Management

Configuration management is concerned with management, display, and control of the network configuration. Minimum specific requirements that shall be satisfied include the following:

a. Provide tools to establish and maintain the backbone topology and configuration information and provide graphical maps depicting the configurations.

b. Gather descriptive information about the current configuration of the equipment. provide operator displays, and prepare reports.

c. Provide tools for planning, establishing, and changing the static equipment configuration. Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.

d. Provide verification testing to support new equipment installation.

e. Have specification and setting of all the NE installed.

3.7.3.2 Fault Management

Fault management is concerned with detecting, diagnosing, bypassing, directing service restoral, and reporting on all the backbone network equipment and system. Minimum specific requirements that shall be satisfied include the following:

a. Display equipment status in a consistent fashion regardless of the source of the data on a graphical topological, map-type display. Status shall be displayed through the use of colours on nodes as well as through text.

b. Obtain status and detect faults through periodic polling, processing of unsolicited alarms and error events, and periodic testing for connectivity.

c. Maintain an alarm summary of unacknowledged alarm events on the management station display and maintain a log of all received alarms. The operator shall be able to acknowledge and clear alarms individually and as a group. The use of alarm correlation techniques is encouraged to minimize the proliferation of alarms caused by a single, common-event. All alarms shall be configurable as critical alarms, major alarms and minor alarms with different colours.

d. Provide the capability to diagnose and isolate failures through analysis of error and event reports and through the use of both on-line and off-line diagnostic tests and display of monitored data.

e. The criteria for fail over shall be configurable as automatic fail over to redundant equipment wherever possible and through operator-initiated actions where automatic fail over is not possible. The status of fail over shall be reported to the NMS.

f. Track network equipment failure history.

3.7.3.3 Performance Management

Performance management is concerned with evaluation of the use of network equipments and their capability to meet performance objectives. Minimum specific requirements that shall be satisfied include the following:

a. Provide support for an operator to initiate, collect, and terminate performance metrics under both normal and degraded conditions. For example, BER of each node, together with other data measured at each node, shall be available on request.

b. Monitor signal quality and history. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:

1. Select/deselect network equipments, events, and threshold parameters to monitor
2. Set monitoring start time and duration or end time
3. Set monitoring sampling frequency
4. Set/change threshold values on selected performance parameters
5. Generate alarm events when thresholds are exceeded.
6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.
7. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the equipment Contractors.
8. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
9. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

3.7.3.4 Security Management

The TMN shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel. One access level of System Administrator and at

least two levels of operator access shall be provided - read (view) only, and write (configure). The system administrator shall be able to create, define and modify operators with different access levels, network domains and perform all kind of maintenance and up gradation of the TMN system. With "read only" access level, network parameters should only be viewed. Access to database maintenance, command control and test functions shall be available with "write" access level. Means shall be provided to ensure only one authorized user has write capability for a selected domain of the network.

Human error and conflict detection are also required. Such errors and access violations shall be reported to the offending user as error messages and warnings.

3.7.4 Communication Channel Requirement and Integration

The TMN data transport shall utilize the transmission system service channel in the overhead. In case supervisory channels are not available, the Contractor shall provide suitable interfaces in their supplied equipment for transport of TMN data. The bidders shall give detailed description in the proposal, about the TMN data transport proposed to be used by the bidder including capacity requirements and various components/equipment proposed to be used.

3.7.5 Hardware Requirements

3.7.5.1 NMS Terminal

NMS system shall be provided as a portable system incorporating the NMS software installed on a notebook/laptop PC together with appropriate interfaces. Portable (laptop PC) computers, each complete with necessary system and application software to support the functions listed above, shall be supplied to the **Purchaser** as per BOQ given in appendices. The craft terminal shall have minimum configuration of 1.83 GHz, 1GB RAM, 256 MB VRAM, DVD RW drive, 100 GB Hard Disk Drive, keyboard, mouse/trackball etc., parallel, serial/USB (2.0) ports to accommodate printers, and Internal/external Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.

3.7.5.2 Peripherals and hardware

TMN system shall be provided with one printer. The supplied printer shall be Laser printer having a minimum print speed of 4 pages per minute and a minimum resolution of 1200 x 1200 dpi. The printer shall be have parallel port and LAN port.

The printers under this specification shall include print enhanced buffering to prevent loss of print data in the event of a print failure.

3.7.6 Power Supplies

The TMN system shall use 220 volt 50 Hz AC (nominal) or -48 Volt DC (nominal) for its operation.

3.7.7 General Software/Firmware Requirements

Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.

3.7.7.1 Operating System Software

Operating system software shall be provided to control the execution of system programs, application programs and management devices to allocate system resources, and manage communications among the system processors. The Contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.

3.7.7.2 Applications Software

All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The CONTRACTOR shall make no modifications to the applications program except as provided as USER development tools.

3.7.7.3 Software Utilities

A utility shall be provided to convert all reports into standard PC applicatio.
dbase, dxf, excel, ASCII etc. as applicable.

3.7.7.4 Revisions, Upgrades, Maintainability

All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required.

All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming. All software shall be easily user expandable to accommodate the anticipated system growth, as defined in this specification. Software provided shall be compliant with national and international industry standards such as IEEE, ISO and OSF.

3.7.7.5 Database(s)

The contractor shall develop all the databases for final wideband network following the global acronyms for all stations. Database(s) to be provided shall contain all structure definitions and data for the integrated functional requirements of TMN system.

TMN operator Groups shall share the same virtual database. This means that they shall share the same database and database manager, whether or not physically separate databases are maintained.

3.15.7.6 Help

All applications shall be supported by USER accessible HELP commands that shall assist the USER in the performance of its tasks. HELP commands for an application shall be available to the USER from within the active application and shall not interfere with the activities of the application.

---------- **End of this Part** ----------

ENVIRONMENT, POWER SUPPLY, CABLING AND EARTHING

This Part describes the minimum general equipment characteristics and specifications for environmental conditions, source power conditioning and backup, equipment construction and installation.

4.1 Environmental Requirements

Equipment and their components provided under this specification shall operate reliably under the following environmental conditions:

4.1.1 Temperature and Humidity

The equipment will not be installed in environmentally controlled premises. Therefore, equipment shall operate in accordance with the limits shown in Table 4-1.

Table 4-1
Environmental Operating Limits

Temperature Range: **To Specification** **Operation without damage** **Shipping/storage**	(Un Controlled Environment) -5 to +45°C **-10 to +55°C** -40 to +60°C
Relative Humidity, non-condensing	Up to 90%
Elevation: **Operating** **Non-operating**	 to 3,800 m to 10,000 m

The Contractor is responsible for all necessary enclosure, rack or equipment upgrades to ensure the proper operation of the installed equipment.

4.1.2 EMI and Electrostatic Interference

At each location, the Contractor shall assess the need for shielding against radiated emissions and shall provide recommended solutions for any EMI problem found at each location.

4.1.3 Tropicalization

Communications equipment will often be stored and operated in uncontrolled environment areas and will be subject to mould, growth of fungus, corrosion and oxidation. The equipment and components shall be suitably tropicalized during manufacture through commissioning, as necessary.

4.1.4 Contaminants

Communications equipment may be located in areas of poor air quality with the main contaminant being dust. Cabinets shall be tight fitting utilizing filtered ventilation openings only.

4.2 Primary Source AC/DC Power Requirements

Facilities will be required to support both AC and DC power load requirements of terminal equipment as specified below:

4.2.1 AC Power Supply

It will be the Purchaser's responsibility to provide required Primary AC Power support for communications equipment installed under this specification. The Primary AC Power supplied will be **220 VAC ± 10%, 50Hz with a frequency variance between 46 and 55 Hz.**

All equipment and components provided under this specification requiring Primary AC Power, shall be designed for normal operation under the above stated tolerances for 220 VAC supply.

4.2.2 -48V DC Power Supply

Power supplies/converters for communications equipment (except computer system supplied as part of TMN which shall use 220 V AC) provided under this specification, shall use -48V DC uninterrupted primary source power. The Contractor shall intimate the MEW the requirement of maximum projected load at -48 V DC for their equipment. The power supply may vary normally within the voltage range -42 to -58 V DC and the supplied equipment shall operate satisfactorily within this range.

4.2.3 Power Distribution and Protection

The Purchaser will furnish one source primary 220 VAC and/or -48 VDC power in each building. However, the equipment shall facilitate termination of two sources. It shall be the Contractor's responsibility for the connection and distribution of all Primary AC and -48V dc source power, in full compliance with all local and national electrical codes.

The Purchaser shall indicate the primary source, the feeders/points that can be used by the Contractor. The Contractor shall supply & install Primary AC and -48Vdc feeder cables to Contractor-furnished distribution panels. The Contractor shall provide required distribution panels, circuit breakers and appropriate Panel Disconnects. Distribution Panel feeders, Panel Disconnects, distribution panels and circuit breakers shall be sized and equipped to support at least 100% expanded load requirements.

The Contractor shall provide and install all required primary power distribution sourced from the distribution panels. The Contractor shall also be responsible for Load Balancing.

The Contractor is responsible for all inter-rack (enclosure) and intra-rack (enclosure) power distribution required to support equipment supplied under this specification. The Contractor shall provide all cabling, fusing, switching and circuit breaker and surge protection required.

4.3 Signal Cabling

Connectorised signal cabling/wiring requires marking with a unique identifier at each connectorised end. The signal cable/wire identifier shall include a cable identifier and the location of both terminations. Signal cable/wiring installed on terminal blocks requires marking with the cable identifier and distant end location. The cable tag shall be clearly visible at the cable fan out point.

All signal cable, wiring and terminations shall be clearly labeled/tagged with identifiers consistent with Contractor supplied cable plant records.

4.4 Equipment Sub-Racks and Cabinets (Enclosures)

All equipment provided under this specification, shall be physically mounted in sub-racks and cabinets (enclosures). The Contractor shall determine and propose for the Employer approval, the type, size, weight and manner of installation for each location.

Selection of equipment sub-racks and cabinets (enclosures) shall meet the following requirements:

(A) Equipment Sub-Rack Construction

Equipment Sub Racks provided for installation in environmentally controlled facilities, shall meet the following minimum requirements:

(1) Equipment Sub Racks shall be steel/aluminum fabricated and finished on all surfaces. All metal and welds shall be thoroughly cleaned and sanded to obtain a smooth finish. All surfaces shall be treated for rust and primed to form a bond between metal and the finish coats of paint.

(2) Equipment covers shall be provided for exposed components mounted in equipment sub Racks.

(3) Dust and moisture protection shall meet or exceed IP20 standards.

(B) Equipment Cabinet (Enclosure) Construction

(1) Equipment cabinets (enclosures) shall be steel/ steel & Aluminum extrusion fabricated and finished on all surfaces. All metal and welds shall be thoroughly cleaned and sanded to obtain a smooth finish. All surfaces shall be treated for rust and primed to form a bond between metal and the finish coats of paint.

(2) Equipment cabinets (enclosures) shall be designed free-standing but shall be mounted to the floor. Cabinets (enclosures) shall have secure fitting, lockable , full-length front doors for access to hardware and wiring. Equipment covers for exposed components mounted inside cabinets are not required unless specifically recommended.

(3) All doors and removable panels shall be fitted with long life rubber beading. All panels shall be fabricated from minimum 2.0mm thickness steel sheet. However, for racks with load bearing Aluminum extrusion frame, door panels and side panels may be fabricated from minimum 1.6mm thickness steel sheet and the top & bottom panels shall be fabricated from minimum 2.0mm thickness steel sheet.

(4) Equipment cabinets (enclosures) shall be dust and moisture-proof as per IP41 specification, or better.

4.5 Lightning and Transient Voltage Protection

The Contractor shall be required to provide protection from lightning and transient voltages for all wideband communications equipment, in accordance with the following:

(1) At the outside cable plant point-of-entry of all cabling penetrations for all cabling installed by the Contractor, the Contractor shall provide lightning and transient

voltage isolation for the inside plant cabling, wiring, and all terminations and equipment.

(2) All equipment installed under this specification that requires 220VAC primary power, shall be surge protected.

4.6 Station Safety Earthing and Signal Grounding

For each facility, the Contractor is responsible for meeting the following station and equipment earthing requirements:

(1) All safety earthing and signal grounding shall be in full compliance with EMI/EMC requirements as per relevant international standards

(2) Each cabinet (enclosure) or cabinet(enclosure) group shall include suitable signal ground and safety earth networks. The signal ground network shall terminate at a separate signal ground stud connection isolated from safety earth.

(3) Each earth/ground network shall utilize copper bus bars, copper braids and/or 16 sqmm or bigger earth cable. All equipment earth/ground connections shall be made directly to the equipment chassis utilizing grounding lugs and secured metal-to-metal with star washers. Use of the enclosure frame, skin or chassis mounting hardware as part of the earthing/grounding networks, is not acceptable.

(4) The safety earth network shall be connected to "earth ground" at the safety earth stud. The earth stud connection shall be sized for an external earthing cable equipped with a 2/0 solid copper lug secured metal-to-metal with star washers. Primary AC feeds and distribution within enclosures requires earthing wire connection to the safety earth stud.

(5) The safety earth and signal ground networks shall be inter-connected only at the safety earth stud and signal ground stud.

At each location, the Purchaser shall extend the existing station earth to the equipment room. The Contractor shall be responsible for determining the suitability of existing station earth for the equipment to be supplied under this contract.

The Contractor is responsible for providing all required earthing/grounding cable and installation. Cabinet (Enclosure) and equipment safety earthing and signal grounding shall be subject to the Employer's approval.

4.7 Interconnections

The Contractor shall supply and install all primary power cords, power strips, receptacles, circuit breakers, fuse panels, switches, earth fault detectors, surge protectors, distribution cabling, and power connectors required to support all equipment enclosures and system components furnished and installed under this specification, except as specifically excluded. Plug-type connectors with captive fasteners (i.e. DB-25, etc) shall be used for the interconnection of all inter and intra-enclosure signalling cable.

---------- **End of This Part** ----------

INSPECTION, TESTS AND AVAILABILITY

This Part describes the specific requirements for testing of the Fibre Optic Communication system.

5.1 Testing requirement

Following are the requirements of testing for Fibre Optic Communication system:

1. Type Testing
2. Factory Acceptance Testing
3. Site Acceptance testing

5.2 Type Testing

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this Specification. Type Testing shall comply with the following:

(a) The Contractor shall submit, within two(2) months of Contract Award, copies of test reports and certificates for all of the Type Tests that are specified in Appendices and that have previously been performed. These certificates may be accepted by the Employer only if they apply to materials and equipment that are essentially identical to those due to be delivered under the Contract and only if test procedures and parameter values are identical to those specified in this specifications, carried out at Internationally accredited labs before the award of the Contract and witnessed by third party / customer's representatives .

(b) Type Tests shall be performed for all equipment types for which certification is not provided as required in (a) above, or if it is determined by the Employer that the certification provided is not acceptable.

(c) Type Tests shall be certified or performed by internationally reputed laboratories using material and equipment data sheets and test procedures that have been approved by the Employer's. The test procedures shall include a complete list of the applicable reference standards and submitted for Employer approval at least four (4) weeks before commencement of test(s). The Contractor shall provide the Employer at least 30 days written notice of the planned commencement of each type test.

(d) The Contractor shall provide a detailed schedule for performing all specified type tests. These tests shall be performed in the presence of Employer's representative.

(e) Testing charges for all the type tests listed in appendices shall be indicated separately for each item (excluding expenses of Employer representative) in the prescribed schedule of the bidding document. The total amount of these charges will be considered in the bid evaluation process.

(f) The Contractor shall ensure that all type tests can be completed within the time schedule offered in his Technical Proposal.

(g) In case of failure during any type test, the Supplier is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type tests at least three times successfully on the samples selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

5.2.1 Type Test Samples

The Contractor shall supply equipment/material for sample selection only after the Quality Assurance Plan has been approved by the Employer. The sample material shall be manufactured strictly in accordance with the approved Quality Assurance Plan. The Contractor shall submit for Employer approval, the type test sample selection procedure. The selection process for conducting the type tests shall ensure that samples are selected at random.

5.2.2 List of Type Tests

The list of required type tests is given in Appendix of this specification.The type testing shall be conducted on the following:

(a) Optical Fibre
(b) Fibre Optic Cable (OPGW & approach cable)
(c) Splice Enclosure
(d) SDH Equipment
(d) Primary Multiplexer with subscriber interface card

It may be mentioned that Contractor shall demonstrate the performance of the equipment in conformance to the approved DRS. The functional tests shall be carried out on one sample before commencement of the type tests mentioned below and shall be repeated after the completion of the type tests on the same sample.

Further, the following functional checks shall be done during and after each type test in order to check the satisfactory performance of the equipment:

a) BER monitoring test and Packet loss test for Ethernet interface
b) Alarm status on craft terminal.
c) Tx/Rx levels (for Voice channels)

5.3 Factory Acceptance Tests (FAT)

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. However visual inspection shall be carried out on 100% of all the equipment/items offered. Factory acceptance testing shall be carried out on SDH Equipments, Network Management System, Termination Equipments (Primary Mux, associated Subscriber Line Interface Cards etc), FODP, Splice enclosure, Underground approach cable and all other items for which price has been identified separately in the Bid Price Schedules.

Equipment shall not be shipped to the Employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the Employer, and the Employer has issued Material Inspection & Clearance Certificate (MICC).

Successful completion of the factory tests and the Employer approval to ship shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the Employer's authorized representatives unless waival for witnessing by Employer's representatives is intimated to the contractor.

The factory acceptance test shall demonstrate the technical characteristics of the Fibre Optic cable & associated accessories and telecom equipment in relation to this specifications and approved drawings and documents. List of factory acceptance tests are given in Appendix of this specification. This list of factory acceptance tests shall be supplemented by the Contractor's standard FAT testing program. In general the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces, alarms and diagnostics etc. For Test equipment, FAT shall include supply of proper calibration certificates. demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/ report.

5.3.1 Sampling for FAT

From each batch of equipment presented by the Contractor for Factory acceptance testing, the Employer shall select random sample(s) to be tested for acceptance. Unless otherwise agreed, all required FAT tests in the approved FAT procedures, shall be performed on all samples. The Sampling rate for the Factory acceptance tests shall be minimum 10% of the batch size (minimum 1) for all items. In case any of the selected samples fail, the failed sample is rejected and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected. In case a number of equipments are required for demonstration of the performance of any equipment during FAT, the sample size shall be taken as that number of equipments which are necessary to demonstrate the performance, irrespective of the percentage. Physical verification shall be carried out on 100% of the offered quantity as per approved FAT procedure.

Since FAT testing provides a measure of assurance that the Quality Control objectives are being met during all phases of production, the Employer reserves the right to require the Contractor to investigate and report on the cause of FAT failures and to suspend further testing/ approvals until such a report is made and remedial actions taken, as applicable.

5.3.2 Production Testing

Production testing shall mean those tests which are to be carried out during the process of production by the Contractor to ensure the desired quality of end product to be supplied. The production tests to be carried out at each stage of production shall be based on the Contractor's standard quality assurance procedures. The production tests to be carried out shall be listed in the Manufacturing Quality Plan (MQP), along with information such as sampling frequency, applicable standards, acceptance criteria etc.

The production tests would normally not be witnessed by the Employer. However, the Employer reserves the right to do so or inspect the production testing records in accordance with Inspection rights specified for this contract.

5.4 Site Acceptance Tests

The Contractor shall be responsible for carrying out site tests and inspection for all equipment supplied in this contract as required by the Employer. All equipment shall be tested on site under the conditions in which it will normally operate. Site acceptance testing shall be carried out for Fibre Optic approach cable, FODP, SDH equipment, Termination equipment subsystem, etc.

5.4.1 SAT for Fibre Optic Cable

SAT shall be carried out link by link from FODP to FODP. Prior to installation, every spooled fibre optic cable segment shall be tested for compliance with the Pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment. Site testing minimum requirements for fibre optic cable are described below:

Table 1
Pre-Installation Testing

Item:	Description:
1.	Physical Inspection of the cable assembly for damage
2.	Optical fibre continuity and fibre attenuation with OTDR at 1550 nm

Table 2
Fibre Optic Cable Splice Testing

Item:	Description:
1.	Per splice average loss with OTDR
2.	Physical inspection of splice box/enclosure for proper fibre routing techniques
3.	Physical inspection of sealing techniques, weatherproofing, etc.

Table 3
Fibre Optic Cable Link Testing

Item:	Description:
1.	Fibre continuity and link attenuation (Bi-directional) between FODP connectors at two ends for each fibre at 1310/1550 nm by OTDR
2.	Fibre continuity and link attenuation (Bi-directional) between FODP connectors at two ends for each fibre at 1310/1550 nm by Power meter & Laser source
3.	Average fibre attenuation and average splice loss
-End of Table-	

5.4.2 SAT for Communication equipment & TMN

The SAT shall be completed in following phases:

5.4.2.1 Installation Testing

The field installation test shall be performed for all equipment at each location. If any equipment has been damaged or for any reason does not comply with this Specification, the Contractor shall provide and install replacement parts at its own cost and expense.

In the installation test report, the Contractor shall include a list of all hardware or components replaced or changed between the completion of factory tests and the start of field tests and show that documentation and spare parts have been updated.

The minimal installation testing requirements for the Fiber Optic Transmission System are provided in Table 4, Table 5 for Termination Equipment Sub-system.

5.4.2.2 Link Commissioning Tests

The commissioning tests shall verify that communication can be performed over the fiber optic link under test. Bit Error measurements & service channel performance monitoring shall be made on the fibre optic to verify compliance with designed link performance.

For Ethernet interface: At a minimum the following test requirements shall be demonstrated as per RFC 2544:

a) Ping Test

b) Through Put

c) Latency

d) Packet loss

10% of the total links (Chosen by the Employer, generally to cover links from all configurations used) shall be tested for duration of 12 Hours. Rest of the links shall be tested for 1 Hour. In case a link does not meet the performance requirements during 1 hour, then the duration of the test shall be increased to 12 hours. In case any link does not meet the performance requirements during 12 hour, then the cause of failure shall be investigated and the test shall be repeated after rectifying the defects.

This phase of testing shall be conducted by the Contractor and witnessed by the Employer. Field adjustments shall be made to meet established standard, however if the field adjustments fail to correct the defects the equipments may be returned to the Contractor for replacement at his own expense. In case any adjustments are required to be made during the interval of the test then the test shall be repeated.

5.4.2.3 Integrated Testing

Prior to commencement of integrated testing the overall system shall be configured as required to provide all the data and voice channel required to interconnect the various control centers and RTU. The integrated testing for a batch shall include end-to-end testing of back-bone network

included in that batch. Integrated testing for last batch shall include testing of the entire back-bone. The intent of integrated testing is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and communications testing have been corrected, and that the communication equipment is compatible with other equipment at all locations. The Integrated System Test shall include all fibre optic transmission equipment, termination equipment, the network management subsystem and other components.

At a minimum the following tests shall be included in the integrated testing :

(1) Installation testing for TMN as per table 6.

(2) Equipment configuration shall be checked to establish that it supports the channel routing.

(3) End to end testing of all individual voice circuits originating from PLCC, PABX or Phones and to establish proper interfacing with PLCC\PABX\Phones and to demonstrate proper operation of channels over wideband systems. Operation shall be checked in terms of quality of voice, call initiation and call termination processes (i.e. proper operation of signaling between Terminal Equipment and PABX\Phones).

(4) End-to-end testing of all individual Data Circuits originating from SCADA Front Ends and to establish proper interfacing with Front End and to demonstrate proper operation of channels over wideband systems. Operation shall be checked in terms of monitoring of BER and packet loss for Ethernet interfaces.

(5) Testing of TMN to demonstrate proper operation of all functions: Configuration Management, Performance Management, Fault Management and Security management. All the standard features of the TMN shall be demonstrated for proper functioning.

(6) Demonstration of Protection switching

Table 4

Fibre Optic Transmission system (SDH) Installation Testing

Item:	Description:
1.	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Station power supply input and equipment power supply output voltage measurements
3.	Terminal transceiver performance testing (Tx power, receive signal strength, etc.)
4.	Service channel performance
5.	Craftsperson interface, alarm and control functional performance
6.	Rack and local alarms: No alarms shall be present and all alarms shall be demonstrated to be functional
7.	Correct configuration, level setting & adjustments and termination of Input/ output interfaces
8.	Proper establishment of Safety and signalling earthing system and resistance to ground to be checked.
9.	Simulation of failure conditions and failover of protected components.

Table 5

Termination Equipments (Multiplexer) Installation Testing

Item	Description:
1.	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Power supply/converter voltage measurements
3.	Muldem performance testing
4.	Craftsperson interface, alarm and control functional performance
5.	Rack and Local alarms
6.	Channel performance
7.	Safety and signalling earthing system
8.	Simulation of failure conditions and failover of protected components.

Table 6

TMN Installation Testing

Item	Description:
1.	Physical inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Workstation hardware inventory, configuration and characteristics
3.	Demonstration of proper operation of all hardware, including workstations peripherals

5.5 Mandatory Spare Parts

Appendix B provides the Mandatory Spare Parts Requirement described in subsystem sets. The mandatory spare parts table represents the minimum spares the Contractor shall be required to supply. The subsystem set of spare parts is defined to include all equipment modules, subunits and parts required to effect replacement, repair and restoration to full operational status of a defined unit of a subsystem.

The spare parts set for each subsystem, will consist of at least one (1) of each replaceable equipment module, subunit or part. Extra modules, subunits or parts shall be included in the set if there is sufficient reason to anticipate a greater failure rate.

5.5.1 Recommended Spare Parts

In addition to the Mandatory Spares the bidder shall provide a list of "Recommended Spare Parts", which may be required over and above the spares listed in Mandatory Spare parts list, to support system availabilities specified in this specification, during a one year period. This list of spares shall be called the "Recommended Spare Parts List". The Recommended spare parts list shall not be considered for evaluation and may be included in the final scope of supply.

5.6 Test Equipment

Appendix B provides mandatory test equipment requirements, to be provided for Employer. The Contractor shall provide in their bid, additionally recommended test equipment list necessary to support system availability figures specified in this Part. These lists shall include all relevant technical descriptions and recommended minimum quantities based upon the guidelines consistent with the telecommunications resource management hierarchy and continuing maintenance concept. The recommended test equipment shall not be considered for evaluation and may be included in the final scope of supply.

5.7 System Maintenance

5.7.1 Defect Liability Period

The one year period commencing immediately after the operational acceptance is called the Defect liability Period. Operational Acceptance shall be given on successful completion of SAT. During this period, the Contractor shall replace or repair all defective parts and shall be responsible for maintaining an operational system to achieve the availability of 99.8% for subscriber to subscriber. The contractor maintenance engineer shall report to the site for restoration of the system within 6 hrs. excluding travel time in case of complete break down of the link. Within four (4) months from Contract Award Date, the Contractor shall submit a

comprehensive maintenance strategy for the maintenance of the system during the Defect Liability Period. For this period which commences immediately after operational acceptance, the actual outage frequency and the availability achieved during the period shall be calculated periodically, jointly by the Contractor and the Employer.

During the Defect Liability Period, the spare parts, test equipment and tools and tackles supplied by the Contractor to Employer under the present procurement including items in both the "Mandatory" and "Recommended" lists, shall be issued as required by the Contractor. Only these supplied items and no additional items, with the exception of general purpose toolkits, shall be used by the Contractor for all its testing and preventive & restorative maintenance activities.

If any additional test equipment or spare parts are required or found to be required, these additional items shall be provided by the Contractor, within a reasonable time, up to the expiry of the Defect liability Period, at no additional cost to Employer. Further, in such case the list of "recommended" spare parts and test equipment and tools & tackles shall be reviewed to identify further spares and test equipment requirement, which shall have to be provided by the Contractor at no additional cost to Employer. Since the spare parts shall be "issued for use", by the end of the Defect Liability Period, the Contractor shall replenish the spare parts stock to the original level plus any additional spares required, found to be required or additionally identified as above.

All test equipment and tools & tackles issued to the Contractor shall be "issued for use" and shall be returned at the earliest in "as issued" condition.

5.7.2 Continuing Maintenance Concept

After the Operational Acceptance, all normal maintenance will be undertaken by the Employer. The Contractor shall ensure that the training imparted and the provided spare parts, test equipment and tools & tackles are sufficient for Employer testing & maintenance activities.

5.8 Support services

The contractor shall ensure the availability of service, spare and expansion parts for the supplied equipments for a minimum period of 15 years from Operational Acceptance by the Employer or 7 years from the date of withdrawal from production whichever is earlier. However, the termination of production shall not occur prior to operational acceptance by Employer.

----------End of the Part----------

TRAINING AND SUPPORT SERVICES

This Part describes the requirements for Contractor-supplied training, support services, and maintenance of the fibre optic cabling system, communication equipment and TMN.

6.1 Training

The Contractor shall provide a comprehensive training program that prepares the Purchaser personnel for on-site installation support, operation, and maintenance. Training may be conducted by the Contractor, the Contractor's subcontractors, and/or manufacturers. The training requirements of this Specification shall apply to all such courses.

Training courses shall be conducted by personnel who speak understandable English and who are experienced in instruction. All necessary training material shall be provided by the Contractor. The training charges quoted by the Contractor shall include training materials and all associated expenses. However for all training courses, the travel (eg airfare) and per diem expenses of the participants will be borne by Purchaser. Hands-on training shall be with equipment identical to that being supplied to the Purchaser.

6.1.1 System Design, Overview and Installation Testing Training

This training shall provide a functional description of the communication equipment, sub-systems and network, and a discussion of the failover in the network. The training shall include an overview of the network configuration and indicate the functional responsibilities of all major subsystems including the network monitoring system hardware and software. The training shall highlight all significant methodologies or concepts utilized by the hardware and software to perform the required functions. High-level hardware configuration block diagrams and network/sub network block/flow diagrams shall be included to enhance the understanding of the overall capability incorporated into all network and sub network equipment.

The overview training shall be customized for the specific functions, features, and equipment purchased by the Purchaser; it shall not be a general presentation of the Contractor' standard equipment repertoire. Personnel assigned by the Contractor to implement the Purchasers system shall conduct this overview training. The Employer shall review and approve the contents of the overview training at least four (4) weeks prior to the course.

The training courses shall also provide the Purchaser personnel with an in-depth working knowledge of the equipment, and operation of the test equipment/ diagnostic tools. The courses shall provide personnel with a theoretical background and extensive hands-on experience.

6.1.2 Supervision, Maintenance and Installation Crew Training at Site

The Installation Supervision & Maintenance training course shall enable the trainees to effectively supervise the fibre optic cable installation work from a Purchaser perspective, particularly with respect to installation quality checks and safety procedures. The training shall cover FO cable handling techniques, stringing and installation, jointing & splicing, OTDR use

and OTDR trace analysis, operation, preventive maintenance, troubleshooting procedures, corrective maintenance, and expansion procedures.

Installation crew training shall be predominantly hands-on training courses provided for a group of persons. This installation group shall be well trained to install offered fibre optic cables under off-line conditions. The intent of this training is to enable Purchaser to undertake maintenance & restoration work in case of cable breaks or other such failures.

The Contractor shall submit for approval a detailed proposal for this training as per the agreed documentation schedule. The proposal shall include information such as proposed number of trainees, trainee profile, course duration, training facilities and methodology to be used etc. The training charges for this training course shall be separately identified in the Bid Price Schedules.

6.1.3 Equipment Installation and Maintenance Training

There shall be two separate modules of the installation & maintenance training:

(1) FO Transmission System Training
(2) Termination Equipment System Training

The installation & maintenance trainings shall enable the Purchaser to be self-sufficient in preventive & restorative maintenance of the respective communications subsystems purchased by the Purchaser. The training courses shall cover equipment installation, testing & commissioning, operation, interfaces and cabling between equipment, preventive maintenance, diagnostic tools and troubleshooting procedures, corrective maintenance, and expansion procedures for all equipment. The courses shall provide theoretical background and extensive hands on experience.

Courses shall include equipment adjustments, board-level troubleshooting and repair and, where appropriate, component-level troubleshooting and repair. Course participants shall operate actual equipment and diagnose and repair simulated failures.

6.1.4 Network Management Training

The Network Management training shall familiarize the Purchasers maintenance personnel with the concepts and techniques for configuring, programming, maintaining, and troubleshooting the Contractor supplied TMN and its associated database.

The Network Management training course shall provide the course participants with hands-on experience using the actual system being supplied. Table 6-1 summarizes the minimal Network Management training requirements.

6.1.5 Tele Communication operator Training

The Contractor shall train the Purchasers telecommunication personnel who will operate the communications network, in the functional capabilities of the communication equipment. Each course shall provide a thorough understanding of the general design concepts, features, and user interface requirements for local and remote monitoring of the equipment, as well as procedures for restoring service after equipment and power failures. Each course shall include hands-on training using the actual hardware and software being delivered to the Purchaser.

Training aids for each course shall include the Operator's User Manual for each type of

DOCUMENTATION AND DELIVERABLES

This section describes the documentation requirements and provides a list of deliverable that the Contractor shall provide to the Purchaser. Complete documentation necessary for the operation and maintenance of the fibre optic cabling system is required. All the documentation shall be provided in hard copy and also on CD-ROMs in full compliance with the specification. Conditions pertaining to Document Review and Approval Rights and Document Submission Scheduling are specified in this section.

As detailed in subsequent sections the documentation shall include the following:

a. Detailed list of the deliverables
b. Description of the products
c. Technical particulars
d. Installation manuals
e. Maintenance manuals
f. Quality assurance manuals, Manufacturing Quality Plan (MQP) & Field Quality Plan (FQP)
g. Tests (type test, production, FAT, SAT) documentation

7.1 Test Documentation

The test documentation shall include the following:

a. Type test Documents (Procedures & Reports)
b. Factory Acceptance Test Documents (Procedures & Reports)
c. Site Acceptance Test Documents (Procedures & Reports)

7.2 Drawings

All drawings submitted by the Contractor including those submitted at the time of bid shall have sufficient detail to indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component, break-up for packing and shipment, shipping arrangement required, the dimensions required for installation and any other information specifically requested in the Specifications.

Each drawing submitted by the Contractor shall be clearly marked with the Purchaser name, the unit designation, the specification title, the specification number and the name of the Project. All titles, notes, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in metric units. The drawing revision level/ issue no, issue date shall be marked on each drawing and the drawing shall carry issue history information and appropriate signatures (eg: originator, checker and approving authority).

7.3 Drawing and Document Approval Procedure

The drawings/documents submitted by the Contractor shall be reviewed by the Employer as far as practicable within stipulated duration and shall be modified by the Contractor if any modifications and/or corrections are required by the Employer in compliance with the Specifications. The Contractor shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delays arising out of failure by the Contractor to rectify the drawings in good time shall not alter the contract completions date.

The approval of the drawing/document conveyed vide above marked copy shall neither relieve the Contractor of its contractual obligations and its responsibilities towards weights, qualities, design details, assembly fits, performance particulars and conformity of supplies with the Statutory Laws as may be applicable, nor shall it limit Purchaser's right under the contract.

Further work by the Contractor shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the MEW.

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

7.4 Final Documentation

Until acceptance of the equipment by the Purchaser, the Contractor shall be responsible for supplying documentation revisions or changes necessitated by inaccuracies, installation requirements, omissions determined by usage, and design or production alterations to the equipment. All changes shall be issued in the form of replacements for the affected drawings, diagrams, charts, graphs, tables, lists, and pages in the various documentation such that all documentation describes the equipment "as delivered".

For Standard Documents, three (3) sets of final approved documentation shall be provided to Purchaser. In addition to the paper prints required above, two(2) soft copies of all final approved documentation shall be provided on CD-ROMs.

The soft copy of this documentation shall be supplied on an internationally reputed format, preferably in MS Office or Novell Perfect Office. The electronic copies of the standard unmodified drawings & documents such as equipment manuals and proprietary drawings and documents may also be provided in Acrobat Reader or equivalent format, however the project engineering related drawings & documents shall be in editable format.

Table 7-1: Documentation Plan

S. No	*Document*	*Applicable Equipments / Item*	*Brief Description*	*Submission guidelines*	*Approval Category*
1.	Documentation Plan and Schedule		This document shall contain the list of all documents to be submitted for approval and their submission/approval schedule.	Within 1 week of Contract award.	Cat - I
2.	Data Requirement Sheets (DRS) and Guaranteed Technical Parameters & Drawings	For each and every item to be supplied including fibre, OPGW cable, aerial FO cable, armoured underground/approach cable, splice enclosures, FODP, FO cable fittings for all types of cables (suspension clamp assembly, tension clamp assembly, vibration damper etc.), SDH equipment, Multiplexer equipment, DDF, TMN equipment, synchronisation equipment, power and signal cables, earthing cables, patchcords, test equipments	These document(s) shall describe all the technical parameters of the item being offered. The formats for some items provided in the appendices shall be used, which may be expanded as required. The DRS shall be submitted for all items. The DRS shall be supported by technical brochures/product manuals.	Within 2 weeks of Contract award.	Cat - I (for DRS) & Cat – IV (for brochure)
3.	Sag tension charts (generic)	For each cable type	Shall accompany the DRS document	Within 2 weeks of Contract award.	Cat - I
4.	Mechanical drawings	As applicable	This document shall fully describe the equipment racks/ enclosures, MDF, peripherals and related hardware with	As above	Cat - I

Table 7-1: Documentation Plan

S. No	*Document*	*Applicable Equipments / Item*	*Brief Description*	*Submission guidelines*	*Approval Category*
			particular reference to mechanical construction, materials and dimensions, appearance, mounting methods, earthing clearances required from walls/roof/other panels, cable entry details, dust and moisture ingress protection provisions etc.		
5.	Equipment Manuals & Standard Documents	For all items	Complete set of all equipment manuals (Construction, Installation, Maintenance, Reference etc) for that product. A set of product brochures, photographs etc.	Within 2 weeks of Contract award.	Cat - IV
6.	Previous type test reports	For all items for which type testing is required. (fibre, OPGW cables, aerial FO cable, armoured underground/approach FO cable, fittings, joint box, SDH equipment, Multiplexer Equipment etc.)	Shall be complete in all respect including all test graphs, curves, calculations, photographs etc.	Within 2 weeks of Contract award.	Acceptanc e Letter
7.	Type test procedures	For all items for which type testing is required. (fibre, OPGW cable, aerial FO cable, armoured underground/approach FO cable, fittings, joint box , SDH	Shall be formatted as per chapter 2 and 3 of the technical specifications	Within 2 weeks of Contract award.	Cat- I

equipment. Operator training that is a standard part of the maintenance training will be applicable.

Table 6-1:
Telecommunications Management System Training

Item:	Description:
1.	Features of the software being supplied
2.	System generation and configuration procedures, including memory allocation, operating system parameterisation, and buffer sizes
3.	Operating system concepts, including resource allocation, priority level processing, performance monitoring, diagnostic messages, and restoration procedures.
4.	Concepts and techniques for generating, modifying, and saving database, CRT displays, and reports
5.	Utilities, techniques, and equipment used for editing, debugging, testing, integrating, expanding and documenting new programs and subsequent implementation in software and/or firmware.

6.1.6 Supplemental Training

The Contractor shall provide extended, duplicate, or additional training for the equipment, if equipment is delivered late (longer than 90 days) and the Employer considers the time lost between training and delivery detrimental to the effectiveness of the training.

Supplemental training shall be provided at no cost to the Purchaser. The Employer will determine the time, location, and extent of any supplemental training in consultation with the Contractor. The extent of supplemental training need not exceed the extent of initial training.

In addition to the structured training courses specified as above, the Contractor shall try to impart On Job Training to Purchaser representatives associated with the Contractor during the project execution.

6.1.7 Training Course Requirements

This Part describes general requirements that apply to training course. Appendix C provides the training requirements. The Contractor shall submit the training proposal along with the bid. The training content, schedule and location shall be finalised during project execution.

6.1.7.1 Training Schedule

The Contractor shall provide training in a timely manner that is appropriate to the overall project schedule. All training courses shall be available to the Purchaser for a minimum of five years after final acceptance of the communication system.

The training courses shall be scheduled so that an individual trainee could attend every course. The training shall be completed prior to the start of installation at site.

The Contractor shall take the above requirements into account in developing the preliminary training schedule. Contractor shall develop a final training schedule in consultation with the Employer after contract award.

6.1.7.2 Manuals and Equipment

The Contractor, subcontractor, or OEM shall prepare training manuals and submit them to the Employer for review at least one month prior to the start of training. The training manuals shall be prepared specifically for use as training aids; reference manuals, maintenance manuals, and user's manuals may be used as supplementary training material. Principal documents used for training shall be tailored to reflect all the Purchaser requirements specified.

Each course participant shall receive individual copies of training manuals and other pertinent material at least two weeks prior to the start of each course. The Purchaser shall retain a master and two additional copies of all training manuals and materials as reference documentation. A complete set of instructor's manuals and training aids shall also be provided.

Upon completion of each course, instructor's manuals, training manuals, and training aids shall become the property of the Purchaser. As part of the delivered system documentation and the final documentation, the Contractor shall supply the Employer/Purchaser with all changes and revisions to the training manuals and other training documentation.

The Contractor shall furnish for use during training courses all special tools, equipment, training aids, and any other materials required to train course participants.

6.1.7.3 Specialisation Certificates

The trainees shall undergo performance evaluation tests during the courses. The Contractor is required to provide certificates to individual trainees, providing the list of activities for which he/she has been trained.

6.2 Support Services

Throughout design, implementation, factory testing, and field installation and testing, the Contractor shall supply consulting assistance, as required by the Employer / Purchaser for site preparation, field installation, and other areas where technical support may be required.

Table 7-1: Documentation Plan

S. No	*Document*	*Applicable Equipments / Item*	*Brief Description*	*Submission guidelines*	*Approval Category*
		equipment, , Multiplexer Equipment etc.)			
8.	Type test schedule	For all items for which type testing is required. (fibre, OPGW cable, aerial FO cable, armoured underground/approach FO cable, fittings, joint box, SDH equipment, Multiplexer Equipment etc.)	Shall indicate the start & finish data for each test & sequence of tests if applicable, test labs.	Within 2 weeks of Contract award.	Acceptance letter
9.	Type test report	For all items for which type testing to be conducted after the Contract .		Within one week of type testing	Cat- I
10.	Physical planning/site preparation manuals	As applicable.	The document shall also contain floor plan, cable trenching/raceway drawings, station block diagrams, rack/cabinet elevation drawings, air-conditioning and power supply requirements, and earthing system details.	Within 2 weeks of site visit.	Cat- I
11.	TMN Description Document	TMN	Functional description of Hardware, Description of all commonly used and major functions in detail, Reference, User, Maintenance Manuals, Interfaces and channel requirements and routing,	As above.	Cat- IV

Table 7-1: Documentation Plan

S. No	*Document*	*Applicable Equipments / Item*	*Brief Description*	*Submission guidelines*	*Approval Category*
12.	Bill of Quantities	For each equipment and each link	Line wise survey reports, indicating tower schedules, drum schedules, crossing details, hardware & fitting requirements etc. Shall include line wise sag-tension charts and other engineering analysis. Shall include sitewise detailed quantities of each equipment	Progressively for each link within 2 weeks after completion of survey	Cat- I
13.	Factory Acceptance tests: test plan, procedures and report format	For all items to be supplied	This document shall include the list of Factory acceptance tests, the administrative & functional test plans, test procedures and formats for recording & reporting factory acceptance test results.	Within 4 weeks of Contract Award Date	Cat- I
14.	Factory acceptance test report	For all Factory acceptance tests		Within 1 week of completion of FAT, progressively for each batch.	Cat- IV
15.	Site Drawings	Site wise complete documentation	This document must include, **general details** of equipments, cubicles, cables, connectors, MDFs, DDFs, network diagram, earthing connections, power supply connections and	First set for review and approval as soon as possible after survey, atleast one month before	Cat- I

The Contractor shall be responsible for minor facility renovation and maintenance of the supplied system up to and including successful completion of the Site Acceptance Test.

After final acceptance of the communications equipment, the Contractor shall offer continuing technical support and spare parts for the communications equipment for a minimum period of 15 years from operational acceptance by the Employer and Purchaser or 7 years after the declaration of withdrawal of equipment from production whichever is earlier.

6.2.1 Technical Support

Consultation with Contractor's technical support personnel and trained field service personnel shall be readily available on a short-term/long-term basis to assist the **Purchaser** personnel in maintaining, expanding, and enhancing the FO Cabling based communication network upon expiration of the warranty period. The Contractor shall include in their offer(s), a proposal for ensuring continued technical support as stated above.

---------- **End of this part** ----------

APPENDIX C

TYPE TESTING / FACTORY ACCEPTANCE TESTING REQUIREMENTS

Appendix C
TYPE TESTING/ FACTORY ACCEPTANCE TESTS REQUIREMENTS

Wherever the referenced test procedures or the technical specifications call for visual inspection for damage, the test report shall include a full description of observed status of the sample.

C-1 Type Tests

C-1.1 Type Tests for Optical Fibres

The type tests listed below in table C-1.1 are applicable to fibres to be used in all types of F.O. cables.

Table C-1.1
Type Tests for Optical Fibres

S.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation	Technical Specification Vol II	EIA/TIA 455- 78A or as per IEC 60793
2	Attenuation Variation with Wavelength	Technical Specification Vol II	EIA/TIA 455- 78A or as per IEC 60793
3	Attenuation at Water Peak	Technical Specification Vol II	EIA/TIA 455- 78A or as per IEC 60793
4	Temp. Cycling (Temp dependence of Attenuation)		EIA/TIA 455- 3A, 2 cycles or as per IEC 60793
5	Attenuation With Bending (Bend Performance)		EIA/TIA 455- 62A or as per IEC 60793
6	Mode Field dia.		EIA/TIA 455-164A/167A/174 or as per IEC 60793
7	Chromatic Dispersion		EIA/TIA 455-168A/169A/175A or as per IEC 60793
8	Cladding Diameter		EIA/TIA 455-176 or as per IEC 60793
9	Point Discontinuities of attenuation		EIA/TIA 455-59 or as per IEC 60793
10	Core -Clad concentricity error		EIA/TIA 455-176 or as per IEC 60793
11	Fibre Tensile Proof Testing		EIA/TIA 455-31B or as per IEC 60793
-End Of table-			

C-1.2 Type Tests for OPGW Cables

The type tests to be conducted on the OPGW cable are listed in Table C-1.2:

Table C-1.2
Type tests for OPGW Cable

S. No.	Test Name	Test Description	Test Procedure	
1	Water Ingress Test	IEEE 1138 Section 4.1.1.1	IEEE 1138, Section 5.1.1.1 (IEC 60794-1-F5 /EIA/TIA 455-82B) : Test duration : 24 hours	
2	Seepage of filling compound	IEEE 1138 Section 4.1.1.2	IEEE 1138 Section 5.1.1.2 (EIA/TIA 455-81B)	Test shall be conduced at 65°C. Preconditioning period: 72 hours. Test duration: 24 hours.
3	Short Circuit Test	IEEE 1138 Section 4.1.1.3	IEEE 1138 Section 5.1.1.3 Or IEC 60794-4-10 (IEC 60794-1-2 Method H1, One sample method)	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. A suitable temperature sensor such as thermocouple shall be used to monitor and record the temperature inside the OPGW tube in addition to monitoring & recording the temperatures between the strands and between optical tube and the strand. Test shall be conducted with the tension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.
4	Aeolian Vibration Test	IEEE 1138 Section 4.1.1.4	IEEE 1138 Section 5.1.1.4	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The vibration frequency and amplitude shall be monitored and recorded continuously. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring. Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.
5	Galloping test	IEEE 1138 Section 4.1.1.5	IEEE 1138 Section 5.1.1.5	Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and clamps shall be visually inspected for mechanical damage and photographed after the test. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.

Table C-1.2
Type tests for OPGW Cable

S. No.	Test Name	Test Description	Test Procedure	
6	Cable Bend Test	Procedure 2 in IEC 60794-1-E11		The short-term and long-term bend tests shall be conducted in accordance with Procedure 2 in IEC:794-1-E11 to determine the minimum acceptable radius of bending without any increase in attenuation or any other damage to the fibre optic cable core such as bird caging, deformation, kinking and crimping.
7	Sheave Test	IEEE 1138 Section 4.1.1.6	IEEE 1138 Section 5.1.1.6 Or IEC 60794-4-10 (IEC 60794-1-2 Method E18, procedure 4)	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The Sheave dia. Shall be based on the pulling angle and the minimum pulley dia employed during installation. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
8	Crush Test	IEEE 1138 Section 4.1.1.7	IEEE 1138 Section 5.1.1.7 (IEC 60794-1-E3/ EIA/TIA 455-41)	The crush test shall be carried out on a sample of approximately one (1) metre long in accordance with IEC:794-1-E3. A load equal to 1.3 times the weight of a 400-metre length of fibre optic cable shall be applied for a period of 10 minutes. A permanent or temporarily increase in optical attenuation value greater than 0.1 dB change in sample shall constitute failure. The load shall be further increased in small increments until the measured attenuation of the optical waveguide fibres increases and the failure load recorded along with results.
9	Impact Test	IEEE 1138 Section 4.1.1.7	IEEE 1138, Section 5.1.1.7 (IEC 60794-1-E4/ EIA/TIA 455-25A)	The impact test shall be carried out in accordance with IEC:794-1-E4. Five separate impacts of 0.1-0.3kgm shall be applied. The radius of the intermediate piece shall be the reel drum radius ± 10%. A permanent or temporary increase in optical attenuation value greater than 0.1 dB/km change in sample shall constitute failure.
10	Creep Test	IEEE 1138 Section 4.1.1.8	IEEE 1138 Section 5.1.1.8	As per Aluminium Association Method, the best-fit straight line shall be fitted to the recorded creep data and shall be extrapolated to 25 years. The strain margin of the cable at the end of 25 years shall be calculated. The

Table C-1.2
Type tests for OPGW Cable

S. No.	Test Name	Test Description	Test Procedure
			time when the creep shall achieve the strain margin limits shall also be calculated.
11	Fibre Strain Test	IEEE 1138 Section 4.1.1.9	IEEE 1138 Section 5.1.1.9
12	Strain Margin Test	IEEE 1138 Section 4.1.1.10	IEEE 1138 Section 5.1.1.10
13	Stress strain Test	IEEE 1138 Section 4.1.1.11	IEEE 1138 Section 5.1.1.11
14	Cable Cut-off wavelength Test	IEEE 1138 Section 4.1.1.12	IEEE 1138, Section 5.1.1.12 (EIA/TIA 455-170)
15	Temperature Cycling Test	IEEE 1138 Section 4.1.1.13	IEEE 1138, Section 5.1.1.13 (EIA/TIA 45-3A
16	Corrosion (Salt Spray) Test	EIA/TIA 455-16A	
17	Tensile Performance Test	IEC 60794-1-2 E1 / EIA/TIA 455-33A / IEC 61089	The test shall be conducted on a sample of sufficient length in accordance with IEC:794-1-E1. The attenuation variation shall not exceed 0.05 dB/kM up to 90% of RTS of fibre optic cable. The load shall be increased at a steady rate up to rated tensile strength and held for one (1) minute. The fibre optic cable sample shall not fail during the period. The applied load shall then be increased until the failing load is reached and the value recorded.
18	Fault Current/ lightning Test	IEEE Std. 4-1978 or IEC60794-4-10 (IEC 60794-1-2 H2)	Tension equal to 20% of the OPGW RTS shall be applied to a sample with minimum length of 15 m of cabled fibres and two separate 4/10 micro second current impulses each having a peak value of 150 KA and a

Table C-1.2
Type tests for OPGW Cable

S. No.	Test Name	Test Description	Test Procedure
			negative polarity shall be applied through a 1 cm gap. The attenuation during the tests shall be continuously measured. After the tests the same shall be visually inspected. Any increase in optical waveguide fibres attenuation measured at 1550 nm shall constitute failure. Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The tensile performance test shall be repeated on the sample subjected to the lightning arc test.
19	DC Resistance Test	IEC 60228	On a fibre optic cable sample of minimum 1 metre length, two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The tests shall be repeated at least five times and the average value recorded after correcting at 20°C.
-End Of Table-			

C-1.3 Type Tests for Underground Fibre Optic Approach Cable

The type tests to be conducted on the Approach cable are listed in table C-1.3. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05 dB/Km.

Table C-1.3:
Type Tests for Underground Fibre Optic approach Cable

S.NO.	Test Name	Test Procedure
1	Water Ingress Test	(IEC 60794-1-2 F5B / EIA 455-82B) Test duration : 24 hours
2	Seepage of filling compound	(EIA 455-81A / IEC60794-1-2 E14) Preconditioning : 72 hours, Test duration : 24 hours.
3	Crush Test	(IEC 60794-1-2 E3/ EIA 455-41)
4	Impact Test	(IEC 60794-1-2 E4/ EIA 455-25A) (Ref. Para D-3.1)
5	Stress strain Test	(EIA 455-33A)
6	Cable Cut-off wavelength Test	(EIA 455-170)
7	Temperature Cycling Test	(IEC60794-1-2 F1/EIA-455-3A) – 2 cycles
-End Of Table-		

Impact Test

The Impact test shall be carried out in accordance with IEC:60794-1-2 E4. Five separate impacts of 2.0 kg shall be applied at different locations. The radius of the intermediate piece shall be the reel drum radius ± 10%. A permanent or temporary increase in optical attenuation value greater than 0.05 dB/km shall constitute failure.

C- 1.4 Type Test on OPGW Cable Fittings

The type tests to be conducted on the OPGW Cable fittings and accessories are listed below:

C-1.4.1 Mechanical Strength Test for Suspension/Tension Assembly

Applicable Standards : IS : 2486 / IEC : 61284 :1997.

Suspension Assembly

The armour rods /reinforcement rods are assembled on to the approved OPGW using the Installation Instructions to check that the assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:
The suspension assembly shall be increased at a constant rate up to a load equal to 50% of the specified minimum Failure Load increased and held for one minute for the test rig to stabilise. The load shall then be increased at a steady rate to 67% of the minimum Failure Load and held for five minutes. The angle between the cable, the Suspension Assembly and the horizontal shall not exceed 16°. This load shall then be removed in a controlled manner and the Protection Splice disassembled. Examination of all the components shall be made and any evidence of visual deformation shall be documented.

Part 2:
The Suspension clamp shall then be placed in the testing machine. The tensile load shall gradually be increased up shall gradually be increased up to 50% of the specified Minimum Failure Load of the Suspension Assembly and held for one minute for the Test Rig to stabilise and the load shall be further increased at a steady rate until the specified minimum Failure Load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Tension Assembly

The Tension Assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:
The tension assembly (excluding tension clamp) shall be increased at a constant rate up to a load equal to 50% of the specified minimum Failure Load increased at a constant rate and held for one minute for the test rig to stabilise. The load shall then be increased at a steady rate to 67% of the minimum Failure Load and held for five minutes. This load shall then removed in a controlled manner and the Tension Assembly disassembled. Examination of the Tension Dead-End and associated components shall be made and any evidence of visual deformation shall be documented.

Part 2:
The Tension Dead-End and associated components shall then be reassembled and bolts tightened as before. The tensile load shall gradually be increased up shall gradually be increased up to 50% of the specified Minimum Failure Load of the Tension Assembly and held for one minute for the Test Rig to stabilise and the load shall be further increased at a steady rate until the specified minimum Failure Load is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value shall be documented.

Acceptance Criteria for Tension/Suspension Assembly:

- No evidence of binding of the Nuts or Deformation of components at end of part 1 of Test.
- No evidence of Fracture at the end of one minute at the minimum failure load during Part 2 of the Test.

Any result outside these parameters shall constitute a failure.

C-1.4.2 Clamp Slip Strength Test for Suspension Assembly

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length fibre optical cable shall be fixed in the clamps. Once the Suspension Clamp has been assembled, the test rig is tensioned to 1 kN and the position scale on the recorder 'zeroed'. The test rig is then tensioned to 2.5 kN and the relative positions of the Reinforcing

Rods, Armour Rods and Suspension Clamp shall be marked by a suitable means to confirm any slippage after the test has been completed. The relative positions of the helical Armour Rods and associated Reinforcing Rods at each end shall be marked and also 2 mm relative position between clamp body and Armour Rods shall be marked on one side. The load shall be increased to 12 kN at a loading rate of 3 kN/min and held for one minute. At the end of this one minute period, the relative displacement between clamp body and the armour rods shall be observed. If the slippage is 2 mm or above, the test shall be terminated. Otherwise, at the end of one minute the position of the clamp body and 2 mm. relative position between clamp body and armour rods shall be marked on the other side. After the one minute pause, the load shall be further increased at a loading rate of 3 kN/min, and recording of load and displacement shall continue until either the relative Position displacement between clamp body and armour rods reaches more than 2 mm.or the load reaches the maximum slip load of 17 kN. On reaching either of the above values the test is terminated. Visual examination of all paint marks shall be recorded, and a measurement of any displacement recorded in the Table of Results.

Acceptance Criteria :

The Suspension Clamp has passed the Slip Test if the following conditions are met :

- No slippage* shall occur at or below the specified minimum slip load.

  * Definition of no slippage in accordance with IEC 61284:1997 :- Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the cable as a result of the test itself are not regarded as slippage.

- Slippage shall occur between the specified maximum and minimum slip load of 12 - 17 kN.

- There shall be no slippage of the Reinforcing Rods over the cable, and no slippage of the Armour Rods over the Reinforcing Rods.

- The relative movement (i.e. more than 2 mm between Armour Rods & Clamp body) between minimum 12 kN and maximum slip 17 kN, shall be considered as slip.

- The Armour Rods shall not be displaced from their original lay or damaged**.

  ** Definition of no damage in accordance with convention expressed in IEC 61284 : 1997 no damage, other than surface flattening of the strands shall occur.

Any result outside these parameters is a failure.

C-1.4.3 Slip Strength Test of Tension Clamp

Tension clamps shall be fitted on a 8 m length of fibre optic cable on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load shall gradually be applied up to 20 % of the RTS of OPGW . Displacement transducers shall be installed to measure the relative movement between the OPGW relative to the Reinforcing Rods and Tension Dead -End relative to Reinforcing Rods. In addition, suitable marking shall be made on the OPGW and Dead-End to confirm grip. The load shall be gradually increased at a constant rate up to 50 % of the UTS and the position scale of the recorder is zeroed. The load shall then gradually increased up to 95 % of the UTS and maintained for one minute. After one minute pause, the load shall be slowly released to zero and the marking examined and measured for any relative movement.

Acceptance Criteria :

- No movement* shall occur between the OPGW and the Reinforcing Rods, or between the Reinforcing Rods and the Dead-End assembly.
- No failure or damage or disturbance to the lay of the Tension Dead-End, Reinforcing Rods or OPGW.

* Definition of no movement as defined in IEC 61284 : Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the conductor as a result of the test itself are not regarded as slippage.

Any result outside these parameters shall constitute a failure.

C-1.4.4 Grounding Clamp and Structure Mounting Clamp Fit Test

For structure mounting clamp, one series of tests shall be conducted with two fibre optic cables installed, one series of tests with one fibre optic cable installed in one groove, and one series of tests with one fibre optic cable in the other groove. Each clamp shall be installed including clamping compound as required on the fibre optic cable. The nut shall be tightened on to the bolt by using torque wrench with a torque of 5.5 kgm or supplier's recommended torque and the tightened clamp shall be held for 10 minutes. After the test remove the fibre optic cable and examine all its components for distortion, crushing or breaking. Also the fibre optic cable shall be checked to ensure free movement within the core using dial callipers to measure the diameter of the core tube. The material shall be defined as failed if any visible distortion, crushing, cracking or breaking of the core tube is observed or the fibre optic cable within the core tube is not free to move, or when the diameter of the core tube as measured at any location in the clamped area is more than 0.5 mm larger or smaller of the core diameter as measured outside the clamped area.

C-1.4.5 Structure Mounting Clamp Strength Test

The clamp and mounting assembly shall be assembled on a vertical 200 mm x 200 mm angle and a short length of fibre optic cable installed. A vertical load of 200 kg shall be applied at the end of the mounting clamp and held for 5 minutes. Subsequently, the load shall be increased to 400 kg and held for 30 seconds. Any visible distortion, slipping or breaking of any component of the mounting clamp or assembly shall constitute failure.

C-1.4.6 Type Test on Vibration Damper

(a)Dynamic Characteristics Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for aeolian vibration frequency band ranging from 10 to 60 Hz for damper for OPGW cable. The damper assembly shall be vibrated vertically with a $\pm$ 1 mm amplitude from 5 to 15 Hz frequency and beyond 15 Hz at $\pm$ 0.5mm to determine following characteristics with the help of suitable recording instruments:

(i) Force Vs frequency

(ii) Phase angle Vs frequency

(iii) Power dissipation Vs frequency

The Force Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably

spread within the aeolian vibration frequency-band between the lower and upper dangerous frequency, limits determined by the vibration analysis of OPGW cable without dampers.

Acceptance criteria for vibration damper.

(i)The above dynamic characteristics test on five damper shall be conducted.

(ii)The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.

(iii)The above mean reactance response curve should lie within following limits :

Vibration Damper for OPGW cable –

0.002 X sqrt (T X M) X f **to** 0.0122 sqrt (T X M) X f kgf/mm

Where f is frequency in Hz.

T is tension in kgs corresponding to 0deg No wind tension for OPGW for 300m span (as per approved sag tension calculations)

M is mass in kg/m of OPGW

(iv)The above mean phase angle response curve shall be between 25^0 to 130^0 within the frequency range of interest.

(v) If the above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.

(vi)Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

(b) Vibration Analysis

The vibration analysis of the OPGW cable shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis :

(i) The analysis shall be borne for single OPGW cable without armour rods as per the parameters given in this Specification. The tension shall be taken as tension corresponding to 0deg No wind tension for OPGW (as per approved sag tension calculations) for a span ranging from 100 m to 1100 m.

(ii) The self damping factor and flexural stiffness (EI) for OPGW cable shall be calculated on the basis of experimental results. The details of experimental analysis with these data should be furnished.

(iii) The power dissipation curve obtained from Dynamic Characteristics Test shall be used for analysis with damper.

(iv) Examine the aeolian vibration level of the OPGW with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 Km per hour, predicting amplitude, frequency and vibration energy input.

(v) From vibration analysis of OPGW cable without damper, antinode vibration amplitude and dynamic strain levels at clamped

span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the aeolian vibration levels exceed the specified limits shall be determined.

(vi) From vibration analysis of OPGW cable with damper/dampers installed at the recommended location, the dynamic strain level, at the clamped span extremities, damper attachment point and the antinodes on the OPGW cable shall be determined. In addition to above damper clamp vibration amplitude and antinode vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment points, clamped span extremities and antinodes shall not exceed the specified limits. The damper vibration amplitude shall not be more than that of the specified fatigue limits.

c) Clamp Slip and Fatigue Tests

(i) Test Set Up

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The tension shall be taken as tension corresponding to 0deg No wind tension for OPGW (as per approved sag tension calculations) and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the OPGW cable has been tensioned, clamps shall be installed to support the OPGW cable at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the OPGW cable. There shall be no loose parts, such as suspension clamps, U bolts on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady. standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) Clamp Slip test

The vibration damper shall be installed on the test span. The damper clamp, after lightning with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 kN parallel to the axis of OPGW cable for a minimum duration of one minute shall not slip i.e. the permanent displacement between OPGW cable and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 kN.

(iii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate

stray signals influencing damper movement.

The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than ± 25/f mm, where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the, test if resonance shift is observed the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned hereinabove shall be repeated after fatigue test without retorquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from OPGW cable and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The OPGW cable under clamp shall also be free from any damage.

For the purpose of acceptance, the following criteria shall be applied.

(1) There shall not be any frequency shift by more than ±2 Hz for frequencies lower than 15 Hz and ± 3 Hz for frequencies higher than 15 Hz.

(2) The force response curve shall generally lie within guar anteed % variation in reactance after fatigue test in comparison with that before fatigue test by the Contractor.

(3) The power dissipation of the damper shall not be less than guaranteed % variation in power dissipation before fatigue test by the Contractor. However, it shall not be less than minimum power dissipation which shall be governed by lower limits of reactance and phase angle indicated in the envelope.

C-1.5 T ype Tests for Splice Enclosures

Following Type tests shall be demonstrated on the Splice Enclosure. For certain tests, lengths of the fibre optic cable shall be installed in the splice box, and the fibres must be spliced and looped in order to simulate conditions of use. The attenuation of the fibres shall be measured, during certain tests, by relevant Fibre Optic Test Procedures (EIA/TIA 455 or IEC 794-1 procedures).

C-1.5.1 Temperature Cycling Test

FO cable is installed in the splice enclosure and optical fibres spliced and looped. The box

must be subjected to 5 cycles of temperature variations of -40°C to +65°C with a dwell time of at least 2 hours on each extreme.

Fibre loop attenuation shall be measured in accordance with EIA 455-20/ IEC 60794-1-C10. The variation in attenuation shall be less than ±0.05dB. The final humidity level, inside the box, shall not exceed the initial level, at the closing of the box.

C-1.5.2 Humid Heat test

The sealed splice enclosure, with fibres spliced and looped inside, must be subjected to a temperature of +55°C ±2°C with a relative humidity rate of between 90% and 95% for 5 days. The attenuation variation of the fibres during the duration of the test shall be less than ±0.05dB, and the internal humidity rate measured, less than 2% .

C-1.5.3 Rain Withstand Test

The splice enclosure with optical fibres cable installed and fibres spliced fixed, shall be subjected to 24 hours of simulated rain in accordance with IEC 60 testing requirements. No water seepage or moisture shall be detected in the splice enclosure. The attenuation variation of the fibres after the test shall be less than ±0.05dB.

C-1.5.4 Vibration Test

The splice enclosure, with fibres united inside, shall be subjected to vibrations on two axes with a frequency scanning of 5 to 50 Hz. The amplitude of the vibrations shall be constant at 0.450mm, peak to peak, for 2 hours, for each of the vibrations' axes. The variation in attenuation, of the fibres, shall be less than ±0.05dB. The splice enclosure shall be examined for any defects or deformation. There shall be no loosening or visible damage of the FO cable at the entry point.

C-1.5.5 Bending and Torsion test

The splice enclosure, with fibres spliced inside, shall be firmly held in place and be subjected to the following sequence of mechanical stresses on the cable:

a) 3 torsion cycles of ±180° shall be exercised on the cable. Each cycle shall be less than one minute.

b) 3 flexure cycles of the cable, of ±180° with one cycle less than one minute.

The variation in the attenuation, of the fibres, shall be less than ±0.05dB. The cables connection ring shall remain securely fixed to the box with the connection maintained firmly. No defects/fissures shall be noted on the joint ring or on the splice enclosure.

C-1.5.6 Tensile test

The splice enclosure with cable fixed to the boxes shall be subjected to a minimum tension of 448 N for a period of two minutes. No fissure shall be noted in the connections or on the box.

C-1.5.7 Drop Test

With 2 lengths of 10 metres of cable fixed to the box, it shall be dropped five times from a height of 11 metres. There shall be no fissure, at all, of the box, and the connections shall remain tight. The test shall be carried out in accordance with procedure described in IEC-68-2-32.

C.1.6 Type Tests for Communication Equipments

The type testing shall be conducted on following equipment

a) SDH equipment with all cards :
b) Optical Amplifier
c) Multiplexer equipment with subscriber interface card

The Contractor shall enclose all the BER print-outs, LCT-logs, print-outs of temperature and humidity of the environmental chambers etc. with the test report to show the performance of the equipment during testing.

C 1. 6.1 Temperature and Humidity Tests

The tests listed below are defined in IEC Publication 60068.

(a) Low Temperature Test: Operation to Specifications

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for sixteen (16) hours. Its performance is checked during the test.

(2) Degree of Severity: Test shall be done at -5 °C.

(3) Acceptance Criteria: No degradation of performance during and after the test.

(b) Low Temperature Test : Operation without Damage

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 72 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (*Post-test*).

(2) Degree of Severity: Test shall be done at -10 °C.

(3) Acceptance Criteria: Degradation of performance is allowable during the test; however there shall be no degradation of performance in the *post-test*.

(c) Dry Heat Test : Operation to Specifications

Dry heat test shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test.

(2) Degree of Severity: Operation to specification range as specified in this

specification

(3) Acceptance Criteria: No degradation of performance during and after the test.

(d) Dry Heat Test : Operation without Damage

Dry heat tests shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (*Post-test*).

(2) Degree of Severity: Test shall be done at 55°C.

(3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the *post-test*.

(e) Damp Heat Test

Damp heat testing reveals aging with respect to the humidity level and applies basically to electronic equipment. This test shall be done as defined in IEC Publication 60068-2-3 with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 10 days. Its performance is checked during the test.

(2) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

(f) Temperature Variation Test

Temperature variation testing shall be as per IEC Publication 60068-2-14 (Gradual Variations, Method Nb). The equipment shall be powered on and various parameters shall be monitored continuously during the test period.

(1) Number of cycles required is five (5)

(2) The degree of severity: temperature: Operation to specification range as specified in this specification.

(3) Cycle duration for each temperature is three (3) hours.

(4) Ramp : 1 °C/minute.

(5) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

C 1.6.2 Power Supply and EMI/EMC tests

The test procedure and acceptance criteria shall be as defined in IEC 60870-2-1.

(a) Immunity Tests

The list of Immunity tests are specified below in Table C 1.6.2.1:

Table C 1.6.2.1
Recommended Immunity Tests

S.N.	Immunity Test IEC 1000-4-1	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para metres
1.1	Harmonics	Yes	N/A	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 - **Level : 1**
1.2	Interharmonics	Yes	N/A	N/A	N/A	
1.3	Signalling Voltage	Yes	N/A	N/A	N/A	
1.4	Voltage Fluctuations	Yes	Yes	N/A	N/A	
1.5	Voltage dips and Interruptions	Yes	Yes	N/A	N/A	
2.1	100/1300 µs surge	Yes	Yes	N/A	N/A	Table 12 of IEC 60870-2-1: 1995 - **Level : 3**
2.2	1.2/50 - 8/20 µs surges	Yes	Yes	Yes	N/A	
2.3	Fast transient bursts	Yes	Yes	Yes	Yes	
2.5	Damped oscillatory waves	Yes	Yes	Yes	Yes	
2.8	10/700 µs surges	N/A	N/A	N/A	Yes	
3.1	Electrostatic discharge	Yes				Table 13 of IEC 60870-2-1: 1995 - **Level : 4**
4.1	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - **Level : 3**
4.3	Damped oscillatory magnetic field	Yes				
5.1	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 - **Level : 3**
6.1	Power Frequency voltage on control and signal lines	N/A	N/A	Yes	Yes	
6.2	DC voltage on control and signal lines	N/A	N/A	Yes	N/A	

Table C 1.6.2.1
Recommended Immunity Tests

S.N.	Immunity Test IEC 1000-4-1	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para metres
-End Of Table-						

(b) Emission Tests

The list of Emission tests are specified below in Table C 1.6.2.2:

Table C 1.6.2.2:
Recommended Emission Tests

S.NO.	Emission test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
1	Harmonics currents IEC 1000-3-2	Yes	N/A	N/A	N/A	Table 17 of IEC 60870-2-1: 1995 - Class : B
2	Voltage fluctuations IEC 1000-3-3	Yes	N/A	N/A	N/A	
3	LF disturbance voltages CCITT recommendation P.53	N/A	Yes	N/A	N/A	
4	Transient disturbance voltages	Yes	Yes	N/A	N/A	
5	RF disturbance voltages CISPR 22	Yes	Yes	N/A	N/A	
6	RF disturbance currents CISPR 22	N/A	N/A	N/A	Yes	
7	RF radiated fields CISPR 22	Yes				
-End Of Table-						

(c) Insulation Withstand Voltages

As per section 6 of IEC 60870-2-1. Recommended class : VW1 of Table 18.

C 1.6.2.3 Mechanical Tests

(a) Mechanical Vibration Test

The procedure for this test is described in IEC Publication 60068-2-6. The testing procedure shall be carried out in the sequence 8.1 + 8.2.1 + 8.1 as described in document 68-2-6.

For the vibration response investigation (clause 8.1 of 60068-2-6), the test shall be carried out over a sweep cycle under the same conditions as for the endurance test (described later), but the vibration amplitude and the sweep rate may be decreased below these conditions so that the determination of the response characteristics can be obtained.

The endurance test conditions are selected according to the vibration withstand requirements.

Transportation tests shall be performed with the equipment packed according to the Contractor's specifications.

(b) Shock Test

The procedure of this test is defined in IEC Publication 60068-2-27 (each test) with a semi sinusoidal shape (clause 3.1.1.2).

The recommended severity shall be A = 294 m/s^2, D = 18 ms. Three shocks per axis per direction shall be applied to the equipment packed according to the Contractor's specifications.

Or Free Fall Test

This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 6008-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 60068-2-32 . The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing.

Or Bump Test

This test could be performed as an alternative to Shock test or Free Fall test. The procedure is defined in IEC 60068-2-29.

C-2 Factory Acceptance Tests On Fibre Optic Cables

Factory acceptance tests shall be conducted on random sampling of fibre optic cable to be

supplied for the present procurement, prior to any shipment.

C-2.1 FAT On Fibre : Optical Acceptance Tests

The Optical acceptance tests listed in table C-2.1 below are applicable for the fibres of all types of Fibre Optic Cables i.e. OPGW and approach cable to be supplied.

Table C-2.1
Factory Acceptance Tests for Fibres of all FO cables

S.No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation Coefficient	Technical Specification Vol II	EIA/TIA 455- 78A or as per IEC 60793
2	Point Discontinuities of attenuation	Technical Specification Vol II	EIA/TIA 455-59 or as per IEC 60793
3	Attenuation at Water Peak	Technical Specification Vol II	EIA/TIA 455- 78A or as per IEC 60793
4	Chromatic Dispersion		EIA/TIA 455-168A/169A/175A or as per IEC 60793
5	Core – Clad Concentricity Error		EIA/TIA 455-/176 or as per IEC 60793
6	Cladding diameter		EIA/TIA 455-176 or as per IEC 60793
7	Fibre Tensile Proof Testing		EIA/TIA 455-31B or as per IEC 60793
		-End Of table-	

The test reports for the above tests for all types of the fibres carried out by the Fibre Manufacturer and used in the OPGW cables and approach cable shall be shown to the inspector during OPGW cable FAT and shall be submitted along with the OPGW cable FAT report.

C-2.2 Factory Acceptance Test On OPGW Cable

The factory acceptance tests for OPGW cable specified below in Table C- 2.2 follow the requirements set forth in section 4.1.2 and section 5.1.2 of IEEE standard 1138. The FAT shall be carried out on 10% of offered drums in each lot as specified in the technical specifications and the optical tests shall be carried out in all fibres of the selected sample drums. The Rated Tensile Strength test shall be carried out on one sample in each lot.

Table C-2.2
Factory Acceptance Tests On OPGW

S. No.	Factory Acceptance Test on Manufactured OPGW
1	Attenuation Co-efficient at 1310 nm and 1550 nm

Table C-2.2
Factory Acceptance Tests On OPGW

S. No.	Factory Acceptance Test on Manufactured OPGW
2	Point discontinuities of attenuation
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Rated Tensile Strength
5	Lay Length Measurements

C-2.3 Factory Acceptance Test On Approach Cable

The factory acceptance tests for Approach Cable specified below in Table C-2.3:

Table C-2.3 Factory Acceptance Tests On Approach Cable

S. No.	Factory Acceptance Test
1	Attenuation Co-efficient at 1310 nm and 1550 nm
2	Point discontinuities of attenuation
3	Visual Material verification and dimensional checks as per approved DRS/Drawings

C-2.4 Factory Acceptance Test On Underground Fibre Optic approach Cable

The factory acceptance tests for approach cable specified below in Table C-2.4:

Table C-2.4
Factory Acceptance Tests on Underground Fibre Optic approach Cable

Item no.	Description
1	Attenuation Coefficient (1310, 1550): By EIA/TIA 455- 78A or OTDR
2	Point discontinuities of attenuation: By EIA/TIA 455- 78A or OTDR
3	Visual Material verification and dimensional checks as per approved drawings
4	Water Ingress test
5	Tensile strength test / Strain test
6	Impact test

Item no.	Description
7	Kink test
8	Environmental test (only for first batch is to be done)
9	Crush Test
10	Drip test
11	Lighting test

C-2.5 Factory Acceptance Test On OPGW Fittings

The factory acceptance tests for OPGW Fittings as specified below in Table C-2.5. The sampling plan shall be as per IS 2486:

Table C-2.5
Factory Acceptance Tests On OPGW Fittings

S. No.	Factory Acceptance Test
	Suspension Assembly
1	UTS/Mechanical Strength of the assembly
2	Clamp Slip Test
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Mechanical strength of each component
	Tension Assembly
5	Clamp Slip Strength test
6	Visual Material verification and dimensional checks as per approved DRS/Drawings
7	Mechanical strength of each component
	Vibration Damper
8	Galvanising test on damper, masses and messenger wires
9	Damper response (resonant frequencies)
10	Clamp Slip test
11	Strength of messenger wires
12	Mass pull off test
13	Visual Material verification and dimensional checks as per approved DRS/Drawings
	Structure Mounting Clamp
14	Clamp fit test
15	Clamp Strength test
16	Visual Material verification and dimensional checks as per approved DRS/Drawings

End of Table

C-2.6 Factory Acceptance Test on Splice Enclosure and FODP

The factory acceptance tests for Splice Enclosure and FODP as specified below in Table C-2.6:

Table C-2.6
Factory Acceptance Tests on Splice Enclosure and FODP

S. No.	Factory Acceptance Test
1	Visual check Kit Quantities and Specific Component Number for each component of In Line Splice Enclosure/Indoor FODP/Outdoor FODP and dimensional checks against the approved drawings.

C.2.7 Factory Acceptance Tests on Communication Equipments

The factory acceptance tests for Communication equipments are specified below:

Table C 2.7.1
Fibre Optic Transmission System Factory Acceptance Testing

Item :	Description:
1.	Physical inspection for conformance to DRS, BOQ , drawings and appearance of equipment
2.	Optical output power
3.	Transmitter light wave spectral analysis
4.	Low receive level threshold
5.	Generation of bit error rate curve
6.	Measurement of analog and digital service channel parameters as well as service channel functionality
7.	Performance of supervision, alarm, Craftsperson interface, diagnostics, loop backs etc.
8.	Electrical interface tests which include: output and input jitter, bit error rate, pulse shape, cable compensation, and line rate tolerance for multiplexers
9	At a minimum tests on Ethernet interface shall include demonstration of Ping test, Through put test, Latency test, Packet loss test as per RFC 2544
10.	Simulation of failure conditions and fail over of each redundant unit.
11.	Test of spare slots
12.	Checks of power supply/converter voltage margins
13.	Random inspections to verify the accuracy of documentation

The factory acceptance tests for Communication equipments are specified below:

Table C 2.7.1

Fibre Optic Transmission System Factory Acceptance Testing

14.	Testing of spare parts /cards as per applicable tests

Table C 2.7.2

Multiplexer Equipment Factory Acceptance Testing Requirements

Item	Description:
1.	Physical Inspection for conformance to drawings and appearance of equipment
2.	Performance of supervision, alarm, control and switching systems, diagnostics, loopbacks, Craftsperson interface etc.
3.	Electrical interface tests which include: output and input jitter, bit error rate, pulse shape, cable compensation, and line rate tolerance for the channel banks/low-level multiplexers
4.	Framing, signalling, and operational and maintenance tests consistent with applicable ITU-T requirements
5.	Simulation of failure conditions and failover of each redundant unit
6.	Test of spare slots and test of spare parts through substitution
7.	Checks of power supply/converter voltage margins, ripple levels, noise rejection, and short circuit and over voltage protection
8.	Random inspections and any other additional tests to verify the accuracy of documentation

NMS FAT requirements: Physical inspection TMN hardware for conformance to approved BoQ & drawing. Testing of TMN to demonstrate proper operation of all functions: Configuration Management, Performance Management, Fault Management and Security management. All the standard features and required customization of the TMN shall be demonstrated for proper functioning.

Annexure - IX

Technical specifications for Digital protection coupler

1.0 Digital protection coupler for protection signalling through optical fibre cable system

1.1 The Digital protection signalling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signaling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 220V DC (+10%, -10%). It shall provide minimum four commands. These commands shall be suitable for Direct tripping, Intertripping and Blocking protection schemes of EHV lines.

The protection signalling equipment shall communicate to the remote end via 64kbps channel of a PCM multiplexer. It shall provide suitable interfaces for protective relays, which operate at 220V DC. Power supply points shall be immune to electromagnetic interface.

1.2 Principle of operation

During normal operation, protection signalling equipment shall transmit a guard signal/code. In case Protection signalling equipment is actuated by protective relays for transmission of commands, it shall interrupt the guard signal/code and shall transmit the command code to the remote end. The receiver shall recognize the command code and absence of the guard code and will generate the command to the protective relays.

All signal processing i.e. generation of tripping signal and the evaluation of the signals being received shall be performed completely digital using Digital Signal Processing techniques.

1.3 Loop testing

An automatic loop testing routine shall check the teleprotection channel.

It shall also be possible to initiate a loop test manually at any station by pressing a button on the front of the equipment.

Internal test routine shall continuously monitor the availability of the protection signaling equipment.

Proper tripping signal shall always take the priority over the test procedure.

The high speed digital protection signaling equipment shall be designed and provided with following features.

- Shall work in conjunction with PCM Multiplexer
- It shall communicate on 64KBPS channel with X.21 and/or V-35 interface
- Full Duplex operation
- Auto loop facility shall be provided
- Shall meet IEC 60834-1 standard
- Shall be able to transmit unto 4 commands with trip counter simultaneously or sequentially in one 64kbps channel

Bidder shall quote for protection signaling equipment suitable for 4 commands with separate trip counters for transmit and receive.

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid.

Reports of the following tests as per clause 9.2 of Section-GTR shall be submitted for approval for protection signaling equipment and relays associated with the protection signaling equipment and interface unit with protective relay units, if any.

i) <u>General equipment interface tests</u> :

a) Insulated voltage withstand tests
b) Damped oscillatory waves disturbance test
c) Fast transient bursts disturbance test
d) Electrostatic discharge disturbance test
e) Radiated electromagnetic field test
f) RF disturbance emission test

ii) <u>Specific power supply tests</u>

a) Power supply variations
b) Interruptions
c) LF disturbance emission
d) Reverse polarity

iii) **Teleprotection system performance tests**

a) Security
b) Dependability
c) Jitter
d) Recovery time
e) Transmission time
f) Alarm functions
g) Temperature and Humidity tests (As per IEC 68-2)

- Dry heat test (50°C for 8 hours)
- Low temperature test (-5°C for 8 hours)
- Damp heat test (40°C/95%RH for 8 hours)

All the above tests at i,ii & iii (except temperature & humidity tests) shall be as per IEC 60834-1 and the standards mentioned therein.

iv) **Relays**

a) Impulse voltage withstand test as per clause 6.1 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686)
b) High frequency disturbance test as per clause 5.2 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686)

The protection signalling equipment shall be of modular construction and preferably mounted in the Relay panels. Cabling between the protection signalling equipment & Protection relays and between protection signalling equipment & Communication equipment shall be in the scope of bidder.

The input/output interface to the protection equipment shall be achieved by means of relays and the input/output rack wiring shall be carefully segregated from other shelf/cubicle wiring.

The isolation requirements of the protection interface shall be for 2kV rms.

1.4 Major technical Particulars

The major technical particulars of protection signaling equipment shall be as follows.

i) Power supply 220V DC +10%, -10%

ii) Number of commands 4 (four)

iii) Operating time <7 ms

iv) Back to back operate time without propagation delay ≤ 8 ms

v) Interface to Protection relays

Input : Contact Rating:
Rated voltage : 250 volts DC
Maximum current rating: 5 amps

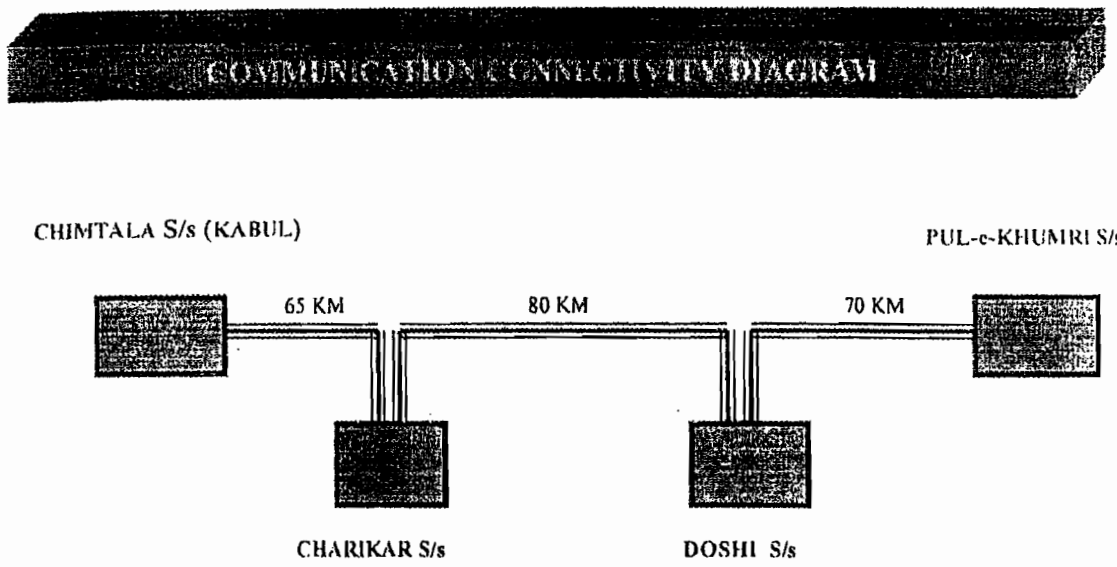
Output :	Contact Rating:		
	Rated voltage	:	250 volts DC
	Rated current	:	0.1 A DC
	Other parameters	:	As per IEC-255-0-20

vi) Alarm contact

Rated voltage	:	250 volts DC
Rated current	:	0.1 A DC
Other parameters	:	As per IEC-255-0-20

vii) Digital communication interface: 64kbps with X.21 and/or V-35 interface

Figure I


COMMUNICATION CONNECTIVITY DIAGRAM
CHIMTALA S/s (KABUL)
PUL-e-KHUMRI S/s
65 KM
80 KM
70 KM
CHARIKAR S/s
DOSHI S/s
LEGEND:
OPGW ON 220 KV T/L
SDH EQUIPMENT

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 : M/s Power Grid Corporation of India Ltd.
b) Project Title : 220/20 kV Charikar & Doshi Sub-station, Afghanistan
c) Transport facilities : Road/Air
d) Site location : The Doshi substation is located at a distance of 70 Km (approx.) from Pul-e-Khumri town & 150 Km (approx) from city of Kabul and Charikar substation is located at a distance of 65 Km (approx) from main city of Kabul.

The following system parameters shall prevail:

Nominal system voltage	**220 kV**	**20 kV**
Highest system voltage	245 kV	24 kV
Frequency	50 Hz	50 Hz
Rated short time current	31.5 kA for 1 sec	12.5 kA for 3 sec
Dry and wet one minute power frequency withstand voltage	460 kV	70 kV
Dry and wet impulse withstand voltage positive and negative	1175 kVp	170 kVp
Minimum total creepage	6125 mm	900 mm
System Earthing	Effectively Earthed	Effectively Earthed

SITE CONDITIONS

3.1.1 Ambient Temperature
a) Ambient air temp. (max.) : 40 deg C
b) Ambient air temp. (min.) : (-)20 deg C
c) Design ambient temp. : 50 deg C

3.1.2 Relative humidity : 100% Max.

3.1.3 Altitude : Not exceeding 1725 m above Mean Sea level for Charikar and 1050 m above Mean Sea level Doshi S/S

3.1.4 Wind speed : As per IS

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	: 327 mm
3.1.6	Iso-ceraunic level (days per year)	: 23 thunder storm days per year
3.1.7	Ice Loading	: 20 mm

3.2 GENERAL REQUIREMENT

3.2.1 The bidders shall submit the technical requirements, data and information as per this specification.

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

3.2.3 It is recognised that the Contractor 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.

3.2.4 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. For lighting fixtures, makes shall be as defined in Section-Lighting System.

3.2.5 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 complement each other.

3.3.4 The Contractor 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 Contractor 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 contractor shall necessarily submit all the drawings/documents unless any thing is waived. The contractor shall submit 4 (four) 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 Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

3.5.3.2 Each drawing submitted by the Contractor 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 Contractor 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 Contractor, 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 Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.5.6 All engineering data submitted by the Contractor 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	*Submission Schedule /Remarks*
i)	Approval/ comments/ by purchaser on Initial Submission	As per agreed schedule
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments including both ways postal time
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies in bound volume	2 Weeks from the date of final approval Five (5) copies for each substation plus one (1) copy for corporate centre.
v)	Furnishing of distribution copies of test reports (a) Type Test Reports	2 Weeks from the date of final approval One (1) copy for each substation plus one (1) copy for corporate centre.
	(b) Routine Test Reports	2 Weeks from the date of final approval One (1) copy for each substation
vi)	Furnishing of instruction/ operation manuals	As per agreed schedule Four (4) copies for each substation plus two (2) copies for corporate centre.
vii)	RTFs of drawings	As per agreed schedule One (1) copy for each substation plus one (1) copy for corporate centre.
viii)	Video Cassette (VHS-PAL)	As per agreed schedule

	highlighting installation and maintenance techniques/ requirements of circuit breaker & Isolators	One (1) copy for each substation plus one (1) copy for corporate centre.
ix)	As-built drawings & RTFs	On completion of entire work Two (2) copies for each substation plus One (1) copy for corporate centre.
x)	ROM Optical Disks for all As built drawings	On completion of entire work One (1) copy for each substation plus One (1) copy for corporate centre.

Notes:

a) The contractor 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 should be submitted in soft copy form, however substation design drawings like SLD, GA , all layouts etc., shall also be submitted in Autocad. SLD, GA & Layout drawings shall be submitted for the entire substation in case of substation extension also.

c) 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.

d) 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 Contractor shall submit the updated final instruction manuals to the Purchaser.

e) The Contractor shall furnish to the Purchaser catalogues of spare parts.

f) All as-built drawings/documents shall be certified by the site indicating the changes before final submission.

3.6 MATERIAL / WORKMANSHIP

3.6.1 General Requirement:

3.6.1.1 Wherever the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

3.6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the contractor.

3.6.1.3 The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken within a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the purchaser.

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

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

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

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

3.6.1.8 A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units, shall have a raised up all around and shall be threaded in air connections, if so required.

3.6.2 Provisions for Exposure to Hot and Humid Climate

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

3.6.2.1 Space Heaters

3.6.2.1.1 The heater shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

3.6.2.1.2 One or more adequately rated thermostatically controlled heaters shall be supplied to prevent condensation in any compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be designed to maintain the compartment temperature to prevent condensation.

3.6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

3.6.2.2 Fungi Static Varnish

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

3.6.2.3 Ventilation Opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment Openings in equipment shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the control cabinets, Junction boxes and Marshalling boxes, panels etc.

3.6.2.4 Degree of Protection

The enclosures of the control cabinets, Junction boxes and Marshalling boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP- 55
b) Installed indoors in air-conditioned area: IP-31
c) Installed in covered area: IP-52
d) Installed indoors in non air-conditioned area where possibility of entry of water is limited: IP-41.
e) For LT Switchgear (AC & DC distribution Boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-1) / IEC-947 (Part-1)/ IS 12063/ IEC-529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

3.6.3 Rating Plates, Name Plates and Labels

3.6.3.1 Each main and auxiliary item of substation shall have, permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

3.6.3.2 All such nameplates, instruction plates, rating plates of transformer, reactors, CB, CT, CVT, SA, Isolators, C&R panels shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates, one with Hindi and the other with English inscription, may be provided.

3.6.4 First Fill Of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

3.7 DESIGN IMPROVEMENTS / COORDINATION

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

3.7.2 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 contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

3.7.3 The Contractor 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.

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

3.7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the consultant of the Purchaser (if any) during the period of Contract. The contractor 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.

3.8 QUALITY ASSURANCE PROGRAMME

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

(a) Contractor'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-Contractor'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 Contractor/ his vendors' quality management and control activities.

3.8.2 Quality Assurance Documents

The Contractor 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.

3.9 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

3.9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

3.9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. 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 accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

i) Lightning Impulse Test

ii) Switching ImpulseTest

iii) Multiple Chopped Impulse Test (For CT)

iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.

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

The Contractor shall intimate the Purchaser the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the contractor.

3.9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of

contract. The price of conducting 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 test charges would be considered in bid evaluation. In case 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.

The Purchaser reserves the right to witness any or all the type tests. The Purchaser also reserves the right to waive the repeating of type tests partly or fully and in case of waival, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E / POWERGRID approved list of subvendors. For the new makes (other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for purchaser's approval.

3.9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch 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.

3.9.5 The Contractor shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser /inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

3.9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, 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 Contractor 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.

3.9.7 When the factory tests have been completed at the Contractor's or Sub- Contractor'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 Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor 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.

3.9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the

Contractor or of any Sub-Contractor, the Contractor 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.

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

3.9.10 The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor'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.

3.9.11 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 equipments for these tests shall be provided by the Purchaser.

3.10 TESTS

3.10.1 Pre-commissioning Tests

On completion of erection of of the equiment and before charging, each item of equipment shall be throughly cleaned and then inspected jointly by purchaser and the contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the contractor's quality assurance programme.

3.10.2 Commissioning tests

3.10.2.1 The testing equipments required for testing and commissioning shall be arranged by the contractor.

3.10.2.2 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

3.10.2.3 The contractor shall be responsible for obtaining stautory clearances from the concerned authories for commissioning the equipment and the switchyard. However necessury fee shall be reimbursed by Powergrid on production of requisite documents.

3.11 PACKAGING & PROTECTION

3.11.1 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.

3.11.2 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.

All the equipments shall be packaged in **Export-worthy / Sea-worthy packaging** and **with anti-termite treatment**.

3.12.0 FINISHING OF METAL SURFACES

3.12.1 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.

3.12.2 HOT DIP GALVANISING

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

3.12.2.2 The galvanized 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.

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

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

3.12.2.5 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 should essentially be performed as per relevant Indian Standards.

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

3.12.2.6 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.

3.12.3 PAINTING

3.12.3.1 All sheet steel work 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.

3.12.3.2 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.

3.12.3.3 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.

3.12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the

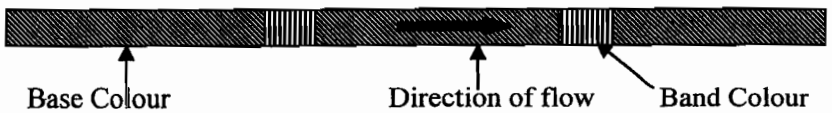
equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

3.12.3.5 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 alongwith the Bids for Purchaser's review & approval.

3.12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

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



3.12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

3.13 HANDLING, STORING AND INSTALLATION

3.13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

3.13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect,test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

3.13.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only.

Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.

During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.

3.13.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

3.13.5 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

3.13.6 Contractor shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit,

handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

3.13.7 The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.

3.13.8 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

3.13.9 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

3.13.10 The words 'erection' and 'installation' used in the specification are synonymous.

3.13.11 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

3.13.12 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances as

given in clause 4.7.1 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

3.13.13 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

3.14.0 TOOLS AND TACKLES

The Contractor shall supply with the 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.

3.15.0 AUXILIARY SUPPLY

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

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

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

3.16.0 SUPPORT STRUCTURE

3.16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e., 5.9 meter from plinth level for 245 kV substations. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

3.16.2 Support structure shall meet the following mandatory requirements:

3.16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

3.17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.17.1 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 — Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617

b) For connecting — Bimetallic connectors made

		equipment ter-minals made of copper with ACSR conductors	from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617
	c)	For connecting G.I	Galvanised mild steel shield wire
	d)	i) Bolts, nuts & Plain, washers	i) Electrogalvanised for sizes below M12, for others hot dip galvanised.
		ii) Spring washers 'a' to 'c'	ii) Electro-galvanised mild steel for items suitable for atleast service condition-3 as per IS:1573

3.17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. 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.

3.17.3 Where copper to aluminum connections are required, bi-metallic 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.

3.17.4 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.

3.17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.

3.17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

3.17.7 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.

3.17.8 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.

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

3.17.10 Clamps and connectors shall be designed to be corona controlled.

3.17.11 Tests

3.17.11.1 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 test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)

iv) Resistance test and tensile test

3.18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

3.18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

3.18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

3.18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

3.18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

3.18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

3.18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

3.18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

3.18.8 For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

3.18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

3.18.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

3.18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

3.18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:

i) Check for wiring

ii) Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

3.19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

3.20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

3.20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.

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

3.20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

3.20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

3.20.6 The terminal blocks shall be of extensible design.

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

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

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

a)	All circuits except CT/PT circuits	Minimum of two of 2.5 sq mm copper flexible.
b)	All CT/PT circuits	Minimum of 4 nos. of 2.5 sq mm copper flexible.

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

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

3.20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

3.20.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the

equipment or due to transients induced from the EHV circuits.

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

3.21.0 LAMPS & SOCKETS

3.21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.21.3 Switches and Fuses:

3.21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

3.21.3.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

3.22.0 Bushings, Hollow Column Insulators, Support Insulators:

3.22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC- 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621.The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite hollow insulators, conforming to IEC-61462.

3.22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

3.22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

3.22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

3.22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

3.22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621.

3.23.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

3.23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

3.23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

3.23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above

20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

3.23.4 Running Requirements:

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.

b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

3.23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

APPENDIX-A

CUSTOMER: **POWER GRID CORPORATION OF INDIA LTD.**
PROJECT: **220/20 kV CHARIKAR & DOSHI SUBSTATION, AFGHANISTAN**

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS DIVISION

P.O. No. : Dated:

Attach your Title block below this block.

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 1	CHECK LIST FOR INFORMATION TO BE FURNISHED WITH THE OFFER
ANNEXURE 2	SCHEDULE OF DEVIATION

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

BIDDER SHALL PUT A TICK '✓' **IF THE INFORMATION IS ENCLOSED** WITH THE OFFER, PUT A CROSS **'X' IF THE INFORMATION IS NOT ENCLOSED** OR WRITE **'NOT APPLICABLE' IF THE QUERY/ SCHEDULE IS NOT RELEVANT** AND **RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED**

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

BIDDER:
OFFER REFERENCE:

1.	Technical offer with detailed schedules of equipment/ material and spares	_____
2.	Guaranteed Technical Particulars as per Section - 4	_____
3.	Schedule of Deviations listing deviations, if any, clause-wise with respect to technical specification	_____
4.	List of past supplies complete with Purchase Order & Project name, quantity, order reference, etc., where identical equipment have been supplied.	_____
5.	Manufacturer's Quality Plans for approval	_____
6.	Field Quality Plan for approval	_____
7.	General Arrangement drawings with dimensions and weights and foundation/ fixing details	_____
8.	Drawing/ data submission Schedule	_____
9.	Type test reports. The type test reports shall be accompanied with a list listing all the relevant clauses of the applicable standard and the corresponding type test report. The manufacturer shall also furnish a certificate certifying that the test reports have been carried out on equipment identical in all respects to the one offered. In case the reports are for a different equipment and the applicability of the report is permitted as per applicable standards, the justification shall be enclosed to the list of type test reports.	_____
10.	Bar Chart showing time schedule showing time required for design, manufacture, test and inspection, transport, erection, site testing and commissioning	_____
11.	Makes of all important components, like motors, operating switches, fuses, etc.	_____
12.	Any additional information called for in any part of the technical specification.	_____

Date:

Signature of the authorized representative of Bidder

Company Seal

SCHEDULE OF DEVIATIONS

Certified that the following are only deviations from the specification (for the equipment and systems being offered)

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

Date :

Signature :

Name:

Designation :

SECTION-4

GUARANTEED TECHNICAL PARTCULARS

DRS Form 1

DATA REQUIREMENTS SHEETS for

OPTICAL POWERLINE GROUND WIRE (OPGW):

Manufacturer: _____

Part #: _____

OPGW Cable Diameter : _____mm

CABLE CONSTRUCTION			
Seq	**Parameter:**	**Unit:**	**Particulars:**
1	Fibre Manufacturer Dual Window Single-Mode:		
2	No. of Fibres Dual Window Single-Mode:	each	
3	Buffer Type:		
4	Buffer Tube Diameter:	mm	
5	Buffer Tube material		
6	No. of Buffer Tubes:	each	
7	No. of Fibers per Tube:	each	
8	Identification/numbering of individual tubes:		
9	No. of empty tubes (If any):	each	
10	Filling material:		
11	Filling material	Yes/No	
12.	Strength member(s):		
13.	Binding yarn/ tape:		

14. Describe Central Core Design:

DRS Form 1 (Continued)

DATA REQUIREMENTS SHEETS for

OPTICAL POWERLINE GROUND WIRE (OPGW):

Seq	Parameter:	Unit:	Particulars:
15.	20% Aluminum Clad steel wire Diameter: Number:	 mm each	
16.	Aluminum alloy wires Diameter: Number:	 mm each	
17.	Aluminum tube inner diameter:	mm	
18.	Aluminum tube outside diameter:	mm	
19.	Cable Diameter: (nominal ± deviation)	 mm	
20.	Cable cross-section area (Nominal):	mm^2	
21.	Cable cross-section area (Effective):	mm^2	
22.	Fully Compliant with IEEE P1138:	Yes/No	

Mechanical Properties of Cable

23.	Max. breaking load/ Ultimate Tensile Strength (UTS):	kN	
24.	Fibre strain margin:	%	
25.	Zero fibre strain up to load	kN	
26.	Weight:	kg/km	
27.	Crush strength:	kg/mm	
28.	Equivalent Modulus of elasticity:	KN/mm^2	

- Continued -

DRS Form 1 (Continued)

DATA REQUIREMENTS SHEETS for

OPTICAL POWERLINE GROUND WIRE (OPGW):

Seq	Parameter:	Unit:	Particulars:
29.	Minimum Bending Radius without microbending:	mm	
30.	Maximum Bending Radius: Short Term: Long Term (Continuous):	mm	
31.	Tensile proof test (Screening) level:	KN/mm^2	
32.	Maximum permissible tensile stress:	KN/mm^2	
33.	Permissible CTS. tensile stress:	KN/mm^2	
34.	Maximum sag at maximum temperature and design span with no wind:	mm	
35.	Everyday tension at 32°C, no wind:	% of UTS	
3 6.	Maximum tension at 32°C with full wind pressure of .....Kg/m^2 on full projected are, 400 meter span:	Kg	

Thermal Properties of Cable

37.	Coefficient of linear expansion:	per °C	
38.	Coefficient of expansion Cladding: Core:	 per °C per °C	
39.	Nominal operating temperature range:	°C	
40.	SC current transient peak temperature:	°C	
41.	Maximum allowable temperature for lightning strike:	°C	

- Continued -

DRS Form 1 (Continued)

DATA REQUIREMENTS SHEETS for

OPTICAL POWERLINE GROUND WIRE (OPGW):

CABLE SPOOL and DRUM			
Seq	**Parameter:**	**Unit:**	**Particulars:**
42.	Available length per spool Maximum: Nominal:	m	
43.	Size of drum:	m	
44.	Weight of empty drum:	kg	
45.	Weight of drum with cable: spooled	kg	
46.	Will drum length scheduling be practiced to match transmission line span lengths?	Yes/No	

47. Describe Drum materials:

48. Describe cable end capping and protection against abrasion etc.:

Signature

Name

Designation

DRS Form 1 (continued)

DATA REQUIREMENTS SHEETS for

OPTICAL POWERLINE GROUND WIRE (OPGW):

INSTALLATION			
Seq	**Parameter:**	**Unit:**	**Particulars:**
49.	Splice Loss: Maximum: Average:	 dB dB	
50.	Operating Temperature Range:	°C	
51.	Rated Isoceraunic No.		
52.	Expected Cable Life:	Years	
53.	Installation rate per team:	km/day	
54.	No. of persons per team:	no.	
55.	Max. possible span for specified operating conditions:	m	
56.	Midspan sag at 0°C with no wind loading:	mm	
57.	Midspan sag at max temp. with no wind loading:	mm	
58.	Midspan sag at max temp. and wind loading	mm	
59.	Cable swing angles: Worst Case: Everyday:		
69	Describe Installation method(s):		

DRS Form 2

DATA REQUIREMENTS SHEETS for OPTICAL FIBRE

DUAL-WINDOW SINGLE MODE (DW-SM)

OPTICAL PARAMETERS			
Seq	**Parameter:**	**Unit:**	**Particulars:**
1.	Fiber manufacturer(s)/Type:		
2.	Fiber production method:		
3.	Attenuation Coefficient@ 1310 nm: @ 1550 nm:	dB/km dB/km	
4.	Attenuation Variation with Wavelength (±25 nm):	dB/km	
5.	Attenuation at water peak:	dB/km	
6.	Point discontinuity @ 1310nm: @ 1550nm:	dB dB	
7.	Temperature dependence (induced attenuation):	dB	
8.	Nominal Mode Field Diameter @ 1310 nm: @ 1550 nm:	µm	
9.	Mode Field Diameter Deviation @ 1310 nm: @ 1550 nm:	µm	
10.	Mode field non-circularity:	%	
11.	Chromatic Dispersion Coefficient @ 1310 (1288-1339) nm: @ 1310 (1271-1360) nm: @ 1550 nm:	ps/nm.km	
12.	Zero dispersion wavelength:	nm	
13.	Zero dispersion Slope:	ps/nm^2.km	
14.	Cut off wavelength:	nm	
15.	Refractive Index:		
16.	Refractive Index profile:		
17.	Cladding Design:		
18.	Numerical aperture:		

DRS Form 2 (Continued)

DATA REQUIREMENTS SHEETS for OPTICAL FIBRE

DUAL-WINDOW SINGLE MODE (DW-SM)

PHYSICAL PROPERTIES			
Seq	**Parameter:**	**Unit:**	**Particulars:**
19.	Bend Performance: (37.5 mm radius, 100 turns) @1310 nm & @ 1550 nm (16mm radius, 1 turn) @1550 nm	dB dB	
20.	Core Diameter (nominal ± deviation):	µm	
21.	Core non-circularity:	%	
22.	Cladding Diameter (nominal ± deviation):	µm	
23.	Core- Clad concentricity Error:	µm	
24.	Cladding non-circularity:	%	
25.	Fibre cut-off wavelength	µm	
26.	Protective Coating type & material Primary: Secondary:		
27.	Protective Coating Diameter (nominal ± deviation):	µm	
28.	Protective Coating removal method:		
29.	Coating Concentricity	µm	
30.	Polarisation mode dispersion coefficient	ps/km^1/2	
31.	Proof test level	kpsi	
32.	Colour coding scheme compliant with EIA/TIA 598 or IEC 60304 or Bellcore GR-20.	Yes/No	
33.	Colouring material compliant with requirement of technical specs?	Yes/No	

DRS Form 3-A

DATA REQUIREMENTS SHEETS for OPGW HARDWARE AND FITTINGS

Suspension Clamp Assembly:

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
1.	Minimum vertical Strength	kN	
2.	Maximum Slip Strength	kN	
3.	Minimum Slip Strength	kN	
4.	Length (nominal)	mm	
5.	Weight (nominal)	kg	
6.	Total Drop (maximum) including shackles	mm	
7.	Tightening torque (nominal)	Nm	
8.	Details of Armour Rod Set		
	a) No. of rods per clamp		
	b) Direction of Lay		
	c) Overall length	mm	
	d) Diameter of each Rod	mm	
	e) Tolerances (i) Diameter of each rod (ii) Length of each rod	 ±% ±%	
	f) Material of manufacture		
	g) UTS of each Rod	kN	
	h) Weight	kg	
9.	Details of Protection Splice Set (Reinforcing Rods)		
	i) No. of rods per clamp		

Signature

Name

Designation

DRS Form 3-A

DATA REQUIREMENTS SHEETS for
OPGW HARDWARE AND FITTINGS

Suspension Clamp Assembly:

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
	j) Direction of Lay		
	k) Overall length	mm	
	l) Diameter of each Rod	mm	
	m) Tolerances (i) Diameter of each rod (ii) Length of each	 ±% ±%	
	n) Material of manufacture		
	o) UTS of each Rod	kN	
	p) Weight	kg	

Signature

Name

Designation

DRS Form 3-B

DATA REQUIREMENTS SHEETS for HARDWARE AND FITTINGS

Dead End Clamp Assembly:

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
1.	Minimum Slip Load	kN	
2.	Length (nominal)		
	a) Reinforcing Rods	mm	
	b) Dead end	mm	
3.	Weight (nominal)		
	a) Reinforcing Rods	kg	
	b) Dead end	kg	
4.	Breaking strength (minimum)	kN	
5.	Wire Size		
	a) Reinforcing Rods	mm	
	b) Dead end	mm	

Signature

Name

Designation

DRS Form 3-C

DATA REQUIREMENTS SHEETS for OPGW HARDWARE AND FITTINGS

Vibration Damper:

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
1.	Total Weight	Kg	
2.	Weight of each Damper	Kg	
3.	Material of Damper Weight		
4.	Clamp Material		
5.	Clamp bolt tightening torque	Nm	
6.	Clamp bolt material		
7.	Messenger Cable Material		
8.	No. of Strands in Messenger Cable		
9.	Breaking Strength of Messenger Cable	kN	
10.	Resonance Frequencies (include tolerances also)		
	a) First Frequency	Hz	
	b) Second Frequency	Hz	
	c) Third Frequency	Hz	
	d) Forth Frequency	Hz	
11.	Minimum Slip Strength of Damper Clamp		
	a) Before Fatigue Test	kN	
	b) After fatigue Test	kN	
12.	Maximum Slip Strength of Damper Clamp		
	a) Before Fatigue Test	kN	
	b) After fatigue Test	kN	

Signature

Name

Designation

DRS Form 3-D

DATA REQUIREMENTS SHEETS for OPGW HARDWARES and FITTINGS

Down Lead Clamp /Fastening Clamp

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	Unit:	Particulars:
1.	Material:		
2.	Suitable for OPGW (range):	mm	
3.	Tightening torques	Nm	
4.	Vertical load	kN	
5.	Filler details:		
(a)	Material		
(b)	diameter:	mm	
6.	Tower attachment arrangement		

Signature

Name

Designation

DRS Form 4

DATA REQUIREMENTS SHEETS for Splice Enclosure

Manufacturer: _____

Model # _____

Seq	Parameter:	Unit:	Particulars:
1.	Dimensions H * W * D:	cm	
2.	Weight:	Kg	
3.	Colour and Finish:		
4.	Cable Glanding & Fixing:		
5.	Construction materials & Gauge:		
6.	Locking arrangements:		
7.	Installation Clearances: Front Access: Rear Access: Top * Bottom * Sides:	cm	
8.	IP Protection	Class	
9.	Total number of optical couplings:	ea	
10.	Provision of pass through splicing:	Yes/No	
11.	Whether filled with suitable encapsulant	Yes/No	
12.	Method(s) for mounting with the tower:		

Optical Fibre Cable Accommodations

13.	Cable Glanding:		
14.	Maximum number of cables that can be accommodated:	each	
15.	Diameter(s) of cables that can be accommodated:		

16. Describe Cable entries :

Signature

Name

Designation

DRS Form 4 (Continued)

DATA REQUIREMENTS SHEETS for
Splice Enclosure

Seq	Parameter:	Unit:	Particulars:
Cable Termination Splice Accomodations:			
17.	Details of Splice Trays:		
	Dimension:		
	Material/Gauge:		
	Weight:	kg	
	Colour & Finish:		
	Method of mounting:		
18.	Maximum number of splice trays:	ea	
19.	Number of splices per tray:	ea	
20.	Provision of Splice organisors:		
21.	Excess length of fibre service loops		

DRS Form 5

DATA REQUIREMENTS SHEETS for Fibre Optic Distribution Panel (FODP)

Manufacturer: _____

Model # _____

Seq	Parameter:	Unit:	Particulars:
1.	Dimensions H * W * D:	cm	
2.	Weight:	Kg	
3.	Colour and Finish:		
4.	Cable Glanding & Fixing:		
5.	Construction materials & Gauge:		
6.	Locking arrangements:		
7.	Installation Clearances: Front Access: Rear Access: Top * Bottom * Sides:	cm	
8.	IP Protection	Class	
9.	Total number of optical couplings:	ea	
10.	Provision of pass through splicing:	Yes/No	
11.	Whether filled with suitable encapsulate	Yes/No	
12.	Method(s) for mounting with the tower:		

Optical Fibre Cable Accommodations

13.	Cable Glanding:		
14.	Maximum number of cables that can be accommodated:	each	
15.	Diameter(s) of cables that can be accommodated:		

Describe Cable entries:

16.

Signature

Name

Designation

Seq	Parameter:	Unit:	Particulars:
	Cable Termination Splice Accomodations:		
17.	Details of Splice Trays:		
	Dimension:		
	Material/Gauge:		
	Weight:	kg	
	Colour & Finish:		
	Method of mounting:		
18.	Maximum number of splice trays:	ea	
19.	Number of splices per tray:	ea	
20.	Provision of Splice organisors:		
21.	Do splice trays require a separate enclosure? If so:	Yes/No	
	Manufacturer:		
	Dimensions H * W * D:	cm	
	Weight:	Kg	
	Colour and Finish:		
	Method(s) of Mounting:		
	Construction materials & Gauge:		
	Locking arrangements:		
	Installation Clearances Front Access: Rear Access: Top * Bottom * Sides:	m	
22.	Excess length of fibre service loops		

DRS Form 6

DATA REQUIREMENTS SHEETS for APPROACH CABLE

Manufacturer: _____

Part #: _____

CABLE CONSTRUCTION			
Seq	**Parameter:**	**Unit:**	**Particulars:**
1.	Fibre Manufacturer Dual Window Single-Mode:		
2.	No. of Fibres Dual Window Single-Mode:	each	
3.	Buffer Type:		
4.	Buffer Tube Diameter:	mm	
5.	Buffer Tube material		
6.	No. of Buffer Tubes:	each	
7.	No. of Fibers per Tube:	each	
8.	Identification/numbering of individual tubes:		
9.	No. of empty tubes (If any):	each	
10.	Filling material:		
11.	Filling material compliant with para 2.1.2.6.1 of vol. IIA of technical specifications?	Yes/No	
12.	Strength member(s):		
13.	Binding yarn/ tape:		
14	Describe centre core design		

Signature

Name

Designation

17/38

DRS Form 6 (Continued)

DATA REQUIREMENTS SHEETS for APPROACH CABLE

Manufacturer: _____

Part #: _____

Seq	Parameter:	Unit:	Particulars:
14.	Outside Jacket coating (if any)		
15.	Jacket thickness	mm	
16.	Jacket non-circularity	%	
17.	Cable Diameter: (nominal deviation)	mm	
18.	Cable cross-section area:	mm^2	
19.	Rip-cord provided?	Yes/No	
20.	Fully Compliant with IEC 60974-3:	Yes/No	

Mechanical Properties of Cable

21.	Max. breaking load/ Ultimate Tensile Strength (UTS):	kN	
22.	Fibre strain margin:	%	
23.	Zero fibre strain up to load	kN	
24.	Weight:	kg/km	
25.	Crush strength:	kg/mm	
26.	Equivalent Modulus of elasticity:	KN/mm^2	
27.	Minimum Bending Radius without microbending:	mm	
28.	Maximum Bending Radius: Short Term: Long Term (Continuous):	mm	
29.	Tensile proof test (Screening) level:	KN/mm^2	
30.	Maximum permissible tensile stress:	KN/mm^2	
31.	Permissible CTS. tensile stress:	KN/mm^2	

- Continued -

Signature

Name

Designation

DRS Form 6 (Continued)

DATA REQUIREMENTS SHEETS for APPROACH CABLE

Seq	Parameter:	Unit:	Particulars:
32.	Every day tensile stress	N	
33.	Torsion	twist/m	

Thermal Properties of Cable

34.	Coefficient of linear expansion:	per °C	
35.	Coefficient of expansion Cladding: Core:	 per °C per °C	
36.	Nominal operating temperature range:	°C	

CABLE SPOOL and DRUM

Seq	Parameter:	Unit:	Particulars:
37.	Available length per spool Maximum: Nominal:	m	
38.	Size of drum:	m	
39.	Weight of empty drum:	kg	
40.	Weight of drum with cable: spooled	kg	
41.	Will drum length scheduling be practiced to match transmission line span lengths?	Yes/No	

42. Describe Drum materials:

43. Describe cable end capping and protection against abrasion etc.:

DRS Form 6 (continued)

DATA REQUIREMENTS SHEETS for APPROACH CABLE

INSTALLATION			
Seq	**Parameter:**	**Unit:**	**Particulars:**
44.	Splice Loss: Maximum: Average:	 dB dB	
45.	Operating Temperature Range:	°C	
46.	Expected Cable Life:	Years	

47. Describe Installation method(s) and the cable duct parameters for installation of approach cable:

DRS Form 7

DATA REQUIREMENTS SHEETS for PIGTAILS and PATCHCORDS

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
1.	Name/Type		
2.	Cord Length (nominal ± deviations)		
3.	Cord Numbers		
4.	Sheath material		
5.	Reinforcing material		
6.	Diameter	mm	
7.	Fibre Properties		
(a)	Attenuation: @1310nm @1550 nm	dB	
(b)	Mode field diameter	µm	
(c)	Cladding diameter	µm	
(d)	Non circularity of cladding		
(e)	Mode field concentricity		
(f)	Cut-off wavelength	µm	
(g)	Proof level		
8.	Type of connector		
9.	Connection loss	dB	
10.	Return loss	dB	
11.	Insertion loss	dB	
12.	Minimum bending radius	dB	
13.	Tensile strength	N	

Signature

Name

Designation

DRS Form 6 (continued)

DATA REQUIREMENTS SHEETS for APPROACH CABLE

INSTALLATION			
Seq	**Parameter:**	**Unit:**	**Particulars:**
44.	Splice Loss: Maximum: Average:	 dB dB	
45.	Operating Temperature Range:	°C	
46.	Expected Cable Life:	Years	

47. Describe Installation method(s) and the cable duct parameters for installation of approach cable:

DRS Form 7

DATA REQUIREMENTS SHEETS for PIGTAILS and PATCHCORDS

Manufacturer: _____

Part #: _____

ITEM	DESCRIPTION	UNIT	PARTICULARS
1.	Name/Type		
2.	Cord Length (nominal ± deviations)		
3.	Cord Numbers		
4.	Sheath material		
5.	Reinforcing material		
6.	Diameter	mm	
7.	Fibre Properties		
(a)	Attenuation: @1310nm @1550 nm	dB	
(b)	Mode field diameter	µm	
(c)	Cladding diameter	µm	
(d)	Non circularity of cladding		
(e)	Mode field concentricity		
(f)	Cut-off wavelength	µm	
(g)	Proof level		
8.	Type of connector		
9.	Connection loss	dB	
10.	Return loss	dB	
11.	Insertion loss	dB	
12.	Minimum bending radius	dB	
13.	Tensile strength	N	

Signature

Name

Designation

DRS Form 7 (Continued)

DATA REQUIREMENTS SHEETS for PIGTAILS and PATCHCORDS

Manufacturer: _____

Part #: _____

14.	Coating Material : Primary : Secondary		
15.	Endface		
16.	Change of temperature	kg	
17.	undercut	kg	
18.	Protrusion	kN	
19.	Apex offset		
20.	Endface Radius (ROC)	mm	
21.	Cable retention	mm	

22. Cross sectional area of the cable:

23. Connector drawings:

Signature

Name

Designation

DRS Form 8

DATA REQUIREMENTS SHEETS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Manufacturer: _____

Model #: _____

GENERAL OLTE FEATURES

Seq	Parameter:	Unit:	Particulars:
1.	SDH hierarchy level: Capacity Aggregate Bit-rate: CEPT E-1 Ports:	STM Mbps n x E1	
2.	Whether ADM & TM, XC (cross connect) are configurable by changing few cards? If no, do both equipment use same type of Tributary card, PSU card?	Yes/No Yes/No	
3.	Protection OLTE = 1:1 APS? E-1 Ports = 1:N APS? STM-1 Ports = 1:1 APS? STM-4 Ports = 1:1 APS?	Yes/No	
4.	Unprotected System Gain for BER 10^{-10}:	dBm	
5.	1+1 APS System Gain for BER 10^{-10}:	dBm	
6.	MTBF Unprotected: 1+1 APS Protected:	Hours	
7.	Code Format:		
8.	List Optical Coupling options:		
9.	Remarks:		

Signature

Name

Designation

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq	Parameter:	Unit:	Particulars:
	OPTICAL TRANSMITTER (Fill for all Types)		
10.	Source (LED or Laser)?		
11.	Source wavelength:	nm	
12.	Source spectral width:	nm	
13.	Mean launched power Maximum: Nominal: End of Life:	dBm	
14.	Launch power during safety power-down due to fibre break:	dBm	
15.	Stability (nominal power variation due to temperature and/or biasing):	" %	
16.	Source rise time:		
17.	Source estimated life span:	hours	
18.	Source extinction ratio:		
19.	Low power alarm threshold: field adjustable?	dBm	
20.	Nominal receive signal strength: End of Life:	dBm	
21.	Receiver Threshold BER 10^{-6}: BER 10^{-10}:	dBm	
22.	Receiver overload limit:	dBm	
23.	Spectral Bandwidth (3 dB point):	nm	

Signature

Name

Designation

DRS Form 8 (Continued)
DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq.	Parameter:	Unit:	Particulars:
24.	Digital Bandwidth:	Mbps	
25.	Signal-to-noise @ center wavelength: @ 3 dB points:		
26.	AGC range:		
	SERVICE CHANNELS AND ORDERWIRE UNIT		
	Engineering Orderwire (Fill for all type of Equipment)		
27.	Omnibus calling available? Describe:	Yes/No	
28.	Selected station calling available? Describe:	Yes/No	
29.	Signalling scheme Describe:		
30.	Tx/Rx level	dBm	
31.	Speech coding method & bit rate	Kbit/s	
32.	Distortion: Noise performance:	S/N_q	
33.	Are Service channel requirements specified in section -3 met?	Yes/No	

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq	Parameter:	Unit:	Particulars:
Voice Channels (Fill for all type of Equipment)			
34.	Are Service channel requirements specified in Section- 3 met?	Yes/No	
35.	No. of VF Channels:	ea	
36.	Pass band:	KHz	
37.	Subscriber side interface:		
38.	Input & output level	dBm	
39.	Idle channel noise	dBmOp	
40.	Distortion:		
Data and Supervisory Channels (Fill for all type of Equipment)			
41.	No of data channels:	ea	
42.	Interfaces/Connectors:		
43.	Data rates:	Kbps	
ELECTRICAL/ OPTICAL INPUT/OUTPUT INTERFACES (Fill for all type of Equipment)			
44.	List ITU-T Standards in compliance with:		
45.	Tributary bit rate (nominal):	Mbit/s	
(Fill for all type of Tributaries)			
46.	Tolerance in bit rate:	ppm	
47.	Line code:		
48.	No. of ports:		
49.	Impedance of coax cable used for electrical Input/Output port:	Ω	
50.	Type of connector		
51.	Spare cable pairs?		
52.	Input jitter acceptance 100 Hz to 10 KHz: 10 KHz to 800 KHz:	UI (p-p)	

Signature

Name

Designation

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq	Parameter:	Unit:	Particulars:
53.	Maximum output jitter in the absence of i/p jitter 100 Hz to 10 KHz: 10 KHz to 800 KHz:	UI (p-p)	
54.	Jitter transfer characteristic:		
	OUTPUT PORT (Fill for all type of Tributaries)		
55.	Line impedance balanced: unbalanced:	Ω	
56.	Test load impedance (Unbalanced):	Ω	
57.	Peak pulse amplitude (nominal " tolerance):	V dc	
58.	Pulse width (nominal " tolerance):	ns	
59.	Ratio of +ve & -ve pulses at the center of a pulse interval		
60.	Ratio of width of +ve & -ve pulses at nominal half amplitude		
61.	Maximum insertion loss	dB	
	INPUT PORT (Fill for all type of Tributaries)		
62.	Attenuation Char. of inter-connecting cable for digital signal presented at input port		
63.	Return loss (at 1.024 MHz)	dB	
64.	Admissible i/p signal attenuation	dB	
65.	Cable loss Equalization Range	dB	
66.	Maximum insertion loss	dB	
	PROTECTION SWITCHING		
67.	List the type of Protection Schemes supported by the Equipment		

DRS Form 8 (Continued)
DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq	Parameter:	Unit:	Particulars:
68.	Discuss the proposed protection scheme and compare it with other schemes described in ITU-T G.841		
	Fill for all supported Protection Schemes		
69.	Switching modes available Auto? Manual? Remote network management?	Yes/No	
70.	Switching priority:		
71.	Tx switchover & switchback criteria:		
72.	Rx switchover & switchback criteria:		
73.	Inbuilt Mux (if applicable) switchover & switchback criteria:		
74.	Switch option mode & status indicators:		
75.	Switching Time Nominal: Maximum:		
	Alarms		
76.	List all alarms supported by Equipment:		
	MECHANICAL AND ENVIRONMENTAL PARAMETERS		
77.	Number of Sub-Racks (including DC/DC converters. O/W muldem etc.) required for Unprotected Terminal: 1:1 Protected Terminal:	ea	
78.	Sub-Rack Dimensions (L*W*H):	cm	
79.	Sub-Rack Weight:	Kg	
80.	Sub-Rack mounting options:		

Signature
Name
Designation

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Seq	Parameter:	Unit:	Particulars:
81.	Sub-Rack clearance requirements Top * Bottom * Sides: Front Access: Rear Access:	m	
82.	Sub-Rack colour and finish		
83.	Cabinet options available 19" ETSI? Slim rack? Others (specify)? Whether Truncated Cabinet Available?	 Yes/No Yes/No Yes/No Yes/No	
	Fill for all Cabinet Types Proposed		
84.	Protection Class (IP Class):		
85.	Rack Colour and Finish:		
86.	Temperature range Guaranteed performance: Operation without damage: Storage/ transport:	EC	
87.	Relative humidity Minimum: Maximum:	%	
88.	Altitude Installed: Transport/storage:	m	
89.	Describe Ventilation requirements:		
90.	Describe dust proofing provisions:		

91. Electromagnetic compatibility (List standards & severity levels)

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

POWER SUPPLY UNIT (DC/DC CONVERTER)

Manufacturer:_____

Model # :_____

Seq	Parameter:	Unit:	Particulars:
1.	Nominal supply voltage:	Vdc	
2.	Power supply variation Guaranteed performance: Operation without damage:	Vdc	
3.	Polarity:	"	
4.	Whether 220 Vac mains operation capability inbuilt		
5.	List derived DC voltages:	V dc	
6.	Total power consumption (Fully equipped incl. service channels) Unprotected terminal: 1+1 Protected terminal:	Watt	
7.	1+1 APS protection provided?	Yes/No	
8.	MTBF of power supply unit:	Hours	
9.	Ultimate power delivery capacity	Watt	
10.	Are the following protections provided? Overvoltage? Undervoltage? Overload? Reverse polarity? Other (specify)?	Yes/No	
11.	Whether proposed equipment has distributed Power Supply?	Yes/No	
12.	Provide AC & DC power supply requirement for each of the proposed equipment.	Watt	

DRS Form 8 (Continued)

DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

MISC

Manufacturer_____

Model #: _____

1.	Provide details for arrangements to mount repeaters/line amplifiers on the Transmission Line Towers		
2.	Provide Procedure to convert Repeaters to Add Drop Multiplexer		
3.	Whether Equipment is Up gradable **From To** STM1 STM4 STM1 STM16	 Yes/no Yes/no	
4.	Expected life of Equipment	Years	
	Patch Cords		
5.	Length	m	
6.	Service Loop	m	
7.	Insertion Loss	dB	
8.	Return Loss	dB	
9.	Connector Type		

Signature

Name

Designation

DRS Form 8-A

DATA REQUIREMENT SHEETS for OPTICAL AMPLIFIERS

Manufacturer: _____

Part #: _____

GENERAL PARAMETERS (Fill for All Type of Amplifiers)			
Seq	**Parameter:**	**Units:**	**Particulars:**
1.	Type of Amplifier:		
2.	Source Power Supply requirements Volts: Current:		
3.	Gain medium:		
4.	Small Signal Gain:		
5.	Connection loss to transmission fibre:	dB	
6.	Insertion Loss:	dB	
7.	System Noise Figure:		
8.	Type of pump laser:		
9.	Pumping Wavelength:		
10.	Bit-Rate distance product:		
11.	Type of optical coupler:		
12.	Type of optical isolator:		
13.	Operating optical bandwidth:		
14.	Polarisation Gain Dependence:		
15.	Can the same optical amplifier operate at: STM-1? STM-4? STM-16? STM-64?	Yes/No	
16.	Operating Bit Rates Lower Limit: Upper Limit:		
17.	"F" Type interface?	Yes/No	

DRS Form 8-A

DATA REQUIREMENT SHEETS for OPTICAL AMPLIFIERS

POWER AMPLIFIER, PRE AMPLIFIER, LINE AMPLIFIER (ALL PROPOSED TYPES)			
Seq	**Parameter:**	**Unit:**	**Particulars:**
18.	Optical Input: Signal wavelength: Signal input power (max): Signal input power (min): End of Life : Spectral width (-20 dB from peak): Connector type: Pulse shape: Optical Reflectance:		
19.	Optical Output: Signal output power (max): Signal output power (min): End of Life: Connector type:		

20. List and describe Monitor, Control and Alarm Points:

21. Describe Network Management Interface provisions:

Signature
Name
Designation

DRS Form 9

DATA REQUIREMENTS SHEETS for

DIGITAL DISTRIBUTION FRAMES

Manufacturer: _____

Model Name & #: _____

Seq	Parameter:	Units:	Particulars:
1.	Dimensions Height: Width: Depth:	 cm cm cm	
2.	Weight:	Kg	
3.	Colour and Finish:		
4.	Method(s) of Mounting		
5.	Clearances required for Installation: Ceiling: Front: Rear:	 m m m	
6.	Cable entry(s):		
7.	Cable Glanding:		
8.	Frame material & Guage:		
9.	Locking Arrangement		
10.	Frame capacity: (Number of co-axial panels)	each	
11.	Co-axial panel capacity: (Number of PCM Systems)	each	
12.	Co-axial connectors: Type: Characteristic impedance: Return loss (up to 90 MHz): Transfer impedance: Test voltage (1 Minute): Maximum current rating:	 Ω dB V A	

13. Provide details on installation, cabling, cross connections and patching facilities (if any):

Signature

Name

Designation

DRS Form 9

DATA REQUIREMENTS SHEETS for TMN

Manufacturer: _____

Model Name & #: _____

Seq	Parameter:	Details:
1.	Hardware Configuration including details of Processors, LAN, Routers, Printers etc	
2.	Describe the flow of data from Network Element to the NMS system, providing details of all the network components in between.	
3.	Describe features of TMN including: Configuration Management: Fault Management: Performance Management: Security Management:	
4.	Describe communication network required for TMN	

Signature

Name

Designation

DATA REQUIREMENTS SHEETS for
Test Equipment and Other Items/Materials being supplied under the Package and not covered in DRS Forms

The following items shall be described as a minimum:

1 Name of item:
2. Make & Model Number:
3. All Major Parameters:
4. Different options available and the specific option proposed to be supplied:
5. Operation Temperature range:

However, the technical brochure from the Manufacturer must be submitted along with the above DRSs in support of the various parameters. The DRS shall also include the list of suppliers for all bought out items.