

BID DOCUMENT

**TENDER FOR PROCUREMENT, SUPPLY,
TRENCHING, LAYING, INSTALLATION, TESTING AND
MAINTENANCE OF OPTICAL FIBER CABLE, PLB DUCT
AND ACCESSORIES FOR CONSTRUCTION OF
EXCLUSIVE OPTICAL NLD BACKBONE AND OPTICAL
ACCESS ROUTES ON TURNKEY BASIS
FOR DEFENCE NETWORK**

TENDER NO-CA/CNP/NFS OFC/T- 441/2013 ISSUED ON 21 June 2013



**BHARAT SANCHAR NIGAM LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)**

MMT SECTION

BHARAT SANCHAR BHAWAN, JANPATH, NEW DELHI-110001

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SECTION I
BHARAT SANCHAR NIGAM LIMITED
(A GOVT. OF INDIA ENTERPRISE)
(MMT SECTION)

NOTICE INVITING TENDER

TENDER ENQUIRY No. **CA/CNP/NFS OFC/T-441/2013** dated **21-06- 2013**

LAST DATE FOR RECEIPT OF PRE BID QUERIES: 11-07-2013

EXPECTED DATE FOR REPLY TO PRE BID QUERIES: 18-07-2013

DUE DATE OF RECEIPT : 07 Aug 2013 TIME UPTO **11.30 HOURS**

DATE OF OPENING : 07 Aug 2013 TIME AT **12:00 HOURS**

VENUE OF TENDER OPENING : MMT Section, Second Floor,
: Bharat Sanchar Bhawan, Janpath,
New Delhi -110001.

1. On behalf of **CHAIRMAN & MANAGING DIRECTOR, BHARAT SANCHAR NIGAM LIMITED Corporate Office, New Delhi** sealed Tenders are invited for '**Procurement, Supply, Trenching, Laying, Installation, Testing and Maintenance of Optical Fiber Cable, PLB Duct and Accessories for construction of Exclusive Optical NLD Backbone and Optical Access routes on Turnkey basis for Defence Network**'. The supply of OFC & associated accessories and Laying, Installation, Testing and Maintenance of Optical Fiber Cable should conform to all the specifications contained in the tender document including TEC specifications wherever applicable.
2. **Overview of Tender.** This tender is intended for rollout of OFC network to be owned and operated by the Defence Services under the Project Implementation Core Group (PICG), MoD. A highly resilient exclusive OFC based nationwide optical backbone for 414 Defence sites and access networks at 219 Army sites will be rolled out as part of this project. The PICG has been created for planning, operations and maintenance requirements of this project on behalf of Ministry of Defence. The implementation of this project will be undertaken jointly by BSNL and PICG, whereby all essential project monitoring, installation, testing and acceptance tasks will be carried out by joint teams. After successful implementation of this project, all the network assets created for this project will be handed over by BSNL to the PICG for subsequent operations and maintenance. This Tender is being invited for 'Procurement, Supply, Trenching, Laying, Installation, Testing and Maintenance of Optical Fiber Cable and Accessories for construction of Exclusive Optical NLD Backbone and Optical Access routes on Turnkey basis'.
3. **Total OFC Routes, aggregating to 57,015 km, to be constructed as per scope of this tender is divided into SEVEN packages. OFC Details are as under:-**
 - 3.1 **Type A: 48 Ribbon Fiber Intrusion Proof Fiber Optic Cable [(2x12F Ribbon G.655 + 2x12F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes.**
 - 3.2 **Type B: 48 Ribbon Fiber Non Intrusion Proof Fiber Optic Cable [2x12F Ribbon G.655 + 2x12F Ribbon G.652D] for NLD Routes.**

3.3 Type C: 48 Ribbon Fiber Intrusion Proof Fiber Optic Cable [4x12F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network.

4. **Package A** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the state of **Jammu and Kashmir** of the **NTP** region.
5. **Package B** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states of **Punjab, Himachal Pradesh, Haryana and NCR** of the **NTP** Region.
6. **Package C** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states of **Rajasthan, Uttar Pradesh and Uttarakhand** of the **NTP** Region.
7. **Package D** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states of **Maharashtra, Goa, Gujarat, Chattisgarh and Madhya Pradesh** of the **WTP** Region.
8. **Package E** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states and union territories of **Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Lakshdweep** of the **STP** Region.
9. **Package F** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states of **West Bengal, Bihar, Jharkhand, Odisha, Andaman & Nicobar Islands and Sikkim** of the **ETP** Region.
10. **Package G** consists of procurement, trenching, laying, installation, testing and maintenance of OFC and accessories for construction of NLD backbone and Access routes on turnkey basis in the states of **Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura** of the **NETF** Region.
11. The details of geographical regions in each package and total and type of OFC required to be laid for NLD as well as Access routes in each package are given at **Table 1.1**.

Ser No	Pkg	BSNL Region	NLD			Access	Grand Total (Kms)
			48 Ribbon Fiber Intrusion Proof OFC (Type A)	48 Ribbon Fiber Non Intrusion Proof OFC (Type B)	Total (Kms)	48 Fiber Intrusion Proof OFC (Type C)	
1.	A.	NTP	5334	147	5481	4014	9495
2.	B.	NTP	1087	4363	5450	2149	7599
3.	C.	NTP	1229	6530	7759	1809	9568
4.	D.	WTP	1973	6163	8136	1524	9660
5.	E.	STP	-	6541	6541	613	7154
6.	F.	ETP	-	5182	5182	839	6021
7.	G.	NETF	-	6470	6470	1048	7518
		Total	9623	35396	45019	11996	57015

Table 1.1

12. **Accessibility of Tender document.** Tender document can be obtained in form of CD from 25-06-2013 (15.00 Hrs.) subject to following requirements:

- 12.1 Submission of tender fee of Rs 10,000/- in form of Demand Draft / Bankers Cheque drawn in favour of A.O. (Cash), BSNL C.O Payable at Delhi.
- 12.2 Submission of duly signed NDA (Format given at Appendix 'N') on a non-judicial stamp paper of Rs 100/-.
- 12.3 Successful registration on the e-tender portal.
- 12.4 Submission of an undertaking of meeting the eligibility criteria in all respect on a non-judicial stamp paper of Rs 100/- duly signed by the authorised signatory of the company along with the power of attorney.

Details for obtaining the prescribed Bid document, receipt and opening thereof shall be as follows:-

S. No.	Stage	Time & Date
A	Start date of availability Detailed Notice Inviting Tender on BSNL website	21-06-2013 (18.00 Hrs.)
B	Start date of availability Tender Document in form of CD	25-06-2013 (15.00 Hrs.)
C	Last date for receipt of queries from bidders	11-07-2013
D	Expected date for replies of queries	18-07-2013
E	Start date of availability Tender Document on e-tender portal for start of e-bidding process	22-07-2013 (18.00 Hrs.)
F	Last date for download of Tender document from e-tender portal	Up to one day prior to last date of submission of bids
G	Last date and time for receipt of sealed bids (both techno-commercial & Financial).	Up to 1130 hrs on bid opening date 07-08-2013
H	Time and date for opening of Eligibility cum Technical Bid.	1200 hrs on 07-08-2013

13. The eligible bidders should be an Indian registered company and should have obtained clearance from Reserve bank of India, wherever applicable. In addition they should meet the following criteria:

13.1 **Eligibility Conditions.** The following conditions must be satisfied by the bidder.

- 13.1.1 The bidder should be either an EPC contractor or an OFC manufacturer.
- 13.1.2 The bidder can bid for **maximum three** packages.
- 13.1.3 EPC (Engineering, Procurement and Construction) contractor means a company having capability of Route Survey, obtaining RoW permission, trenching, laying, testing & commissioning of OFC routes.
- 13.1.4 The OFC Manufacturer must be an Optical Fiber Cable Manufacturer in India.

13.1.5 The bidder must furnish the documentary evidence to meet the eligibility conditions laid down in general, technical, experience and financial eligibility criteria.

13.2 General Eligibility Criteria. *The Compliance to the following general conditions is a must for all prospective bidders.*

13.2.1 The bidder shall be an Indian Registered Company under Company Act 1956 with 'Management & control with Resident Indian Nationals'. The bidder shall provide the following documents:-

13.2.1.1 Certificate of Incorporation from Registrar of Companies.

13.2.1.2 Articles and Memorandum of Association.

13.2.1.3 Annual Report for the last three financial years.

13.2.1.4 Documentary evidence for registration with proof for Management and Control of Company with Resident Indian Nationals.

13.2.2 Bidder should quote for 100% of the quantities for package otherwise such bids shall be treated as non responsive and shall be summarily rejected.

13.2.3 The bidder should provide Copy of Permanent Account Number.

13.2.4 Bidder should have excise, permanent sales tax and service tax registration number, if applicable.

13.3 Technical Eligibility Criteria. All the interested bidders shall have adequate infrastructure facilities, capacities and procedures including quality control. Important eligibility conditions for technical eligibility criteria are given below:-

13.3.1 Bidder (OFC Manufacturer/EPC Contractor)

13.3.1.1 The Bidder shall submit TSEC for 48 Fiber Ribbon Type Metal Free Optical Fiber Cable and QF-103 issued from QA Circle for all the products against specifications given at Section VI of the tender document.

13.3.1.2 The Bidder will be required to submit proof of submission for having applied for TSEC evaluation of samples (QF-103) complying to specifications given in this tender as part of the bid. If a bidder fails to obtain TSEC/ Type Approval certificate for the product, as per specification given in this tender, within two months from the last date of submission of bids, the bid will be technically disqualified.

13.3.1.3 QF-103/TSEC Certification obtained in respect of BSNL Tender No CA/CNP/NFS-OFC/T-419/2012 dated 06 Nov 2012 shall remain valid for submission as part of this tender.

13.3.2 OFC Manufacturer

13.3.2.1 The bidder must be an Optical Fiber Cable Manufacturer in India. The bidder should be an Indian company registered to manufacture and supply optical fiber cable during the last three years. The proof of manufacturing and supply of optical fiber cables in India shall be furnished by the bidder.

13.3.2.2 The OFC manufacturer should have Infrastructure Assessment (IA) certificate issued by BSNL, QA,

Bangalore for the following at the time of bid submission:-

- 13.3.2.2.1 48 Fiber Loose tube / Ribbon Type Metal Free Optical Fiber Cable with minimum manufacturing capacity of 18,000 Km per annum.
- 13.3.2.2.2 Infrastructure Assessment certificate for ribbon type metal free optical cable.
- 13.3.2.3 The OFC manufacturer should use ITU-T grade G.655 and G.652D optical fiber, sourced from CACT approved indigenous sources.
- 13.3.2.4 The OFC manufacturer should have ISO 9001:2008 certification or better with no prior history of withdrawal.
- 13.3.2.5 The OFC manufacturer should have in-house test facilities of Optical, Geometrical, Mechanical and Reliability parameters of Fiber and Cable as per EIA/TIA, IEC and ITU standards for fiber, ribbon fiber and cable.
- 13.3.2.6 The OFC manufacturer should have its own material and transmission lab as well as climatic chamber for testing of temperature range.

13.3.3 EPC Contractor

- 13.3.3.1 The EPC Contractor should have ISO 9001:2008 certification or better with no prior history of withdrawal.
- 13.3.3.2 The EPC Contractor should have company owned, leased or rented OTDR, OFC Blowing machine, Optical Power meter, laser source, cable route locator, splicing machine and HDD machine. The EPC contractor should have company owned, leased or rented equipment for OFC laying and committing resources for execution and maintenance of project in the stipulated time as per clause 13.4.2.1 below. In case the equipment is leased or rented, then the bidder is required to submit agreement details in this regard.
- 13.3.3.3 The EPC Contractor should have sufficient technical manpower on their payroll that should be committed for this project to undertake execution of trenching, laying, installation, testing and maintenance of NLD and access OFC routes on turnkey basis in the stipulated time as per clause 13.4.2.1 below.
- 13.3.3.4 The EPC contractor shall own sufficient infrastructure including plant, machineries, tools, other equipments and technical Manpower for successful completion of the required job, as mentioned above. A detailed list showing plant, machineries, tools and other equipments owned by the bidder, clearly highlighting its' make, model and year of purchase and a list of technical staff clearly showing their educational qualification and experience shall be submitted.

- 13.3.3.5 The EPC Contractor should have proper safety set-up, with an independent Health Safety & Environment Department.

13.4 Experience Eligibility Criteria

13.4.1 OFC Manufacturer

- 13.4.1.1 The OFC Manufacturer should have manufactured and supplied minimum of cumulative 10,000 Km of OFC for Telecom Service Provider in the last five years, as on date of submission of bid. Trading and supply is not acceptable.
- 13.4.1.2 The OFC Manufacturer should have manufactured and supplied minimum of 1,000 Km of Ribbon type OFC for telecom service provider in the last five years, as on date of submission of bid. Trading and supply is not acceptable.
- 13.4.1.3 The OFC Manufacturer should not be blacklisted for Telecom business by any Central/ State Government/ PSU or Telecom operator in India at the time of submission of bid.

13.4.2 EPC Contractor

- 13.4.2.1 The EPC Contractor should have capability for trenching and OFC laying at least 25 km per day per package for the project duration on turnkey basis. An undertaking to this effect needs to be submitted as part of the bid.
- 13.4.2.2 The EPC Contractor should have an experience of laying minimum of 3,000 Kms of OFC for Telecom service provider, which should include at least 1,000 Kms of Underground OFC, as on date of submission of bid.
- 13.4.2.3 The EPC contractor should not be blacklisted for Telecom business by any Central/State Government/ PSU or Telecom operator in India at the time of submission of bid.

- 13.5 **Financial Eligibility Criteria.** The interested bidders shall be financially sound. All the bidders shall submit audited financial/annual reports for the last three financial years. In case the audited report of the last financial year is not finalized at the time of bid submission, the report of the previous three financial years will be considered. The conditions for financial eligibility criteria are given as below :-

13.5.1 OFC Manufacturer

- 13.5.1.1 In case OFC Manufacturer participates as Bidder for one package, then he should have a cumulative turnover of at least Rs. 200 Cr over the last three financial years.
- 13.5.1.2 In case OFC Manufacturer participates as Bidder for two packages, then he should have a cumulative turnover of at least Rs. 400 Cr over the last three financial years.
- 13.5.1.3 In case OFC Manufacturer participates as Bidder for three packages, then he should have a cumulative

turnover of at least Rs. 600 Cr over the last three financial years.

13.5.1.4 In case OFC Manufacturer participates as Bidder for one package, then he should provide banker's solvency certificate for Rs 75 Cr.

13.5.1.5 In case OFC Manufacturer participates as Bidder for two packages, then he should provide banker's solvency certificate for Rs 150 Cr.

13.5.1.6 In case OFC Manufacturer participates as Bidder for three packages, and then he should provide banker's solvency certificate for Rs 200 Cr.

13.5.2 **EPC Contractor**

13.5.2.1 In case EPC Contractor participates as Bidder for one package, then he should have cumulative turnover of at least Rs. 1000 Cr over last three financial years.

13.5.2.2 In case EPC Contractor participates as Bidder for two packages, then he should have cumulative turnover of at least Rs. 2000 Cr over last three financial years.

13.5.2.3 In case EPC Contractor participates as Bidder or for three packages, then he should have cumulative turnover of at least Rs 3000 Cr over last three financial years.

13.5.2.4 In case EPC Contractor participates as Bidder or for one package, then he should provide banker's solvency certificate for Rs 300 Cr.

13.5.2.5 In case EPC Contractor participates as Bidder or for two packages, then he should provide banker's solvency certificate for Rs 600 Cr.

13.5.2.6 In case EPC Contractor participates as Bidder for three packages, then he should provide banker's solvency certificate for Rs 900 Cr.

13.6 In case the bidder is an OFC manufacturer, he will be required to choose an EPC contractor as his partner after being declared as L1, such that the EPC partner meets all the eligibility conditions of the tender clauses 13.3.3, 13.4.2, 13.5.2 above. Relevant documents of the partner, meeting all the tender conditions, a teaming agreement between the bidder and his partner shall be submitted, within two weeks of declaration of L1.

13.6.1 If the bidder fails to submit the requisite documents within the laid down time period as given in Clause 13.6 above, or the documents submitted for the partner do not meet the qualifying requirements as given in the tender, his bid shall be summarily rejected, EMD will be forfeited and the bidder shall be debarred from participation in any tender(s) of BSNL for a period of two years.

13.7 In case the bidder is an EPC contractor, he will be required to choose an OFC manufacturer as his partner after being declared as L1, such that the OFC partner meets all the eligibility conditions of the tender clauses 13.3.2, 13.4.1, 13.5.1 above. Relevant documents of the partner, meeting all the tender conditions, a teaming agreement between the bidder and his partner shall be submitted, within two weeks of declaration of L1.

- 13.7.1 If the bidder fails to submit the requisite documents within the laid down time period as given in Clause 13.7 above, or the documents submitted for the partner do not meet the qualifying requirements as given in the tender, his bid shall be summarily rejected, EMD will be forfeited and the bidder shall be debarred from participation in any tender(s) of BSNL for a period of two years.

14. Earnest Money Deposit

- 14.1 **The EMD for each package is Rupees Five Crores Only. EMD shall be submitted separately for each package.**
- 14.2 The bidder shall furnish the bid EMD in one of the following ways:-
- 14.2.1 Demand Draft / Bankers Cheque drawn in favour of A.O. (Cash), BSNL C.O Payable at Delhi.
- 14.2.2 Bank Guarantee from a scheduled bank drawn in favour of DGM (MMT), BSNL C.O Delhi which should be valid for 210 days from the tender opening date.

SECTION II

INSTRUCTION TO BIDDERS

A. Introduction and Eligibility Conditions

15. Definitions

- 15.1 **“The Purchaser”** means the CMD, BSNL, New Delhi.
- 15.2 **“The Bidder”** means the OEM, EPC Contractor or individual or firm who participates in this tender and submits its bid.
- 15.3 **“The Supplier”** means the OEM, EPC Contractor or individual or firm supplying the goods/work who executes the project on turnkey basis under the contract.
- 15.4 **“The Goods/Work”** means all the equipment, machinery, and/or other materials which the Supplier is required to supply to the Purchaser under the contract.
- 15.5 **“The Advance Purchase Order”** means the intention of Purchaser to place the Purchase Order on the bidder.
- 15.6 **“The Purchase Order”** means the order placed by the Purchaser on the Supplier signed by the Purchaser including all attachments and appendices thereto and all documents incorporated by reference therein. The purchase order shall be deemed as “Contract” appearing in the document.
- 15.7 **“The Contract Price”** means the price payable to the Supplier under the purchase order for the full and proper performance of its contractual obligations.
- 15.8 **“Validation”** is a process of testing the equipment as per the Generic Requirements in the specifications for use in BSNL and Defence network. Validation is carried out in simulated field environment and includes stability, reliability and environmental tests.
- 15.9 **“Telecom Service Provider”** means any Telecom operator in India, who is licensed by the Department of Telecommunications (DOT), Government of India to provide telecom services to the general public or to the other DOT licensed Telecom operators. **“Telecom Service Provider”** also refers to any Telecom operator in other countries providing telecom services to general public of that country.
- 15.10 **Contract.** The term contract means, the documents forming the tender and acceptance thereof and the formal agreement executed between the competent authority on behalf of BSNL and the contractor, together with the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time, jointly by the Engineer-in-charge, BSNL and all these documents taken together shall be deemed to form one contract and shall be complementary to one another. In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them. The expression works or work shall unless there be something either in the subject or context repugnant to such construction, be constructed and taken to mean the works by or by virtue of the contract contracted to be executed

whether temporary or permanent, and whether original, altered, substituted or additional.

- 15.11 **Contractor.** The Contractor shall mean the individual, firm or company.
- 15.12 **Work.** The expression “works” shall unless there be something either in the subject or context repugnant to such construction be construct and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent and whether original altered, substituted or additional.
- 15.13 **Schedule(s).** The Schedule(s) referred to in these conditions shall mean the relevant schedule(s) or the standard schedule of rates mentioned in the document.
- 15.14 **Site.** The site shall mean the land /or other places on, into or through which work is to be executed under the contract or any adjacent land, path or street through which, the work is to be executed under the contract or any adjacent land, path or street which may be allotted used for the purpose of carrying out the contract.
- 15.15 **Normal Time or Stipulated Time.** Normal time or stipulated time means time specified in the work order to complete the work.
- 15.16 **Extension of Time.** Extension of Time means the time granted by BSNL to complete the work beyond the normal time or stipulated time.
- 15.17 **Date of Commencement of Work.** Date of commencement of work means the date of actual commencement of work or 7th day from the date of issue of work order, whichever is earlier.
- 15.18 **Due Date of Completion.** Due date of completion shall be the date by which the work shall be completed at site including clearance of site.
- 15.19 **Duration of Completion of Work.** The duration of completion of work or completion time shall be time specified in the work order plus extension of time granted, if any
- 15.20 **Excepted Risk.** Excepted risk are risks due to war (whether declared or not), invasion, act of foreign enemies, hostilities, civil war, rebellion, revolution, insurrection, military or usurped power, any acts of Government damages from aircraft, acts of God, such as earthquake, lightening and unprecedented floods and other causes over which, the contractor has no control and the same having been accepted as such, by the Accepting Authority or causes solely due to use or occupation by the government of the part of the work, in respect of which a certificate of completion has been issued.
- 15.21 **BSNL Authority.** The BSNL authority means the Bharat Sanchar Nigam Limited, which invites the tenders on behalf of all officers in BSNL, whatever designations assigned to them from time to time, who may be the in-charge of direction supervision, testing, acceptance & testing including their successor(s) in the office appearing in various clauses shall be taken to mean BSNL.)
- 15.22 **“BSNL Authority”** means the Bharat Sanchar Nigam limited, which invites the tenders on behalf of all the references of:
- 15.22.1 CMD BSNL.

- 15.22.2 Director (Enterprise).
- 15.22.3 ED (Core Network).
- 15.22.4 Chief General Managers.
- 15.22.5 Principal General Managers.
- 15.22.6 General Managers.
- 15.22.7 Deputy General Managers.
- 15.22.8 Assistant General Managers/Managers/Deputy Managers.
- 15.22.9 Divisional Engineers/ Sub Divisional Engineers.
- 15.22.10 Junior Telecom Officers.
- 15.22.11 Chief Accounts Officers.
- 15.22.12 Accounts Officers.
- 15.22.13 Assistant Accounts Officers.
- 15.22.14 Junior Accounts Officers.
- 15.22.15 Including other officers in BSNL, whatever designations assigned to them from time to time, who may be the in-charge of direction supervision, testing, acceptance & testing including their successor(s) in the office appearing in various clauses shall be taken to mean BSNL.
- 15.23 **The GM (Projects)** means the Unit Head of Projects.
- 15.24 **Representative of the DGM (Projects):** Representative of the DGM (Projects) means Officers and staff for the time being in the DGM (Projects) Area deputed by the DGM (projects) for inspecting or supervising the work or testing etc.
- 15.25 **PICG Authority.** The PICG authority means the Project Implementation Core Group, Ministry of Defence which will be involved during evaluation, execution, testing and operate the entire infrastructure created after successful implementation of this project by BSNL. The Defence Forces will own, operate and maintain the entire infrastructure created after successful implementation of this project by BSNL. The PICG refers to an Defence organization on behalf of following references :-
 - 15.25.1 Chairman, PICG.
 - 15.25.2 Chief Network Architect, PICG.
 - 15.25.3 Director (NFS).
 - 15.25.4 Joint Director (NFS).
 - 15.25.5 (Including other officers in the PICG, whatever designations assigned to them from time to time, who may be the in-charge of direction supervision, testing, acceptance & testing including their successor(s) in the office appearing in various clauses shall be taken to mean the PICG).
- 15.26 **Director (NFS)** means the Single Point of Contact for Project Management aspects functional under the Chairman, PICG, Ministry of Defence and his successors.

- 15.27 **Representative of the Director (NFS).** Representative of Director (NFS) means Officer and staff deputed by him for inspecting or supervising the work or testing etc.
- 15.28 **Engineers-in-charge.** The Engineers-in-charge means the joint team of Engineering Officers nominated by the PICG and BSNL to supervise the work, under the contract. (Minimum Divisional Engineer level officer from BSNL and a Defence Officer).
- 15.29 **Site Engineer.** It shall mean an SDE/JTO of BSNL who may be placed by the (the SSA Head), (Name of SSA) / the DGM (Projects) as in-charge of the work at site at any particular period of time or a Defence officer nominated by PICG.
- 15.30 **Inspection Circle.** It shall mean A/T (Acceptance Testing) unit of BSNL.
- 15.31 **A/T Officer (BSNL).** An officer authorized by Inspection Circle, BSNL to conduct A/T.
- 15.32 **A/T Officer (PICG).** An officer authorized by PICG to conduct A/T.
- 15.33 **OFC Link.** Means end to end NLD link as given in Section IV E.
- 15.34 **Access.** Means complete access OFC for each station including Access Interconnect and DCN OFC, as given in Section IV E.
- 15.35 **DCN OFC.** Laying of OFC as part of Access Network for use by a specific end user.
- 15.36 **Commissioning.** Means successful completion of Acceptance Testing as per clauses 112.7 and 119 to 124 and issue of commissioning memo.
16. The eligible bidders should be an Indian registered company and should have obtained clearance from Reserve bank of India, wherever applicable. In addition they should meet the following criteria:
- 16.1 **Eligibility Conditions.** The following conditions must be satisfied by the bidder.
- 16.1.1 The bidder should be either an EPC contractor or an OFC manufacturer.
- 16.1.2 The bidder can bid for **maximum three** packages.
- 16.1.3 EPC (Engineering, Procurement and Construction) contractor means a company having capability of Route Survey, obtaining RoW permission, trenching, laying, testing & commissioning of OFC routes.
- 16.1.4 The OFC Manufacturer must be an Optical Fiber Cable Manufacturer in India.
- 16.1.5 The bidder must furnish the documentary evidence to meet the eligibility conditions laid down in general, technical, experience and financial eligibility criteria.
- 16.2 **General Eligibility Criteria.** *The Compliance to the following general conditions is a must for all prospective bidders.*
- 16.2.1 **The bidder shall be an Indian Registered Company under Company Act 1956 with 'Management & control with Resident Indian Nationals'. The bidder shall provide the following documents:-**

- 16.2.1.1 Certificate of Incorporation from Registrar of Companies.
- 16.2.1.2 Articles and Memorandum of Association.
- 16.2.1.3 Annual Report for the last three financial years.
- 16.2.1.4 Documentary evidence for registration with proof for Management and Control of Company with Resident Indian Nationals.
- 16.2.2 Bidder should quote for 100% of the quantities for package otherwise such bids shall be treated as non responsive and shall be summarily rejected.
- 16.2.3 The bidder should provide Copy of Permanent Account Number.
- 16.2.4 Bidder should have excise, permanent sales tax and service tax registration number, if applicable.

16.3 **Technical Eligibility Criteria.** All the interested bidders shall have adequate infrastructure facilities, capacities and procedures including quality control. Important eligibility conditions for technical eligibility criteria are given below.

16.3.1 **Bidder (OFC Manufacturer/EPC Contractor)**

- 16.3.1.1 The Bidder shall submit TSEC for 48 Fiber Ribbon Type Metal Free Optical Fiber Cable and QF-103 issued from QA Circle for all the products against specifications given at Section VI of the tender document.
- 16.3.1.2 The Bidder will be required to submit proof of submission for having applied for TSEC evaluation of samples (QF-103) complying to specifications given in this tender as part of the bid. **If a bidder fails to obtain TSEC/ Type Approval certificate for the product, as per specification given in this tender, within two months from the last date of submission of bids, the bid will be technically disqualified.**
- 16.3.1.3 QF-103/TSEC Certification obtained in respect of BSNL Tender No CA/CNP/NFS-OFC/T-419/2012 dated 06 Nov 2012 shall remain valid for submission as part of this tender.

16.3.2 **OFC Manufacturer**

- 16.3.2.1 The bidder must be an Optical Fiber Cable Manufacturer in India. The bidder should be an Indian company registered to manufacture and supply optical fiber cable during the last three years. The proof of manufacturing and supply of optical fiber cables in India shall be furnished by the bidder.
- 16.3.2.2 The OFC manufacturer should have Infrastructure Assessment (IA) certificate issued by BSNL, QA, Bangalore for the following at the time of bid submission:-
 - 16.3.2.2.1 48 Fiber Loose tube / Ribbon Type Metal Free Optical Fiber Cable with minimum manufacturing capacity of 18,000 Km per annum.
 - 16.3.2.2.2 Infrastructure Assessment certificate for ribbon type metal free optical cable.

- 16.3.2.3 The OFC manufacturer should use ITU-T grade G.655 and G.652D optical fiber, sourced from CACT approved indigenous sources.
 - 16.3.2.4 The OFC manufacturer should have ISO 9001:2008 certification or better with no prior history of withdrawal.
 - 16.3.2.5 The OFC manufacturer should have in-house test facilities of Optical, Geometrical, Mechanical and Reliability parameters of Fiber and Cable as per EIA/TIA, IEC and ITU standards for fiber, ribbon fiber and cable.
 - 16.3.2.6 The OFC manufacturer should have its own material and transmission lab as well as climatic chamber for testing of temperature range.
- 16.3.3 EPC Contractor**
- 16.3.3.1 The EPC Contractor should have ISO 9001:2008 certification or better with no prior history of withdrawal.
 - 16.3.3.2 The EPC Contractor should have company owned, leased or rented OTDR, OFC Blowing machine, Optical Power meter, laser source, cable route locator, splicing machine and HDD machine. The EPC contractor should have company owned, leased or rented equipment for OFC laying and committing resources for execution and maintenance of project in the stipulated time as per clause 16.4.2.1 below. In case the equipment is leased or rented, then the bidder is required to submit agreement details in this regard.
 - 16.3.3.3 The EPC Contractor should have sufficient technical manpower on their payroll that should be committed for this project to undertake execution of trenching, laying, installation, testing and maintenance of NLD and access OFC routes on turnkey basis in the stipulated time as per clause 16.4.2.1 below.
 - 16.3.3.4 The EPC contractor shall own sufficient infrastructure including plant, machineries, tools, other equipments and technical Manpower for successful completion of the required job, as mentioned above. A detailed list showing plant, machineries, tools and other equipments owned by the bidder, clearly highlighting its' make, model and year of purchase and a list of technical staff clearly showing their educational qualification and experience shall be submitted.
 - 16.3.3.5 The EPC Contractor should have proper safety set-up, with an independent Health Safety & Environment Department.

16.4 Experience Eligibility Criteria

16.4.1 OFC Manufacturer

- 16.4.1.1 The OFC Manufacturer should have manufactured and supplied minimum of cumulative 10,000 Km of OFC for Telecom Service Provider in the last five years, as on date of submission of bid.
- 16.4.1.2 The OFC Manufacturer should have manufactured and supplied minimum of 1,000 Km of Ribbon type OFC for telecom service provider in the last five years, as on date of submission of bid. Trading and supply is not acceptable.
- 16.4.1.3 The OFC Manufacturer should not be blacklisted for Telecom business by any Central/ State Government/ PSU or Telecom operator in India at the time of submission of bid.

16.4.2 **EPC Contractor**

- 16.4.2.1 The EPC Contractor should have capability for trenching and OFC laying at least 25 km per day per package for the project duration on turnkey basis. An undertaking to this effect needs to be submitted as part of the bid.
- 16.4.2.2 The EPC Contractor should have an experience of laying minimum of 3,000 Kms of OFC for Telecom service provider, which should include at least 1,000 Kms of Underground OFC, as on date of submission of bid.
- 16.4.2.3 The EPC contractor should not be blacklisted for Telecom business by any Central/State Government/ PSU or Telecom operator in India at the time of submission of bid.

16.5 **Financial Eligibility Criteria.** The interested bidders shall be financially sound. All the bidders shall submit audited financial/annual reports for the last three financial years. In case the audited report of the last financial year is not finalized at the time of bid submission, the report of the previous three financial years will be considered. The conditions for financial eligibility criteria are given as below :-

16.5.1 **OFC Manufacturer**

- 16.5.1.1 Incase OFC Manufacturer participates as Bidder for one package, then he should have a cumulative turnover of at least Rs. 200 Cr over the last three financial years.
- 16.5.1.2 Incase OFC Manufacturer participates as Bidder for two packages, then he should have a cumulative turnover of at least Rs. 400 Cr over the last three financial years.
- 16.5.1.3 Incase OFC Manufacturer participates as Bidder for three packages, then he should have a cumulative turnover of at least Rs. 600 Cr over the last three financial years.
- 16.5.1.4 Incase OFC Manufacturer participates as Bidder for one package, then he should provide banker's solvency certificate for Rs 75 Cr.
- 16.5.1.5 Incase OFC Manufacturer participates as Bidder for two packages, then he should provide banker's solvency certificate for Rs 150 Cr.

- 16.5.1.6 In case OFC Manufacturer participates as Bidder for three packages, and then he should provide banker's solvency certificate for Rs 200 Cr.

16.5.2 EPC Contractor

- 16.5.2.1 In case EPC Contractor participates as Bidder for one package, then he should have cumulative turnover of at least Rs. 1000 Cr over last three financial years.
- 16.5.2.2 In case EPC Contractor participates as Bidder for two packages, then he should have cumulative turnover of at least Rs. 2000 Cr over last three financial years.
- 16.5.2.3 In case EPC Contractor participates as Bidder or for three packages, then he should have cumulative turnover of at least Rs 3000 Cr over last three financial years.
- 16.5.2.4 In case EPC Contractor participates as Bidder or for one package, then he should provide banker's solvency certificate for Rs 300 Cr.
- 16.5.2.5 In case EPC Contractor participates as Bidder or for two packages, then he should provide banker's solvency certificate for Rs 600 Cr.
- 16.5.2.6 In case EPC Contractor participates as Bidder for three packages, then he should provide banker's solvency certificate for Rs 900 Cr.

- 16.6 In case the bidder is an OFC manufacturer, he will be required to choose an EPC contractor as his partner after being declared as L1, such that the EPC partner meets all the eligibility conditions of the tender clauses 16.3.3 above, 16.4.2, 16.5.2 above. Relevant documents of the partner, meeting all the tender conditions, a teaming agreement between the bidder and his partner shall be submitted, within two weeks of declaration of L1.

- 16.6.1 If the bidder fails to submit the requisite documents within the laid down time period as given in Clause 16.6 above, or the documents submitted for the partner do not meet the qualifying requirements as given in the tender, his bid shall be summarily rejected, EMD will be forfeited and the bidder shall be debarred from participation in any tender(s) of BSNL for a period of two years.

- 16.7 In case the bidder is an EPC contractor manufacturer, he will be required to choose an OFC manufacturer as his partner after being declared as L1, such that the OFC partner meets all the eligibility conditions of the tender clauses 16.3.2, 16.4.1, 16.5.1 above. Relevant documents of the partner, meeting all the tender conditions, a teaming agreement between the bidder and his partner shall be submitted, within two weeks of declaration of L1.

- 16.7.1 If the bidder fails to submit the requisite documents within the laid down time period as given in Clause 16.7 above, or the documents submitted for the partner do not meet the qualifying requirements as given in the tender, his bid shall be summarily rejected, EMD will be forfeited and the bidder shall be debarred from participation in any tender(s) of BSNL for a period of two years.

17. Earnest Money Deposit

17.1 **The EMD for each package is Rupees Five Crores Only. EMD shall be submitted separately for each package.**

17.2 The bidder shall furnish the bid EMD in one of the following ways:-

17.2.1 Demand Draft / Bankers Cheque drawn in favour of A.O. (Cash), BSNL C.O Payable at Delhi.

17.2.2 Bank Guarantee from a scheduled bank drawn in favour of DGM (MMT), BSNL C.O Delhi which should be valid for 210 days from the tender opening date.

18. **Cost of Bidding.** The bidder shall bear all cost associated with the preparation and submission of the bid. The purchaser will, in no case, be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

B. The Tender Documents

19. Tender Document Structure

19.1 The goods/work required to be supplied; bidding procedures and contract terms and conditions are prescribed in the Bid Documents. The Bid documents include:

19.1.1 Notice Inviting Tender and Eligibility.

19.1.2 Instructions to Bidders including instructions for e tendering.

19.1.3 General (Commercial) Conditions of Contract

19.1.4 Special Conditions of Contract. (Part A to D. **Part E will be issued separately**).

19.1.5 Schedule of Requirement.

19.1.6 Detailed Technical Specifications (Part A and B).

19.1.7 Bid Form.

19.1.8 Bid Security Form.

19.1.9 Price Schedule.

19.1.10 Performance Security Bond.

19.1.11 Bid Authority Certificate.

19.1.12 Appendix 'A' to Appendix 'P'.

19.2 The Bidder is expected to examine all instructions, forms, terms and specifications in the Bid Documents. **Failure to furnish all information required as per the Bid Documents or submission of the bids not substantially responsive to the Bid Documents in every respect will be at the bidder's risk and may result in rejection of the bid.**

19.3 **The Bidder is required to furnish details required for evaluation of eligibility criteria as per the format given at Appendix A. The Bidder is also required to furnish documents as per list given at Appendix B.**

20. Clarification of Bid Documents

20.1 A prospective bidder, requiring any clarification on the Bid Documents shall submit his queries through Email to the Purchaser's mailing address indicated in the invitation of Bid. The Purchaser shall respond in writing to

any request for the clarification of the Bid Documents, which it receives **not later than 11-07-2013**. Copies of the query (without identifying the source) and clarifications by the Purchaser shall be uploaded as Clarifications to the concerned tender on BSNL C.O. website & on ETS portal, as addenda, for all the prospective bidders who have downloaded the official copy of tender documents from ETS portal.

20.2 Any clarification issued by BSNL in response to query raised by prospective bidders shall form an integral part of bid documents and it may amount to amendment of relevant clauses of the bid documents.

20.3 Details regarding methodology for seeking clarifications on the tender document have been further elaborated at Clause 81 below Section IV Part A.

21. **Amendment of Bid Documents**

21.1 At any time, prior to the date of submission of Bids, the Purchaser may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify bid documents by amendments.

21.2 The amendments shall be notified in writing or by FAX to all prospective bidders on the address intimated at the time of purchase of the bid document from the purchaser and these amendments will be binding on them.

21.3 In order to afford prospective bidders a reasonable time to take the amendment into account in preparing their bids, the purchaser may, at its discretion, extend the deadline for the submission of bids suitably.

C. **Preparation of Bids**

22. **Documents Comprising the Bid.** The bid prepared by the bidder shall comprise the following components:

22.1 Documentary evidence established in accordance with the clause 16 above & 25 below that the bidder is eligible to bid and is qualified to perform the contract if his bid is accepted.

22.2 Bid Security furnished in accordance with clause 27 below.

22.3 A Clause by Clause compliance as per clause 26.2.3 below.

22.4 A Bid form and price schedule completed in accordance with clause 23 & 24 below.

23. **Bid Form.** The bidder shall complete the bid form and appropriate Price Schedule furnished in the Bid Documents, indicating the goods/work to be supplied, brief description of the goods/work, quantity and prices as per Section VII PART-II.

24. **Bid Prices**

24.1 The bidder shall give the total composite price inclusive of all Levies & Taxes i.e. Sales Tax & Excise, packing, forwarding, freight and insurance in case of material to be supplied and inclusive of all taxes and levies in case of works to be executed etc but excluding Octroi /Entry Tax which will be paid extra as per actual, wherever applicable. The contractor shall be responsible for transporting the materials to execute the work under the contract, to the site at his/their own cost. The costs of transportation are subsumed in the standard Schedule Rates and therefore no separate charges are payable on this account. The basic unit price and all other components of the price need to be individually indicated against the goods/work it proposes to supply

under the contract as per the price schedule given in Section VII Part-II. Prices of incidental services should also be quoted. The offer shall be firm in Indian Rupees. No Foreign exchange will be made available by the purchaser.

24.2 Prices indicated in the Price Schedule shall be entered in the following manner:-

24.2.1 The Basic Unit price (Ex Factory Price) of the goods/work, Excise duty, Sales Tax, Freight, Forwarding, Packing, Insurance and any other Levies/Charges already paid or payable by the supplier shall be quoted separately item wise.

24.2.2 The supplier shall quote as per price schedule given in Section VII Part-II for all the items given in schedule of requirement.

24.3 A bid submitted with an adjustable price quotation will be treated as non-responsive and rejected.

24.4 The prices quoted by the bidder shall be in sufficient detail to enable the Purchaser to arrive at the price of equipment/system offered.

24.5 "DISCOUNT, if any, offered by the bidders shall not be considered unless specifically indicated in the price schedule. Bidders desiring to offer discount shall therefore modify their offers suitably while quoting and shall quote clearly net price taking all such factors like discount, free supply, etc, into account".

24.6 The price approved by BSNL for procurement will be inclusive of Levies and Taxes, packing, forwarding, freight and insurance as mentioned in Clause 24.1 above subject to other terms and condition as stipulated in Clause 36.2 below of Section II and clause 61.3 below of Section III of bid document.

24.7 The freight by sea for transportation of equipment/Stores from the nearest port in the main land to Andaman & Nicobar Islands and Lakshadweep Islands will be reimbursed to the supplier at the concessional rates levied by Ministry of Water and Surface Transport on production of proof.

25. Documents Establishing Bidder's Eligibility and Qualification

25.1 The bidder shall furnish, as part of bid documents establishing the bidder's eligibility, the following documents or whichever is required as per terms and conditions of Bid Document :-

25.1.1 Certificate of Incorporation.

25.1.2 Article or Memorandum of Association or partnership deed or proprietorship deed/ joint venture deed as the case may be.

25.1.3 Registration certificate from State Director of Industries or from Secretariat for Industrial Approval (SIA), Ministry of Industries, Government of India, if applicable.

25.1.4 Approval from Reserve Bank of India/SIA, in case of foreign collaboration.

25.1.5 Type Approval Certificate (TAC) issued by Telecom Engineering Centre/TSEC issued by QA circle, BSNL or proof of having applied for TEC/TSEC (Copy of Form B/QF 103 be attached. (If applicable). The TSEC will be done for all the items mentioned in the BOM.

- 25.1.6 Inspection Certificate issued by BSNL (QA) for execution of Education/ Commercial Order. (If applicable). In case of supply to agencies other than BSNL/MTNL the copy of purchase order and completion Certificate from the Purchaser for completion of supply.
- 25.1.7 Indication of CACT approval Indigenous fiber source for meeting technical specifications. The relevant information for CACT approved sources for optical fiber should be submitted in following format:-

Ser No	Details	G.655	G.652D
1.	Manufacturer		
2.	Component/Raw Material		
3.	Part/Grade No		
4.	Certificate No		
5.	Validity		

- 25.1.8 Copies of CACT Approval Certificate for Indigenous CACT approved optical fiber sources as per indication given in clause 25.1.7 abovesould be submitted.
- 25.1.9 For accessories like FDMS, duct, joint closure, eletronic route markers/locators, warning tape etc, copy of teaming agreement with the lead bidder shall be submitted.
- 25.1.10 Undertaking duly signed by Lead bidder and its partner stating that both of them shall be liable for due performance of the contract jointly and severally, shall be submitted after declaration of L1 bidder as given at Clause 13.6 and 13.7 above.
- 25.2 The bidder shall furnish Audited Annual Report as evidence that he has financial capability to perform the contract.
- 25.3 The bidder shall furnish documentary evidence about technical and production capability necessary to perform the contract.
- 25.4 In order to enable the Purchaser to assess the suitability of the system offered, the bidder shall provide documentary evidence regarding the system being offered by him.
- 25.5 The offered product has to be type approved as per requirement of the tender. For this purpose, the supplier shall submit a sample type for evaluation. The sample would be evaluated for its ability to meet the technical specifications, manufacturability, reliability, testability, ease of installation, maintainability etc. Necessary documents to substantiate these attributes will have to be submitted at the time of application for approval by the supplier for obtaining type approval. (Applicable to all items mentioned in the BOM).

or

- 25.6 In case goods offered have already been type approved/validated by the Purchaser, documentary evidence to this effect shall be submitted by the bidder.
- 25.7 A signed undertaking from Authorised Signatory of the bidder that shall certify that all the components/parts/assembly/software used in the Desktops and Servers like Hard Disk, Monitors, memory etc. shall be original, new components/parts/assembly/software and that no refurbished/duplicate/second hand components/ parts/ assembly/software are being used or shall be used.

26. Documents Establishing Good's Conformity to Bid Documents

- 26.1 Pursuant to clause 22 above, the bidder shall furnish, as part of his bid, documents establishing the conformity of his bid to the Bid Documents of all goods/work and services which he proposes to supply under the contract.
- 26.2 The documentary evidences of the "goods/work and services" conformity to the Bid Documents, may be, in the form of literature, drawings, data etc and the bidder shall furnish:
 - 26.2.1 A detailed description of goods/work with essential technical and performance characteristics;
 - 26.2.2 A list, giving full particulars including available sources and current prices of all spare parts, special tools, etc, necessary for the proper and continuous functioning of the goods/work for a period of three years following commencement of use of the goods by the purchaser.
 - 26.2.3 A clause-by-clause compliance on the purchaser's Technical Specifications and Commercial Conditions demonstrating substantial responsiveness to the Technical Specifications and Commercial Conditions. A bid without clause-by-clause compliance of the technical Specifications (Section VI), Commercial Conditions (Section II and Section III) and Special Conditions (Section IV) with classifications thereof shall not be considered.
- 26.3 For the purpose of compliance to be furnished pursuant to the clause 26.2.3 above, the bidder shall note that the standards for the workmanship, material and equipment and reference to the brand names or catalogue number, designated by the Purchaser in its Technical specifications are intended to be descriptive only and not restrictive.

27. Bid Security

- 27.1 Pursuant to clause 22.2 above, the bidder shall furnish, as part of his bid, a bid security amount. EMD for each package is Rs Rupees Five Crores only. EMD shall be submitted separately for each package.
- 27.2 The bid security is required to protect the purchaser against the risk of bidder's conduct, which would warrant the forfeiture of bid security pursuant to Para 27.6 below.
- 27.3 The bid security shall be in the form of a Bank Guarantee issued by a scheduled bank in favour of the purchaser, valid for a period of **210 days from the date of tender opening**.
- 27.4 A bid not secured in accordance with Para 27.1 & 27.2 above shall be rejected

by the Purchaser being non-responsive at the bid opening stage and returned to the bidder unopened.

- 27.5 The bid security of the unsuccessful bidder will be discharged/returned as promptly as possible but not later than 30 days after the expiry of the period of the bid validity prescribed by the purchaser pursuant to clause 28 below.
- 27.6 The successful bidder's bid security will be discharged upon the bidder's acceptance of the advance purchase order satisfactorily in accordance with clause 41 below and furnishing the performance security.
- 27.7 The bid security may be forfeited :
 - 27.7.1 If the bidder withdraws his bid during the period of bid validity specified by the bidder in the Bid form or
 - 27.7.2 In the case of successful bidder, if the bidder fails:
 - 27.7.2.1 To sign the contract in accordance with clause 42 below.
 - or
 - 27.7.2.2 To furnish performance security in accordance with clause 41 below.
 - 27.7.3 In both the above cases, i.e. 27.7.1 above & 27.7.2 above the bidder will not be eligible to participate in the tender for same item for one year from the date of issue of APO. The bidder will not approach the court against the decision of BSNL in this regard.

28. Period of Validity of Bids

- 28.1 Bid shall remain valid for 180 days from the date of opening of bids prescribed by the purchaser pursuant to clause 33.1 below. A bid valid for a shorter period shall be rejected by the purchaser being non-responsive.
- 28.2 In exceptional circumstances, the purchaser may request the consent of the bidder for an extension to the period of bid validity. The request and the response thereto shall be made in writing. The bid security provided under clause 27 above shall also be suitably extended. The bidder may refuse the request without forfeiting his bid security. A bidder accepting the request and granting extension will not be permitted to modify his bid.

29. Format and Signing of Bid

- 29.1 The bidder shall submit his bid, online, complying all eligibility conditions, other terms and conditions of tender document to be read along with the clarifications and amendments issued in this respect. All the documents must be authenticated using Digital Signature by the authorized person. **Please refer to Section II for further instructions on e tendering.**
- 29.2 The copy of quality manual and Article or Memorandum of Association may be provided in original copy and copy No 1.
- 29.3 The bid shall be digitally signed by the bidder or a person duly authorized to bind the bidder to the contract. The letter of authorization shall be indicated by written power-of-attorney accompanying the bid.
- 29.4 The bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the bidder in which case such corrected

documents or revisions shall be authenticated by the person signing the bid using digital signature.

- 29.5 The Power of Attorney should be submitted and executed on the non-judicial stamp paper of appropriate value as prevailing in the respective states(s) and the same be attested by a Notary public or registered before Sub-Registrar of the states(s) concerned. The bidder will submit original in the original bid (1st) and copies of the POA in the other sets of additional bid document.
- 29.6 The Power of Attorney is to be executed by a person who has been authorized by the Board of Directors of the bidder in this regard, on behalf of the Company/Institution/Body Corporate.
- 29.7 In case of the bidder being a firm, the said Power of Attorney should be executed by all the partner(s) in favour of the said Attorney.

D. Submission of Bids

30. Sealing and Marking of Bids

- 30.1 The bid should be submitted online using Two Envelope methodology. The First Envelope- Technical part shall consist of the eligibility requirements, technical specification and compliance to all terms and conditions of the bid document including clarifications, addenda. The Second Envelope - The financial part shall contain Price Schedule only.

30.1.1 Venue of Tender Opening: BSNL has adopted e-tendering process which offers a unique facility for public online tender opening event (TOE). BSNL's tender opening officers as well as authorized representatives of the bidders can attend the public online TOE from the comfort of the offices. However, if required, authorized representatives of the bidders can attend the TOE at meeting room, Second Floor, Bharat Sanchar Bhawan, Janpath, New Delhi-110001 at date and time as specified in NIT, where BSNL's tender opening officers would be conducting public online TOE. If due to administrative reason, the venue of Bid opening is changed, it will be displayed prominently on Second Floor of Bharat Sanchar Bhawan.

- 30.2 **Bids must be submitted online by the bidders as per instructions in Section II not later than the specified date & time indicated in the covering letter.**

- 30.3 The Purchaser may, at its discretion, extend this deadline for the submission of bids by amending the Bid Documents in accordance with clause 21 above in which case all rights and obligations of the purchaser and bidders previously subject to the deadline will thereafter be subjected to the deadline as extended.

- 30.4 The bidder shall submit his bid offer against a set of bid documents purchased by him for all or some of the systems/equipment as per requirement of the Bid Documents. He may include alternate offer, if permissible as per the bid. However, not more than one independent and complete offer shall be permitted from the bidder.

31. **Late Bids.** No bid shall be accepted online by the Electronic Tender System® (ETS) after the specified deadline for submission of bids prescribed by the purchaser pursuant to clause 30.2 above.

32. **Modification and Withdrawal of Bids**

- 32.1 The bidder may modify or withdraw his bid after submission provided that the written notice of the modification or withdrawal is received by the purchaser prior to the deadline prescribed for submission of bids.
- 32.2 The bidder's modification, revision or withdrawal shall have to be online and digitally authenticated as per clause 30 above.
- 32.3 The bidder's modification or withdrawal notice shall be prepared, sealed, marked and dispatched as required in the case of bid submission in accordance with the provision of clause 30 above. A withdrawal notice may also be sent by FAX but followed by a signed confirmation copy by post not later than the deadline for submission of bids.
- 32.4 Subject to clause 34 below no bid shall be modified subsequent to the deadline for submission of bids.

E. **Bid Opening and Evaluation**

33. **Opening of Bids by Purchaser**

- 33.1 The purchaser shall open bids online in the presence of bidders or their authorized representatives who chose to attend, at time specified in Clause 30.1.1 above on due date. The bidder's representatives, who are present, shall sign in an attendance register. Authority letter to this effect shall be submitted by the bidders before they are allowed to participate in bid opening (Format is given in Section X).
- 33.2 A maximum of two representatives of any bidder shall be authorized and permitted to attend the bid opening.
- 33.3 The bidder's names, Bid prices, modifications, bid withdrawals and such other details as the purchaser, at its discretion, may consider appropriate will be made available online at the time of respective opening (Technical and Financial).
- 33.4 The date fixed for opening of bids, if subsequently declared as holiday by the BSNL, the revised date of schedule will be notified. However, in absence of such notification, the bids will be opened on next working day, time and venue remaining unaltered.

- 34. **Clarification of Bids.** To assist in the examination, evaluation and comparison of bids, the purchaser may, at its discretion ask the bidder for the clarification of its bid. The request for the clarification and the response shall be in writing. **However, no post bid clarification at the initiative of the bidder shall be entertained.**

35. **Preliminary Evaluation**

- 35.1 Purchaser shall evaluate the bids to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed and whether the bids are generally in order.
- 35.2 **Disproportionate pricing for supply and services component of the tender as per prevalent industry norms shall render the bid to be rejected at the discretion of the Purchaser.**
- 35.3 If the sum of components of the unit price adds up to an amount different than the quoted unit price, still the quoted unit price will be taken into account for evaluation. However, if the sum of the components of the unit price is lower than the quoted unit price, then the lower component prices shall become the basis for determining the ordering price.

- 35.4 Arithmetical errors shall be rectified on the following basis. If there is a discrepancy between the unit price and total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected by the purchaser. If there is a discrepancy between words and figures, the amount in words shall prevail. **If the supplier does not accept the correction of the errors, his bid shall be rejected.**
- 35.5 Prior to the detailed evaluation pursuant to clause 36 below, the Purchaser will determine the substantial responsiveness of each bid to the Bid Document. For purposes of these clauses, a substantially responsive bid is one which confirms to all the terms and conditions of the Bid Documents without material deviations. The purchaser's determination of bid's responsiveness shall be based on the contents of the bid itself without recourse to extrinsic evidence.
- 35.6 A bid, determined as substantially non-responsive will be rejected by the purchaser and shall not subsequent to the bid opening be made responsive by the bidder by correction of the non-conformity.
- 35.7 The Purchaser may waive any minor infirmity or non-conformity or irregularity in a bid which doesn't constitute a material deviation, provided such waiver doesn't prejudice or effect the relative ranking of any bidder.

36. **Evaluation and Comparison of Substantially Responsive Bids**

- 36.1 The Purchaser shall evaluate in detail and compare the bids previously determined to be substantially responsive pursuant to clause 35 above.
- 36.2 The evaluation and comparison of responsive bids shall be done on the basis of Net cost to BSNL on the prices of the goods/work offered inclusive of Duties and taxes (but excluding Cenvatable Duties & Taxes), Sales Tax, Packing, Forwarding, Freight and Insurance charges etc. as indicated in Col. 18 of the price schedule in the Section VII Part-II A of the Bid document. As stipulated in clause 24.1 above Octroi/Entry Taxes are not to be included in the composite price and hence the same will not be considered for the purpose of evaluation and comparison of responsive bids. However, Octroi/Entry Taxes will be paid extra as per actual wherever applicable on production of proof of payment/relevant invoices/documents as per Govt guidelines issued on the subject from time to time.
- 36.2.1 "Duties & Taxes for which the firm has to furnish Cenvatable Challans/ Invoices will be indicated separately in the PO/APO.
- 36.2.2 Vendors should furnish the correct E.D./Customs tariff Head in the price Schedule. If the credit for the Duties and Taxes under CENVAT Credit Rules, 2004 is found to be not admissible at any stage subsequently owing to wrong furnishing of Tariff Head, then the vendors will be liable to refund such non admissible amount, if already paid, along with penalty if charged by the concerned authority.
- 36.2.3 In case the Duties & Taxes which are non CENVAT-able as per the quotes indicated in the price schedule by the vendors and subsequently at any stage it is found that Credit for such Duties & Taxes is admissible as per CENVAT Credit Rules, 2004, then the vendors will be liable to refund the amount equivalent to such Duties & Taxes if already paid to them. However, the purchaser may allow the supplier to submit necessary documents in this

regard which may enable the purchaser to avail the CENVAT credit provided such credit is still available for the amount so paid as per CENVAT Credit Rules 2004.

36.2.4 The purchaser reserves the right to ask the bidders to submit documentary proof confirming the correct Tariff Head from the E.D./Customs authority where the Tariff Head furnished against the particular tendered item by different bidders differs from each other or the same is found apparently not furnished in accordance with E.D./Customs Tariff notifications.

36.2.5 "If the supplier fails to furnish necessary supporting documents i.e. Excise/Customs invoices etc. in respect of the Duties/taxes which are Cenvatable, the amount pertaining to such Duties/Taxes will be deducted from the payment due to the firm".

37. **Contacting the Purchaser**

37.1 Subject to Clause 34 above, no bidder shall try to influence the Purchaser on any matter relating to its bid, from the time of the bid opening till the time the contract is awarded.

37.2 Any effort by a bidder to modify his bid or influence the purchaser in the purchaser's bid evaluation, bid comparison or contract award decision shall result in the rejection of the bid.

F. **Award of Contract**

38. **Placement of Order.** The Purchaser shall consider placement of orders for commercial supplies only on those eligible bidders whose offers have been found technically, commercially and financially acceptable and whose goods/work have been type approved/validated by the purchaser. The Purchaser reserves the right to counter offer price(s) against price(s) quoted by any bidder.

39. **Purchaser's Right to Vary Quantities**

39.1 BSNL will have the right to increase or decrease up to 25% of the quantity of goods/work and services specified in the schedule of requirements without any change in the unit price or other terms and conditions at the time of award of contract and / or up to 50% of the additional quantities of goods/work and services contained in the running tender/contract can be ordered within a period of twelve months from the earliest date of acceptance of APO at the same rate or a rate negotiated (downwardly) with the existing vendors considering the reasonability of rates based on prevailing market conditions and the impact of reduction in duties and taxes etc. and supplies to be obtained within delivery period scheduled afresh.

39.2 BSNL Board will have full power to accord administrative approval and financial concurrence to procure any equipment/material in any quantity by any means in the exigencies of services and interest of BSNL or Defence Forces.

40. **Purchaser's Right to Accept any Bid and to REJECT ANY OR ALL BIDS**

40.1 The Purchaser reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of contract without assigning any reason whatsoever and without thereby incurring any liability to the affected bidder or bidders on the grounds of purchaser's action.

41. **Issue of Advance Purchase Order**

- 41.1 The issue of an Advance Purchase Order shall constitute the intention of the Purchaser to enter into contract with the bidder.
- 41.2 The bidder shall, within 14 days of issue of, from the date of advance purchase order, give his acceptance along with performance security in conformity with Section IX provided with the bid document.

42. **Signing of Contract**

- 42.1 The issue of Purchase order shall constitute the award of contract on the bidder.
- 42.2 Upon the successful bidder furnishing performance security pursuant to clause 41 above, the Purchaser shall discharge the bid security in pursuant to clause 27 above.

43. **Annulment of Award.** Failure of the successful bidder to comply with the requirement of clause 42 above shall constitute sufficient ground for the annulment of the award and the forfeiture of the bid security in which event the Purchaser may make the award to any other bidder at the discretion of the purchaser or call for new bids.

44. **Quality Assurance Requirements.** The supplier shall have Quality Management System supported and evidenced by the following :-

- 44.1 A Quality Policy.
- 44.2 A management representative with authority and responsibility for fulfilling QA requirements and for interfacing with purchaser in the matters of Quality.
- 44.3 Procedure for controlling design/production engineering, materials, choice of components/vendors, manufacturing and packaging process for supplying quality products.
- 44.4 System of Inward Good Inspection.
- 44.5 System to calibrate and maintain required measuring and test equipment.
- 44.6 System for tracing the cause for nonconformance (traceability) and segregating product which don't conform to specifications.
- 44.7 Configuration management and change control mechanism.
- 44.8 A quality plan for the product.
- 44.9 Periodical internal quality audits.
- 44.10 A 'Quality Manual' detailing the above or infrastructure assessment certificate and Type Approval Certificate issued by "TEC" shall be furnished.

45. **Rejection of Bids.** While all the conditions specified in the Bid documents are critical and are to be complied, special attention of bidder is invited to the following clauses of the bid documents. **Non-compliance of anyone of which shall result in outright rejection of the bid.**

- 45.1 **The bids will be recorded/ returned unopened if covers are not properly sealed with 'PERSONAL SEAL' of the bidder (applicable for hard copy only).**
- 45.2 **Clauses of Section II:** The bids will be rejected at opening stage if Bid security is not submitted as per Clauses 27.1 above & 27.2 above and bid validity is less than the period prescribed in Clause 28.1 above.
- 45.3 **Clause 16 & 25 above of Section II:** If the eligibility condition is not met as per clause 16 above of section II and/or documents prescribed to establish

the eligibility as per clause 25 above of Section II are not enclosed, the bids will be rejected without further evaluation.

- 45.4 **Clause 26.2.3 above of Section II:** If clause-by-clause compliance as prescribed is not given, the bid will be rejected at the stage of primary evaluation. **A Nil Deviations Certificate must be given with respect to all clauses of the tender by the Bidder. Compliance if given using ambiguous words like “Noted”, “Understood”, “Noted & Understood” shall not be accepted as complied. Mere “Complied” will also be not sufficient, reference to the enclosed documents showing compliances must be given.**
- 45.5 **Section VII Part-II A Price Schedule.** **Prices are not filled** in as prescribed in price schedule.
- 45.6 **Section II clause 24.5 above on discount which is reproduced below:** “Discount, if any, offered by the bidder shall not be considered unless specifically indicated in the price schedule. Bidders desiring to offer discount shall therefore modify their offer suitably while quoting and shall quote clearly net price taking all such factors like Discount, free supply etc. into account”.
- 45.7 Before outright rejection of the Bid by Bid opening team for noncompliance of any of the provisions mentioned in clauses 45.1 to 45.6 above of Section II though the bidder company is given opportunity to explain their position, however if the person representing the company is not satisfied with the decision of the Bid opening team, he/they can submit the representation to the Bid opening team immediately but in no case after closing of the tender process with full justification quoting specifically the violation of tender condition if any.
- 45.8 Bid opening team will not return the bids submitted by the bidders on the date of tender opening even if it is liable for rejection and will preserve the bids in sealed cover as submitted by taking the signatures of some of the desirous representatives of the participating bidder/companies present on the occasion.
- 45.9 The in-charge of Bid opening team will mention the number of bids with the name of the company found unsuitable for further processing on the date of tender opening and number of representations received in Bid opening Minutes and if Bid opening team is satisfied with the argument of the bidder/company mentioned in their representation and feel that there is prima facie fact for consideration, the in-charge of the bid opening team will submit the case for review to competent authority i.e. GM in circles and Director (Enterprise) in corporate office BSNL as early as possible preferably on next working day and decision to this effect should be communicated to the bidder company within a week positively. Bids found liable for rejection and kept preserved on the date of tender opening will be returned to the bidders after issue of P.O. against the instant tender.
- 45.10 If the reviewing officer finds it fit to open the bid of the petitioner, this should be done by giving three (working) days notice to all the participating bidders to give opportunity to desirous participants to be present on the occasion.
46. Purchaser reserves the right to disqualify the supplier for a suitable period who habitually failed to supply the equipment in time. Further, the suppliers whose equipment does not perform satisfactory in the field in accordance with the specifications may also be disqualified for a suitable period as decided by the purchaser.

47. Purchaser reserves the right to blacklist a bidder for a suitable period in case he fails to honour his bid without sufficient grounds. **The Purchaser also reserves the right to blacklist the bidder in case he fails to honour the AMC commitment after expiry of warranty period.**
48. The bidder should give a certificate that none of his/her near relative is working in the units as defined below where he is going to apply for the tender.
- 48.1 In case of proprietorship firm certificate will be given by the proprietor.
- 48.2 For partnership firm certificate will be given by all the partners and in case of limited company by all the Directors of the company excluding Government of India/Financial institution nominees and independent non Official part time Directors appointed by Govt. of India or the Governor of the state and full time Directors of PSUs both state and central.
- 48.3 Due to any breach of these conditions by the company or firm or any other person the tender will be cancelled and Bid Security will be forfeited at any stage whenever it is noticed and BSNL will not pay of any damage to the company or firm or the concerned person.
- 48.4 The company or firm or the person will also be debarred for further participation in the concerned unit. The near relatives for this purpose are defined as:-
- 48.4.1 Members of a Hindu undivided family.
- 48.4.2 They are husband and wife.
- 48.4.3 The one is related to the other in the manner as father, mother, son(s) & Son's wife (daughter in law), Daughter(s) and daughter's husband (son in law), brother(s) and brother's wife, sister(s) and sister's husband (brother in law).
- 48.5 The format of the certificate to be given is as per format given at Appendix 'P'
49. **Verification of Documents and Certificates**
- 49.1 "The bidder will verify the genuineness and correctness of all documents and certificates, including experience/performance certificates, issued either by the bidder or any other firm / associate before submitting them in the bid. The onus of proving genuineness of the submitted documents would rest with the bidder.
- 49.2 As per requirement of the tender's conditions, if any document / paper / certificate submitted by the participant bidder is found to be false / fabricated / tempered / manipulated at any stage during bid evaluation or award of contract, then the bid security (EMBG) of the bidder would be forfeited and the bidder would be disqualified from the tender. Action would also be taken for banning of business dealing with the defaulting firm. In case contract has already awarded to the bidder, then PBG would be forfeited and the contract would be rescind / annulled and BSNL would be at liberty to procure the ordered goods and services from any other source at the risk and cost of the defaulting bidder. Action would also be taken for banning business dealing with the defaulting firm. To obviate any possibility of doubt and dispute and maintain veracity of the documents / papers / certificates, the documents conforming to eligibility part will be submitted by the participant bidder duly authenticated by the authorized signatory along with EMBG (bid security) of requisite amount and will be checked at the time of tender opening. The

documents / papers to be submitted in respective bid part will be explicitly mentioned in clause 23. This bid part (already digitally signed by the authorized representative of the bidder company during bid submission) will be digitally signed by the in charge of the tender opening team and will be kept preserved along with the bid submitted online. In case of any dispute these papers will be treated as authentic one”.

BSNL

SPECIAL INSTRUCTIONS TO BIDDERS FOR E-TENDERING

50. General

- 50.1 The Special Instructions (for e-Tendering) supplement 'Instruction to Bidders', as given in these Tender Documents. Submission of Online Bids is mandatory for this Tender.
- 50.2 E-Tendering is a new methodology for conducting Public Procurement in a transparent and secured manner. Suppliers/ Vendors will be the biggest beneficiaries of this new system of procurement. For conducting electronic tendering, BSNL has decided to use the portal (<https://www.tcil-india-electronictender.com>) through TCIL, a Government of India Undertaking.
- 50.3 Benefits to Suppliers are outlined on the Home-page of the portal.

51. Instructions

51.1 Tender Bidding Methodology

- 51.1.1 Sealed Bid System – **Single Stage Bidding - Two Stage Opening using Two Electronic Envelope System.**

51.2 Broad outline of activities from Bidders prospective

- 51.2.1 Procure a Digital Signing Certificate (DSC).
- 51.2.2 Register on ElectronicTendering System® (ETS).
- 51.2.3 Create Users and assign roles on ETS.
- 51.2.4 View Notice Inviting Tender (NIT) on ETS.
- 51.2.5 Download Official Copy of Tender Documents from ETS.
- 51.2.6 Clarification to Tender Documents on ETS.
 - 51.2.6.1 Query to BSNL (Optional).
 - 51.2.6.2 View response to queries posted by BSNL, as addenda.
- 51.2.7 Bid-Submission on ETS.
- 51.2.8 Attend Public Online Tender Opening Event (TOE) on ETS.
 - 51.2.8.1 Opening of Technical & Financial-Part.
- 51.2.9 View Post-TOE Clarification posted by BSNL on ETS (Optional).
 - 51.2.9.1 Respond to BSNL's Post-TOE queries.

- 51.3 **Digital Certificates.** For integrity of data and its authenticity/ non-repudiation of electronic records, and be compliant with IT Act 2000, it is necessary for each user to have a Digital Certificate (DC). also referred to as Digital Signature Certificate (DSC), of Class 2 or above, issued by a Certifying Authority (CA) licensed by Controller of Certifying Authorities (CCA) [refer <http://www.cca.gov.in>].

- 51.4 **Registration.** To use the ElectronicTender® portal (<https://www.tcil-india-electronictender.com>). Vendor needs to register on the portal, if not registered earlier. Registration of each organization is to be done by one of its senior persons who will be the main person coordinating for the e-tendering activities. In ETS terminology, this person will be referred to as the Super User (SU) of that organization. For further details, please visit the

website/portal, and click on the 'Supplier Organization' link under 'Registration' (on the Home Page), and follow further instructions as given on the site. Pay Annual Registration Fee as applicable.

- 51.4.1 **Note:** After successful submission of Registration details and Annual Registration Fee (as applicable). Please contact TCIL/ ETS Helpdesk (as given below), to get your registration accepted/activated.

TCIL Helpdesk/ ETS Helpdesk	
Telephone	011-26241071 <i>[between 9:30 hrs to 18:00 hrs on working days]</i>
Mobile Nos.	9868393717 / 9868393775
E-mail ID	ets_support@tcil-india.com <i>[Please mark CC: support@electronicstender.com]</i>

BSNL Contact-1	
BSNL's Contact Person	Mr. AK Verma, AGM(MMY)
Telephone/ Mobile	011-23717844 <i>[between 9:30 hrs to 18:00 hrs on working days]</i>
E-mail ID	akverma@bsnl.co.in

BSNL Contact-2	
BSNL's Contact Person	Mr. Manoj Jain ,Dy. Mgr.(MMX)
Telephone/ Mobile	011-23037172 <i>[between 9:30 hrs to 18:00 hrs on working days]</i>
E-mail ID	manoj_jain@bsnl.co.in

- 51.5 **Some Bidding related Information for this Tender (Sealed Bid).** The entire bid-submission would be online on ETS. Broad outline of submissions are as follows:

- 51.5.1 Submission of Bid Security/ Earnest Money Deposit (EMD).
51.5.2 Submission of digitally signed copy of Tender Documents/

Addenda.

51.5.3 **Two Envelopes.**

51.5.3.1 Techno-commercial.

51.5.3.2 Financial.

51.5.4 Each of the above electronic envelopes consists of Main Bid and Electronic Form (both mandatory) and bid annexures (optional). Bidders must ensure that after following above submissions, the status of bid submission becomes – “Complete”.

51.6 **Offline Submissions.** The bidder is requested to submit the following documents offline to DM (MMT), BSNL Corporate Office, 2nd Floor, Bharat Sanchar Bhawan, Janpath, New Delhi – 110001 on or before the date & time of submission of bids specified in covering letter of this tender document, in a Sealed Envelope. The envelope shall bear (the project name), the tender number and the words ‘DO NOT OPEN BEFORE’ (due date & time).

51.6.1 EMD-Bid Security (Original copy).

51.6.2 Integrity Pact as per Appendix ‘E’.

51.6.3 Power of attorney in accordance with clauses 29.5 to 29.7 above of Section II.

51.6.4 One set of complete technical portion of the bid is to be submitted in hard and soft copy in CD/DVD.

Note: The Bidder has to upload the Scanned copy of all above said original documents as Bid-Annexures during Online Bid-Submission also.

51.7 **Special Note on Security of Bids.** Security related functionality has been rigorously implemented in ETS in a multi-dimensional manner. Starting with 'Acceptance of Registration by the Service Provider', provision for security has been made at various stages in ElectronicTender's software. Specifically for Bid Submission, some security related aspects are outlined below:-

51.7.1 As part of the ElectronicEncrypter™ functionality, the contents of both the 'ElectronicForms' and the 'Main-Bid' are securely encrypted using a Pass-Phrase created by the Bidder himself. Unlike a 'password', a Pass-Phrase can be a multi-word sentence with spaces between words (eg I love this World). A Pass-Phrase is easier to remember, and more difficult to break. It is recommended that a separate Pass-Phrase be created for each Bid-Part. This method of bid-encryption does not have the security and data-integrity related vulnerabilities which are inherent in e-tendering systems which use Public-Key of the specified officer of a Buyer organization for bid-encryption. Bid-encryption in ETS is such that the Bids cannot be decrypted before the Public Online Tender Opening Event (TOE), even if there is connivance between the concerned tender-opening officers of the Buyer organization and the personnel of e-tendering service provider.

51.7.2 Typically, 'Pass-Phrase' of the Bid-Part to be opened during a particular Public Online Tender Opening Event (TOE) is furnished online by each bidder during the TOE itself, when demanded by the concerned Tender Opening Officer.

- 51.7.3 There is an additional protection with SSL Encryption during transit from the client-end computer of a Supplier organization to the e-tendering server/ portal.
- 51.7.4 It is important for the bidder to keep a safe record of his pass phrases for decrypting his bid parts. In case the bidder is unable to provide the correct pass phrase during TOE, it will not be possible to open his online bid and his bid will be rejected (i.e. archived unopened). Before rejection in such a situation, the bidder will be given opportunity to himself enter the pass phrase from his own office or from BSNL's office, if his representative is physically present there.

51.8 **Public Online Tender Opening Event (TOE)**

- 51.8.1 ETS offers a unique facility for 'Public Online Tender Opening Event (TOE)'. Tender Opening Officers as well as authorized representatives of bidders can attend the Public Online Tender Opening Event (TOE) from the comfort of their offices. For this purpose, representatives of bidders (i.e. Supplier organization) duly authorized are requested to carry a Laptop and Wireless Connectivity to Internet.
- 51.8.2 Every legal requirement for a transparent and secure 'Public Online Tender Opening Event (TOE)' has been implemented on ETS.
- 51.8.3 As soon as a Bid is decrypted with the corresponding 'Pass-Phrase' as submitted online by the bidder himself (during the TOE itself), salient points of the Bids are simultaneously made available for downloading by all participating bidders. The tedium of taking notes during a manual 'Tender Opening Event' is therefore replaced with this superior and convenient form of 'Public Online Tender Opening Event (TOE)'.
- 51.8.4 ETS has a unique facility of 'Online Comparison Chart' which is dynamically updated as each online bid is opened. The format of the chart is based on inputs provided by the Buyer for each Tender. The information in the Comparison Chart is based on the data submitted by the Bidders in electronic forms. A detailed Technical and/ or Financial Comparison Chart enhances Transparency. Detailed instructions are given on relevant screens.
- 51.8.5 ETS has a unique facility of a detailed report titled 'Minutes of Online Tender Opening Event (TOE)' covering all important activities of 'Online Tender Opening Event (TOE)'. This is available to all participating bidders for 'Viewing/ Downloading'.
- 51.8.6 There are many more facilities and features on ETS. For a particular tender, the screens viewed by a Supplier will depend upon the options selected by the concerned Buyer.
- 51.8.7 In case of internet related problem at bidders end, especially during critical events such as a short period before bid submission deadline, during online public TOE, it is the bidder's responsibility to have backup internet connections. In case there is a problem at the e-procurement service providers end (in the server, leased line

etc) due to which all the bidders face a problem during critical events and this is brought to the notice of BSNL by the bidders in time, then BSNL will promptly reschedule the affected events.

51.9 Other Instructions

- 51.9.1 For further instructions, the vendor should visit the home-page of the portal (<https://www.tcil-india-electronictender.com>), and go to the User-Guidance Center
- 51.9.2 The help information provided through 'ETS User-Guidance Center' is available in three categories – Users intending to Register / First-Time Users, Logged-in users of Buyer organizations, and Logged-in users of Supplier organizations. Various links are provided under each of the three categories.
- 51.9.3 Important Note: It is strongly recommended that all authorized users of Supplier organizations should thoroughly peruse the information provided under the relevant links, and take appropriate action. This will prevent hiccups, and minimize teething problems during the use of ETS.
- 51.9.4 The following '**FOUR KEY INSTRUCTIONS for BIDDERS**' must be assiduously adhered to:
 - 51.9.4.1 Obtain individual Digital Signing Certificate (DSC or DC) well in advance of your first tender submission deadline on ETS.
 - 51.9.4.2 Register your organization on ETS well in advance of your first tender submission deadline on ETS
 - 51.9.4.3 Get your organization's concerned executives trained on ETS well in advance of your first tender submission deadline on ETS
 - 51.9.4.4 Submit your bids well in advance of tender submission deadline on ETS (There could be last minute problems due to internet timeout, breakdown, et al) While the first three instructions mentioned above are especially relevant to first-time users of ETS, the fourth instruction is relevant at all times.

51.10 Minimum Requirements at Bidders end

- 51.10.1 Computer System with good configuration (Min P IV, 1 GB RAM, Windows XP)
- 51.10.2 Broadband connectivity.
- 51.10.3 Microsoft Internet Explorer 6.0 or above
- 51.10.4 Digital Certificate(s) for users.

51.11 Vendors Training Program

- 51.11.1 One day training (10:00 to 17:00) would be provided. Training is optional.
- 51.11.2 Vendors are requested to carry a Laptop and Wireless Connectivity to Internet.

Tentative Dates	Date of uploading of Tender document + 7 days
Venue	Meeting Room, 2 nd Floor, BSNL Corporate Office, Bharat Sanchar Bhawan, Janpath, New Delhi – 110001
Vendors Training Charges (Per Participant) per training day	Rs. 2,500/- (plus Service Tax @ 12.36 %)
Mode of Payment of Fees	DD payable to M/s TCIL, New Delhi at New Delhi

SECTION III

GENERAL COMMERCIAL CONDITIONS OF CONTRACT

52. **Application.** The general condition shall apply in contracts made by the purchaser for the procurement of goods/works.
53. **Standards.** The goods/works supplied under this contract shall conform to the standards prescribed in the Technical Specifications mentioned in Section VI.
54. **Patent Rights.** The bidder shall indemnify the purchaser against all third-party claims of infringement of patent, trademark or industrial design rights arising from use of the goods/work or any part thereof in Indian Telecom Network.
55. **Performance Security**
- 55.1 All bidders (including small scale units who are registered with the National Small Scale Industries Corporation under Single point registration scheme) shall furnish **performance bank guarantee to the purchaser for an amount equal to 5% of the value of purchase order within 14 days from the date of issue of Advance Purchase Order by the Purchaser. The Performance Bank Guarantee shall be valid for up to three months after completion of warranty period.**
- 55.2 The proceeds of the performance security shall be payable to the Purchaser as compensation for any loss resulting from the bidder's failure to complete its obligations under the contract.
- 55.3 The performance security Bond shall be in the form of Bank Guarantee issued by a scheduled Bank and in the form provided in Section IX of this Bid Document.
- 55.4 The performance security Bond will be discharged by the Purchaser after completion of the bidder's performance obligations including any warranty obligations under the contract.
56. **Inspection and Tests**
- 56.1 The Purchaser or his representative shall have the right to inspect and test the goods/works as per prescribed test schedules for their conformity to the specifications. Where the Purchaser decides to conduct such tests on the premises of the bidder or its subbidder(s), all reasonable facilities and assistance like Testing instruments and other test gadgets including access to drawings and production data shall be furnished to the inspectors at no charge to the purchaser. Joint inspection will be carried out by PICG and BSNL during technical evaluation, Pre Dispatch and after delivery of goods.
- 56.2 Should any inspected or tested goods/works fail to conform to the specifications the purchaser may reject them and the bidder shall either replace the rejected goods/works or make all alterations necessary to meet Specification requirements free of cost to the purchaser.
- 56.3 Notwithstanding the pre-supply tests and inspections prescribed in clause 56.1&56.2 above, the equipment and accessories on receipt in the Purchaser's premises will also be tested during and after installation and construction before "take over" and if any equipment or part thereof is found defective, the same shall be replaced free of all cost to the purchaser as laid down in clause 56.4 below.

- 56.4 If any equipment or any part thereof, before it is taken over under clause 56.5 below, is found defective or fails to fulfill the requirements of the contract, the inspector shall give the Bidder notice setting forth details of such defects or failure and the bidder shall make the defective equipment good, or alter the same to make it comply with the requirements of the contract forthwith and in any case within a period not exceeding three months of the initial report. These replacements shall be made by the bidder free of all charges at site. Should it fail to do so within this time, the purchaser reserves the discretion to reject and replace at the cost of the bidder the whole or any portion of equipment as the case may be, which is defective or fails to fulfill the requirements of the contract. The cost of any such replacement made by the purchaser shall be deducted from the amount payable to the bidder.
- 56.5 When the performance tests called for have been successfully carried out, the inspector / ultimate consignee from BSNL and PICG will forthwith issue a Taking Over Certificate. The inspector /ultimate consignee shall not delay the issue of any "Taking Over Certificate" contemplated by this clause on account of minor defects in the equipment which do not materially affect the commercial use thereof provided that the bidder shall undertake to make good the same in a time period not exceeding six months. The Taking Over Certificate shall be issued by the ultimate consignee within six weeks of successful completion of tests. In this case, BCPC (Bills Copy Payable Challan) shall be equivalent to "Taking Over Certificate", issuance of which shall certify receipt of goods in safe and sound condition. However, they shall not discharge the bidder of their warranty obligation. BCPC in respect of last consignment against the purchase order will be equivalent to "Taking Over Certificate" for the material only. Bidder will make own arrangement of storage. BCPC & TOC will be jointly issued by BSNL and PICG.
- 56.6 Nothing in clause 56 above shall in any way release the Bidder from any warranty or other obligations under this contract.

57. Delivery and Documents

- 57.1 Delivery of the goods and documents shall be made by the bidder in accordance with the terms specified by the purchaser in its schedule of requirements and special conditions of contracts, and the goods shall remain at the risk of the bidder until delivery has been completed. The delivery of the equipment shall be to the ultimate consignee as given in the purchase order and indicated in delivery schedule as part of this tender document.
- 57.2 All Technical assistance for construction, commissioning and monitoring of the equipment shall be provided by the Bidder at no extra cost during laboratory evaluation, FAT, inspection AT/ type approval etc and field trial, if any.
- 57.3 The extension of delivery period against the purchase order, if any, should be granted subject to the condition that BSNL and PICG shall have the absolute right to revise the price(s) and also to levy penalty for the delayed supplies.

58. Training

- 58.1 The bidder shall provide training for installation and maintenance staff for this Defence project free of cost where required. The Training will be provided as per the details given at Para No 186 in section IV.
- 58.2 The bidder shall specify in his bid pre-training qualifications required of the trainees.

- 58.3 The bidder shall provide all training material and documents required for the conduct of training.

59. Incidental Services

- 59.1 The bidder may be required to provide any or all of the following services.
- 59.1.1 Performance or supervision of on-site assembly and/or start-up of the supplied Goods/works;
 - 59.1.2 Furnishing of tools required for assembly and/or maintenance of supplied Goods/works;
 - 59.1.3 Performance of supervision or maintenance and/or repair of the supplied Goods/works, for a period of time agreed by the parties provided that this service shall not relieve the bidder of any warranty obligations under this contract.

60. Spares

- 60.1 The bidder shall be required to provide a list of the following material and notifications pertaining to spare parts manufactured or distributed by the bidder of spares including cost and quantity considered for arriving at the price of spares as in the SoR and details attached at Appendix 'H'.
- 60.1.1 Such spares parts as the purchaser may elect to purchase from the bidder provided that such purchase shall not relieve the bidder of any warranty obligation under the contract.
 - 60.1.2 In the event of termination of production of the spare parts, the bidder shall :
 - 60.1.2.1 Give advance notification to the purchaser pending termination (not less than 2 years), in sufficient time to enable the purchaser to procure life time spares;
 - and
 - 60.1.2.2 Following such advance intimation of termination, furnish at no cost to the purchaser, the blue prints, drawings and specifications of spare parts, if and when requested.

61. Warranty

- 61.1 The bidder shall warrant that the stores to be supplied shall be new and free from all defects and faults in materials used, workmanship and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for materials of the type ordered and shall perform in full conformity with the specifications and drawings. The bidder shall be responsible for any defect that may develop under the conditions provided by the contract and under proper use, arising from faulty material, design or workmanship such as corrosion of the equipment, inadequate quantity of material to meet equipment requirements, inadequate contact protection, deficiencies in circuit design and/or otherwise and shall remedy such defects at his own cost when called upon to do so by the Purchaser who shall state in writing in what respect the stores are faulty. Details of warranty have been elaborated as part of Section IV Part A.
- 61.2 If it becomes necessary for the Bidder to replace or renew any defective portion(s) of the equipment under this clause, the provisions of the clause 61.1 above shall apply to the portion(s) of the equipment so replaced or

renewed or until the end of the warranty period. If any defect is not remedied by the bidder within a reasonable time, the Purchaser may proceed to get the defects remedied from other bidder etc., at the bidder's risk and expenses, but without prejudice to any other rights which the purchaser may have against the bidder in respect of such defects.

- 61.3 Replacement under warranty clause shall be made by the bidder free of all charges at site including freight, insurance and other incidental charges.

62. **Payment Terms**

- 62.1 Details of Payment Terms are given at Section IV Part A.
- 62.2 A certificate stating that the tendered item (stores) are meant for the use of BSNL shall be provided by the purchaser on the request of the bidder as and when asked will be issued in the name of Lead Bidder.
- 62.3 **No payment will be made for goods rejected at the site on testing.**
- 62.4 The bidder has to give the mandate for receiving the payment costing Rs.5 lacs and above electronically and the charges, if any, levied by bank has to be borne by the bidder/bidder/bidder. The bidder company is required to give the following information for this purpose:—
- 62.4.1 Beneficiary Bank Name.
 - 62.4.2 Beneficiary Branch Name.
 - 62.4.3 IFSC Code of beneficiary Branch.
 - 62.4.4 Beneficiary account No.
 - 62.4.5 Branch Serial No. (MICR No.)

63. **Prices**

- 63.1 Prices charged by the bidder for goods delivered and services performed under the contract shall not be higher than the prices quoted by the Bidder in his Bid.
- 63.2 Prices will be fixed at the time of issue of purchase order as per taxes and statutory duties applicable at that time.
- 63.3 In case of reduction of taxes and other statutory duties during the scheduled delivery period, purchaser shall take the benefit of decrease in these taxes/duties for the supplies made from the date of enactment of revised duties/taxes.
- 63.4 In case of increase in duties/taxes during the scheduled delivery period, the purchaser shall revise the prices as per new duties/taxes for the supplies, to be made during the remaining delivery period as per terms and conditions of the purchase order.
- 63.5 Any increase in taxes and other statutory duties/levies after the expiry of the delivery date shall be to the bidder's account. However, benefit of any decrease in these taxes/ duties shall be passed on to the Purchaser by the bidder.

64. **Changes in Purchase Orders**

- 64.1 The purchaser may, at any time, by a written order given to a bidder, make changes within the general scope of the contract in any one or more of the

following: -

- 64.1.1 Drawings, designs or specifications, where Goods/work to be supplied under the contract are to be specifically manufactured for the Purchaser.
 - 64.1.2 The method of transportation or packing;
 - 64.1.3 The place of delivery; or
 - 64.1.4 The services to be provided by the bidder.
- 64.2 If any such change causes an increase or decrease in the cost of, or the time required for the execution of the contract an equitable adjustment shall be made in the contract price or delivery schedule, or both, and the contract shall accordingly be amended. Any proposal by the bidder for adjustment under this clause must be made within thirty days from the date of the receipt of the change in order.

65. **Subcontracts.** The bidder shall notify the Purchaser in writing of all subcontracts awarded under this contract if not already specified in his bid. Such notification, in his original bid or later shall not relieve the bidder from any liability/ obligation under the contract.

66. **Delays in the Bidder's Performance (As per OFC Link list given in Section IV Part E OFC Link List.)**

66.1 Delivery of the Goods and performance of the services shall be made by the Bidder in accordance with the time schedule approved by the BSNL and PICG as part of the approved implementation plan. In case the supply is not completed in the stipulated delivery period, as indicated in the Purchase Order, purchasers reserve the right to either short close /cancel this purchase order and/or recover liquidated damage charges. The cancellation/short closing of the order shall be at the risk and responsibility of the bidder and purchaser reserves the right to purchase balance unsupplied item at the risk and cost of the defaulting vendors.

66.2 Delay by the Bidder in the performance of its delivery obligations shall render the Bidder liable to any or all of the following sanctions: forfeiture of its performance security, imposition of liquidated damages and/or termination of the contract for default.

66.3 If at any time during the performance of the contract, the bidder encounters condition impeding timely delivery of the goods and performance of service, the bidder shall promptly notify to the Purchaser in writing the fact of the delay, its likely duration and its cause(s). As soon as practicable after receipt of the bidder's notice, the purchaser shall evaluate the situation and may at its discretion extend the period for performance of the contract (by not more than 20 weeks or as per provisions of clause 67.2 to 67.6 below of Section-III) as per provision given below.

66.4 The vendor has to submit their request for extension along with the required additional BG, undertaking as per clause 73 below of Section-III (Fall Clause) and a copy of QA inspection certificate at least two weeks before the expiry of delivery period. The decision regarding extension shall be communicated within two weeks of the receipt of request.

66.5 In case extension is being granted beyond 20 weeks then the vendor shall submit additional BG while seeking extension. For piece meal items the amount of additional BG shall be 5% of the value of balance quantity of items

to be supplied for which extension in delivery period has been sought. In case of infrastructure/turnkey projects other than as stated above, 1% of the total project value shall be the value for additional BG. The additional BG shall be valid for six months beyond extension of delivery period sought and shall be discharged after the full ordered quantity has been supplied to the ultimate consignee and executed zone wise within the last extended delivery period on submission of inspection certificate from QA and consignee receipt without prejudice to the other remedies available to the purchaser.

- 66.6 If the vendor fails to deliver the full ordered quantity even during extended delivery period then the PO shall be short-closed and the Performance Bank Guarantee as well as additional BG shall be forfeited.
- 66.7 Format letter for conveying conditions of DP extension is given at Appendix 'C'.
- 66.8 Format for Conveying conditions of DP extension letter is given at Appendix 'D'.

67. **Liquidated Damages**

- 67.1 The completion date of turnkey project for delivery of stores and works/ services for execution of this project stipulated in the acceptance of the tender should be deemed to be the essence of the contract and delivery must be completed not later than the dates specified therein. Extension will not be given except in exceptional circumstances. Should, however, if the completion of contract be made after expiry of the contracted delivery period, without prior concurrence of the purchaser and be accepted by the consignee, such delivery will not deprive the purchaser of his right to recover liquidated damage under clause 66.2 above. However, when contract is completed within 21 days of the contracted original delivery period, the consignee may accept the work and in such cases the provision of clause 66.2 above will not apply.
- 67.2 Should the bidder fail to complete the delivery of stores or any consignment thereof within the period prescribed and agreed for delivery, the purchaser, without prejudice to other remedies available to the purchaser shall be entitled to recover, as agreed liquidated damages for breach of contract, a sum equivalent to 0.5% of the value of the delayed work for each week of delay or part thereof for a period up to 10 (TEN) weeks, and thereafter at the rate of 0.7% of the value of the delayed work for each week of delay or part thereof for another TEN weeks of delay.
- 67.3 DP extension beyond 20 weeks would not be generally allowed. The extension beyond 20 weeks may be decided in most exceptional circumstances on case to case basis, by the CGM concern in case of tenders floated by circles concern in case tender floated by Corporate Office, BSNL, stating reasons and justifications for grant of extension of delivery period beyond 20 weeks.
- 67.4 In the case of package supply / turnkey projects when the delayed portion of the supply materially hampers construction and commissioning of the systems, LD charges shall be levied as above on the total value of the concerned package of the Purchase Order.
- 67.5 Quantum of liquidated damages assessed and levied by the purchaser and decision of the purchaser thereon shall be final and binding on the bidder, further the same shall not be challenged by the bidder either before

Arbitration tribunal or before the court. The same shall stand specifically excluded from the purview of the arbitration clause, as such shall not be referable to arbitration. However, when supply is made to the ultimate consignee within 21 days of QA clearance in the extended delivery period and the goods/work were dispatched within this delivery period, the consignee may accept the stores and in such cases the LD shall be levied up to the date of dispatch after QA clearance only.

- 67.6 The total value of the liquidated damages as per above sub-clauses shall be limited to a maximum of 12% (Twelve percent) i.e. LD shall be levied up to 20 weeks. In this regard Penalty clause No 103 below Section IV may also be referred.

68. **Force Majeure**

- 68.1 If, at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract is prevented or delayed by reasons of any war or hostility, acts of the public enemy, civil commotion, sabotage, fires, floods, explosions, epidemics, quarantine restrictions, strikes, lockouts or act of God (hereinafter referred to as events) provided notice of happenings of any such eventuality is given by either party to the other within 21 days from the date of occurrence thereof, neither party shall by reason of such event be entitled to terminate this contract nor shall either party have any claim for damages against other in respect of such non-performance or delay in performance, and deliveries under the contract shall be resumed as soon as practicable after such an event come to an end or cease to exist, and the decision of the Purchaser as to whether the deliveries have been so resumed or not shall be final and conclusive. Further that if the performance in whole or part of any obligation under this contract is prevented or delayed by reasons of any such event for a period exceeding 60 days, either party may, at its option, terminate the contract.

- 68.2 Provided, also that if the contract is terminated under this clause, the Purchaser shall be at liberty to take over from the Bidder at a price to be fixed by the purchaser, which shall be final, all unused, undamaged and acceptable materials, bought out components and stores in course of manufacture which may be in possession of the Bidder at the time of such termination or such portion thereof as the purchaser may deem fit, except such materials, bought out components and stores as the Bidder may with the concurrence of the purchaser elect to retain.

69. **Termination for Default**

- 69.1 The Purchaser may, without prejudice to any other remedy for breach of contract, by written notice of default, sent to the bidder, terminate this contract in whole or in part.

69.1.1 If the bidder fails to deliver any or all of the goods/work within the time period(s) specified in the contract, or any extension thereof granted by the purchaser pursuant to clause 66 above.

69.1.2 If the bidder fails to perform any other obligation(s) under the Contract;

and

69.1.3 If the bidder, in either of the above circumstances, does not remedy his failure within a period of 15 days (or such longer period

as the purchaser may authorize in writing) after receipt of the default notice from the purchaser.

69.2 In the event the purchaser terminates the contract in whole or in part pursuant to Para 68 above the purchaser may procure, upon such terms and in such manner as it deems appropriate, goods/works similar to those undelivered and the bidder shall be liable to the Purchaser for any excess cost for such similar goods/works. However the bidder shall continue the performance of the contract to the extent not terminated

70. **Termination for Insolvency.** The Purchaser may at any time terminate the Contract by giving written notice to the Bidder, without compensation to the bidder. If the bidder becomes bankrupt or otherwise insolvent as declared by the competent court provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the purchaser.

71. **Arbitration**

71.1 In the event of any question, dispute or difference arising under this agreement or in connection there-with (except as to the matters, the decision to which is specifically provided under this agreement up to the installation and commissioning stage), the same shall be referred to the sole arbitration of the CMD, BSNL or in case his designation is changed or his office is abolished, then in such cases to the sole arbitration of the officer for the time being entrusted (whether in addition to his own duties or otherwise) with the functions of the CMD, BSNL or by whatever designation such an officer may be called (hereinafter referred to as the said officer), and if the CMD, BSNL or the said officer is unable or unwilling to act as such, then to the sole arbitration of some other person appointed by the CMD, BSNL or the said officer. The agreement to appoint an arbitrator will be in accordance with the Arbitration and Conciliation Act 1996. There will be no objection to any such appointment on the ground that the arbitrator is a Government Servant or that he has to deal with the matter to which the agreement relates or that in the course of his duties as a Government Servant he has expressed his views on all or any of the matters in dispute. The award of the arbitrator shall be final and binding on both the parties to the agreement. In the event of such an arbitrator to whom the matter is originally referred, being transferred or vacating his office or being unable to act for any reason whatsoever, the CMD, BSNL or the said officer shall appoint another person to act as an arbitrator in accordance with terms of the agreement and the person so appointed shall be entitled to proceed from the stage at which it was left out by his predecessors.

71.2 The arbitrator may from time to time with the consent of both the parties enlarge the time frame for making and publishing the award. Subject to the aforesaid Arbitration and Conciliation Act, 1996 and the rules made there under, any modification thereof for the time being in force shall be deemed to apply to the arbitration proceeding under this clause.

71.3 The venue of the arbitration proceeding shall be the office of the CMD, BSNL or such other places as the arbitrator may decide.

71.4 The venue of the arbitration proceeding shall be the office of Arbitrator appointed by Ministry of Defence (MoD) or such other places as the arbitrator may decide.

72. **Set Off**

- 72.1 Any sum of money due and payable to the bidder (including security deposit refundable to him) under this contract may be appropriated by the purchaser or BSNL or any other person(s) contracting through BSNL and set off the same against any claim of the Purchaser or BSNL or such other person or person(s) for payment of a sum of money arising out of this contract or under any other contract made by the bidder with the Purchaser or BSNL or such other person(s) contracting through BSNL.
- 72.2 The bidders, who are given Purchase Orders, must give the details of the supplies made against all the Purchase Orders every month on the first working day of the following month to MM, and concerned Planning Branches of BSNL (Corporate Office).
- 72.3 The bidder should furnish the name of his collaborator (if applicable), brand name, model No. and type of the products offered in this tender. The technical literatures of the products should also be submitted. No change in either technology or product shall be permitted after opening of bids.

73. **Fall Clause**

- 73.1 The prices once fixed will remain valid during the scheduled delivery period except for the provisions in clause 63.1 above of Section III. Further, if at any time during the contract.
- 73.1.1 It comes to the notice of purchaser regarding reduction of price for the same or similar equipment/ service,
and /or
- 73.1.2 The prices received in a new tender for the same or similar equipment/ service are less than the prices chargeable under the contract. The purchaser, for the purpose of delivery period extension, if any, will determine and intimate the new price, taking into account various related aspects such as quantity, geographical location etc., and the date of its effect for the balance quantity/ service to the vendor. In case the vendor does not accept the new price to be made applicable during the extended delivery period and the date of its effect, the purchaser shall have the right to terminate the contract without accepting any further supplies. This termination of the contract shall be at the risk and responsibility of the bidder and the purchaser reserves the right to purchase the balance unsupplied quantity/ service at the risk and cost of the defaulting vendor besides considering the forfeiture of his performance security.
- 73.1.3 The bidder while applying for extension of time for delivery of equipment/services, if any, shall have to provide an undertaking as "We have not reduced the sale price, and/ or offered to sell the same or similar equipment/ service to any person/organization including Department of central/state Government or any central/state PSU at a price lower than the price chargeable under the contract for scheduled delivery period."
- 73.1.4 In case under taking as in Clause 73.1.3 above is not applicable, the vendor will give the details of prices, the name(s) of purchaser, quantity etc. to the purchaser, while applying extension of delivery period.

74. **Court Jurisdiction**

- 74.1 Any dispute arising out of the tender/bid document/evaluation of bids/issue of APO shall be subject to jurisdiction of the competent court at the place from where the NIT/tender has been issued.
- 74.2 Where a bidder has not agreed to arbitration, the dispute/claims arising out of the Contract/PO entered with him shall be subject to the jurisdiction of the Competent Court at the place from where Contract/PO has been issued. Accordingly , a stipulation shall be made in the contract as under:

“This Contract/PO is subject to jurisdiction of Court at Delhi only”

BSNL

SECTION IV
PART A : SPECIAL TERMS AND CONDITIONS OF CONTRACT

75. The special conditions of contract shall supplement the 'Instructions to the Bidders' as contained in Section II & "General (Commercial) Conditions of the Contract" as contained in Section III and wherever there is a conflict, the provisions herein (Section IV) shall prevail over those in Section II and Section III.
76. The bidder will abide by the Non Disclosure Agreement and therefore not disclose any information to any unwarranted source.
77. The Trenching, Ducting, laying, Installation and Maintenance of OFC routes will be exclusively carried for Defence Network. Ducts provided by Governmental agencies for laying of OFC may be utilized along highways etc but ducts of private agencies cannot be utilized. However no third party/service provider will be allowed to lay OFC / duct through same trench.
- 77.1 Guidelines in the form of Engineering Instructions (E.Is.) on Construction Practices of Optical Fiber Cables issued by BSNL are attached at Appendix 'J' & 'Appendix 'K'. In case of any conflict with regards to OFC route construction and laying practices then requirements/ procedures given in Section IV shall supersede those given in Appendix 'J' & 'K'.
78. **Participation of Indian Agent or Principal/OEM**
- 78.1 Either the Indian agent on behalf of the Principal/OEM or Principal/OEM itself can bid but both cannot bid simultaneously for the same item/product in this tender.
- 78.2 If an agent submits bid on behalf of the Principal/OEM, the same agent shall not submit a bid on behalf of another Principal/OEM in this tender for the same product.
79. **Submission and Opening of Bids.** Date fixed for opening of bids is, if subsequently, declared as holiday by BSNL, the revised schedule will be notified. However, in absence of such notification, the bids will be opened on next working day, time and venue remaining unaltered.
80. **Important Aspects during Bid Preparation**
- 80.1 Each and every page of the bid must be page numbered serially. Complete bid must be properly indexed and flagged. All documents should be placed in the sequence as given in the tender. If the bid is submitted in multiple volumes, the index of complete bid must be available in respective volume. Reference page number(s) of all the documents required as per the bid document must be clearly mentioned. The entire document must be legible and attested.
- 80.2 One set of complete technical portion of the bid is to be submitted in hard and soft copy.
- 80.3 Minimum quantity to be quoted in the bid by the bidder is for 100% of the particular package wise quantity.
- 80.4 The bidder must comply to all tender and GRs conditions. Clause by Clause compliance for the tender document shall be submitted by the bidder along with the Nil Deviation Certificate.
- 80.5 The Bidder shall submit proof of submission for having applied for TSEC

evaluation of samples complying to specifications given in this tender. If a bidder fails to obtain TSEC/ Type Approval certificate for the product, as per specification given in this tender, within two months from the last date of submission of bids, the bid will be technically disqualified.

80.6 **Vendors are allowed to offer only one option in terms of Make/Model as part of the Technical Bid; Bids offering more than one option will be rejected.**

80.7 Purchaser reserves the right to disqualify such bidders who have a record of not meeting contractual obligations against earlier contracts entered into with the purchaser.

80.8 The Bid shall be liable to be rejected without seeking any clarifications from the bidder, if any of the above clauses are not complied by the bidder.

80.9 Bids will be submitted package wise and evaluation and ordering will also be done package wise.

81. **Clarifications on the Tender Document**

81.1 The clarifications to be sought by the bidders from the purchaser shall be furnished in the following format.

S. No.	Section	Clause	Brief Description of the clause	Ref Page No in Tender	Query/ Comments of Bidder

81.2 A prospective bidder, requiring any clarification on the Bid Documents shall submit his queries through E-tender portal. Clarifications by the Purchaser shall be uploaded as Clarifications to the concerned tender on BSNL website & on ETS portal, as addenda, for all the prospective bidders who have downloaded the official copy of tender documents from ETS portal.

81.3 The clarifications should be sought for commercial conditions and technical conditions separately in the above format. The clarifications sought without any mention of the clauses of the tender document/GR may not be considered.

81.4 Any clarification issued by BSNL in response to query raised by prospective bidders shall form an integral part of Bid Documents and it may amount to an amendment of relevant clauses of the Bid Documents.

82. **Ordering Quantity for Works**

82.1 BSNL will order for Supply of all materials for the construction of Optical Fiber Cable on Turnkey Basis, in seven packages i.e. Package A ,B, C, D, E, F and G. Each Package will consist of laying of NLD backbone and Access routes in the regions as per **Table 1.1** at Section I of this document. The bids submitted should clearly have markings on the sealed e-envelope for the package for which it has been made. The bids for multiple packages will be made in separate e-envelopes. The details of links in each package are available in Section IV Part E OFC Link List.

82.2 The purchaser intends to limit the number of bidders selected for ordering

against this tender to one eligible bidder for each package. The bidders for placement of order will be shortlisted after they meet the eligibility criteria. The bidders for placement of order will be selected from the list of the technically and commercially responsive bidders arranged in increasing order of their evaluated prices starting from the lowest evaluated price. The lowest evaluated prices will be worked out on the basis of cost comparison of totalcost of all the items as per attached SoR for each of seven packages of this project. The evaluation will be done on package cost of all items mentioned in SoR.

83. **Selection Process.** The tender will be evaluated by Committee for Evaluation of Tender (CET) which will comprise of representatives of BSNL and PICG. The CET will adopt 'Two Stage Processes' to select the successful bidders who can execute this project on turnkey basis as per details given below.

83.1 **Stage I.** Inviting technical and financial bids through tendering process and short-listing techno-commercially responsive and compliant Bidders who fulfill the eligibility and special conditions as per requirements set against the project as defined in the tender document. The loading, if any, to be done as per the tender conditions in the financial bid shall be determined in this stage using the unpriced BOM and the technical bid submitted by the bidder. Necessary documents in form of manufacturing/ reputed third party lab reports to substantiate the compliance status of offered products/ systems with respect to technical specifications and tests mentioned in the tender documents will be submitted by the bidders as part of their technical documentation along with the bid. These documents will be one of the important technical evaluation criteria for this tender.

83.1.1 In case any item is not quoted by a Bidder mentioned in the SoR of the tender document or the price of any item is not available in its own bid, then the bid shall be loaded by the highest price quoted by any of the bidders for that item. The loaded item shall be supplied at lowest cost quoted by any of the bidder.

83.1.2 Cases in which the bidder has quoted for less quantity for any of the items than that indicated in the SoR of the tender document, then the price bid shall be loaded to the extent of the difference in quantity of the item to meet the full requirement of the SoR on a pro-rata basis for the purpose of evaluation & ordering.

83.1.3 No de-loading of the bid is envisaged, if the quoted quantity in the bid is higher than that requested in the tender for the purpose of evaluation.

83.1.4 AMC cost shall not be paid for all items supplied free of cost on account of the loading. The same principle shall be applied for the cost towards services and all other items

83.1.5 Offer to the L1 bidder(s) after correcting the arithmetical errors and effecting change in unit prices due to loading shall not tantamount to counter offer.

83.2 **Stagell.** The financial bids of technically and commercially responsive and compliant bidders shall be opened and evaluated package wise with the loading determined in the stage-I, for determination of the rankings of the various bidders. The lowest evaluated bidder shall be designated as L-1 for the purpose of ordering. Warranty charges for three years will be included in

the basic cost of project. The supplier shall also quote for a year wise comprehensive AMC for seven years. The cost of AMC will be added to the basic cost of project for the purpose of financial evaluation. The evaluation will be done based on package cost inclusive of cost of all items materials, spares as well as services (incl AMC charges). The evaluation will be done on the package cost of all items mentioned in the Price Schedule.

84. **Payment Terms**

- 84.1 **Payment for 60% of the material cost price** shall be made on receipt of goods by consignee at site and after successful inspection by the concerned store-in-charges nominated by PICG. Inspection will be carried out by PICG after delivery of goods. The consignee receipt will be issued after completion of inspection.
- 84.2 **Payment for 30% amount of the cost of the materials and 80% amount of the cost of the worksexecuted** shall be released after commissioning of the respective NLD link and completion of Access Networks at respective Army sites as described in clause 85 below. Reimbursement of RoW charges shall be made on commissioning of the respective NLD link/ access network.
- 84.3 **Payment for 10% amount of the cost of the materials and 20% amount of the cost of the works** shall be released against PBG of equivalent amount for one year for which provisions of clause 55.2 above shall also be applicable. All the payments will be released to the bidder by BSNL after issue of requisite inspection and acceptance test certificates after successful completion of joint testing by BSNL and PICG.
- 84.4 The payment shall be made for actual completed route Km on the basis of quoted rate per Km.

85. **Implementation and Payment. The Bidder would be required to implement the requirements as per the tender over duration of six quarters (eighteen months).** Model Implementation Schedule to be followed as a guideline is provided at Annexure I to Section IV A.

- 85.1 Post issue of Purchase Order by BSNL, the successful Bidder may be required to revise the detailed implementation plan for the entire project, which was submitted as part of the Technical Bid, based on any additional inputs provided by the Purchaser. The Bidder would be required to interact with BSNL and PICG and seek approval of the proposed implementation plan that includes testing schedules, delivery schedules, route implementation, acceptance testing schedules etc. The approval process should be completed within the end of the first month from date of issue of Purchase Order. The bidder would also be required to commence route survey and obtain RoW for the approved routes in this period.
- 85.2 The approved implementation plan for commissioning of NLD links and Access Networks would be spread over balance five quarters as per priority of links/ access stations as given at Section IV E. Priority 1 links shall be implemented in the second quarter, Priority 2 in the third quarter and so on till Priority 5 links in the sixth quarter. The NLD and Access OFC links have been prioritized as per operational necessity. Changes to priority of these links due to implementation imperatives, if any, may be considered and jointly discussed during preparation of final implementation plan post award of contract.
- 85.3 Payment for supply of material would be based on calculation of material

delivered to warehouses as per delivery schedule. Payment for services executed by the Bidder would be based on successful commissioning of NLD links / Access OFC as per the approved implementation plan. Only fully completed NLD links / Access OFC (station wise) would be considered as commissioned links for calculation of payments.

85.4 **Package Discipline.** The joint teams of BSNL and PICG while clearing the equipment/ stores offered for site acceptance tests will strictly adhere to the package discipline as described in Purchase Order. Supplies made in full, "as per purchase order", during delivery period only will be deemed to have been supplied within the schedule delivery period. No testing shall be carried out for part deliveries and accordingly initial payment for supply component shall also not be processed.

85.5 Liquidated Damages would be deducted every quarter, based on calculation of delay incurred by the Bidder in supply of material as well as commissioning of NLD links / Access OFC as compared to the approved delivery schedule and implementation plan. Details of such charges that would be levied are given at clause 103 below.

86. Other Payment Terms

86.1 RoW (Right of Way) Charges.

86.1.1 The reimbursement of RoW charges shall be done as per actuals on submission of proof of payment on commissioning of the link.

86.1.2 RoW charges shall not be paid in case they are waived off.

86.1.3 There will be no ROW charges in Type A1 Defence Land (land in possession of Defence Forces). However all restoration and reinstatement work within defence area will be carried out by the Bidder at his own cost.

87. **Warehousing.** Warehousing services shall be provided by the Bidder as part of the implementation services. Land for construction of temporary warehouses shall be provided by PICG, wherever available, for conduct of Site Acceptance Test only. Consignee Receipt in this regard shall be provided by PICG rep for claiming material charges.

88. Spares.

88.1 The bidder shall be required to provide a list of the following material and notifications, pertaining to spare parts manufactured or distributed by the bidder, of spares including cost and quantity considered for arriving at the price of spares as in the SoR and details attached as an Appendix 'H'.

88.2 Spares that are being procured as per requirement given at Appendix 'H' would be delivered to the Purchaser after 75% completion of supply/works as part of the contract and after obtaining written intimation from the Purchaser.

89. **Warranty.** The bidder shall warrant that the material supplied for the work shall be new and free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for materials of the type ordered and shall perform in full conformity with the specifications and drawings. The bidder shall be responsible for any defects that may develop under the conditions provided by the contract the under proper use, arising from faulty materials, design or workmanship such as corrosion of the cable, inadequate quantity of materials etc. and shall remedy such defects at his own cost when called upon to do so by BSNL/ PICG and Purchaser who shall state in

writing in what respect the stores are faulty. **This warranty shall survive inspection or payment for/and acceptance of goods/work, but shall expire (except in respect of complaints notified prior to such date), after thirty six months. The warranty for each NLD link / Access OFC in that package will commence on completion of eighteen months from award of contract or date of commissioning whichever is later.**

90. The cable joint shall be guaranteed for a period of THREE years from the date of closing of joint of the last OFC route of each of the packages of this project. In case of failure of the joint due to poor workmanship i.e. failure of joint, within the stipulated period of guarantee, the bidder shall repair the joint(s) at his own cost within agreed MTTR, failing which BSNL and PICG may carry out the repairs and penalty equivalent to five times of the approved rate of the jointing work plus the cost of materials used shall be recovered from the bidder from his pending bill/SD or any amount due to him without prejudice to any other action as per terms and conditions of the tender. The cost of jointing kit, supplied by the owner of this project, so used to revive the joint shall be deducted from the running bills of the bidder pending for payment or from security if all bills have been settled.
91. Replacement/repair under warranty clause shall be made by the bidder free of all charges at site including freight, insurance, cost of works and other incidental charges.
92. **Audit and Technical Evaluation.** BSNL and PICG shall have the right to cause an audit and technical examination of the work and the final bills of the bidder including all supporting vouchers, abstract etc. to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the bidder under the contract or any work claimed by him to have been done by him under the contract and found not to have been executed, the bidder shall be liable to refund the amount of over payment and it shall be lawful for BSNL and PICG to recover the same from him and if it is found that the bidder was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by BSNL to the bidder.
 - 92.1 Provided that BSNL shall be entitled to recover any sum overpaid, nor the bidder shall be entitled to payment of any sum paid short where such payment have been agreed upon between the Divisional Engineer or his subordinate officer on one hand and the bidder on the other under any term of the contract permitting payment for work after assessment by the DGM (Projects).
 - 92.2 Any sum of money due and payable to the bidder (including security deposit returnable to him) under this contract may be appropriate by BSNL for the payment of a sum of money arising out of or under any other contract made by the bidder with BSNL.
93. BSNL and PICG has right to check the route within three years from the date of commissioning the route by any agency nominated. Any discrepancies found by them will be legally binding to the bidder for rectification of defect without any additional cost.
94. **Terms & Conditions**
 - 94.1 **The delivery of the goods** and services including laying and documentation shall be completed **within 18 months from the start date of contract.** The delivery of goods/services shall be completed every quarter as per delivery schedule in the approved Implementation Plan. First three months are for the lead period to approve implementation plan, conduct of survey etc. Evenly

distributed supplies/works are expected in remaining time on a quarterly basis. **Failure to adhere to this quarterly delivery schedule will attract liquidated damages.**

- 94.2 If a bidder who is given Purchase Order fails to commence supply during the original delivery period or fails to deliver the goods evenly, **the purchaser reserves the right to cancel the P.O. and encash the Performance Bank Guarantee.**
- 94.3 Purchaser reserves the right to blacklist a bidder for a suitable period in case he fails to honour his bid without sufficient ground. The Purchaser reserves the right to offer counter offer price(s) against the price(s) quoted by any bidder.
- 94.4 BSNL reserves the right to cancel or modify the scope of work stipulated to be carried out against the PO in the event of change of plan necessitated on account of technical reasons or in the opinion of the PO issuing authority or if the bidder is not executing the work at the required pace.
95. **Extension of the Time Limit.** Work order shall be considered from the date of commencement of work. The work order issuing authority shall specify the time allowed for completion of work consistent with the magnitude and urgency of work. The time allowed for carrying out the work is to be strictly observed by the bidder.
- 95.1 In as much as **“the time being deemed to be the essence of contract”**, throughout the stipulated period of contract, the work is to be proceeded with all due diligence on the part of the bidder.
- 95.2 **Application for Extension of the Time and Sanction of Extension of Time (EOT).**
- 95.3 There may be some hindrances, other than covered under force majeure, while execution of work and in such cases the bidder shall apply in writing to the Engineer-in-Chief (PICG), Engineer-in-charge (BSNL) for extension of time (EOT), on account of which he desires such extension within three days of occurrence of hindrance. Engineer-in-charge (BSNL) with consultation with PICG authorities shall forward the request to the competent authority (In-charge of cable construction work) with his detailed report and photocopy of the hindrance register, within three days of receipt of request from the bidder. The competent authority is empowered to grant extension of time for completion of work on certain conditions. He shall exercise such powers, if the following conditions are satisfied:
- 95.3.1 The application contains the ground (s), which hindered the bidder in execution of work.
- 95.3.2 Engineer-in-charge (PICG and BSNL) is of the opinion that the grounds shown for extension of time are reasonable.
- 95.4 The competent authority shall consider the request keeping all the facts and circumstances in view and shall grant extension of time, if in his opinion, there are reasonable and sufficient grounds for granting such extension and the reason for delay are not ascribable to the bidder.
- 95.5 The competent authority may also grant extension of time for completion of work in cases where reasons for delay are ascribable to the bidder, but such extension of time shall be with LD charges as per clause dealing with penalty for delays in execution of works. The extension of time with LD charges shall be jointly issued by BSNL and PICG to grant the extension of time.

- 95.6 The competent authority shall grant EOT with time period for completion of work expressly mentioned. The sanction of the competent Authority of EOT shall be issued under by the Corporate Office, BSNL.
- 95.7 If the competent authority is of the opinion that the grounds shown by the bidders are not reasonable and sufficient and declines to grant the extension of time, the bidder cannot challenge the soundness of the opinion by reference to arbitration. The decision of the competent authority on period of extension of time or refusal for extension of time shall be final and binding on the bidder.

96. Measurement & Inspection

- 96.1 **Measurement.** The measurement books are to be maintained by the bidder. The entry shall be made in ink. No entry shall be erased. If a mistake is made, it should be corrected by crossing out the incorrect words or figures and inserting the corrections, the corrections thus made shall be initialed & dated by the bidder. The measurement books shall invariably be consulted at the time of making final payments to the bidder.
- 96.2 Method of recording of nomenclature of items Complete nomenclature of items, as given in the agreement need not be reproduced in the measurement book for recording the measurement but corresponding item code as provided, shall be used.
- 96.3 The measurements of various items of work shall be taken and recorded in the measurements book. The measurements shall be taken and recorded by bidder which will be countersigned by the authority appointed by BSNL and the supervision team appointed by the PICG (Defence). Bidder shall be directly responsible for supervision of work, shall be responsible for accuracy of 100% of measurements. The Divisional Engineer / Sub Divisional Engineer along with the designated project site officers of PICG at various regions will be responsible for conducting Acceptance Test (A/T) check of up to **10%** of measurements at different locations on sample basis. **In case the sample measured data does not match with the measurement book entry up to a lesser depth of 5cm, penalty as given at Clause 96.4.1 below will be levied on 5% of the length (route km for NLD/total OFC for Access station) for each such default instance on the payment due for the link.**
- 96.4 **Method of measurement.** The measurement of the work shall be done activity-wise as and when the item of work is ready for measurement. The methods of measurement of various items are enumerated as under:
- 96.4.1 **Measurement of Depth of Trenches.** The cable route shall be divided into a number of segments each of maximum 200 Meters length bounded by identifiable landmarks at both the ends of the segments. If landmarks are not available, length of segment may be maintained at 200 Meters. The measurement of depth shall be recorded at each point of measurement (POM) in the measurement book in Meters in the multiples of 5 cms. For example 97 cms will be recorded as 95 cms and 103 cms as 105 cms. The points of measurements shall be at a distance of 10 Meters starting from 0 (Zero) Meter. For example, if the length of segment is 75 Meters, the POMs shall be at 0 M, 10 M, 20 M, 30 M, 40 M, 50 M, 60 M, and 70 M. The last POM shall be at 75th M to be recorded against residual POM. Normally the workers tend to dig shallow trenches due to effort involved. As standard

depth of the trench is important for future life and protection of cables, this tendency has to be discouraged. In order to discourage the bidder to provide less depth due to site constraints, the following scale of payment shall be applied for digging trenches:-

Payment = Approved rate x (Actual Depth in cm/165).

Note: However, bidder shall take prior permission of BSNL and PICG for digging lesser depth based on site constraints such as rocky area, presence of pipelines, power cables etc.

96.4.2 In case of lesser depth the bidder shall compulsorily provide adequate protection to offset the reduced depth in the following manner:

96.4.2.1 **0 Cms. to 30 Cms.** No Permission

96.4.2.2 **30 Cms. to 60 Cms.** GI Pipe class B (nominal bore 65 mm) with Concrete Work.

96.4.2.3 **60 Cms. to 120 Cms.** DWC

96.4.2.4 **> 120 cm.** No protection

96.4.3 **Measurement of lengths and profiles of strata and protection.**
The measurements of length of trenches are on running Meter basis, irrespective of type of soil encountered while digging. The type of protection utilized (item code – wise) to include RCC Half Round and Full Round Pipe, DWC HDPE Pipe, GI Pipe, MS Weld Mesh etc in a segment shall be recorded in the measurement book in the sheet provided for this purpose.

96.4.4 **Measurement of length of cable.** The length of cables laid in trenches, through pipes and through ducts shall be measured by use of OTDR. **The payment for Services component shall be made as per the RODO Meter readings and not as per the OTDR readings.** The length should be cross-verified with the marking of lengths on the cables. The lengths shall be recorded in sheet provided in the measurement book.

96.4.5 **Measurement of other items.** The measurement/ numerical details of other items shall be recorded in the sheets provided for respective items viz.

96.4.5.1 Digging of joint pit/manholes and preparation of chambers along with details of its dimensions and location.

96.4.5.2 Fixing, Painting and sign writing of route/joint indicators.

96.4.5.3 Location and Marking of Electronic Route Indicators.

96.4.5.4 Termination of Cable in equipment room and no. of joints.

96.4.5.5 Record splice loss details for each joint.

96.4.6 The bidder shall sign all the measurement recorded in the measurement book. This will be considered as an acceptance by

the bidder, of measurements recorded in the MB. In case bidder fails to attend at the measurements or fails to countersign or to record the difference within a week, than in any such events the measurements taken by Engineer-in-charge, PICG and or by the subordinate as the case may be shall be final and binding on the bidder and the bidder shall have no right to dispute the same.

96.4.7 Measurement of the work of cable for calculation of services portion will be taken equal to the length of the pipe/ duct (as measured in the RODO meter) through which the cable has been pulled and not the total length of the cable pulled through pipe/duct.

96.5 **Site Order Book.** The Bidder shall also maintain a Site Order Book for each link. The site order book is one of the primary records to be maintained by the supervisor supervising the work during the course of execution of works. The noting made by supervisor will form as basis for operation of many contractual clauses. The bidder shall remove all the defects pointed out by BSNL & PICG, in the Site order book. The site order book is to be maintained in a standard format. The bidder or their authorized representatives shall also be at liberty to note their difficulties etc. in these books. The site order books shall invariably be consulted at the time of making final payments to the bidder.

97. **Procedure for Preparation and Settlement of Bills for Material.** The first payment shall be released for the material received at site for that particular route and inspection by the concerned store-in-charge for its good condition. Documents required to be furnished for claiming cost of supply of material are as given below:-

97.1 Invoice clearly indicating break up details of composite price i.e Basic, E.D, Sales Tax, any other Duties and Taxes, Freight/Packing Charges, Service Tax etc.

97.2 Delivery Challan.

97.3 Bidder certificate for dispatch.

97.4 Excise gate pass/invoice or equivalent document.

97.5 Inspection Certificate of QA duly signed by BSNL /PICG rep.

97.6 Consignee receipt duly signed by BSNL /PICG rep.

97.7 The sea freight receipt as per the rates approved by the Ministry of Water and surface Transport, if any.

97.8 Proof of payment of octroi/entry tax etc.

97.9 "If the bidder fails to furnish necessary supporting document i.e excise/custom invoices etc. in respect of the Duties/Taxes which are CENVAT table, the amount pertaining to such Duties/Taxes will be deducted from the payment due to the firm".

98. **Procedure for preparation, processing and payment of bill for works.** For claiming the second payment on successful completion of the works, the bidder shall prepare the final bill in triplicate & along with acceptance and testing document of all the works provided jointly by BSNL and PICG and submit the same to S.D.E. in-charge of works within 30 days of acceptance and testing and payment shall be made within one month, if all documents are as per the contract. The final bill shall be prepared as per measurements of all items involved in execution of complete route.

- 98.1 The bidder shall prepare the final bill containing the following details:
- 98.1.1 The bill for all the quantities as per Measurements at the approved rates.
 - 98.1.2 Six set of bound documentation along with the updated softcopy in CD/ Pen drive for counter verification of the following:-
 - 98.1.2.1 Route ABD documents.
 - 98.1.2.2 Details of that route populated in OFC Network Inventory Tool.
- 98.2 The S.D.E. in-charge of work shall scrutinize the final bill against the works entrusted and accord necessary certificates stating that the work has been executed satisfactorily in accordance with specification and terms and condition of the contract. The S.D.E. shall verify the quantities of items of work with reference to measurement recorded in the measurement book (and also A/T reports in case of any deviation noted by A/T officer) and OFC Network Inventory Tool.
- 98.3 The S.D.E. Site-in-charge of work shall submit the final bills, along with other documents mentioned above, with the document as mentioned hereunder to the Divisional Engineer, In-charge of work.
- 98.3.1 Bill prepared by the bidder.
 - 98.3.2 Material reconciliation statement.
 - 98.3.3 Measurement Book.
 - 98.3.4 A/T Certificate jointly provided by PICG and BSNL.
 - 98.3.5 The Hindrances Register.
 - 98.3.6 Details of recoveries/penalties for inferior quality of work, delays, damages to BSNL and PICG/Third party properties as per provisions of the contract. In case no recovery is to be made, NIL report needs to be submitted.
- 98.4 The Divisional Engineer shall exercise the prescribed checks on the bills and accord necessary certificates on the bills. The Divisional Engineer shall retain the third copy of the bill along with photocopies of other documents not available in his estimate file and send first and second copies of the bill, measurement book and other document submitted by S.D.E. along with the bills as above to the higher officer for processing and final payment.
- 98.5 The office cell dealing with OFC bills shall process the bills in the estimate file of the concerned work and scrutinize the bills vis-à-vis P.O issued, sanctioned provisions in the estimate etc. The office cell shall also scrutinize the bill to recover all liabilities of the bidder and statutory taxes. The bill shall be passed, after necessary scrutiny by Work Section, by the officer competent to pass the final bill.
99. **Procedure for Payment for Sub Standard Works.** The bidders are required to execute all works satisfactorily and in accordance with the specification. If certain items of work are executed with unsound, imperfect or unskilled workmanship or with materials of any inferior description or that any materials or articles provided by him for execution of work or unsound or of a quality inferior to that contracted for or otherwise not in accordance with the contract (referred to as substandard work hereinafter), the Division Engineer-in-charge or an officer designated by PICG shall

make a demand in writing specifying the work, materials or articles about which there is a complaint.

100. Timely Action by Construction Officer

100.1 Timely reporting and action, to a great extent, can prevent occurrence of sub standard work, which will be difficult or impossible to rectify later on. It is incumbent on the part of Construction Officers (BSNL and PICG personnel involved in supervision) to point out the defects in work in time during progress of the work. The Junior Telecom Officer/Sub Divisional Engineer and supervision teams nominated by PICG responsible for execution and supervision of work shall without any loss of time submit a report of occurrence of any sub standard work to the Divisional Engineer in – charge and Project Officers, PICG besides making an entry in the site order book. A notice in respect of defective work shall be given to the bidder by Divisional Engineer-in-charge and Project Officer, PICG in writing during the progress of work asking the bidder to rectify/replace/remove the sub standard item of work and also definite time period within which such rectification/removal/replacement has to be done. After expiry of the notice period, if the bidder fails to rectify/ replace/ remove the sub standard items, the defects shall be rectified/replaced/removed departmentally or through some other agency at the risk and cost of the bidder.

100.2 Non-reporting of the sub standard work in time on the part of Construction Officer (s) shall not in any way entitle the bidder to claim that the defects were not pointed out during execution and as such the bidder cannot be absolved of the responsibility for sub standard work and associated liabilities.

101. Authority and procedure to accept sub standard work and payment thereof.

There may be certain items of work pointed out as sub standard which may bedifficult to rectify and in the opinion of the GM (Projects) and Project Officer, PICG, the items in question will not materially deteriorate the quality of service provided by the construction, the GM (Projects) and Regional Project Manager, PICG shall appoint committee to work out the reduced rates payable to the bidder for such sub standard work. The committee shall constitute one Divisional Engineer and Project Officer, PICG other than the one who is directly in-charge of Cable Construction involving sub standard items of work, as Chairman and one S.D.E. and an Accounts Officer as members. The committee shall take into account the approximate cost of material/ works pointed out as sub standard and recommend the rates payable for sub standard work as given in Clause 96.4.1 above.

102. **Record of sub standard work:** The items adjudged as sub standard shall be entered into the measurement book with red ink.

103. Penalty Clause

103.1 Liquidated Damages

103.2 The time allowed for completion of the work as approved in the implementation plan shall be strictly adhered by the bidder and shall be deemed to be the most important aspect of the contract on the part of the bidder and shall be reckoned from Seventh day from issue of P.O by BSNL or start of work whichever is earlier. The work shall, throughout the stipulated period of contract be proceeded with all due diligence to achieve the desired progress uniformly. Clause 67.6 above for levying Liquidated Charges in Section III refers.

103.3 On any date the total penalty payable as above, reaches 12 percent of the estimated cost of the work, the bidder should proceed with the work further

only on getting written instructions from the Divisional Engineer that, he is allowed to proceed further with the work. It will be in the discretion of the Divisional Engineer to allow the bidder to continue with the work on the basis of any written agreement reached between the bidder and the Divisional Engineer. One of the conditions of such agreement may be stipulation for the bidder to agree for realization of penalty for delay at a higher rate as may be agreed between BSNL and bidder.

- 103.4 Penalty for delay in completion of the work shall be recoverable from the bills of the bidder and/or by adjustment from the security deposit or from the bills of any other contract. However, adjustment from security deposit will be made only when the contract has been terminated or at the time of final settlement of bills on completion of work.
- 103.5 In case of slow progress of the work in a section which have been awarded to a particular bidder, and the public interest does not permit extension of time limit for completion of the work, the DGM (Projects)/ Project Manager, PICG will have the full right to order that the scope of the bidder may be restricted to such fraction of the whole of the work and get the balance executed at the risk and cost of the bidder. The details are given in Rescission of the contract clause of the bid document. All such payments shall be recovered from the bidder's pending bills or security deposit.
- 103.6 **LD for delay in supply** for that quarter would be levied after completion of the twenty first day of the quarter as per the delivery schedule in the approved implementation plan on the total supply cost.
- 103.7 **LD for delay in services**, due to non commissioning of NLD link/ Access OFC as per the approved implementation plan, would be levied from the due date i.e. at the start of the next quarter, on the total basic cost (cost of supply and services excluding taxes) of that NLD Link / Access OFC.
- 103.8 **Penalty for causing inconvenience to the Public.**
- 103.9 The bidder shall not be allowed to dump the empty cable drums/waste materials in Govt/public place, which may cause inconvenience to Govt/ Public. If the bidder does not dispose off the empty cable drums/waste materials within 3 days of becoming empty, BSNL is at liberty to dispose off the drum in any manner deemed fit and the costs incurred by BSNL in disposing off such materials shall be borne by the Bidder. BSNL may also levy a **penalty up to Rs One Thousand for each such default.**
- 103.10 **Penalty for cutting/damaging the old cable.**
- 103.11 During excavation of trench utmost care is to be taken by the bidder, so that the existing underground cables are not damaged or cut. In-case any damage/ cut is done to the existing cables, a penalty as per the schedule given below will be charged from the bidder or the amount will be deducted from his running bills. Penalty shall not be levied subject to verification of repair of damages and submission of No Objection Certificate from the operator/user within 10 days of occurrence.

Ser No	Size of existing UG/OF cables Cut/ Damaged	Amount of penalty per cut/ Damage
1.	Up to 100 pairs cable	Rs 50,000.00 (Fifty Thousand)

2.	Above 100 pairs & up to 400 pairs	Rs 1,000,00.00 (One lac)
3.	Above 400 pairs	Rs 1,50,000.00 (One lac Fifty thousand)
4.	OFC of any size	Rs 2,00,000 (two Lakh)
5.	Misc (to include electrical cable, drainage/sewage pipe, water pipe etc.)	Rs 1,50,000 (One Lakh fifty thousand) per cut

103.12 Besides the above penalty, the bidder shall carry out such repairs for restoration of the damaged cable free of charge. The cost of jointing kit shall also be borne by the bidder. If bidder fails to repair the damage, the cost of repair (including cost of labour + Jointing kit) shall be recovered from the bidder.

104. **Indemnities**

104.1 The bidder shall at all times hold BSNL and PICG harmless and indemnify from against all action, suits, proceedings, works, cost, damages, charges claims and demands of every nature and descriptions, brought or procured against BSNL and PICG, its officers and employees and forthwith upon demand and without protect or demur to pay to BSNL and PICG any and all losses and damages and cost (inclusive between attorney and client) and all costs incurred in endorsing this or any other indemnity or security which BSNL and PICG may now or at any time have relative to the work or the bidders obligation or in protecting or endorsing its right in any suit on other legal proceeding, charges and expense and liabilities resulting from or incidental or in connection, with injury, damages of the bidder or damage to property resulting from or arising out of or in any way connected with or incidental to the operations caused by the contract document. In addition the bidder shall reimburse BSNL and PICG or pay to BSNL and PICG forthwith on demand without protect or demur all cost, charges and expenses and losses and damages otherwise incurred by it in consequences of any claim, damages and actions which may be brought against BSNL and PICG arising out of or incidental to or in connection with the operation covered by the bidder.

104.2 The bidder shall at his own cost at BSNL request defend any suit or other proceeding asserting a claim covered by this indemnity, but shall not settle, compound or compromise any suit or other finding without first consulting BSNL.

105. **Accounting of Stores.**

105.1 All materials supplied to the bidder by BSNL shall remain the absolute property of PICG/Purchaser and shall not be removed from the site of work except for use in the work and shall be at all times open to inspection by the Representative of DGM (Projects)/PICG reps. In case the materials like cable and accessories are taken delivery of by the bidder and stored at the site office/ store of the bidder such site office/ store will also be treated "as site" for this purpose, Any such materials remaining unused at the time of the abandonment, completion or determination of the contract shall be returned to BSNL/PICG at a place informed to him by BSNL, failing which the cost of

the unused materials shall be deducted from the bidder's material security or any of his pending bills or from any other security.

105.2 The bidder shall submit a proper account every month of all the materials supplied to him by BSNL and PICG and those consumed for items of work. Any discrepancy of difference between the materials issued to the bidder and those consumed in the work as per BSNL and PICG calculation (which shall be final) will be charged to the bidder or deducted from his bills at 1.5 times of prevailing standard price including freight, handing charges, storage charges etc.

105.3 The bidder shall ensure that only the required materials are issued to him. Upon completion of work, the bidder shall return to BSNL and PICG at the designated store in good condition, free of charges, any unused materials that were supplied by BSNL and PICG.

106. **Easements, Permits, Licenses and Other Facilities**

106.1 The bidder shall obtain / provide at his own cost all easements, permits and license necessary to do work including following for which the payment to the concerned authorities shall be provided by the bidder against the demand note/estimate raised by the concerned department and submit the copy of the same along with bill for works for payment.

106.1.1 "Right of Way" easements and permits.

106.1.2 Railway, Highway, Forest and other Authorities crossing permits including bridge.

106.1.3 Canal/stream crossing permits.

106.1.4 ROW, etc.

106.2 **No any extra charges will be paid to the bidders for pursuance of easements, permits, RoW etc.** from the different local authorities.

106.3 The bidder shall be fully responsible for angling and obtaining all necessary easements, permits and licenses, for moving all construction equipment, tools, supplied materials and men across Railways and Highway, across public or private road as well as premises of any public utility within the right of user and for bearing all costs that may be incurred in respect of the same.

106.4 The bidder is to confine his operation to the provided construction "Right of User" unless it has made other arrangement with the particular property owners and /or tenants such other arrangements shall be entirely at the responsibility of the bidder as to cost and arrangement as also breach and claim and shall be entitled with a copy to the Divisional Engineer.

106.5 The bidder will not be entitled to extra compensation for hardship and increase in cost by the cable trench being routed adjacent to or across other pipeline, Highway, Railways, telephones or poser poles and wires or guy wires, embankment, cliffs, streams or other obstacles which may physically or otherwise in any manner, restrict or limit the use of the construction "Right of User". Some construction and such contingency shall be deemed to have been provided for in the rates.

106.6 At locations where the optical fiber cable trench is routed across or along railways or roads the bidder shall without extra cost provide and maintain such detours and road controls as are required by the railways or government or local agencies having jurisdiction.

107. **Protection of Life and Property and Existing Facilities.** The bidder is fully responsible for taking all possible safety precaution during preparation for and actual performance of the works and for keeping the construction site in a reasonable safe condition. The bidder shall protect all life and property from damage or losses resulting from his construction operations and shall minimize the disturbance and inconvenience to the public.
- 107.1 If the excavation of trench alters the contours of the ground around road and highway crossing in such locations dangerous to traffic, the bidder shall at his own cost, take all necessary precautions to protect public and shall comply with all BSNL and PICG regulations as to placing of warning boards (minimum size 3' x 2'), traffic signals, barricades, flags etc, at such location. If the bidder does not put the warning signal as per above directions, then a penalty of Rs 1000/- per day shall be levied on the bidder, till the directions are complied by the bidder. The bidder shall take due precautions to avoid damages to other pipe lines, water mains, sewers, telephones, telegraphs and power conduits, laid wires poles and guy wires, railways, highways, bridges or other underground or above ground structure and/or property crossing or adjacent to the cable trench being excavated.
- 107.2 Attention of the bidder is drawn to the rules regarding laying of cables at road crossing, along Railways Bridges, highways safety precautions while working in Public Street as per Engineering Instructions.
- 107.3 The bidder shall be solely responsible for location through approved non-destructive means and ensuring the safety of all existing underground pipeline, electrical cables, and or other structures.
- 107.4 The bidder shall be solely liable for all expense for and in respect of repairs and/or damages occasioned by injury of or damage to such underground and above structures or other properties and under take to indemnify BSNL and PICG from and against all actions, cause of actions, damages, claims and demands what-so-ever, either in law or in equity and all losses and damages and costs (inclusive between attorney and client), charges and expenses in connection therewith and/ or incidental thereto. The bidder shall take all responsibilities and risk in crossing other pipelines and cables and shall be responsible for protecting all such existing pipelines, poles, electric lines, sewers, cables or other facilities from damage by the bidder's operation in connection with the work. The bidder without cost of BSNL and PICG shall promptly repair any damage incurred.
- 107.5 The current market value of any commodities lost as a result of any damage to the aforesaid existing facilities shall be paid by the bidder together with such additional sums necessary to liquidate the personal of property damages, resulting there from.
108. **Labour Welfare Measures and Workman Compensation**
- 108.1 **Obtaining License before commencement of work.** The bidder shall obtain a valid labour license under the Contract Labour (R &A) Act 1970 and the Contract Labour (Regulation and Abolition) Central Rules 1971, before commencement of the work, and continue to have a valid license until the completion of work. The bidder shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act 1986. Any failure to fulfill this requirement shall attract the penal provisions of the contact arising out of the resultant non-execution of work.
- 108.2 **Bidders Labour Regulations.** The bidder shall ensure compliance of all

statutory obligations, viz. payment of wages / salary to the workers engaged by him on regular and timely basis (by 7th every month) and any other amounts including any Statutory Dues, charges, taxes and levies payable as per the relevant statutes applicable and subsequent amendment thereof and same should be sole liability of Bidder and BSNL and PICG will not be liable in any circumstances whatsoever. The Bidder shall comply with the provisions of Employees State Insurance Act 1948, Workmen's Compensation Act, the Employees Provident Fund (and Family Pension Fund) Act 1952, the Payment of Bonus Act 1963, the Industrial Disputes Act 1947, the Payment of Wages Act, Contract Labour (Regulation & Abolition) Act 1970 with Contract Labour (R&A) 1971 and / or any other rules, regulations and / or statutes that may be applicable from time to time or that may be introduced by the Central /State Government or Municipal / Local Self Government authorities, subsequent to the date of this agreement. Default on this account shall be deemed as sufficient ground for termination of the Agreement. In case of accident arising out of and in the course of this agreement. BSNL and PICG being owner / Principal Employer will not be responsible for payment of any compensation or under any other law. It will be the sole responsibility of the bidder for payment towards loss or compensation whatsoever.

- 108.3 The person engaged by bidder shall be treated as bidder's own employees and they will claim no privileges from BSNL and PICG. The bidder will be directly responsible for administration of his employee as regards their wages, uniforms, general discipline and courteous behavior.
109. **Insurance.** Without limiting any of his other obligations or liabilities, the bidder shall, at his own expense, take and keep comprehensive insurance including third party risk for the plant, machinery, men, materials etc. brought to the site and for all the work during the execution. The bidder shall also take out workmen's compensations insurance as required by law and under take to indemnify and keep indemnified BSNL and PICG from and against all manner of claims and demands and losses and damages and cost (including between attorney and client) charges and expenses that may arise in regard the same or that BSNL and PICG may suffer or incur with respect to end / or incidental to the same. The bidder shall have to furnish originals and/or attested copies as required by the department of the policies of insurance taken within 15 (fifteen) days of being called upon to do so together with all premium receipts and other papers related thereto which BSNL and PICG may require.
110. **Compliance with Laws and Regulation.** During the performance of the works the bidder shall at his own cost and initiative fully comply with all applicable laws of the land and with any and all applicable by-laws, rules, regulations and orders and any other provisions having the force of law made or promulgated or deemed to be made or promulgated by the Government, Governmental agency or BSNL and PICG municipal board, Government of other regulatory or Authorized body or persons and shall provide all certificates of compliance therewith as may be required by such applicable law, By-laws, Rules, Regulations, orders and/or provisions. The bidder shall assume full responsibility for the payment of all contributions and pay roll taxes, as to its employees, servants or agents engaged in the performance of the work specified in the bidder documents. If the bidder shall require any assignee or sub-bidder to share any portion of the work to be performed hereunder may be assigned, sub-leased or sub-contracted to comply with the provisions of the clause and in this connection the bidder agrees as to undertake to save and hold BSNL and PICG harmless and indemnified from and against any/all penalties, actions, suits, losses and damages, claims and demands and costs (inclusive between attorney and client)

charges and expenses whatsoever arising out or occasioned, indirectly or directly, by failure of the bidder or any assignee or sub-bidder to make full and proper compliance with the said by-laws, Rules, Regulations, Laws and Order and provisions as aforesaid.

111. **Tools and Plants.** The bidder shall provide at his own cost all tools, plants appliances, implements, measuring instruments etc. required for proper execution of works. The bidder shall also supply without charge the requisite number of persons with the means and material necessary for the purpose of setting out works, counting, weighing and assisting the measurements for examination at any time and from time to time. The bidder shall be responsible to make all arrangements, at his own cost for dewatering of trenches/ducts and de-gasification of the ducts before carrying out the work. The bidder shall also be responsible to make arrangements at his own cost for water required for carrying of works at sites including curing of CC/RCC works. Falling his so doing the same may be provided by the Engineer-in charge at the expense of the bidder and the expenses shall be deducted from any money due to the bidder under this contract or otherwise.

112. **Quality Control of Works**

112.1 The importance of quality of Fiber optic cable splicing works cannot be over-emphasized. The quality and availability of long distance media and efficiency of the reliable media connectivity between terminal equipment depends upon quality of optic fiber cable plant. The quality of fiber optic cable plant depends upon the quality of individual items of work involved viz. Depth of cable laid, care while paying & laying, Protection, Jointing of cables and Terminations in equipment room and also on documentation of cable network. In order to ensure quality in cable construction work, each component of work needs attention. The work shall be carried out strictly in accordance with specifications laid down to achieve the requisite quality aim. The OF cable will be laid as per the specifications laid down in Section IV . In the absence of any specific detail BSNL laying practices given at Appendix 'J' shall be strictly adhered to.

112.2 BSNL and PICG shall be the final judge of the quality of the work and the satisfaction of BSNL and PICG in respect thereof set forth in the contract document. Laxity or failure to enforce compliance with the contract documents by BSNL and PICG and/ or its representative shall not manifest a change or intent of waiver, the intention being that, notwithstanding the same, the bidder shall be and remain responsible for complete and proper compliance with the contract documents and the specification there in. The representative of BSNL and PICG has the right to prohibit the use of men and any tools, materials and equipment which, in his opinion, do not produce the required work or performance meet the requirement of the contract documents.

112.3 It is imperative that the bidder(s) is/are fully conversant with the construction practices and shall be fully equipped to carry out the work in accordance with the specifications. The bidders are expected and bound to ensure quality in construction works in accordance with specifications laid down. The bidder shall engage adequate and experienced supervisors to ensure that work is carried out as per specifications and with due diligence and in a professional manner. A two stage testing process will be incorporated as follows:

112.3.1 The first level of testing shall be carried out the bidder/bidders himself. Once the bidder is confirmed about the quality assurance

of their work and material then they will hand it over to BSNL testing teams.

112.3.2 The Joint PICG and BSNL testing teams shall carry out the second level of testing.

112.4 In addition to Acceptance Testing being carried out by joint Inspection teams of PICG & BSNL, supervision by Construction Officers (BSNL) and supervision teams (PICG), all works at all times shall be open to inspection of BSNL & PICG (Defence). The bidders shall be bound, if called upon to do so, to offer the works for inspection without any extra payment. The presence of monitoring teams nominated by BSNL/PICG during construction shall not preclude separate acceptance testing teams to recheck adherence to all aspects as mentioned in the contract.

113. **Inspection and Testing**

113.1 All materials furnished and all work performed under this Contract shall be inspected and tested. The Bidder shall furnish all manpower and materials for tests, including testing facilities, power and instrumentation, and replacement of damaged parts. The costs shall be borne by the Bidder and shall be deemed to be included in the contract price.

113.2 The entire cost of testing for factory & site acceptance, routine tests, production tests and other test during manufacture & site activities specified herein shall be treated as included in the quoted unit price of materials, except for the expenses of Inspector/Purchaser representative.

113.3 All tests shall be witnessed by the BSNL and PICG reps and/or its authorised representative (hereinafter referred to as the Purchaser). The Purchaser's representative shall sign the test form indicating approval of successful tests.

113.4 Should any inspections or tests indicate that specific item does not meet specification requirements; the appropriate items shall be replaced, upgraded, or added by the Bidder as necessary to correct the noted deficiencies at no cost to the Purchaser. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

114. **Testing Methodology**

114.1 There is a need to have an elaborate test methodology to ensure quality of supply and services being delivered as part of this tender. The following tests shall be conducted:-

114.2 **Product Qualification Tests**

114.2.1 The bidders will have to obtain Technical Specification Evaluation Certificate (TSEC) from Quality Assurance Circle, BSNL for all items being procured, against the technical specifications mentioned in this tender, within two months from last date of submission of bids.

114.3 **Production Tests**

114.3.1 Production testing shall mean those tests which are to be carried out during the process of production by the Bidder to ensure the desired quality of end product to be supplied by him. The production tests to be carried out at each stage of production shall be based on the Bidder'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.

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

114.4 **Factory Acceptance Tests**

- 114.4.1 Factory acceptance tests shall be conducted on randomly selected final material to be supplied. Factory acceptance testing shall be carried out on all items being supplied. Equipment shall not be shipped to the Purchaser until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the Purchaser, and the Purchaser has issued Clearance Certificate. Successful completion of the factory tests and the Purchasers 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 joint Purchasers authorised representatives. In case of ex import items, the bidder shall make suitable arrangements for carrying out FAT within India.
- 114.4.2 Factory acceptance tests shall not proceed without the prior submission and approval of all test documentation by the Purchaser.
- 114.4.3 The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to this specifications and approved drawings and documents. The list of factory acceptance tests shall be supplemented by the Bidder's standard FAT testing program. The factory acceptance tests for all items other than OFC and PLB shall be proposed by the Bidder in accordance with technical specifications and Bidder's (including Sub-Bidder's / bidder's) standard FAT testing program.
- 114.4.4 From each batch of equipment presented by the Bidder for Factory acceptance testing, the Purchaser 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 10% of the batch size (minimum 1) for OFC drums, FDMS, splice enclosures and other similar 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.
- 114.4.5 For the OFC hardware fittings & accessories, the minimum sampling rate and batch acceptance criteria shall be as defined above. Since FAT testing provides a measure of assurance that the Quality Control objectives are being met during all phases of production, the Purchaser reserves the right to require the Bidder 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.

114.5 Site Acceptance Tests

- 114.5.1 The Bidder shall be responsible for the submission of all equipment supplied in this contract for site acceptance tests and inspection as required by the Purchaser. All equipment shall be tested on site by nominated rep of PICG.
- 114.5.2 These tests shall be conducted to ensure that there is no deterioration of quality of material after dispatch of material from factory premises. Necessary tests shall be conducted to demonstrate that the overall performance of the supplied items shall be able to meet the final requirements after deployment.
- 114.5.3 The site acceptance certificate will be issued by PICG rep. Initial payment for supply shall be released only after successful conduct of site acceptance.

114.6 Acceptance Tests

- 114.6.1 The works shall be deemed to have been completed only after the same has been accepted by the inspection teams. **The Acceptance Testing will be undertaken jointly by the reps of BSNL and PICG.** The acceptance certificate will be jointly issued by BSNL and PICG for release of second payment after successful completion of Joint Acceptance Testing.
- 114.6.2 The bidder shall make test pits at the locations desired by Inspection Officers for conducting test checks without any extra payment. The bidder shall restore the pits after test measurements to its original shape. The bidder shall be responsible to provide test/ measurement tools and testers for conducting various tests. It will be ensured by the Joint Acceptance Teams that there is no compromise on the network attributes with specific reference to mission critical requirements for NLD backbone and optical access networks.
- 114.6.3 The bidder, after having satisfied himself of completion of work, from FDMS at one end to FDMS at other end, shall offer the work to Inspection Officers for conducting Acceptance Testing. The work shall be offered for Inspection as soon as part of work is complete in all respects. The work against any P.O can be offered for Inspection in a number of stages. Scope of Acceptance Testing is as given at clause 121 below.
- 114.6.4 The Inspection Officers shall not be responsible for recording of measurements for the purpose of billing and contractual obligations. However, if the measurements taken by Inspection Officers are found to be lesser than the measurements recorded by the supervisor responsible for recording the measurements, the measurement taken by A.T Officers shall prevail without prejudice to any punitive action against the bidder as per provisions of the contract and the officer recording the measurements.
- 114.6.5 The bidder shall be obligated to remove defects/deficiencies pointed out by the Inspection Officers without any additional cost. BSNL does not take any responsibility of return of defective used items.

115. Miscellaneous

- 115.1 The supply will be accepted only after Joint Quality Assurance tests are carried out by Quality Assurance Wing of BSNL and Quality Assurance Officers to be nominated by PICG as per prescribed schedule and material passing the test successfully and after excise gate pass/ excise invoice or equivalent replacement are issued by the manufacturer for that purpose.
- 115.2 The approved raw material used in the manufacturing of Optical Fiber Cable and other accessories will be ensured by the joint QA teams of BSNL and PICG by the following:-
 - 115.2.1 Verification of Invoices of raw materials.
 - 115.2.2 Testing at CACT.
 - 115.2.3 Testing at in house laboratories of the vendor.
 - 115.2.4 Getting the invoices verified by the original bidders of the raw materials.
 - 115.2.5 Successful bidder shall provide necessary documents and facilities for the above verifications.

116. Inspection. Access to the Bidder's facilities during system manufacturing and testing and to any facility where systems/ equipment are being produced/ tested/ integrated for the fiber optic communication network, shall be available to the Purchaser. At all times the Purchaser shall have full facilities for unrestricted inspection of such materials or equipment. To facilitate this, the Bidder shall submit for the Purchaser approval, a comprehensive Quality Assurance Plan using ISO 9000 as a general guideline. In addition, the Quality Assurance Plan shall satisfy the following:

- 116.1 Sufficient office facilities, equipment, and documentation necessary to complete all inspections and to verify that the equipment is being fabricated and maintained in accordance with the Specification shall be provided by the Bidder to the Purchaser.
- 116.2 Inspections to be performed by the Purchaser will include visual examination of hardware, cable dressings, and labelling. Bidder's documentation will also be examined to verify that it adequately identifies and describes all offered items and spare parts.
- 116.3 Access to inspect the Bidder's standards, procedures, and records that are applicable to the supplied equipment shall be provided to the Purchaser. Documents will be inspected to verify that the Bidder has performed the required quality assurance activities.
- 116.4 The inspection rights described above shall also apply to sub Bidders who are responsible for supplying major components described in this Specification. These items shall be inspected and tested at the sub Bidder's premises by the purchaser representatives prior to shipping this equipment to the Bidder's facility or directly to the purchaser. In case of ex import items, suitable facility will be created by the Bidder in India, to carry out the testing.
- 116.5 The above inspection rights shall also apply to sub Bidders supplying assemblies, subassemblies and components. However, such items will normally be inspected and tested by the purchaser's representatives at the Bidder's site before acceptance.

117. Test Plans

- 117.1 **A comprehensive test plan with schedules and test procedures for all tests shall be provided by the Bidder as part of the technical bid.** Test plans and test procedures shall ensure that each test is comprehensive to verify all the features of the equipment to be tested. Test plans and test procedures shall be modular to allow individual test segments to be repeated upon request.
- 117.2 The bidder will be required to prepare test plan to cater for testing of OFC cable and accessories as per the quantities mentioned at Appendix 'G'
- 117.3 The Bidder shall submit a revised Test Schedule after interaction with the Purchaser for approval within one (1) week after the award of contract. The schedule will contain Factory Acceptance, Site Acceptance and Acceptance Tests for all quarters. The test schedule shall list the tests to be carried out, and the approximate test duration. The test periods shall also be indicated in the PERT chart or equivalent for the work.
- 117.4 The Bidder shall give the Purchaser fourteen (14) days written notice of any material being ready for testing. Seven (7) days prior to the scheduled testing, the Purchaser shall provide written notice to the Bidder of any drawings, equipment, material, or workmanship which, in the Purchaser's opinion, are not compliant to the specification. The Bidder shall give due consideration to such objections, if valid, effecting the corrections as necessary or shall prove, in writing, that said modifications are unnecessary for contract compliance.
- 117.5 The test plan, submitted as part of the technical bid, shall be a single overview document that defines the overall schedule and individual responsibilities associated with conducting the tests, documenting the test results, and successfully completing the test criteria. Test Plans shall include, at a minimum, the information contained in **Table 4.2**.

Test Plan Requirements

Item	Description
1.	Detailed Test schedule
2.	Record-keeping assignments, procedures and forms
3.	Procedures for monitoring, correcting and retesting variances
4.	Procedures for controlling and documenting all changes made to the communications equipment after the start of testing

Table 4.2

118. Test Procedures

- 118.1 Test procedures for testing shall be submitted as part of the test plan. These plans will be duly approved by BSNL and PICG. Testing shall not commence without approved test procedures. At a minimum, test procedures shall include the items listed in **Table 4.3**.
- 118.2 All test equipment and/or instruments shall bear calibration stickers indicating valid calibration on and beyond the testing date. The time lapsed since last calibration shall not exceed the test equipment/ jig manufacturer recommended calibration interval or the interval recommended in the test

lab's internal quality procedures.

- 118.3 The Bidder shall ensure that all testing will be performed by qualified testing personnel well experienced in performing such tests.

Test Procedure Requirements

Item	Description
1.	Test Title and Revision Level, if applicable
2.	Function(s) / parameter(s) to be tested
3.	Purpose of each test segment
4.	List of required test equipment
5.	Description of any special test conditions or special actions required. This includes complete descriptions, listings and user interface procedures for all special hardware and software tools and/or display formats to be used during the test.
6.	Test setup including test configuration block diagrams and/or illustrations.
7.	Test procedures to be followed.
8.	Required inputs and expected outputs for each test segment
9.	Acceptance criteria for each test segment.
10.	List of test data to be supplied by the Bidder(s) and copies of any certified data to be used
11.	Format of test reports.

Table 4.3

119. **Test Records.** Complete and indexed records of all test results shall be maintained and provided to the Purchaser by the Bidder in hardcopy and its scanned copy on DVD. The records shall be keyed to the steps enumerated in the test procedures. The minimal items required as part of the test records are described in **Table 4.4.**

Test Record Requirement

Item	Description
1.	Test Title and Revision Level, if applicable; contract references
2.	Date and time for test start and test completed
3.	Test title and reference to the appropriate section of the test procedures
4.	Description of any special test conditions or special actions taken (Includes test-case data).
5.	Test results for each test segment including an indication of Passed, Conditional Pass, Incomplete or Failed.
6.	Test procedure modifications made during testing.

7.	Variance Report(s) tracking information and copies (if variance(s) was detected).
8.	Bidder's test engineer(s) identification, signature and remarks
9.	The Purchasers test witness identification, signature and remarks
10.	List of all attachments
11.	Attachments (including system logs, printouts, variances, hard copies of visual test result displays, etc.)

Table 4.4

119.1 All principle test records, test certificates and performance curves shall be supplied for all tests carried out as proof of compliance with the specifications and/or each and every specified test. These test certificates, records and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Purchaser. Information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificates refer, and shall also bear the Bidder's reference and heading.

120. Rejection of Elements

120.1 Any item or component which fails to comply with the requirements of this specification in any respect, at any stage of manufacture, test or on completion at site may be rejected by the Purchaser either in whole or part as considered necessary.

120.2 Material or components with defects of such a nature that do not meet the requirements of the specification by adjustment or modification shall be replaced by the Bidder at his own expense. After adjustment or modification, the Bidder shall submit the items to the Purchaser for further inspection and/or tests.

121. Scope of Acceptance Testing

121.1 It is essential to verify the integrity and the capability of the Fiber Optic Cable and to assess its readiness for intended DWDM services. This scope defines the methodology for technical acceptance of fiber optic cable and accessories, duct and accessories. The purpose of acceptance and testing is to verify integrity of measurement and quality of work done.

121.2 Upton 10% of the measurements recorded in the Measurement book would be verified by the AT teams for correctness as explained at Clause 96.3 above. The Joint Acceptance Teams will finalize the detailed methodology and procedure for AT in consultation with successful bidder after award of contract. The essential aspects to be checked for proper implementation of works are given in the clauses below:-

122. Fiber Optic Cable

122.1 **Post-Installation Inspection.** The parameters mentioned below shall form the minimum acceptance criteria post the installation of fiber optic cables as per specifications mentioned at Section VI.

122.2 **For Cable with G.655 fiber**

- 122.2.1 Attenuation measurements by OTDR at 1550nm and 1625nm.
- 122.2.2 Fiber continuity check.
- 122.2.3 Linked splice loss measurement at 1550nm and 1625nm.
- 122.2.4 Chromatic Dispersion at 1530-1565nm and 1565-1625nm.
- 122.3 **For Cable with G.652 D fiber**
 - 122.3.1 Attenuation measurements by OTDR at 1310nm and 1550nm.
 - 122.3.2 Fiber continuity check.
 - 122.3.3 Linked splice loss measurement at 1310nm and 1550nm
 - 122.3.4 Chromatic Dispersion at 1285-1330nm, 1550nm and 1625nm.
- 123. **Termination arrangement at the communication nodes/repeater locations.** The fibers of the cable shall be spliced to the pigtails for connection to the optical line systems. Pigtails shall be duly terminated at the FDMS (fiber distribution management system).
- 124. **Link testing**
 - 124.1 Once splicing and termination are completed OTDR traces from both terminal station of link shall be taken. Prepare event table, workout event averages and average splice losses of the link event table calculation.
 - 124.2 Average splice losses at 1550 nm should be $\leq 0.1\text{dB}$. Net losses at event = (Sum of splice losses A to B & B to A) / 2 x No of splices.
 - 124.3 After OTDR testing power meter link testing should be taken.
 - 124.4 Power loss in link should be less than the value obtained by calculating using the formula given below:
 - 124.4.1 Value in dB at 1310nm = No. of connectors X 0.5 + No of splices X 0.1 + distance in Km X 0.36.
 - 124.4.2 Value in dB at 1550nm = No. of connectors X 0.5 + No of splices X 0.1 + distance in Km X 0.22.
- 125. **Civil AT.** OFC route constructions and laying practice of Section IV Part B is to be followed. The following aspects in this regard will be checked by the AT teams for quality of work done.
 - 125.1 **Excavation**
 - 125.1.1 Ensure that trench is within ROW limits.
 - 125.1.2 Marking with lime powder before digging for AT.
 - 125.1.3 Trench depth should be as per the specification.
 - 125.1.4 In case of low depth, prior permission should have been taken and approval obtained.
 - 125.1.5 Duct alignment should be as per plan. All the ducts should be laid parallel. Jointing must be done properly by using the couplers.
 - 125.1.6 Suitable protection should have been applied, wherever required, as per direction of Engineer-in-Charge using RCC/DWC/GI Pipes.
 - 125.2 **Warning Tape**
 - 125.2.1 Warning tape should be placed on the trench at 0.75m depth from the ground.

125.2.2 Warning tape should be as per specification provided.

125.3 Railway /Road crossings

125.3.1 G.I. pipes should be extended for 2m on both sides from the end of the road.

125.3.2 G.I. pipes should be joined by using G.I. Collars.

125.3.3 RCC pipes should be extended for 2m on both sides from the end of the road.

125.3.4 RCC full round should be joined by using RCC collars.

125.4 Bridge/culvert crossings

125.4.1 G.I. pipes should be extended up to depth of 1.55m in case duct running on bridge.

125.4.2 G.I. pipes to be extended up to 2m length from both edges of the bridge/culvert in case the trench running through the bed of the bridge.

125.4.3 RCC pipes should be used parallel to dry culvert. For wet culvert G.I. protection and concrete encasement to be provided.

125.4.4 Collars of RCC pipes to be jointed with RCC pipes with a cement mortar of 1:2.

125.4.5 In case of duct in G.I. pipe placed on clamps outside the railing the clamps should be made up of strip thickness 6mm and width 50mm. The nuts bolts should be of 12mm diameter. All clamps should be tightened properly. Clamp should be placed at every 2m interval.

125.4.6 In case of duct in G.I. pipe placed on bridge, the G.I. pipe should be encased with M20 concrete with 1:2:4 mix all around the G.I. pipes.

125.5 Cement Route Markers

125.5.1 Route markers should be installed in a span of 200m and at every location where deviation placed. (From left to right of the road or vice versa.)

125.5.2 Cement Route Markers should be placed alternatively with an electronic route marker as specified by the purchaser.

125.5.3 Route markers should be straight and facing the road side.

125.5.4 Route markers should be offset 1m from the trench towards the jungle side.

125.5.5 Cement concrete dimensions should be as per specifications provided.

125.5.6 Route markers should be fixed 0.5 m depth below ground level.

125.5.7 Color separation should be maintained between splice chambers & blowing chambers.

125.5.8 Route markers should be provided on both sides of bridge/culvert.

125.6 Electronic Route Markers. The electronic route markers should be placed every 200m. These would be staggered with reference to the RCC route markers in a manner that there should be a marker placed every 100m

along the OFC route.

125.6.1 The electronic route markers should be placed in the trench after partial backfilling of earth and should be aligned directly over the PLB duct such that it is not more than 3 feet deep from the surface.

125.6.2 The exact location of the electronic route marker should be recorded as part of the ABD documentation and in the measurement book.

125.7 **Backfilling**

125.7.1 Every layer of backfill about 25 to 30 cm should be compacted with sufficient quantity of water to achieve adequate compaction.

125.7.2 It is essential to have compaction not less than 90%, when the excavation is carried out along and across the road shoulders and foot paths.

125.7.3 A hump of 15cm shall be maintained over the trench to compensate the settlement of backfilled soil below the ground level.

125.7.4 Housekeeping after removing all the debris should be complete.

125.8 **Restoration**

125.8.1 If the trench comes under Asphalt, then 30 cm soil from the trench should have been removed and compacted. 10cm has to be backfilled by 40mm aggregate as first layer and compacted, 10cm has to be backfilled by 20mm aggregate Tar as second layer and compacted, 10cm seal coat as final layer and compacted.

125.8.2 If it is in concrete portion, then 15cm soil should be removed and compacted, pour concrete of M20 grade with the proper mix of 1:2:4.

125.8.3 If it is in Tiles, then 15cm soil should be removed and compacted, the tiles should be laid (of similar tiles and specify) by using the cement mortar in the ratio of 1:2.

125.9 **Splice and Pull through Chambers**

125.9.1 Splice chambers shall be placed at an interval as per planning to facilitate optical fiber splicing. One pull through chamber in between every two splice through chambers to facilitate blowing of fiber optical cable through HDPE ducts.

125.9.2 The chamber should be built of bricks with mason work such that it has an inner dimension of at least 1.2m x 1.2m.

125.9.3 In chambers duct entry hole should be sealed as a sealing with cement mortar 1:2 to avoid the entry of water into the chamber after duct laying.

125.9.4 The duct length inside the chamber should be between 5-10 cm.

125.9.5 Suitable length of cable loops up to 20m should be left in each direction within the chamber.

125.9.6 Chamber cover should not fall down inside the chamber while opening. OFC route constructions and laying practice of Section IV Part B is to be followed.

125.10 Splicing

- 125.10.1 The splice pit made at the time of cable laying shall be emptied of the soil, sand and stone.
- 125.10.2 **Splicing of Fibers.** The cable ends shall be prepared after the cable entry in to the closure. The strength member shall be fixed to its fixing mechanism provided in the closure. After fixing the cable in the splice closure, the bare fibers shall be guided to the fiber Organizer provided in the closure through transport tubes. The bare fibers shall be taken through transport tubes to the fiber organizer for splicing. These fibers shall be spliced as per standard procedures. The spliced fibers shall be made to rest on the concerned tray/cassette (fiber organizer).
- 125.10.3 **Sealing of Splice Closure.** After completion of splicing, the base and the dome of the closure and the cable entry shall be air sealed. It shall be ensured that the splice closures are air tight and water proof.
- 125.10.4 **Re- instatement of Pit.** After completion of splicing arrangements, the pit is to be filled with sand / soil incorporating warning bricks / stone etc. as per standard procedures.

125.11 Termination

- 125.11.1 All fiber will be terminated on fiber distribution management system (FDMS).
- 125.11.2 Proper racking and clamping of cable within the building is to be ensured.
- 125.11.3 The fiber optic cable should be properly clamped to the FDMS.
- 125.11.4 Fiber optic cable should be properly tagged for identification and every fiber to be identified when spliced to the pigtails and terminated on the frame.
- 125.11.5 End to end testing can be carried out from the FDMS to FDMS using the connectors which are mounted on the FDMS.

126. **In addition, all the tests/specifications mentioned in the respective technical specifications for this project as per Section VI will also be checked and verified by the Joint Acceptance Team as part of A/T procedures, as applicable.**

Annexure I
(Refer Para 85 of
Section IV Part A)

Model Implementation Schedule

[illegible]

SECTION IV

PART B : OFC CONSTRUCTION PRACTICES

127. **OFC Installation & Commissioning.** The bidder should be capable to carryout route survey, obtain RoW permission, provide storage, undertake laying & installation, jointing, testing and commissioning including all related civil work of OFC network over a large geographical area.
128. **Route Survey**
- 128.1 Extensive routesurvey and reconnaissance is to be carried out prior to designing the OFC network. This survey will be carried out by the bidder and due approval of the route needs to be taken from BSNL/PICG rep prior tofinalization of the route alignment. The project roll out will be planned to the level of delivery and laying on each fortnightand progress will be monitored online. The roll out plan for each link would be prepared only after completion of route survey and approval of route alignment. Following essential data will be collected and supported by Web based Online Tracking on daily basis to monitor the daily progress.
- 128.1.1 Route Survey Completed.
- 128.1.2 Right of Way demarcation.
- 128.1.3 Soil strata.
- 128.1.4 Existing Underground utilities.
- 128.1.5 Road / Rail / Bridge / River / Canal Crossings.
- 128.1.6 Any other criticalities or risk factors.
- 128.2 A detailed measurement of lengths of cable route along with details of rail/road crossings, culverts, causeways, etc. may be recorded in the detailed survey register. The probable locations of joints, terminations and regenerators may also be decided and marked on the route map.
- 128.3 On the basis of surveys, general permission from road and rail authorities for laying the Optical Fiber Cable along the decided routes and permission for rail / road crossings will have to be obtained. Generally, OFC is to be laid straight as far as possible along the road near the boundaries, away from the burrow pits. The OFC is to be laid along the roads at a minimum distance of 15 Meters from the centerline of the road or in accordance with the permission from the concerned road authorities in view of their road-widening plan. As the OFC carries high capacity traffic and is planned for 40 years of life, it is imperative that the cable is laid after obtaining due permission from all the concerned authorities to avoid any damage/shifting at a later stage and also disruption of services/revenue loss.
129. **RoW.** The bidder has to obtain the RoW from central/stage/local authorities as per the route approved after the survey.
130. **Excavation of Trenches**
- 130.1 **Location and Alignment of the Trench.** In city areas, the trench will normally follow the foot-path of the road except where it may have to come to the edge of the carriage way cutting across road with specific permissions from the concerned authorities maintaining the road (such permissions shall be obtained by the department). Outside the city limits the trench will

normally follow the boundary of the roadside land. However, where the road side land is full of burrow pits or afforestation or when the cable has to cross culverts/ bridges or streams, the trench may come closer to the road edge or in some cases, over the embankment or shoulder of the Road. The alignment of the trench will be decided by a responsible PICG official. Once the alignment is marked, no deviation from the alignment is permissible except with the approval of Engineer-in-charge PICG and BSNL. While marking the alignment only the centre line will be marked and the Contractor shall set out all other work to ensure that, the excavated trench is as straight as possible. The Contractor shall provide all necessary assistance and labour, at his own cost for marking the alignment. Contractor shall remove all bushes, undergrowth, stumps, rocks and other obstacles to facilitate marking the centre line without any extra charges. It is to be ensured that minimum amount of bushes and shrubs shall be removed to clear the way and the contractor shall give all, consideration to the preservation of the trees.

- 130.2 **Line-Up.** The line-up of the trench must be such that HDPE/PLB pipe(s) shall be laid in a straight line, both laterally as well as vertically, except at locations where it has to necessarily take a bend because of change in the alignment or gradient of the trench, subject to the restrictions mentioned elsewhere.
- 130.3 **Method of Excavation.** The contractor shall ensure that no damage is caused to any underground or surface constructions belonging to other public utility services and/or private parties.
- 130.3.1 HDD/Molling shall be the preferred means for duct laying rather than excavation for quick completion of the project. There shall be no objection to resort to mechanical means to bore a hole of required size and to push through HDPE/PLB duct through horizontal bore at road crossing or rail crossing or small hillocks etc. HDD is allowed in NLD routes as well as in city, urban areas, built up areas etc.
- 130.3.2 All excavation operations shall include excavation and 'Getting out'. 'Getting out' shall include throwing the excavated materials at a distance of at least one meter clear off the edge of excavation.
- 130.3.3 In Rocky strata excavation shall be carried out by use of electro mechanical means like breakers or by blasting wherever permissible with express permission from the competent authority. If blasting operations are prohibited or not practicable, excavation in hard rock shall be done by chiseling.
- 130.3.4 Trenching shall as far as possible be kept ahead of the laying of pipes. Contractor shall exercise due care that the soil from trenching intended to be loose for back filling is not mixed with loose debris. While trenching, the Contractor should not cause damage to any underground constructions belonging to other agencies and any damage caused should be made good at his own cost and expense.
- 130.3.5 Necessary barricades, night lamps, warning board and required watchman shall be provided by the contractor to prevent any accident to pedestrians or vehicles. While carrying out the blasting operations, the contractor shall ensure adequate safety by cautioning the vehicular and other traffic. The contractor shall

employ sufficient manpower for this with caution boards, flags, sign writings etc.

- 130.3.6 The contractor should provide sufficient width at the trench at all such places, where it is likely to cave in due to soil conditions without any extra payment. A minimum free clearance of 15 cms should be maintained above or below any existing underground construction. No extra payment will be made towards this.
- 130.3.7 In order to prevent damage to HDPE/PLB pipes over a period of time, due to the growth of tree roots, bushes, etc., the contractor shall cut them when encountered in the path of alignment of trench without any additional charges.
- 130.3.8 In large burrow pits, excavation may be required to be carried out for more than 165 cms in depth to keep gradient of bed less than 15 degrees with horizontal. If not possible as stated above, alignment of trench shall be changed to avoid burrow pit completely.

130.4 Depth and Size of the Trench. The depth of the trench from top of the surface shall not be less than 165 cms unless otherwise relaxation is granted by competent authority of BSNL and PICG under genuine circumstances. In rocky terrain, the depth of the trench may be restricted to a depth of 100 to 140 cms. However, Engineer-in-charge in exceptional cases due to adverse site conditions encountered, may allow to lay HDPE/PLB pipes at a lesser depth with additional protection. In all cases, the slope of the trench shall not be less than 15 degrees with the horizontal surface. The width of the trench shall normally be 45 cms at the top & 30 cms at the bottom. In case, additional pipes (HDPE/GI/RCC Pipes) are to be laid in some stretches, the same shall be accommodated in this normal size trench.

130.4.1 When trenches are excavated in slopes, uneven ground, inclined portion, and the lower edge shall be treated, as top surface of land and depth of trench will be measured accordingly. In certain locations, such as uneven ground, hilly areas and all other places, due to any reason whatsoever it can be ordered to excavate beyond standard depth of 165 cms to keep the bed of the trench as smooth as possible. Near the culverts, both ends of the culverts shall be excavated more than 165 cms. to keep the gradient less than 15 degree with horizontal.

130.4.2 If excavation is not possible to the minimum depth of 165 cms, as detailed above, full facts shall be brought to the notice of the Engineer in charge PICG and BSNL in writing giving details of location and reason for not being able to excavate that particular portion to the minimum depth. Approval shall be granted by the competent authority in writing under genuine circumstances. The decision of the competent authority shall be final and binding on the contractor.

130.5 Dewatering. The Contractor shall be responsible for all necessary arrangements to remove or pump out water from trench. The Contractor should survey the soil conditions encountered in the section and make his own assessment about dewatering arrangement that may be necessary. No extra payment shall be admissible for this.

130.6 Wetting. Wherever the soil is hard due to dry weather conditions, if

watering is to be done for wetting the soil to make it loose, the same shall be done by the contractor. No extra payment shall be admissible for this.

- 130.7 **Blasting for excavation.** In hard rock conditions, where blasting operations are considered necessary, the contractor shall inform BSNL rep prior to resorting to any blasting operation. The contractor shall obtain license from the competent authority for undertaking blasting work as well as for obtaining and storing the explosive as per the Explosive Act, 1884 as amended up to date and the explosive Rules, 1983. Alternatively, a sub contractor already having license may be employed for blasting work. The contractor shall purchase the explosives fuses, detonators, etc. only from a licensed dealer. Transportation and storage of explosive at site shall conform to the aforesaid Explosive Act and Explosive Rules. The contractor shall be responsible for the safe custody and proper accounting of the explosive materials. Fuses and detonators shall be stored separately and away from the explosives. The Engineer-in-Charge PICG and BSNL or their authorized representatives shall have the right to check the contractor's store and account of explosives. The contractor shall provide necessary facilities for this.

130.7.1 The contractor shall be responsible for any damage arising out of accident to workmen, public or property due to storage, transportation and use of explosive during blasting operation.

130.7.2 Blasting operations shall be carried out under the supervision of a responsible authorized agent of the contractor (referred subsequently as agent only), during specified hours as approved in writing by the competent authority. The agent shall be conversant with the rules of blasting. All procedures and safety precautions for the use of explosives drilling and loading of explosives before and after shot firing and disposal of explosives shall be taken by the contractor as detailed in IS: 4081 safety code for blasting and related drilling operation.

- 130.8 **Laying of Overhead Cables.** In case after route survey it is ascertained that the optical fiber cable cannot be laid underground due to terrain constraints or miscellaneous reasons, then the cable may be planned to be laid overhead after obtaining due approval from reps of BSNL/PICG. In case approval is granted for laying overhead cable for certain sections of the route then the following would be adhered to by the Bidder.

130.8.1 BSNL construction practice for laying of overhead cables in that region would be followed to include span length, construction of poles, fastening and securing of cables etc.

130.8.2 The cable to be laid for these sections would be separately designed and manufactured to provide the necessary tensile strength. The essential design specifications for overhead optical fiber cable would include the following:-

130.8.2.1 The cable shall be subjected to Tensile Strength Test procedure as enumerated in IEC 60794-1-2-E1. It should withstand up to $6 * W * 9.81$ N where W is the weight of the cable per km.

130.8.2.2 The cable shall be constructed using Aramid yarn

instead of Glass Roving yarn to provide the necessary tensile strength.

- 130.9 **Trenching Near Culverts/ Bridges.** The HDPE/PLB pipes shall be laid in the bed of culvert at a depth not less than 165 cms protected by G.I. pipes and concreting as decided by Engineer- in charge PICG and BSNL. Both ends of culverts shall be excavated more than 165 cms in depth to keep the gradient of not less than 15 degree with horizontal. The bed of trench should be as smooth as possible.

130.9.1 While carrying out the work on bridges and culverts, adequate arrangement for cautioning the traffic by way of caution boards during day time and danger lights at night shall be provided.

130.9.2 In case of small bridges and culverts, where there is a likelihood of their subsequent expansion and remodeling, the cable should be laid with some curve on both sides of the culvert or the bridge to make some extra length available for readjustment of the cable at the time of reconstruction of culvert or the bridge.

131. **Laying of HDPE/PLB Pipes**

131.1 Optical Fiber Cables should be blown through Permanently Lubricated HDPE Duct of 40 mm-OD and 33 mm ID Pipe of 500/1000 meter coil which meets the specification as given in G/R No-G/CDS-08/02 Nov 2004 with latest amendments shall only be used for laying the OFC. Wherever DWC pipe or GI pipes or R.C.C. pipes are used for protection, the two ends of the pipes should be properly sealed to protect HDPE pipe from sharp edge of GI pipe and to bar the entry of rodents. For providing additional protection Split RCC/GI pipes should be used from top instead of full RCC/GI pipes. The method of duct laying will be as per Appendix 'K' with appropriate method being used as per BSNL construction manual and OFC laying practices as per soil conditions.

131.2 After the trench is excavated to the specified depth, the bottom of the trench has to be cleared of all stones or pieces of rock and leveled up properly. A layer of soft soil/or sand (in case the excavated material contains sharp pieces of rock/stones) of not less than 5 cms is required for leveling the trench to ensure that the cable when laid will follow a straight alignment. Adequate care shall be exercised while laying so that the optical fiber cables are not put to undue tension/pressure after being laid as this may adversely affect the optical characteristics of cables with passage of time. The contractor shall ensure that trenching and pipe laying activities are continuous, without leaving patches or portions incomplete in between. In case intermediate patches are left, measurement of the completed portions will be taken only after work in such left over patches are also completed in all respects. Preparatory to aligning the pipe for jointing, each length of the HDPE/PLB pipe shall be thoroughly cleaned to remove all sand, dust or any other debris that may clog, disturb or damage the optical fiber cable when it is blown at a later stage. The ends of each pipe and inside of each socket shall be thoroughly cleaned of any dirt or other foreign materials.

131.3 After the trench is cleaned the HDPE/PLB pipes/Coil shall be laid in the cleaned trench, jointed with couplers at every 500/1000m or at bends or turns, the HDPE end caps shall be used for sealing the HDPE/PLB pipes to avoid entry of rodents/mud etc. At the end of each days work, the open ends of the pipes sections shall be tightly closed with end caps to prevent the

entry of dirt/mud, water or any foreign matter into HDPE/PLB pipes until the work is resumed.

- 131.4 In City, Town, Urban area falling within Municipal/Corporation limits, the HDPE/PLB pipes shall be laid with protection using RCC/G.I. Pipes/ Concreting reinforced with weld mesh. Moreover, in cross country routes, if depth is less than 1.2 Meters, protection by using RCC/G.I. Pipe/ Concreting reinforce with weld mesh shall be provided. Engineer-in-Charges PICG and BSNL shall decide about such stretches and type of protection to be provided in view of the site requirements. Normally 100 mm ID RCC Pipes shall be used for protecting HDPE/PLB pipe but if more than one HDPE/PLB pipe is to be laid and protected, RCC Pipe of suitable size to accommodate the required number of HDPE Pipes shall be used.
- 131.5 The HDPE/PLB pipes shall be laid in RCC Full Round spun Pipes/GI Pipes as required at road crossings. The RCC pipes/GI pipes shall extend at least 3 Meters on either side of the road at road crossings. At road crossings, extra GI/HDPE/PLB pipes may be laid as per the direction of the Engineer-in charge PICG and BSNL. On Rail bridges and crossings, the HDPE/PLB pipes shall be encased in suitable cast iron as prescribed by the Railway Authorities.
- 131.6 Wherever RCC pipes are used for protection, the gaps between the RCC collars and the RCC pipes shall be sealed using cement mortar 1:3 (1 part 53 grade cement of reputed brand, 3 parts of fine sand without impurities) to bar entry of rodents. Every third collar of RCC pipes (normally of 2 Meters length) and also both ends of RCC Pipes will be embedded in a concrete block of size 40 cms (L)x 40 cms (W) x 25 cms (H) of 1:2:4 cement concrete mix (1 part 53 grade cement of reputed brand, 2 part coarse sand, 4 part stone aggregate of nominal size of 20 mm) so that the alignment of RCC pipes remain firm and intact and to avoid entry of rodents. Wherever GI pipes are used, special care should be taken to ensure that G.I. Pipes are coupled properly with the sockets so as to avoid damage to HDPE/PLB pipe and eventually the OFC in the event of pressure coming on the joint and G.I. Pipe joint giving its way. Rubber bushes shall be used at either ends of the GI pipes to protect HDPE/PLB pipe. Both the ends of G.I. Pipe will be embedded in a concrete block of size 40 cms (L) x 40 cms ((W) x 25 cms (H) of 1:2:4 cement concrete mix (1 part 53 grade cement of reputed brand, 2 part coarse sand, 4 part stone aggregate of nominal size of 20 mm) so that the alignment of G.I. Pipes remain firm and intact and to avoid entry of rodents. In case of protection by concreting at site, the nominal dimension of concreting shall be 250 mm x 250 mm section. Cement Concrete Mixture used shall be of 1:2:4 composition (1 part 53 grade Cement of a reputed company, 2 part Coarse Sand, 4 part Graded Coarse Stone aggregate of 20 mm nominal size, reinforced with MS weld mesh. As the RCC is cast at site, it is imperative to ensure that special care is taken to see that proper curing arrangements are made with adequate supply of water. The contractor shall invariably use mechanical mixer at site for providing RCC protection, to ensure consistency of the mix.
- 131.7 For carrying out concreting work in trenches, yellow PVC sheets of width not less than 1.0 M and of weight not less than 1 kg. Per 8 sq. meters shall be spread and nailed on sides of the trench to form trapezoidal section for concreting in the cleaned trench, to avoid seepage of water into the soil. A bed of cement concrete mixture of appropriate width and 75 mm thickness

shall be laid on the PVC sheet, before laying HDPE pipes. The HDPE/PLB pipes shall then be laid above this bed of concrete. After laying the HDPE/PLB pipes, MS weld mesh is wrapped around and tied and concrete mix is poured to form the cross sectional dimensions as instructed by the Engineer-in-charge. The strength of RCC is dependent on proper curing; therefore, it is imperative that water content of RCC mix does not drain out into the surrounding soil. Portions where cement concreting has been carried out shall be cured with sufficient amount of water for reasonable time to harden the surface. After curing, refilling of the balance depth of the trench has to be carried out with excavated soil.

- 131.8 The HDPE/PLB pipes/RCC/GI Pipes shall be laid only in trenches accepted by Engineer-in-Charge PICG and BSNL or their representatives. The Contractor shall exercise due care to ensure that the HDPE/PLB pipes are not subjected to any damage or strain. Water present in the trench at the time of laying the HDPE/PLB pipes shall be pumped out by the contractor before laying the pipes in the trench to ensure that no mud or water gets into the pipes, thus choking it.
- 131.9 In case of nallahs, which are dry for nine months in a year, the HDPE/PLB pipes shall be laid inside the RCC Pipes/ or GI Pipes and concrete laid at a minimum depth of 165 cms, as instructed by the Engineer-in-charge PICG and BSNL. The mechanical protection shall extend at least 5 meters beyond the bed of nallah on either side.
- 131.10 Notwithstanding anything contained in clauses referred above, the Engineer-in-charge PICG and BSNL may order, based on special site requirements, that the HDPE Pipes may be encased in reinforced cement concrete, as detailed, *ibid*.
- 131.11 While laying the pipes, a gap of 2 M is to be kept at convenient locations approx. 200 m apart and at the bends and turns, which will be used as manholes during OF cable blowing. Ends of the HDPE/PLB pipes at the manholes shall be sealed using end caps after tying the PP rope to the end caps to avoid choking of the pipes. In a similar manner, manholes shall be kept while approaching bridges, road crossings etc., as instructed by the Engineer-in-charge PICG and BSNL.

132. **Laying Protection Pipes on Bridges and Culverts.** In case trenching and pipe laying is not possible in the beds of the culverts, the pipes shall be laid over the culverts/bridges after getting due permission from the competent authority. Of late the bridge construction authorities are providing ducts below the footpaths on the bridges for various services. In such ducts, G.I. Pipes can be coupled and laid for blowing the cables. However, for laying cables on existing bridges, where duct arrangement does not exist, one of the following methods may be adopted.

- 132.1 Normally in the Bridges/Culverts, where there are no ducts and where the cushion on the top of the Arch is 50 cm to 100 cm or more, G.I. Pipe (Carrying HDPE/PLB pipe and cable) may be buried on the top of the arch adjoining the parapet wall, by digging close to the wheel guards. Every precaution shall be taken to see that no damage occurs to the arch of the culvert. After burying the GI pipe, the excavated surface on the arch shall be restored. Where the thickness of arch is less than 50 cms, the pipe must be buried under the wheel guard masonry and the wheel guard rebuilt.
- 132.2 If neither of the two methods is possible, the G.I. Pipes/GI Troughs must be clamped outside the parapet wall with suitable clamps. If necessary, the

pipes may be taken through the parapet wall at the ends where the wall diverges away from the road.

- 132.3 In case where the methods explained in clauses referred above are not possible, the G.I. Pipe/GI Troughs can be fixed on the top of the road kerb close to the inside face of the parapet wall by means of clamps supplied, using raw plugs and wood screws or small diameter bolts, without damaging the concrete and limiting the external diameter of the bolts to 7.5 mm. The permission for carrying out this work will be obtained from the Road Authorities by the Bidder.
- 132.4 Methods cited in above clauses should be carried out under close supervision of Road authorities. The surface to be concreted should be thoroughly cleaned and leveled before concreting. At both ends of the Bridges/Culverts, where the GI Pipes /GI Troughs slope down and get buried, the concreting should be extended to ensure that no portion of the GI Pipes/GI Troughs is exposed as ordered by the Engineer- in- charge PICG and BSNL to protect the pipe/Trough from any possible damage externally caused. Where white wash/ colour wash exists on the Bridges/ Culverts, the same should also be carried out on the concreted portion to ensure uniformity.

133. **Back Filling and Dressing of the Trench.** Back Filling activity would commence only after due measurements have been recorded in the measurement book and duly verified by BSNL /PICG reps. The earth used for filling shall be free from all roots, grass, shrubs, vegetation, trees, saplings and rubbish. Provided that the HDPE/PLB pipes have been properly laid in the trench at the specified depth, the back filling operation shall follow as closely as practicable. The back filling operation shall be performed in such a manner so as to provide firm support under and above the pipes and to avoid bend or deformation of the HDPE/PLB pipes when the pipes get loaded with the back filled earth.

- 133.1 At locations where the back filled materials contains stones/sharp objects which may cause injury to the HDPE/PLB pipes and where the excavated or rock fragments are intended to refill the trench in whole or in part, the trench should be initially filled, with a layer of ordinary solid or de-rocked loose earth of not less than 10 cms above the pipes.
- 133.2 The electronic route marker should be placed such that it is at a depth of maximum three feet from the surface. The electronic route markers will be placed every 200m and shall be staggered along with RCC route markers.
- 133.3 Back filling on public, private roads, railway crossings, footpaths in city areas shall be performed immediately after laying the HDPE pipes. Back filling at such locations shall be thoroughly rammed, so as to ensure original condition and made safe for traffic. All excess soil/ material left out on road/ footpath/railway crossing shall be removed by contractor. However, along the high way and cross-country, the dug up material left out should be kept as heap above the trench while refilling.
- 133.4 In city limits, no part of the trench should be kept open for more than the minimum distance as specified by local authorities at any time and in all places where excavation has been done, no part of the trench should be kept open over night to prevent any mishap or accident in darkness.
- 133.5 Duct through test of the PLB laid and pressure test shall be carried out after successful completion of backfilling and compaction and shall be completed before blowing of optical cable.

133.6 Duct integration Test (DIT) for HDPE ducts

- 133.6.1 Ensure that the trench does not have any sharp bend and the couplers are tightened to the maximum.
- 133.6.2 Ensure the backfilling and the compaction of the trench are satisfactory prior to start of DIT.
- 133.6.3 Pass the compressed air at 8Kg/Sq.cm and clean the duct from deposits like mud and small stones.
- 133.6.4 Insert a medium density sponge into the duct and push it with compressed air of 8Kg/Sq.cm. The sponge should eject with full force.
- 133.6.5 The mandrill made of hard rubber or polished wood in the shape of cylinder of diameter 0.75 x D in diameter of HDPE duct and 75 mm long shall be used.
- 133.6.6 On completion of test seal the ends with end plugs.
- 133.6.7 Ensure that there is no pressure leakage during DIT.

134. Cable Blowing and Joining/Splicing

134.1 **Cable Blowing.** Manholes shall be marked during HDPE/PLB pipe laying of approx. size of 2m X 2m x 2m shall be excavated for blowing the cables. There may be situations where additional manholes are required to be excavated, for some reasons, to facilitate smooth blowing of cable. Excavation of additional manholes will be carried out, without any extra cost. De-watering of the manholes, if required, will be carried out without any extra costs. De-watering/De-gasification of the ducts, if required, will be carried out without any extra costs.

- 134.1.1 The Optical fiber cables are available in drums in lengths of approx. $2/4 \pm 5\%$ kms. The cables shall be blown by blowing machine through already laid HDPE/PLB. This work is to be carried out under the strict supervision of site in-charge. Only blowing of cables is permitted and pulling of cables shall not be resorted to by the bidder, as tension applied on cable may lead to deterioration/breaking of fibers. **Every instance of cable pulling reported will attract a penalty of Rs 1 Lakh. In addition, the bidder will be required to replace the cable at his own cost.**
- 134.1.2 After blowing of the drum is completed, both ends of the HDPE/PLB pipe in each joint chamber should be sealed by hard rodent resistant rubber bush, to avoid entry of rodents/mud into HDPE/PLB pipes.
- 134.1.3 The Manholes are prepared by providing 65 mm split HDPE/PLB pipe of 2.5 to 3m length and closing the split HDPE/PLB pipes by providing necessary clamps/ adhesive tape as per the directions of Engineer-in- charge. Afterwards, the split/cut HDPE/PLB pipe are covered with 100 mm split RCC pipe of 2m length and sealing the ends of RCC pipe with lean cement solution for protecting bare cable in the manhole . After fixing of HDPE/RCC Split Pipes necessary back filling/reinstatement and dressing of manholes should be carried out as referred under trenching(**brickwork/RCC chambers are not required for manholes**). The location of the blowing manhole should be recorded for preparation of

documentation.

134.1.4 **Method of Blowing of Fiber Optic Cable through HDPE duct**

- 134.1.4.1 Ensure the duct Integrity test has been completed.
- 134.1.4.2 Drum should be kept approximately at the center of two adjacent chambers. (I.e. if drum length is 4 Km, at 2 Km.) So that on either side 2 Km blowing can be done.
- 134.1.4.3 Cable drum should be mounted on jack, which shall be kept on a plain surface.
- 134.1.4.4 Cable blowing to be done with the help of compressor, hydraulic power pack and blowing Machine. Anti twist tool can be used to avoid twisting of cable while blowing.
- 134.1.4.5 It is then necessary to coil the cable in the figure of 8 to facilitate installation.

134.2 **Jointing/ Splicing.** The OFC drums are of $2/4 \pm 5\%$ Kms in length hence optical fiber joints will be approx. at every $2/4$ Kms. The fibers are to be spliced at every $2/4$ Kms. & at both ends (Terminations) in the equipment room as directed by the Engineer-in-charge PICG and BSNL. Min distance between joint chambers for NLD routers should be $2/4$ Kms. The jointing of 08 (eight) sensory fibers will be done along with 48 fiber OF cable.

134.3 **Preparation of Cable for Jointing**

- 134.3.1 Necessary road traffic signs, barriers etc shall be put up at site.
- 134.3.2 During the installation, a minimum of 20 meters of cable of each end is coiled in the jointing pit to provide for jointing to be carried out at convenient location as well as spare length to be available for future use in case of failures.
- 134.3.3 Bracket to support the cable coil are also fixed on the wall of the pit.
- 134.3.4 The cable is then coiled on to the pit wall in the same position as required after the joint is complete. The marking is done on all the loops so that it will be easier to install it later.
- 134.3.5 The distance from the last centre to the end of the cable must be at least 1.8 meter. This is being the minimum to be stripped for preparation of joint.
- 134.3.6 Sufficient cable at each end upto the jointing vehicle/enclosure is then uncoiled from the pit for jointing.

134.4 **Stripping/Cutting of the Cable**

- 134.4.1 The cable is stripped of their outer and inner sheath with each sheath staggered approximately 10mm from the one above it.
- 134.4.2 Proper care must be taken when removing the inner sheath to ensure the fibers are not scratched or cut with the stripping knife or tool to prevent this, it is best to only score the inner sheath twice on opposite sides of the cable, rather than cut completely through it. The two scores marking on either side of the cable are then

stripped of the inner sheath by hand quite easily.

- 134.4.3 The fibers are then removed from cable one by one and each fiber/ribbon is cleaned individually.

134.5 **Preparation of Cable Joint Closure for Splicing.**

- 134.5.1 The strength members of each cable are joined to each other and/or the central frame of the joint closure.
- 134.5.2 The joint closure is assembled around the cable.
- 134.5.3 The mechanical sealing is applied to the cables and closure or prepared for application after splicing is complete.
- 134.5.4 Tags which identify the fibers Nos are attached at suitable locations on the fibers.
- 134.5.5 Splice protectors are slipped over each fiber in readiness for splicing over the bare fiber after splicing.

134.6 **Stripping and Cleaving of Fiber**

- 134.6.1 Prior to splicing each fiber must have approximately 50mm of its primary protective U.V. cured coating removed, using fiber stripper.
- 134.6.2 The bare fiber is then wiped with a lint free tissue doused with ethyl alcohol.
- 134.6.3 Cleaving of the fiber is then performed to obtain as close as possible to a perfect 90° face on the fiber.

134.7 **Splicing of the Fibers.**

- 134.7.1 Wash hands thoroughly prior to connecting this procedure.
- 134.7.2 Place the bare fiber inside 'V' groove of the splicing machine by opening clamp handle such that the end of fiber is app.1 mm. over the end of the 'V' groove towards the electrodes.
- 134.7.3 Repeat the same procedure for other fiber; however first insert heat shrink splice protector.
- 134.7.4 Press the start button on the splice controller.
- 134.7.5 The machine will pre fuse, set align both in 'X' and 'Y' direction and then finally fuse the fiber.
- 134.7.6 Inspect the splice on monitor if provided on the fusion splicing machine and assure no nicking, bulging is there and cores appear to be adequately aligned if the splice does not visually look good repeat the above procedure.
- 134.7.7 Slide the heat shrink protector over the splice and place in tube heater. Heat is complete when soft inner layer is seen to be 'oozing' out of the ends of the outer layer of the protector.
- 134.7.8 Repeat the same procedure for all the other fibers.

134.8 **Organising Fiber and Finishing Joints**

- 134.8.1 After each fiber is spliced, the heat shrink protection sleeve must be slipped over the bare fiber before any handling of fiber takes place, as uncoated fibers are very brittle and cannot withstand small radius bends without breaking.

- 134.8.2 The fiber is then organized into its tray by coiling the fibers on each side of the protection sleeve using the full tray side to ensure the maximum radius possible for fiber coils.
- 134.8.3 The tray is placed in the position.
- 134.8.4 OTDR reading taken for all splices in this organized state and recorded on the test sheet to confirm that all fibers attenuation are within 0.1 db per splice. This OTDR test will confirm fibers were not subjected to excessive stress during the organizing process.
- 134.8.5 After this the joint can be closed with necessary sealing etc and ready for placement in the pit.

134.9 **Placing of Completed Joint In Pit**

- 134.9.1 Joint is taken out from the vehicle and placed on the tarpaulin provided near the pit.
- 134.9.2 The cable is laid on the ground, loop the cable such that pen mark previously placed on the cable line up. Tape these loops together at the top of the coil.
- 134.9.3 The joint can now be permanently closed and sealed mechanically. However, before closing, silica gels to be kept inside for moisture protection.
- 134.9.4 Now the joint closure is fixed to the bracket on the pit wall and pit is closed.

134.10 **Splicing Requirements**

- 134.10.1 Suitable infrastructure needs to be catered for by the bidder to carry out splicing at his own cost. The Infrastructure required for cable splicing is as given below:-
 - 134.10.1.1 Splicing machine.
 - 134.10.1.2 Air Conditioned Van.
 - 134.10.1.3 OTDR.
 - 134.10.1.4 Optical talk set.
 - 134.10.1.5 Tool kit
 - 134.10.1.6 Any additional accessories, e.g. DG set.
- 134.10.2 BSNL/PICG rep would accompany the Site-in-charge and would be taken along with the jointing team to supervise the quality of work.
- 134.10.3 The optical fiber cable thus jointed end-to-end will be tested by during Acceptance Testing for splice losses and transmission parameters. The OFC should meet all the parameters specified and no relaxation will be granted.
- 134.10.4 It should also be ensured that during jointing no fibers are interchanged or broken. The number of joints should not be more than 10 % of the theoretical value calculated for the length of OFC laid.

- 134.11 **Construction of Jointing Chamber.** The joint chambers are provided at every joint to keep the OFC joint well protected and also to keep extra length of cable, which may be, required to attend the faults at a later date. Jointing chambers are to be prepared normally at a distance of every 2/4 kms. Actual

location of jointing chamber depends on length of cable drum and appropriateness of location for carrying out jointing work. The location is finalized by Engineer-in-charge PICG and BSNL. The jointing chambers will preferably be of pre-cast RCC type as per [Appendix J](#); where not possible, bidder may construct brick chamber as per [Appendix J](#).

134.12 The work of cable laying includes the work of cable laying up to exchange termination point and has to be carried out as per the directions of Engineer-in-charge PICG and BSNL.

135. **Electronic Route Markers.** The electronic route markers are to be placed every 200m. These would be staggered with reference to the RCC route markers in a manner that there should be a marker placed every 100m along the OFC route.

135.1 The electronic route markers should be placed in the trench after partial backfilling of earth and should be aligned directly over the PLB duct such that it is not more than 3 feet deep from the surface.

135.2 In case horizontal boring is resorted to then the placement of route markers (Electronic / RCC Type) shall be done at every point of use of the machine.

135.3 The exact location of the electronic route marker should be recorded as part of the ABD documentation and in the measurement book.

136. **Fixing of RCC Route /Joint Indicators.** Joint Indicators Pits shall be dug 1m. towards jungle side at every manhole and jointing chamber for fixing of Route/Joint Indicator. In addition, Route Indicators are also required to be placed where OFC changes directions like road crossing etc. These RCC route indicators shall be placed every 200m and staggered along with electronic route markers.

136.1 The pits for fixing the indicator shall be dug for a size of 60 cms x 60 cms and 75 cms (Depth). The indicator shall be secured in upright position by ramming with stone and minimum upto a depth of 60 cms and concreting in the ratio of 1:2:4 (1: cement, 2: coarse sand, 4: stone aggregate 20 mm nominal size) for the remaining portion of 15 cms. Necessary curing shall be carried out for the concreted structure with sufficient amount of water for reasonable time to harden the structure.

136.2 Depth of pit for fixing the route indicator should be 50 cm for hilly terrain. The route/joint indicator shall protrude at least 18 inches above ground level for easy identification. The route /joint indicator made of pre-cast RCC should have the following dimensions:

136.2.1 Base - 250 mm x 150 mm

136.2.2 Top - 200 mm x 75 mm

136.2.3 Height - 1250 mm

136.3 The route and joint indicator shall be painted with primer before painting with oil paint. The material used should bear ISI mark. The size of each written letter should be at least 3.5 cms. The colors of painting and sign writing is as under :

136.3.1 For Joint Indicator Red.

136.3.2 For Route Indicator Dark Blue.

136.3.3 For Letters White

136.4 The word '**NFS OFC**' should be engraved on the route/joint indicators. The engraved word "NFS OFC" should be further painted in white over the specified background colour.

136.5 The numbering scheme for route indicators will be Joint No./Route Indicators No. for that joint. For example 2/6 indicator means 6th route indicator after 2nd joint. Additional joints on account of faults at a later date should be given number of preceding joint with suffix A, B, C and D. For example sign writing 2A on a joint indicator means, additional joint between Joint No. 2 and 3. The numbering existing route/ joint indicator should not be disturbed on account of additional joints.

137. **Documentation.** The documentation, consisting of the following shall be prepared node to node for NLD routes as well as for Access Network routes.

137.1 **Route Index Diagrams.**

137.2 **As Built Diagrams.** The ABD shall be an essential part of the documentation process and shall ensure easy maintenance of the OFC route. The ABD shall be separately prepared for each route.

137.3 The ABD will contain the following details: -

137.3.1 Cable Details

137.3.1.1 Make and size of the cable.

137.3.1.2 Identification of cable drums deployed.

137.3.1.3 Test reports.

137.3.2 Joint Details

137.3.2.1 Location of Joint Chamber (lat/long details in decimal degree format up to eight decimal places).

137.3.2.2 Depth of Joint Chamber covers from ground level.

137.3.2.3 Details of cable slack left at each joint chamber.

137.3.2.4 Splice loss details.

137.3.3 FDMS Details

137.3.3.1 Details of FDMS deployment.

137.3.3.2 OTDR measurements for each fiber terminated at FDMS.

137.3.3.3 Fiber Connectivity Details.

137.3.4 Route marker Details

137.3.4.1 Location of Cement / Electronic Route Marker (lat/long details in decimal degree format up to eight decimal places)

137.3.4.2 Route Marker Identification details.

137.3.5 Optical Test results

137.3.5.1 OTDR readings.

137.3.5.2 Light Source Power Meter readings.

137.3.5.3 Chromatic Dispersion measurement readings.

137.3.5.4 Optical test results for each fiber shall be furnished.

137.3.5.5 OTDR settings to include wavelength, pulse width and average time shall also be recorded.

- 137.3.5.6 Bi-directional OTDR readings shall be furnished for each Joint Closure.
- 137.3.6 OFC Alignment Details
- 137.3.6.1 Offset of cable from centre of the road at every 10 meters.
- 137.3.6.2 Details of crossings (road/rail/nala etc) should be provided.
- 137.3.6.3 Depth profile of Cable at every 10 Meter interval.
- 137.3.6.4 Details of protection with type of protection.
- 137.3.6.5 Location of culvert and bridges with their lengths and scheme of laying of HDPE/PLB pipe thereon.
- 137.3.6.6 Important landmarks to facilitate locating the cable in future to include culverts, houses, petrol pumps, schools etc.
- 137.3.6.7 Location of Joints and manholes.
- 137.3.6.8 Location of Cement and Electronic Route Markers.
- 137.3.6.9 The OFC alignment details shall be provided at multiple Levels of Detail (LOD) to facilitate section wise identification of route. While one sheet shall contain the entire link the LOD would gradually increase to upto 400m on a single sheet.
- 137.3.6.10 Diagram shall consist of Cable Route Details on Geographical Map drawn to scale with prominent land marks and alignment of cable with reference to road.
- 137.3.6.11 Indexing and referencing of the diagrams shall be made to provide easy identification of route details.
- 137.3.7 Landmarks along route
- 137.3.7.1 All important landmarks for verification along the OFC route corridor would be recorded as part of the ABD. The corridor would include all verifiable landmarks upto 25m on each side along the center of the road.
- 137.3.7.2 All landmarks recorded as part of the ABD would be provided along with accurate lat long details in decimal degree upto eight decimal places.
- 137.3.7.3 The broad category of landmarks to be recorded would be as given below:-
- 137.3.7.3.1 Milestones.
- 137.3.7.3.2 Culverts.
- 137.3.7.3.3 Bridges.
- 137.3.7.3.4 Important building footprint.
- 137.3.7.3.5 Road Features.

- 137.4 ABD shall provide the basis for carrying out GIS mapping of the entire OFC route alignment. The GIS details required to be recorded as part of the ABD shall be measured using DGPS system (providing sub meter accuracy) and Total Stations. Readings recorded through these systems would use accurate control stations and shall be digitally corrected by using appropriate software. **ABD shall be generated using CAD tool(s).**
- 137.5 **Accuracy of details provided as part of the ABD will be very critical for successful implementation of the GIS based Optical Fiber NMS being procured through a separate tender. A penalty of Rs 50,000.00 will be levied on the Bidder for each inaccurate recording of lat/long and distance details in the ABD and discovered during the ATP.**
- 137.6 All the diagrams shall bear the signatures of the contractor and the project manager as a proof of accuracy of the details. The diagrams shall be bound in A-4 size book with cover. The cover sheets shall be laminated and should have the following details.
- 137.6.1 Name of the Project Organization.
 - 137.6.2 Name of the OFC Link with ID.
 - 137.6.3 Name of the Contractor.
 - 137.6.4 Name of BSNL Rep as part of Acceptance Test.
 - 137.6.5 Name of PICG Rep as part of Acceptance Test.
 - 137.6.6 Date of commencement of work.
 - 137.6.7 Date of completion of work.
 - 137.6.8 For each route/section 6 sets of above mentioned document shall be submitted.

138. Specifications of Material to be used during OFC Route Construction.

While the specifications of the material to be supplied are given in Section VI Part A & B, the succeeding paragraphs gives out specifications of material to be utilized during the OFC route construction. For lesser depths requiring mechanical protection as per specifications and in built up areas, in towns and cities falling within the municipal limits, suitable mechanical protection is provided to HDPE/PLB pipes/coils using RCC/DWC full round/split RCC/DWC pipes or GI pipes or concreting of size 25 cms x 25 cms reinforced with MS weld mesh or a combination of any of these as per the written instructions of the Engineer-in-charge.

- 138.1 **DWC HDPE Duct.** The DWC HDPE Ducts required for the construction of the OFC shall be from the TSEC approved manufacturer conforming to GR No. GR/DWC-34/01 SEP2007 with latest amendment, if any, issued by TEC, DOT for DWC HDPE Ducts of required size(s) (for preferably Orange & Blue colours mentioned against each Package for which supply is to be offered and executed. The full DWC HDPE Ducts shall have OD of 75-90mm and ID of 56 mm (min). DWC HDPE Full Ducts are to be supplied in length of 6 Meters ($\pm 1\%$) each. DWC HDPE Full Pipe required as part of all the packages is to be supplied preferably in orange and blue colours. These ducts shall be joined by suitable DWC couplers with rubber 'O' ring to meet IP 67 requirements.
- 138.2 **RCC Full Round Pipes.** Reinforced cement concrete pipes (spun type) coupled with RCC collars sealed with cement mortar are used to provide mechanical protection to HDPE/PLB pipes/coils. The RCC pipes/collars should be of NP-3 class for 100 mm /150mm full round,

conforming to IS standard 458-1988 revised upto date. The pipes should have a nominal length of 2 Meters. The RCC collars should be properly sealed using cement mortar 1:3 (1 part grade 53 cement of reputed brand, 3 part fine sand without Impurities). If the mechanical protection is provided by RCC pipes, every third joint will be embedded in a concrete block of size 60 cms (L) x 40 cms (W) x 25 cms (H) of 1:2:4 cement concrete mix 1:2:4 (1: cement, 2: coarse sand, 4: stone aggregate of 20 mm nominal size) so that the alignment of RCC pipes remain firm and intact. Both ends of RCC / GI pipes will be sealed by providing concrete block of size 40 cm (L) x 40 cm (W) x 25 cm (H) of 1:2:4 cement concrete mix to avoid entry of rodents.

138.3 **RCC Full Split Pipes.** Reinforced cement concrete pipes (spun type) with in-built collars are used to provide mechanical protection to HDPE/PLB pipes/coils. The RCC pipes should be of 100mm internal dia. (Spigotted), Class--NP-3, Thickness: 25mm, Length: 2 Meters with inbuilt collar at one end, conforming to ISI Specification IS: 458, 1988 with latest amendment.

138.4 **G.I. Pipes.** G.I. pipes should be of Class B having diameter of 76mm. The G.I. Pipes should conform to IS 554/1985 (revised upto date) IS 1989 (Part-I), 1900 Sockets (revised upto date) & IS 1239 (Part-II) 1992 (revised upto date). Wherever protection by G.I. pipe is provided, it is preferable to use HDPE coils. If space on parapet wall on Bridges/culverts is limited, 40 mm GI pipes may be used with 32 mm HDPE coil drawn inside.

138.5 **M.S. Weld Mesh.** The HDPE/PLB pipes can also be protected by embedding it in concrete of size of 25 cms x 25 cms reinforced with MS weld mesh. The MS weld mesh used should be of 50 mm x 100 mm size, 12 SWG, 120 cms in width in rolls of 50m each. One Meter of MS weld mesh caters to approx. 3 Meters of concreting. The strength of RCC/CC is dependent on proper curing therefore, it is imperative that water content of CC/RCC mix does not drain out into the surrounding soil. In order to ensure this, the RCC/CC work should be carried out by covering all the sides by yellow PVC sheets of weight not less than 1 kg per 8 sq.m. to avoid seepage of water into the soil.

138.6 **Rubber Bush.** To prevent entry of rodents into HDPE/PLB pipes, the ends of HDPE/PLB pipes are sealed at every manhole and joint using rodent resistant hard rubber bush (cap) after optical fiber cable is pulled/blown. The rubber bush should be manufactured from hard rubber with grooves and holes to fit into 40/33 mm HDPE/PLB pipe (class V), so that it should be able to prevent the entry of insects, rodents, mud, and rainwater into the HDPE/PLB pipe. It should weigh 150 gms (with a tolerance of $\pm 5\%$). It should conform to specification No. G/CDS-05/01 dated December. 1994 and revised upto date.

139. **Safety Precautions.** Safety Precautions when excavating or working in excavations close to electric cables.

139.1 The Engineer-in-charge PICG and BSNL of the work should get full information from Electricity undertaking regarding any electric cables, which are known or suspected to exist near the proposed excavation and unless this is done, excavation should not be carried out in the section concerned. The electricity undertaking should be asked to send a representative and work should be preceded in close consultation with them.

139.2 Only wooden handled hand tools should be used until the electric cables have been completely exposed. Power Cables, not laid in conduits, are

usually protected from above by a cover slab of concrete, brick or stone. They may or may not be protected on the sides. It is safer, therefore, always to drive the point of the pickaxe downwards then uncovering a cable, so that there is less chance of missing such warning slabs. No workman should be permitted to work alone where there are electric cables involved. At least one more man should be working nearby so that help can be given quickly in case of an accident. If disconnection of power could be arranged in that section it will be better. No electric cables shall be moved or altered without the consent of the Electric Authority and they should be contacted to do the needful. If an electric cable is damaged even slightly, it should be reported to the Electric Authority and any warning bricks disturbed during excavation should be replaced while back filling the trench. Before driving a spike into the ground, the presence of other underground properties should be checked. Information on plans regarding the location of power cables need not to be assumed as wholly accurate. Full precautions should be taken in the vicinity until the power cable is uncovered. All electric cables should be regarded as being live and consequently dangerous. Any power is generally dangerous, even low voltage proving fatal in several cases.

139.3 **Electric shock-Action and Treatment.** Free the victim from the contact as quickly as possible. He should be jerked away from the live conductors by dry timber, dry rope or dry clothing. Care should be taken not to touch with bare hands as his body may be energized while in contact. Artificial respiration should begin immediately to restore breathing even if life appears to be extinct. Every moment of delay is serious, so, in the meanwhile, a doctor should be called for.

139.4 **Safety Precautions while Working in Public Street and along Railway Lines.** Where a road or footpath is to be opened up in the course of work, special care should be taken to see that proper protection is provided to prevent any accidents from occurring. Excavation work should be done in such a manner that it will not unduly cause inconvenience to pedestrians or occupants of buildings or obstruct road traffic. Suitable bridges over open trenches should be so planned that these are required for the minimum possible time. Where bridges are constructed to accommodate vehicular traffic and is done near or on railway property, it should be with the full consent and knowledge of the competent railway authorities.

139.4.1 **Danger from Falling Material.** Care should be taken to see that apparatus, tools or other excavating implements or excavated materials are not left in a dangerous or insecure position so as to fall or be knocked into the trench thereby injuring any workman who may be working inside the trench.

139.4.1.1 Care when working in excavations as jumping into a trench is dangerous. If it is deep, workmen should be encouraged to lower themselves. Workers should work at safe distance so as to avoid striking each other accidentally with tools. If the walls of the trench contain glass bits, corroded wire or sharp objects they should be removed carefully. If an obstruction is encountered, it should be carefully uncovered and protected if necessary. If an obstruction is encountered, it should be carefully uncovered and protected if necessary. Care must

be taken to see that excavated material is not left in such a position that it is likely to cause any accident or obstruction to a roadway or waterway. If possible the excavated material should be put between the workmen and the traffic without encroaching too much on the road.

139.4.2 Danger of cave in. When working in deep trenches in loose soil, timbering up/shoring the sides will prevent soil subsidence. The excavated material should be kept at sufficient distance from the edge of the trench or pit. Vehicles or heavy equipment must not be permitted to approach too close to the excavation. When making tunneled opening, it should be ensured that the soil is compact enough to prevent cave in even under adverse conditions of traffic. Extra care should be taken while excavating near the foundations of buildings or retaining walls. In such cases, excavation should be done gradually and as far as possible in the presence of the owners of the property.

139.4.3 Protection of Excavations. Excavations in populated areas, which are not likely to be filled up on the same day should be protected by barriers or other effective means of preventing accidents and the location of all such openings must in any event be indicated by red flags or other suitable warning signs. During the hours from dusk to dawn, adequate number of red warning lamps should be displayed. Supervisory officers should ensure that all excavations are adequately protected in this manner as serious risk and responsibility is involved. Notwithstanding adoption of the above mentioned precautions, works involving excavations should be so arranged as to keep the extent of opened ground and the time to open it to a minimum.

139.4.4 Precautions while working on roads. The period between half an hour after sun-set and half an hour before sunrise, and any period of fog or abnormal darkness may also be considered as night for the purpose of these instructions, for the purpose of providing the warning signs. Excavation liable to cause danger to vehicles or the public must at all times be protected with fencing of rope tied to strong uprights or bamboo poles at a suitable height or by some other effective means. Any such temporary erection which is likely to cause obstructions and which is not readily visible should be marked by posts carrying red flags or boards with a red background by day and by continuously lighted lamps at night.

139.4.4.1 The flags and the lamps should be placed in conspicuous positions so as to indicate the pedestrians and drivers of vehicles the full expanse i.e. both width and length of the obstruction. The distance between lamps or between floors should not generally exceed 1.25 m along the width and 6m along length of the obstruction in non congested areas, but 4 meters along the length in congested areas. If the excavation is extensive, sufficient notice to give adequate warning of the danger should be displayed consciously not less than 1.25

m above the ground and close to the excavation. Where any excavation is not clearly visible for a distance of 25m to traffic approaching from any direction or any part of the carriage way of the road in which the excavation exists, a warning notice should be placed on the kerbed or edge of all such roads from which the excavation or as near the distance as is practicable but not less than 10 m from the junction of an entering or intersecting road in which the excavation exists. All warnings, in these should have a red background and should be clearly visible and legible. All warning lamps should exhibit a red light, but white lights may be used in addition to facilitate working at night. Wherever required a passage for pedestrians with footbridge should be provided. At excavations, cable drums, tools and all materials likely to offer obstructions should be properly folded round and protected. This applies to jointer's tents as well. Leads, hoses etc. stretched and across the carriageway should be guarded adequately for their own protection and also that of the public.

139.5 **Traffic Control.** The police authorities are normally responsible for the control of traffic and may require the setting up of traffic controls to reduce the inconvenience occasioned by establishment of a single line of traffic due to restriction in road width or any other form of obstruction caused by the work. As far as possible, such arrangements should be settled in advance. If there are any specific regulations imposed by the local authorities, these should be followed.

139.6 **Work along Railway Lines.** Normally all works at Railway crossing is to be done under supervision of the railway authorities concerned, but it is to be borne in mind that use of white, red or green flags by the Departmental staff is positively forbidden to be used when working along a railway line as this practice may cause an accident through engine drivers mistaking them for railway signals. When working along a double line of railway, the men should be warned to keep a sharp look on both the "UP" and 'DOWN" lines to avoid the possibility of any accident when trains pass or happen to cross one another near the work spot.

140. **Procedure and Safety Precautions for use of Explosives during Blasting for Trenching.** In areas where the cable trench cannot be done manually on account of boulders and rocks, it is necessary to blast the rocks by using suitable explosives. The quality of explosive to be used depends on the nature of the rocks and the kind of boulders. A few types of explosive fuses and detonators normally used for making trenches for cable works are detailed below :

- 140.1 Gun powder.
- 140.2 Nitrate Mixture.
- 140.3 Gilatine.
- 140.4 Safety fuse.
- 140.5 Electric Detonator.

140.6 Ordinary Detonator.

141. **Procedure.** A detailed survey of the route is to be done to assess the length of the section where trenching is to be done with the help of blasting. A route diagram of the rocky section may be prepared indicating the length of the route where the explosives are to be used. For the purpose of obtaining license, a longer length of route should be given in the application as in many cases, after digging; rocks appear which was not initially anticipated.
- 141.1 Next a license will have to be obtained for use and storing of explosive in that section. If the area falls under a police commissioner, the authority for granting such license is the police commissioner of the concerned area. When the route does not fall in the jurisdiction of a police commissioner, the authority for issuing license is the District Magistrate.
- 141.2 The concerned authority should be applied in prescribed form with a route map. The concerned authority will make an enquiry and issue license for using/storing explosives for cables trenching work. Such license will be valid for 15 days only. The license should be renewed if the blasting operation needs to be extended. Once the license is granted, it is the responsibility of the holders of the license for the proper use of explosives, its transportation and storing.
- 141.3 **Method of Using.** The safest explosive is the Gilatine and electric detonator. Gilatine is in the form of a stick. Electric detonator is a type of fuse used for firing the explosive electrically. Holes are made at suitable intervals on rocky terrain or boulders either by air compressor or by manual chipping. The depth of the holes should be 2 to 3 ft. Fill up the holes with small quantity of sand for about 6". First the electric detonator is to be inserted into the Gilatine and the Gilatine is to be inserted into the holes keeping the +ve and -ve wirings of electric detonators outside the holes. Again refill the holes with sand. These +ve and -ve insulated wires of detonator are then extended and finally connected to an EXPLoder kept at a distance of not less than 100 m. Now the explosive is ready for blasting. But, before connecting wires to exploder for blasting, all necessary precautions for stopping the traffic, use of red flags, exchange of caution signals, etc, should be completed and only then Exploder should be connected and operated.
142. **Operation of Exploder (IDL schaffler type 350 type exploder).** The type 350 blasting machine consists of a bearing block with blasting machine system and the explosion proof light- alloy injection molded housing. The exploder is held with the left hand. The twist handle is applied to the drive pin, clapped with the right hand turned in the clock wise direction in continuous measurements at the highest speed from the initial position until it reached to a stop. At this stage an indication lamp will glow. When the indication lamp glows, "press button switch" should be pressed. This will extend the electric current to detonator and Gilatine will be detonated. The rock will be blasted out of the trench. Number of holes can be blasted in a single stroke by connecting all such detonators in series connection and finally to the exploder. After blasting, again mazdoors are engaged on the work to clear the debris. If the result of the first blasting is not satisfactory, it should be repeated again on the same place.
143. **Warning.** There may be two reasons for unsatisfactory results of the blasting.
- 143.1 Misfire of Gilatine due to leakage of current from detonator.
- 143.2 Over loading because of overburdens.
- 143.3 Never pull the broken wire pieces from the holes in such cases. Attempt

should not be made to re blast the misfired Gilatine. The safest way is to make a fresh hole by its side and put fresh Gilatine in that hole and blast it.

144. **Precautions.** The abstract of Explosives Rules 1983 which are relevant to our work is given below:-

144.1 Restriction of delivery and dispatch of explosives.

144.2 No person shall deliver or dispatch any explosives to anyone other than a person who is the holder of a license to possess the explosives or the agent of a holder of such a license duly authorized by him in writing on his behalf.

or

144.3 Is entitled under these rules to possess the explosives without a license.

144.4 The explosives so delivered or dispatched shall in no case exceed the quantity, which the person to whom they are delivered or dispatched is authorized to possess with or without a license under these rules.

144.5 No person shall receive explosives from any person other than the holder of a license granted under these rules. No person shall receive from or transfer explosives to any person for a temporary storage or safe custody in a licensed premise unless prior approval is obtained from the Chief Controller.

144.6 A person holding license for possession of explosives granted under these rules shall store the explosives only in premises specified in the license.

144.7 **Protection from Lightning during Storing.** Every magazine shall be attached to one or more efficient lightening conductors designed and erected in accordance with the specification laid down in Indian Standard Specifications No. 2309 as amended from time to time. The connections to various parts of earth resistance of the lightening conductor terminal on the building to the earth shall be tested at least once in every year by a qualified electrical engineer or any other competent person holding a certificate of competency in this behalf from the State Electricity Department. A certificate showing the results of such tests and the date of the last test shall be hung up in conspicuous place in the building.

144.8 **Precautions during Thunder-Storm.** When a thunder-storm appears to be imminent in the vicinity of a magazine or store house every person engaged in or around such magazine and store house shall be withdrawn to a safe distance from such magazine or store house and the magazine and store house shall be kept closed and locked until the thunder storm has ceased or the threat of it has passed.

144.9 **Maintenance of Records.** Every person holding a license granted under these rules for possession, sale or use of explosives shall maintain records in the prescribed form and shall produce such record on demand to an Inspection Officer.

144.10 **Explosives not to be kept in Damaged Boxes.** The licensee of every magazine or store house shall ensure that, the explosives are always kept in their original outer package. In case, the outer package gets damaged so that the explosive contained therein cannot be stored or transported, such explosives shall be repacked only after the same are examined by controller of explosives.

144.11 **Storage of Explosives in excess of the Licensed Quantity.** The quantity of any kind of explosives kept in any licensed magazine or store house shall not exceed the quantity entered in the license against such kind of explosives.

No explosives in excess of the licensed quantity shall be stored in the magazine or store house unless a permit in this behalf is obtained from the licensing authority by a letter or telegram.

- 144.12 **Precautions to be Observed at Site.** The electric power at the blasting site shall be discontinued as far as practicable before charging the explosives. No work other than that associated with the charging operations shall be carried out within 10 meters of the holes unless otherwise specified to the contrary by the licensing authority. When charging is completed, any surplus explosive detonators and fuses shall be removed from the vicinity of the hole and stored at a distance which should prevent accidental detonation in the event of a charge detonating prematurely in any hole. The holes which have been charged with explosive shall not be left unattended till the blasting is completed. Care shall be taken to ensure that fuse or wires connected to the detonation are not damaged during the placing of stemming materials and tamping.
- 144.13 **Suitable Warning Procedure to be Maintained.** The licensee or a person appointed by the licensee to be in charge of the use of explosives at the site shall lay down a clear warning procedure consisting of warning signs and suitable signals and all persons employed in the area shall be made fully conversant with such signs and signals.
- 144.14 **Precautions to be Observed while Firing.** The end of the safety fuse (if used in place of a detonator should be freshly cut before being lighted. The exploders shall be regularly tested and maintained in a fit condition for use in firing. An exploder shall not be used for firing a circuit above its rated capacity. The electric circuits shall be tested for continuity before firing. All persons other than the shot-firer and his assistant, if any, shall be withdrawn from the site before testing the continuity.
- 144.15 For the purpose of jointing, the ends of all wires and cables should have the insulation removed for a maximum length of 5 cms and should, then be made clear and bright for a minimum length of 2.5 cms and the ends to be joined should be twisted together so as to have a positive metal contact. Then these should be taped with insulation to avoid leakage when in contact with earth.
- 144.16 In case of blasting with dynamite or any other high explosive, the position of all the bore holes to be drilled shall be marked in circles with white paint. These shall be inspected by the Contractor's agent. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the agent shall inspect the holes to ensure that drilling has been done only at the marked locations and no extra hole has been drilled. The agent shall then prepare the necessary charge separately for each bore hole. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Only cylindrical wooden tamping rods shall be used for tamping. Metal rods or rods having pointed end shall never be used for tamping. One cartridge shall be placed in the bore hole and gently pressed but not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuses of required length. All fuses shall be cut to the length required before being inserted into the holes. Joints in fuses shall be avoided. Where joints are unavoidable, a semi-circular niche shall be cut in one piece inserted into the niche. The two pieces shall then be wrapped together with string. All joints exposed to dampness shall be wrapped with rubber tape. The maximum of eight bore holes shall be

loaded and fired at one occasion. The charges shall be fired successively and not simultaneously. Immediately before firing, warning shall be given and the agent shall see that all persons have retired to a place of safety. The fuses of the charged holes shall be ignited in the presence of the agent, who shall see that all the fuses are properly ignited. Careful count shall be kept by the agent and other of each blast as it explodes. In case all the charged bore holes have exploded, the agent shall inspect the site soon after the blast but in case of misfire the agent shall inspect the site after half an hour and mark red crosses (X) over the holes which have not exploded. During this interval of half an hour, nobody shall approach the misfired holes. No driller shall work near such bore until either of the following operations has been done by the agent for the misfired boreholes.

- 144.17 The contractor's agent shall very carefully (when the tamping is a damp clay) extract the tamping with a wooden scraper and withdraw the primer and detonator.
- 144.18 The holes shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired holes shall also explode along with the new one.
- 144.19 Before leaving the site of work, the agent of one shift shall inform the another agent relieving him for the next shift, of any case of misfire and each such location shall be jointly inspected and the action to be taken in the matter shall be explained to the relieving agent. The Engineer-in-charge PICG and BSNL shall also be informed by the agent of all cases of misfire, their cause and steps taken in that connection.
- 144.20 **General Precautions.** For the safety of persons red flags shall be prominently displayed around the area where blasting operations are to be carried out. All the workers at site, except those who actually ignite the fuse, shall withdraw to a safe distance of at least 200 meters from the blasting site. Audio warning by blowing whistle shall be given before igniting the fuse. Blasting work shall be done under careful supervision and trained personnel shall be employed. Blasting shall not be done within 200 meters of an existing structure, unless specifically permitted by the Engineer-in-Charge in writing.
- 144.21 **Precautions against Misfire.** The safety fuse shall be cut in an oblique direction with a knife. All saw dust shall be cleared from inside of the detonator. This can be done by blowing down the detonator and tapping the open end. No tools shall be inserted into the detonator for this purpose. If there is water present or if the borehole is damp, the junction of the fuse and detonator shall be made water tight by means of tough grease or any other suitable material. The detonator shall be inserted into the cartridge so that about one-third of the copper tube is left exposed outside the explosive. The safety fuse just above the detonator shall be securely tied in position in the cartridge. Water proof fuse only shall be used in the damp borehole or when water is present in the borehole
- 144.22 If a misfire has been found to be due to defective fuse, detonator or dynamite, the entire consignment from which the fuse, detonator or dynamite was taken shall be got inspected by the Engineer-in-Charge or his authorized representative before resuming the blasting or returning the consignment.

- 144.23 **Precaution against Stray Currents.** Where electrically operated equipments is used in locations having conductive ground or continuous metal objects, tests shall be made for stray current to ensure that electrical firing can proceed safely.

BSNL

SECTION IV

PART C: PROJECT MANAGEMENT AND TRAINING REQUIREMENTS

145. **Scope of Work.** The plan is to set up intelligent fiber optic cable network with the state-of-the-art technology to connect 219 Army stations, 33 Navy stations and 162 Air Force stations across the country. The scope of this tender is supply, survey, trenching, laying installation, testing & commissioning of Fiber Optic Cable and related accessories to be deployed across the country. The critical success factors of the fiber optic cable network to be deployed are :
- 145.1 Timeline of the project to include designing and planning.
 - 145.2 Timeline for getting ROW.
 - 145.3 Timeline for implementation & execution.
 - 145.4 Quality of implementation of the fiber network.
146. **Project Management Aspects**
147. **Objective.** To define process, logistics and flow chart with clear demarcation of activities and steps involved to design, plan & implement the plan for creating the fiber optic cable network. The process will optimize the time line required in serial and parallel activities to streamline each & every activity, so involved.
- 147.1 **Areas Covered**
 - 147.1.1 Collect details from the purchaser for the project requirements.
 - 147.1.2 Draw the optical network requirement and design the network to meet the requirement and issue plan proposal.
 - 147.1.3 Plan for detailed survey with options for PICG and BSNL to evaluate and approve.
 - 147.1.4 Issue OFC roll out plans & get these plans executed.
 - 147.1.5 Network services.
 - 147.1.6 Resource commitment.
148. **Project Management Organization**
- 148.1 The prospective bidders should have an efficient organization structure to handle the project on PAN India basis. **The prospective bidders must submit the organization structure to handle & execute the project and a detailed implementation plan for execution of the project along with the bid.**
 - 148.2 Minimum expected requirements from the prospective bidder are as follows:
 - 148.2.1 Well established organization structure.
 - 148.2.2 PAN India Presence.
 - 148.2.3 Adherence to timelines.
 - 148.2.4 Quality of work and services.
149. **Scope.** The broad scope under this contract shall include:
- 149.1 Route survey, planning, design, engineering, manufacturing, supply, transportation, insurance, delivery at site, unloading, handling, storage, installation, splicing, termination, testing, training, and demonstration for

acceptance, commissioning and documentation for the following items complying to the functional and performance requirements stipulated in the specification.

- 149.2 Fiber optic cable including all associated hardware, accessories & fittings.
- 149.3 All other associated work/items for successful installation of OFC Network.

150. Responsibilities & Obligations

150.1 **Bidder's Responsibilities and Obligations.** The Bidder's obligations include:

- 150.1.1 The Bidder shall be responsible for implementation of Fiber Optic Cable System complying to the functional and performance requirements of this specification and submit a detailed project management plan containing design data, work method, schedules, project organization chart, safety, quality and manufacturing plan to BSNL and PICG for review and approval in the engineering/design phase of the project.
- 150.1.2 Site visits, path surveys, and studies necessary to identify and develop the installation guidelines and procedures for the excavation, installation, and splicing of all Fiber Optic Cable, including testing and documentation.
- 150.1.3 The Bidder shall submit the project organization chart appointing key personnel for the project such as Project Manager, Site Manager, Design Engineer, Installation and Testing Engineer.
- 150.1.4 Obtaining statutory clearances from regulatory bodies, statutory bodies such as municipality, highway authority, electrical utilities, forest department, gas authorities etc. on behalf of BSNL and PICG.
- 150.1.5 Review of available data at each location to check conformance with local environmental and earthing requirements.
- 150.1.6 Project management, project scheduling, including monthly project reports documenting progress during the contract period.
- 150.1.7 Co-ordination with Optical Systems Package Bidder for phased implementation and commissioning of the overall OFC network.
- 150.1.8 Engineering and technical assistance during the contract and warranty period.
- 150.1.9 Design, manufacturing, supply, inspection, delivery at site including trenching and installation, of the Fiber Optic Cable and HDPE pipe including all accessories, and hardwires required for installation of all overhead fiber cable wherever underground cabling is not feasible. Specifications as per BSNL standards applicable in North and North East regions. Exact locations to be suggested on the basis of survey to be carried by the bidder. Assessment of suitability for installation of OFC on the present infrastructure, towers etc and requirement of erecting new towers where required.
- 150.1.10 Facilitate site acceptance testing of all equipment provided.
- 150.1.11 Staging, maintenance and security of staging area including full responsibility for protection from theft and fire.

150.1.12 All documentation and drawings as specified.

150.1.13 Training of the PICG personnel.

150.1.14 Due diligence in properly planning and executing the work so as to minimize any damage to crop, forestry or vegetation, internal utilities of any private or government party.

150.2 **Purchaser responsibilities and obligations.** The BSNL and PICG will jointly provide the following items and services as part of the procurement project:

150.2.1 Review and approval of the Bidder's implementation plan, drawings, survey report and recommendations.

150.2.2 Review and approval of test procedures.

150.2.3 Participation in and approval of Site Acceptance tests.

150.2.4 Review & approval of training plans.

150.2.5 Providing support and access to facilities at the sites.

150.2.6 Provide to the extent possible drawings for existing sites and facilities for which equipment installation are planned.

150.2.7 Providing input / support required from the other package Bidder during testing & commissioning.

151. **Organization.** The Bidder shall identify the project team, clearly identifying the key personnel for the following activities.

Ser No	Key Roles	Minimum Qualification	Minimum Experience related to Fiber Optic Infrastructure Project(Yrs)
1.	Project Manager	B.E (With IPMA/PMP Certification)	10
2.	Planning Manager	B.E	5
3.	Splicing, Testing & Commissioning Engineer	B.E / Diploma	3
4.	Site Supervisor	B.E / Diploma	3 to 5
5.	Procurement Engineer	B.E / Diploma	10
6.	Surveyor	B.E / Diploma	5

151.1 Minimum infrastructure, executives, managerial and supervisory staff to be deployed at different levels shall be as follows (considering completion period as 18 months).

Ser No	Key activities	Type	Infrastructure / Supervisory / management manpower to be deployed for at least 75% duration of the project in stretches of length		
		(Max / Min)	Up to 10000 Kms	10000 to 20000 Kms	20000 to 40000 Kms
1	No of project office each of size 250 Sqm	Min	10	20	30
2	No of stores each of size 1000 Sqm	Min	4	8	16
3	No of qualified engineers (Degree Holder) including Key persons	Min	50	75	125
4	No of Testing Team	Min	12	24	48
5	Set of Testing & Measuring Instruments (comprising of OTDR, FSM, Optical Power Meter, laser Source, talk set and variable attenuator etc)	Min	30	60	120
6	Cable Locator	Min	15	30	60
7	Fiber optic blowing machine	Min	10	20	30
8	Rock splitter / Driller	Min	10	16	20
9	Hydraulic excavator	Min	10	20	40

151.1.1 The project team shall be headed by a senior level executive who shall be responsible to BSNL and PICG for the execution of the project. Separately designated functions shall be identified for each of the areas mentioned above. These functions shall have sufficient personnel to coordinate technical matters and to quickly resolve any day to day issues of the Bidder and also to resolve quickly any queries or references made by BSNL and PICG.

151.1.2 Bidder shall submit detailed Bio-data of their key personnel, proposed sub-Bidder's credential and the details of equipment to be mobilized along with the bid, for evaluation. **Bids which do not accompany these details shall be treated as Non-responsive and will be summarily rejected.**

151.2 General Requirements of Programmes and Schedules

151.2.1 Bidder shall include in his Bid proposal a Level-1 (L-1) network showing the major activities and various major milestones to achieve the Commercial Operation Date. In case of award, the

Bidder shall use **Primavera (latest edition) Software or equivalent** to develop and monitor the Detailed Project Master Network. The schedule shall fully inter-relate design and manufacture. Events shall indicate points in the programs at which a significant stage has been reached and which is of sufficient status for reporting to management. All programs containing scheduled dates including those for design, manufacturing shall be adhered to by the Bidder and shall not be changed except as may be agreed by BSNL and PICG. The Bidder shall designate a Planning Representative who shall be readily available at all reasonable times to the Engineer and who shall be of sufficient status to have free access to the Bidder's management staff and to the Bidder's and Sub-Bidders workshops, site works etc. and shall be able to represent the Bidder on all matters of planning and progress. BSNL/PICG reps shall have unrestricted access.

151.2.2 The Bidder shall not change the Master Network without prior intimation to BSNL and PICG in accordance with the Conditions of Contract. In the event that BSNL and PICG has comments to a revision to the Master Network in accordance with the Conditions of Contract, the Bidder shall submit a revised Master Network within two weeks thereafter. Such a revised programme shall become the Overall Contract Programme for the outstanding Works.

151.3 **Delivery Schedule.** The Bidder shall submit to BSNL and PICG his detailed delivery schedules to include location wise date and quantity for all material within thirty (30) days from the date of start of contract. Such schedules shall be in line with the detailed network rollout plan for all phases of work. Such schedules shall be reviewed, updated and submitted to BSNL and PICG, once every month thereafter, by the Bidder. Schedules shall also include the materials and equipment purchased from outside Bidders.

151.4 **Monitoring, Progress Reporting & Management Information System.** The progress reports shall be issued every month by the Bidder. Reports shall include such schedules, charts and drawings as BSNL and PICG considers necessary for adequately monitoring the Contract. The reports shall be made available to BSNL and PICG at least five working days prior to scheduled progress review meeting. The progress report should necessarily include the following sections :

151.4.1 Report on key milestones.

151.4.2 Management summary indicating critical areas with details of actions Initiated and its effect, if any, on the project.

151.4.3 Action needing attention of BSNL and PICG.

151.4.4 Detailed route wise status of survey, documentation, quality plan submissions and approval, procurement, manufacture and dispatch.

151.4.5 Critical Path Analysis along with corrective actions

151.5 **Project Co-ordination Meeting.** The Bidder and his sub-vendors will be called upon to attend project coordination meetings with BSNL and PICG, other Bidders, Consultants or agencies authorised by BSNL and PICG during the period of execution of Contract. The Bidder including his sub-vendors shall attend such meetings at their own cost at BSNL and PICG office or at any mutually agreed venue as and when required and fully cooperate with

such persons and agencies involved during those discussions.

- 151.6 **Co-operation with other Bidders and Consulting Engineers.** The Bidder shall cooperate with BSNL, PICG, other Bidders and Consulting Engineers and freely exchange with them such technical information as are necessary to obtain the most efficient way and to avoid unnecessary duplication of efforts. Purchaser (BSNL and PICG)'s Consulting Engineer shall be provided with copies of all correspondences addressed by the Bidder to other Bidders and Engineers in respect of such exchange of technical information.
- 151.7 **Post-Contract Stage Document Submission and Review Procedure.** The Bidder shall furnish a comprehensive and detailed schedule of activities which shall be submitted by him after award of contract indicating submission dates against each document. The list shall be subject to the approval of BSNL and PICG. The documents shall be divided into two categories:
- 151.7.1.1 For Review.
 - 151.7.1.2 For information/reference only.
- 151.7.2 This schedule of submission for drawing and document shall require approval by BSNL and PICG before award of Contract. In preparing this schedule, the Bidder shall allow two (2) weeks from the date of receipt for review and comments by BSNL and PICG for each submission of a document.
- 151.7.3 All contract documents shall be marked, without fail, with the name of BSNL and PICG, the Project, the specification title and number and the unit designation.
- 151.7.4 All dimensions shall be in metric units.
- 151.7.5 All notes, markings etc. shall be in English.
- 151.7.6 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.
- 151.7.7 Documents submitted during bid stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of BSNL and PICG.
- 151.7.8 Documents stamped with comments must be resubmitted for review by BSNL and PICG. Bidder may go ahead with manufacturing taking care of the comments from BSNL and PICG.
- 151.7.9 Except when a document is stamped without any comments, the Bidder can proceed with manufacturing and other sequential activities for those areas of a document which do not have any review comment by BSNL and PICG.
- 151.7.10 The Bidder is fully responsible for any delay in preparing and obtaining comments from BSNL and PICG and no extension of time shall be allowed on such grounds. The Bidder's work shall be in strict accordance with the finalised drawings and no deviation shall be permitted without written approval of BSNL and PICG.
- 151.7.11 Bidder shall be responsible to update the Drawings and Documents in case there is any change during detail engineering.
- 151.8 **"As-built" Documentation.** The Bidder shall provide and keep up to date "As built" drawings of all OFC routes installed and all equipment and accessories and miscellaneous works erected or installed. These drawings

shall show all changes and revisions from the original drawings and specifications, including the exact "As-built" locations, sizes and kinds of equipment and accessories, miscellaneous works. These drawings shall be kept in Bidder's field office and shall be made available at all times for review of BSNL and PICG reps. At the end of every work, all entries, changes or revisions made in the drawings by the Bidder shall be checked and approved by the Engineer. The Bidder shall submit all "As-Built" drawings progressively to BSNL and PICG before Acceptance tests commence.

152. **Construction Management**

- 152.1 **General.** The L-1 Master Network Implementation Programme, shall be submitted as part of the technical bid for evaluation. Based on this, the Bidder shall submit a Detailed Master Network (L-2) programme, in Primavera (latest edition) or equivalent software, for the implementation to include construction/erection/commissioning within one month of the award of the Contract.
- 152.2 These programs would be amplified (as L-3) showing when the survey report shall be released by the Bidder and construction of civil works shall be completed by him to facilitate laying of cables and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programs. The Bidder shall also be involved along with BSNL and PICG to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.
- 152.3 The L-3 programme would be jointly finalised by the site incharge of the Bidder with BSNL and PICG project coordinator as well as the site planning representative.

153. **Project Scheduling**

- 153.1 Prospective bidders should give the detailed mapping with the timeline of the activities listed below or additional activities (if any) necessary for the completion of the project within approved timeline.
- 153.2 The project scheduling should be done keeping in view the serial and parallel activities.
- 153.3 BSNL and PICG may ask any clarifications regarding the detailed project execution any time during the evaluation.
- 153.4 The successful bidder will have to submit the progress report as per the project scheduling during the execution of the project at the regular intervals.

Ser No	Description
1.	Conduct of Route Survey
2.	Submission and Approval of Survey Report
3.	Obtaining ROW Clearance
4.	Manufacturing & Supply of Materials
5.	Inspection and Delivery at site
6.	Mobilization of Work force and Equipments

7.	Trenching
8.	Duct Laying
9.	Fiber Optic Cable Blowing
10.	Splicing of Fiber Optic Cable
11.	As Build Drawing preparation, Submission and Handover
12.	Acceptance Testing of Links

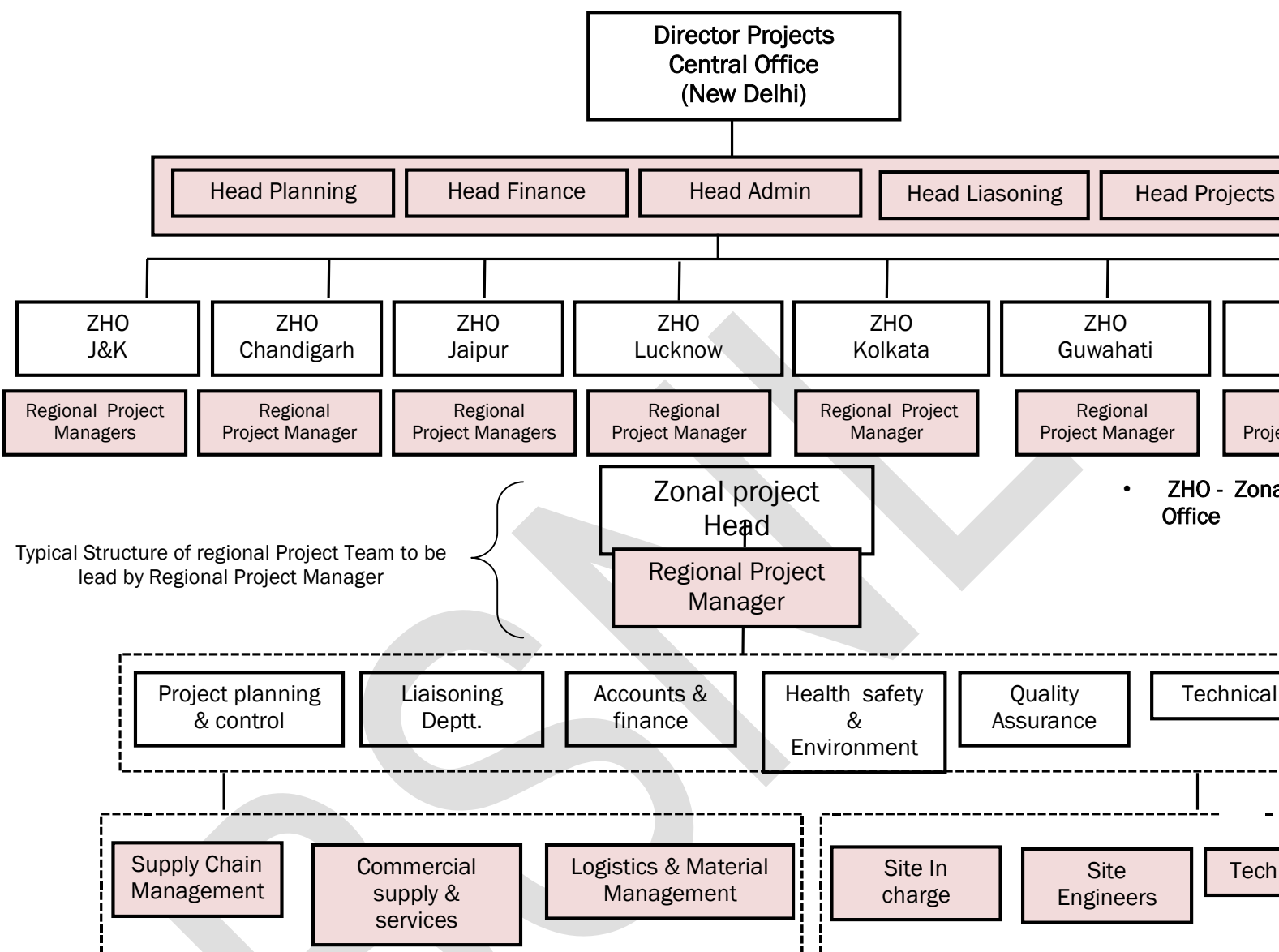
154. **AMC (for passive optical infrastructure on end to end basis)**

- 154.1 Prospective bidders should provide detailed plan on AMC.
- 154.2 The scope of work identified in AMC is maintenance of passive optical infrastructure on end to end basis. Details are as given at Section IV D.
- 154.3 The network will be built by the successful bidder and will be maintained by him for three years during warranty and subsequently for at least seven years under AMC.

155. **Resource Commitment**

- 155.1 In order to execute the project on PAN India basis, efficient and sufficient resources management is required.
- 155.2 Bidders are thus expected to submit their plan on the resources to be deployed to execute the project.
- 155.3 Resources are human resources, machinery, tools equipments, information systems resources, labor, or other such resources that shall be used to execute the project.
- 155.4 Execution of the project needs planned process and every process should have process owner. The process owner who is responsible for the process performance needs to be provided as part of the overall structure.
- 155.5 Controls & Constraints: Every process has a set of policies, guidelines, regulations, rules, shared values and frameworks by which it has to abide. Such things are called controls/constraints since it has to work within the frameworks and cannot exceed/violate them as given below:-
 - 155.5.1 Time lines of the network rollout, implementation and commissioning.
 - 155.5.2 Quality of the work to be implemented.
- 155.6 Commitment in order to overcome the constraints, the prospective bidders should have sufficient resources in terms of manpower, machinery etc.
- 155.7 Structure: No project is successful, unless it is supported by a well established organization structure. The bidders are expected to submit along with the proposals a detailed organization structure, to execute the project on PAN India basis. A typical organization structure can be as follows:-

Typical Organisation Structure



155.8 The above flowchart/ diagram is for reference only. The bidders can use their own terminology to prepare and present their organization structure along with the bid.

156. Support Services

- 156.1 This section describes the requirements for Bidder-supplied support services, and maintenance of the fiber optic cabling system. The intent of the support program is to ensure a smooth transfer of systems and technologies from the Bidder to Purchaser to ensure that Purchasers staffs are fully trained to operate and maintain the fiber optic network.
- 156.2 Throughout design, implementation, factory testing, and field installation and testing, the Bidder shall supply consulting assistance, as required by the Purchaser for site preparation, field installation, and other areas where technical support may be required.
- 156.3 **Technical Support.** Consultation with Bidder's technical support personnel and trained field service personnel shall be readily available on a short-term/long-term basis to assist the Purchasers personnel in maintaining, expanding, and enhancing the Optical Fiber Cabling network upon expiration of the warranty period. The Bidder shall include in their offer(s), a proposal for ensuring continued technical support as stated above.

157. **Spare Parts**

- 157.1 All mandatory Spare Parts will be provided by the Bidder. Also, the bidder shall propose a comprehensive spare parts strategy, suitable to support the specified level of system availability. The intent of the spare parts strategy is to ensure a readiness against unforeseen cabling system breakdowns, and to carry out replacement maintenance of susceptible or failed components. Consistent with the proposed spare parts strategy, the bidder shall provide a list of "Recommended Spare Parts", which may be required over and above Mandatory Spare parts to support the Fiber Optic Cabling system during the warranty and AMC period. The list of mandatory spares to be provided as part of the project is given at Appendix 'H'.
- 157.2 The Recommended spare parts list shall not be considered for evaluation and shall be included in the final scope of supply. The Bid shall include the following minimum information for the recommended spare parts:
 - 157.2.1 Original manufacturer and part number.
 - 157.2.2 Name and Description.
 - 157.2.3 Number of units in each set.
 - 157.2.4 Total number of sets to be provided.
 - 157.2.5 The unit as well as set prices shall be provided in the appropriate Bid Price Schedule.

- 158. **System Maintenance.** The three year period commencing as per details mentined in Section IV A is called the Guaranteed Availability Period (GAP)/ Warranty. During the guaranteed availability period, the Bidder shall guarantee that there shall be no outage of the supplied system. During this period, the Bidder shall replace or repair all defective parts and shall have prime responsibility for maintaining an operational system. Within two (2) months from Contract Award Date, the Bidder shall submit a comprehensive maintenance strategy for the maintenance of the system during the Guaranteed Availability Period/Warranty. For the GAP period, the actual outage frequency and the availability achieved during the period shall be calculated periodically, jointly by the Bidder and the Purchasers representatives. The Bidder shall take continual actions to ensure that the guaranteed outage figure is not exceeded.

- 159. **Continuing Maintenance Concept.** After the Guaranteed Availability Period, all

normal maintenance will be undertaken by the respective organization operating the system. The Bidder shall ensure that the provided spare parts and tools & tackles are sufficient for Purchasers testing & maintenance activities.

160. **Miscellaneous Supplies.** The Bidder shall provide all required consumable and non-consumable supplies necessary to support all installation and test activities through final operational acceptance.
161. **Project Management, Schedule and Implementation Plan.** This section describes the project management, schedule, quality assurance, and implementation plan requirements for the Project.
162. **Project Management.** The Bidder shall assign a Project Manager with the authority to make commitments and decisions that are binding on the Bidder. The Project Manager's responsibility shall include interface and coordination with the Project Bidder(s). The BSNL and PICG will designate a Project Manager to coordinate all the Purchasers project activities. All Project correspondence and communications between the Purchaser and the Bidder shall be coordinated through the Project Managers.
 - 162.1 The project shall be staffed from the list of project management and engineering personnel presented in the proposal. The assignment and reassignment of the Bidder's principal participants in the project shall be subject to the Purchaser's approval.
163. **Reporting Period.** The Project Manager shall provide updated project schedules and complete progress reports on fortnightly basis for the duration of the project. All references to the reporting period throughout this Specification shall refer to this period.
164. **Progress Meetings.** The Project Managers shall schedule and attend Progress Meetings as deemed necessary but no less than once in every month.
165. **Transmittals.** Every document, letter, progress report, change order, and any other written or electronic media transmissions exchanged between Bidders and the Purchaser shall be assigned a unique transmittal number. Discussions, phone calls and e-mails where project related information is exchanged shall be documented in a transmittal. The Bidder shall maintain a correspondence index and assign transmittal numbers consecutively for all Bidder documents. The Purchaser will maintain a similar correspondence numbering scheme identifying documents and correspondence that the Purchaser initiates.
166. **Use of Consultants.** The Purchaser shall have the option of adding consultants to the transmittal distribution list and document distribution list to receive all correspondence and all or selected system documents. The consultants will be bound by the same confidentiality restrictions imposed on the Purchasers personnel.
167. **Quality Assurance**
 - 167.1 **General.** The Bidder shall adhere to a Quality Assurance (QA) program for the preparation of all Contract deliverables, including documentation, hardware, firmware and software. The program shall provide for early detection of actual or potential deficiencies, timely and effective corrective action, and a method of traceability of all such deficiencies.
 - 167.2 The Bidder's proposal shall include the relevant ISO 9001:2008 certificates from the main Bidder and from all sub Bidders which have a major part (over 10%) of the delivery.
168. **Quality Assurance System and Requirements**

- 168.1 The ISO 9001 Certificate and the assessment and visit reports shall be available to Purchaser throughout the duration of the contract.
- 168.1.1 The Quality Assurance program shall be outlined by the Bidder and shall be finally accepted by the Purchaser after discussions before the award of contract. A Quality Assurance program of the Bidder shall generally cover but not limited to the following:-
 - 168.1.2 Organization structure for the management and implementation of the proposed quality assurance program.
 - 168.1.3 Documentation control system.
 - 168.1.4 Qualification data for Bidder's key personnel.
 - 168.1.5 The procedure for purchases of materials, parts/components and selection of sub-Bidders' services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
 - 168.1.6 System for shop manufacturing including process controls and fabrication and assembly controls.
 - 168.1.7 Control of non-conforming items and system for corrective action.
 - 168.1.8 Control of calibration and testing of measuring and testing equipments.
 - 168.1.9 Inspection and test procedure for manufacture.
 - 168.1.10 System for indication and appraisal of inspection status.
 - 168.1.11 System for quality audits.
 - 168.1.12 System for authorizing release of manufactured product to Purchaser.
 - 168.1.13 System for maintenance for records.
 - 168.1.14 System for handling storage and delivery.
 - 168.1.15 A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics of the product.
- 168.2 The Quality Assurance Plan shall be mutually discussed and approved by representatives of PICG after incorporating necessary corrections by the Bidder as may be required.
- 168.3 This Quality Assurance Plan shall then form part of the contractual documentation and shall not be changed without prior agreement with the Purchaser. The Bidder shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Assurance Plan at the time of purchaser's inspection of equipment/material.
- 168.4 The Purchaser or his duly authorised representatives reserve the right to carry out Quality Audit and Quality Surveillance of the systems and procedures of the Bidder/his vendor's Quality Management and Control Activities.

169. Variance Reporting and Processing

- 169.1 An automated variance recording and tracking system shall be placed in service at least one month before the initially scheduled beginning of the FAT. This system shall be designed to record and track variances for

documentation deficiencies, functional deficiencies, performance deficiencies, procedural deficiencies (as when deviations from contractually required QA procedures are observed), and test deficiencies (when the System cannot satisfactorily pass a step within a test procedure).

169.2 Variances may be initiated by both Bidder and BSNL/ PICG personnel and shall be classified as follows:

169.2.1 Open (recorded but not necessarily agreed to).

169.2.2 Assigned (denoting acceptance by the Bidder).

169.2.3 Pending (denoting fixed, in the Bidder's opinion, and awaiting retest or verification).

169.2.4 Resolved (denoting Purchaser acceptance or verification).

169.3 For the tracking of the variances and to support the automatic printout of subset lists, the following information fields shall be stored for each variance:

169.3.1 Variance number (automatically assigned).

169.3.2 Date initially recorded.

169.3.3 Status (open/assigned/pending/resolved).

169.3.4 Date current status recorded.

169.3.5 Names of involved BSNL/ PICG representatives.

169.3.6 Names of assigned Bidder personnel.

169.3.7 Subsystem involved.

169.3.8 Test name (where applicable).

169.3.9 Description (up to five lines in a full printout and part of the first line in a one-line-per-variance printout).

169.3.10 Urgency description (1, 2, or 3).

169.4 The variance recording and tracking system shall allow full printouts of all of the above information, condensed printouts of abbreviations of the above information (one-line-per-variance) and shall produce subsets of the variances based on searches of the fields singly or in combinations. For example, it shall be possible to produce a printout of all the variances (and only those variances) that were at level 1 or 2 urgency, concerning a specific named subsystem, had open or assigned status, and were initiated within a named period.

169.5 Depending on its impact, each variance shall be assigned to one of three urgency levels the Bidder with BSNL/ PICG Purchaser having level assignment approval rights.

169.5.1 **Level 1.** Testing will stop for immediate evaluation and correction by the Bidder.

169.5.2 **Level 2.** Testing will continue and the variance will be corrected at the end of the current session or day.

169.5.3 **Level 3.** Testing will continue and the variance will be corrected and tested at a mutually agreed upon time (e.g., at the end of the test or later in the test period prior to shipment).

169.6 A variance status summary shall be included in the monthly project progress reports, and up-to-date variance reports shall be made available to Purchaser

on demand.

- 169.7 The variance recording and tracking system shall be subject to approval by Purchaser.

170. Additional Quality Assurance Requirements

- 170.1 Purchaser shall have access to the Bidder's premises at any mutually agreed time and be provided access to inspect and assess the quality system should any specific need arise. Purchaser shall also be able to conduct on site reviews as mutually agreed.
- 170.2 Purchaser shall have access to any relevant documentation for verification that quality procedures are in accordance with the contract-specific quality plan.

171. Document Review and Approval Rights

- 171.1 To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Bidder shall submit documentation describing the systems to the Purchaser for review and approval.
- 171.2 All standard documentation shall be submitted to the Purchaser within duration. The Purchaser will respond with written comments to the Bidder within fifteen (15) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the Bidder to the Purchaser within 7 calendar days. The Purchaser will respond to resubmitted documents within fifteen (15) calendar days after receipt of the document. No implementation schedule relief is to be implied for documents requiring correction and resubmission to the Purchaser.
- 171.3 The Purchaser shall have the right to require the Bidder to make any necessary documentation changes at no additional cost to the Purchaser to achieve conformance with the Specification.
- 171.4 Any purchasing, manufacturing, or programming implementation initiated prior to written approval of the relevant documents or drawings by the Purchaser shall be performed at the Bidder risk. Review and approval by the Purchaser shall not relieve the Bidder of its overall responsibilities to satisfy system functions and performance requirements in accordance with the Specification.
- 171.5 To help the Purchaser manage the review and approval of documents during any given period, the Bidder shall stagger the release of documents over the time allocated in the project schedule. The number and size of documents shall be factored into the document release schedule.

- 172. Project Schedule.** The project schedule shall consist of an implementation schedule and a documentation schedule.

172.1 ImplementationSchedule

- 172.1.1 The Bidder shall produce and maintain the implementation schedule using Primavera/ Microsoft Project®/Maximo/any other equivalent Project Management solution with web based capability. A copy of the implementation schedule files on a / DVD or CD-ROM shall also be provided to the Purchaser. The overall project plan shall consist of a Milestone Plan and a detailed Schedule Plan.

- 172.1.2 The Bidder shall provide a critical path analysis report and a

manpower resource analysis report using the project management software. Other standard reports will be defined during the Work statement.

- 172.1.3 The project schedule shall include all tasks to track overall direction and integration of the project from inception through completion. The Schedule Plan shall be developed utilizing the concept of Work Breakdown Structures. No task shall be greater than 3 weeks in duration.
- 172.1.4 The implementation schedule shall include the project milestones, the Bidder activities, and the Purchasers activities. The project schedule shall be an accurate representation of the progress and planned activities of the project.
- 172.1.5 The actual progress made to date and the scheduled delivery date for the completed systems shall be closely monitored by both the Bidder and the Purchaser project managers. The following information shall be reported to the Purchaser in a clear and concise manner using the tabular and graphic capabilities of the project management software:
- 172.1.6 An overview and general assessment of all the Purchaser and Bidder activities and any progress or delays in these activities since the last reporting period.
- 172.1.7 Identification of tasks in the critical path together with an analysis indicating any required remedial action.
- 172.1.8 The amount of contingency time (float) remaining in the schedule.
- 172.1.9 Information on each task, including:
 - 172.1.9.1 Estimated start and finish dates.
 - 172.1.9.2 Any change in the estimated dates since the last reporting period.
 - 172.1.9.3 Estimated total number of calendar-days to complete the task.
 - 172.1.9.4 Percent of task completed.
 - 172.1.9.5 An indication of whether the start date was manually entered or computed.
- 172.1.10 Total project resources.
- 172.1.11 The tasks to begin in the next two reporting periods.
- 172.1.12 The tasks to be completed in the next two reporting periods.
- 172.1.13 The tasks completed in the last two reporting periods.
- 172.1.14 The content and format of the project schedule shall be subject to the Purchasers approval. The Bidder shall update and submit the project schedule to the Purchaser at least one week prior to each progress meeting.
- 172.1.15 **Bidder Activities**
 - 172.1.15.1 The implementation schedule shall be compiled by the Bidder summarizing all activities, and shall include but not be limited to the following:

- 172.1.15.1.1 Survey, Design & Engineering.
- 172.1.15.1.2 Hardware purchases and development.
- 172.1.15.1.3 Hardware production schedules.
- 172.1.15.1.4 Documentation preparation and release.
- 172.1.15.1.5 Documentation revision and release following the Purchasers review.
- 172.1.15.1.6 Type Tests and Factory testing.
- 172.1.15.1.7 Delivery.
- 172.1.15.1.8 Receipt, forwarding and staging.
- 172.1.15.1.9 Installation.
- 172.1.15.1.10 Site acceptance testing.
- 172.1.15.1.11 Availability test.

172.1.15.2 Each scheduled task shall have an estimated duration for completion and predefined relationships with other tasks. Relationships shall be used to enforce the logical progression of work in as much as certain tasks cannot start until others have been completed.

172.1.15.3 **The Purchaser Activities.**
The implementation schedule shall contain all the purchaser activities required in order for the Bidder to complete their system, including the following:

- 172.1.15.3.1 Document reviews and approvals.
- 172.1.15.3.2 Regulatory Clearances.
- 172.1.15.3.3 Participation in all levels of testing.
- 172.1.15.3.4 Any major site preparations, if required.

172.2 **Documentation Schedule**

172.2.1 The documentation schedule shall include an entry for each document and drawing to be delivered throughout the project. Each documentation schedule entry shall include the document or drawing title, number, revision level, actual or future submittal date for the Purchaser review or approval, date of completion of review or approval by the Purchaser, and outcome of review or approval by the purchaser. When the purchaser requires correction to any document, the documentation schedule shall be updated with a new entry for the next revision of the document. The content and format of the documentation schedule shall be subject to the purchasers approval.

172.2.2 The documentation schedule shall allow for at least two submissions of each document requiring review or approval.

173. **Progress Reporting** With the intent to assure quality management and project

progress as per the implementation schedule, progress reports submitted for each reporting period and Progress Review Meetings shall focus on the following:

173.1 Monthly Progress Reports A Monthly Progress Report shall be prepared by the Project Manager that includes inputs from all its subsystem. The report shall be made available to the Purchaser as hard copy by the 10th working day of each month and shall include but not be limited to:

- 173.1.1 Updated project schedule highlighting any deviations from the previous issue of the project schedule.
- 173.1.2 Explanation and anticipated effect of each schedule deviation and its implication to the Purchaser.
- 173.1.3 Schedule recovery plan for any deviation incurring a delay in delivery date. (All delays shall be factored into the project schedule as soon as they are known to the Bidder).
- 173.1.4 A summary of activities performed by the Bidder and the Purchaser during the previous reporting period.
- 173.1.5 An updated list of all correspondence transmitted and received by the Bidder.
- 173.1.6 Updated documentation schedule.
- 173.1.7 List of all Bidder personnel and the Purchaser personnel resident at the Bidder facility, identifying all activities performed by each person and the activities scheduled for the next two reporting periods.
- 173.1.8 Updated list of Bidder and the Purchasers action items with status, description of required information, and required resolution dates.
- 173.1.9 Summary of pending and upcoming Bidder and the Purchaser activities during the next two reporting periods along with required completion dates.
- 173.1.10 Status of unresolved contract questions and change requests.
- 173.1.11 Summary of variances.
- 173.1.12 Log of invoice status.
- 173.1.13 Description of current and anticipated project problems and steps to be taken to resolve each problem.

173.2 Quarterly Progress Review Meetings

- 173.2.1 Progress Review Meetings shall be scheduled by the project managers and attended by the Bidder and the Purchaser to review progress of the project. Progress meetings shall be used to review the progress reports for the previous reporting periods, written correspondence exchanged since the last meeting, and open action items.
- 173.2.2 The Bidder shall also attend technical meetings as required to discuss technical aspects of the project and to review the Purchaser comments on approval documents. When appropriate, these splinter meetings shall be conducted as extensions to the progress meetings.
- 173.2.3 At least one-half of all meetings shall be held at the Purchaser's

offices. The Bidder Project Manager shall record the minutes of each meeting and shall provide hard copies to the Purchaser and all attendees on the same day whenever possible, but not later than within two working days after the meeting. **Table 4.5** provides a suggested agenda for Progress Review Meetings.

Item	Title	Description
1.	Meeting Minutes	Review minutes from previous meeting, with comments
2.	Open Action Items	Review all outstanding action items
3.	Progress Review	Review with participating Project Managers and Bidder, most recent project schedule. Update schedule and develop Action Items.
4.	Technical Discussion	Discuss Technical Issues.
5.	Action Items	Assign responsibilities for new action items.
6.	Administrative Matters	Discuss administrative matters
7.	Action Items	Assign responsibilities for action items.
8.	Next Meeting	Schedule time and place for next meeting and agree on agenda
9.	Adjourn	Adjourn meeting.

Table 4.5 Suggested Progress Review Meeting Agenda

174. **Implementation Plan.** This section describes the Purchaser's phased implementation strategy for the fiber optic system of the project. The Bidders shall propose preliminary implementation plans that will follow this approach. The Purchaser and the Bidder shall finalise the detailed implementation plan following the award of the contract.
175. **Implementation Steps.** The basic implementation steps pertaining to Optical Fiber Cabling system of the project are:-
- 175.1 Implementation strategies for rollout of OFC network.
 - 175.2 Conduct site /route surveys, identify equipment locations and required site preparations.
 - 175.3 Subsystems design, manufacture, factory & type test (if applicable).
 - 175.4 Delivery, installation and field testing for above.
 - 175.5 Site Acceptance testing.
176. **Implementation Schedule.** The Bidder shall submit a project schedule as detailed as possible, showing the activities of both the Bidder and Purchaser and also including the documentation schedule.

177. Logistics Management

177.1 **General.** The Bidder shall describe in the appropriate schedule in the Bid Proposal Sheets, the sequence of erection of major items and his proposed construction methods supported by diagrams and drawings, as necessary. The Bidder shall relate movement of major Bidder's equipment to the construction programme time scale. Bidder shall ensure that.

177.1.1 Central stores are established at strategic location to receive and keep inventory of major supply items for multiple links.

177.1.2 Site Office and Other Stores shall also be located near the site office to maintain the stock of the equipments, tools and consumables for immediate requirement.

177.1.3 Stores shall be equipped with P&M of adequate capacity to facilitate proper loading, unloading and shifting of materials.

177.1.4 Dedicated P&M shall be deployed to facilitate smooth transportation and distribution of materials from central store to various sites and returning the dismantled materials from site to client's store.

177.1.5 Proper watch & ward shall be provided round the clock at all store locations to avoid theft.

177.1.6 Store in-charge at project office shall ensure smooth operation of stores.

177.1.7 The No. of site office, stores and other personnel to be deployed shall be in line with clause No. 151.1 above.

178. **Resource Control.** To enable the Purchaser (BSNL) to assess whether the Bidder's proposals are adequate to meet the Contract requirements, the Bidder shall describe his resource management system for the Contract in the appropriate Schedule in the Bid Proposal Sheets in line with Clause No 151.1 above.

179. The Bidder in his proposal shall define the resources that shall be deployed during design, manufacture, erection, and commissioning phases and show that those will be adequate to meet the Contract commitment.

180. Following the placing of the Contract, the Bidder shall submit monthly resource deployment schedules segregated into design, manufacture, and erection and commissioning.

181. Bidder shall have facility and proper material management system in place to keep inventory of major supply items viz, OFC, HDPE pipes, accessories in advance of installation schedule subject to an accumulation of stock for a period of not more than 30 days from the date of receipt of materials at site.

182. **Commissioning Management.** For supervision/monitoring of commissioning of the various equipment/system covered under the scope of the Contract, the Purchaser will form a suitable organization structure, The Bidder shall nominate his representative(s) to the various working group(s) formed, on receipt of instruction in this regard from the Purchaser.

183. Progress Reports

183.1 During the construction stages the Bidder shall submit to the Purchaser, reports and information on the progress of Construction by himself and by the Sub-Bidders of the execution of the works. The reports shall be based on the construction programs.

183.2 The detailed procedure and requirements for progress reporting will be agreed with the Purchaser during the early phase of the Contract, as part of regular contract/project status reporting.

184. **Purchaser's Rights.** The Purchaser reserves the right to evaluate and audit the Bidder's management systems and controls concerning Contract Management, Management Information, Programme Management, Resource Management, Quality Assurance, Design, Production and Manufacture, Industrial Relations, Erection, Testing, Commissioning, Sub-Contract Control and Site Management. The Bidder shall provide all necessary assistance to enable the Purchaser's Engineer to carry out such audits and evaluations. Such audits and evaluations shall not in any way relieve the Bidder of any of his liabilities and responsibilities under the Contract. A corrective action programme shall be agreed and implemented in respect of any deficiencies revealed by such monitoring, without any cost implication to the Purchaser and impact on the time schedule for the project.

185. **Project Progress Review Meetings.** Periodic project progress reviews will be held at least once every month at venues mutually agreed. These meetings will be attended by of the Bidder and their leading sub-Bidders. Responsibility for actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued and circulated to all concerned for reference and action. The Bidder shall be responsible for ensuring that actions placed on him in such meetings are carried out in time. In addition to the above, a suitable forum of periodic meetings between the Bidder and the Purchaser's Engineer will be decided upon as part of coordination procedure.

186. **Training.** The bidder shall provide suitable O&M training to all the personnel nominated by PICG as per the details below:

186.1 Training shall be imparted at the PICG designated sites. Conduct of training of the PICG personnel shall be at the bidders' plant and/or on-site in assembly start-up operation, maintenance and/or repair of the supplied goods.

186.2 Training schedule:

186.2.1 For a period of Five working days (8 hours each day).

186.2.2 Two (2) days are compulsory for on the job training (installation, testing, commissioning, testing, maintenance)

186.2.3 Training shall be provided twice a year for the number of days specified above for a minimum period of three(3) years

186.3 Maximum number of trainees per batch: 20.

186.4 **Selection of Trainees**

186.4.1 Trainees shall be nominated by the purchaser.

186.4.2 The bidder shall specify in his bid the pre-training qualifications required of the trainees for the proposed training.

186.5 **Trainer/Instructor**

186.5.1 Trainer/Instructor shall be appointed by the bidder.

186.5.2 All the instructors/trainers shall possess high technical ability to impart training.

186.5.3 Trainer should have minimum of five (5) years of work experience in manufacturing and maintenance of OFC and training experience

on the related subjects.

186.6 **Training Expectations**

- 186.6.1 The training shall be sufficiently comprehensive and include hands on practical operations to allow trainees to carry out installation, operation and maintenance, supervise etc. of different types of fiber optic cables independently.
- 186.6.2 Sufficient diagrams and explanatory material shall be prepared by the bidder and distributed to the trainees during the training sessions.
- 186.6.3 The persons trained are expected to train the other people at the Purchasers end.

186.7 **Training Process**

- 186.7.1 Theoretical and practical sessions shall be conducted by the instructor.
- 186.7.2 The training shall cover the following:-
 - 186.7.2.1 Understanding of the fiber optic cables technology.
 - 186.7.2.2 Drum handling (cables and duct pipes).
 - 186.7.2.3 Cable fault detection.
 - 186.7.2.4 Understanding the mid span access of the fiber optic cables.
 - 186.7.2.5 Safety procedures for fiber optic cable storage and installation.
 - 186.7.2.6 Splicing.
 - 186.7.2.7 Laying and installation of fiber optic cables.
 - 186.7.2.8 Cable blowing.
 - 186.7.2.9 Laying of duct pipes.
 - 186.7.2.10 Understanding on the cable and duct accessories and the related equipment/hardware.
 - 186.7.2.11 Handling, installation, storage of cable and duct accessories and related equipment/hardware.
 - 186.7.2.12 Testing.
 - 186.7.2.13 Maintenance and repair of fiber optic cable link.
 - 186.7.2.14 Supervision.

186.8 **Training Material.** Technical Evaluation will also include the methodology for conduct of training.

- 186.8.1 The bidder shall provide the proposed training manuals along with the bid.
- 186.8.2 The bidder shall provide sufficient training material and explanatory notes to the trainees during the training period one set for each trainee.
- 186.8.3 The training material (text books, notes etc.) provide to the trainees shall cover all the aspects of the cables, ducts and

installation practices & procedures, testing and maintenance.

- 186.8.4 The training material (text books, notes etc.) provided to the trainees shall be written in English.

186.9 Training Certifications

- 186.9.1 Bidder shall provide the training certifications to the trainees after the successful completion of the training after conducting the test.

- 186.9.2 The bidder can decide the procedure and the format for certification (e.g the trainees can be subjected to a test – theoretical/practical as specified by the instructor after the completion of the training to check the understanding of the trainee).

- 186.9.3 The certification provided to the trainee shall strictly be inline with the training procedures and the details mentioned under the various headings above.

- 186.10 **Training Cost.** The training cost shall be included in the space provided in the price schedule on a per batch basis. The payment for training would be made quarterly based on the number of batches of training concluded.

186.11 Others

- 186.11.1 The Purchaser shall intimate Bidder the training schedule and locations at least thirty (30) days prior to the commencement of training.

- 186.11.2 Training will be carried out at different locations in each region at PICG nominated sites..

- 186.11.3 Bidder shall bear the trainer expenses for providing the training at different locations.

- 186.11.4 Training program for imparting training to new batches of trainees proposed by the Purchaser shall be compulsorily done on six month basis during warranty as well as AMC for the complete project life cycle.

SECTION IV

PART D : OFC MAINTENANCE REQUIREMENTS

Preamble

187. There is a requirement of **“Deployment of Maintenance Teams in various sections for Preventive Maintenance and Fault Rectification of Exclusive NFS OFC based NLD and Access Routes on Pan India Basis for the Project.”** Details of zone wise deployment of these teams are given at Appendix ‘L’.
188. PICG through BSNL intends to award contract to reputed bidders who are financially and technically meeting the eligibility criteria to undertake various activities required in maintaining & ensuring OFC connectivity along NFS OFC routes and access networks. **The bidder(s) shall produce along with their bids all documentary support for their experience in this regard.**
189. Bidder’s special attention is invited to the fact **that all material (which is part of the supply component of this contract) shall be arranged /supplied by PICG for Preventive Maintenance and Fault Rectification and hence need NOT be included in the quoted cost of AMC. However the maintenance service and any material required in achieving the end objective including any special protection materials needed are to be supplied by the bidder.** The material used by bidder, in such cases, should be of approved quality failing which appropriate penalty shall be imposed to the extent of cost of getting the work done by other agency
190. **The Bidder is hence required to quote only for the fixed AMC charges involving provision of maintenance services for all commissioned NLD links / Access OFC. The essential material (components supplied as part of this tender) required for maintenance would be provided by the PICG.**
191. After commissioning and handing over of the network to PICG by BSNL, PICG will sign the agreement for AMC with the successful Lead Bidders. In the event of any question, dispute or difference arising out under this agreement or in connection there-with (except as to the matters, the decision to which is specifically provided under this agreement), the same shall be referred to the Sole Arbitrator appointed by Ministry of Defence (MoD). The agreement to appoint an arbitrator will be in accordance with the Arbitration and Conciliation Act 1996.
192. Before quoting, the bidders are advised to ascertain the nature of work involved. If required, site inspection can be undertaken.
193. Bid should be submitted for the maintenance work during the entire warranty and AMC period.
194. The Bidder as part of his tender has to submit a detailed plan for the maintenance of the network including the details of the manpower and equipments proposed to be located at different sites to cover the jurisdiction. The plan shall include communication facilities, the planned maintenance bases and the detailed plans to fulfill the tender conditions.
195. Bidders are advised to submit their quotations strictly based on the terms, conditions, and specifications in the tender document and not to stipulate any deviations.
196. The submission of bid will be deemed to imply that the Bidder has studied and understood the requirement given in this section and the bidder is aware of the full scope of the maintenance work to be done and the conditions affecting the execution during warranty and AMC period.

197. Warranty and Annual Maintenance Contract (AMC)

- 197.1 **The warranty of thirty six months for each link/ each access station will start on completion of eighteen months from award of contract or date of commissioning whichever is later.** The successful lead bidder will be required to enter into Annual Maintenance Contract with the purchaser or a third party as nominated by the purchaser for a **period of seven years** as per Annual Maintenance Contract Agreement after completion of warranty period.
- 197.2 The supplier shall quote for a year wise comprehensive **Annual Maintenance Contract for 7 years** to be signed at the end of warranty period.
- 197.3 The cost of AMC will be added to the basic quotation for the purpose of evaluation at the discount rate of 12% per year. Since the AMC is to be entered at the end of warranty period of three years, the calculation for NPV of AMC will be done as follows:
- 197.3.1 Net Present Value (NPV) of AMC = Quoted rates for AMC for 1st year / (1.12)⁴
 + Quoted rates for AMC for 2nd year / (1.12)⁵
 + Quoted rates for AMC for 3rd year / (1.12)⁶
 + Quoted rates for AMC for 4th year / (1.12)⁷
 + Quoted rates for AMC for 5th year / (1.12)⁸
 + Quoted rates for AMC for 6th year / (1.12)⁹
 + Quoted rates for AMC for 7th year / (1.12)¹⁰
- 197.4 **If the bidder quotes AMC rates are less than 3% of the package cost per year, then the evaluation of AMC will be done on 3% of package cost.**
- 197.5 **The Bidder shall deposit a security deposit, for a value of 2% of the original purchase order value of the package, prior to commencement of AMC period and shall be valid upto seven years and six months to cover the entire AMC period.**
- 197.6 **The Performance Bank Guarantee provided during the warranty period will be redeemed by the Bidder only after the security deposit given in Clause 197.5 above has been deposited.**
- 197.7 During warranty the bidder shall perform all the functions as enunciated under the AMC free of cost. All the penalty clauses shall be applicable during the period of warranty and AMC.

198. OFC Maintenance Requirements

- 198.1 The nationwide optical backbone network for PICG will comprise of nearly 45000 km of 48 Core OFC for NLD routes and 12000 km of 48 Core OFC for Access networks. This backbone component on its successful completion will then form the physical layer of a highly resilient and intelligent DWDM transmission network. As the OFC is to be installed across various geographical parts of the country, the Bidder should demonstrate abilities ensuring long term usability with minimal damages or disruptions, calling for least maintenance activities, as required for "Exclusive, Secure, Non Disruptive and Mission Critical" usage.
- 198.2 To maintain high availability of services over its telecom networks, PICG

requires the bidder to provide agencies for maintaining the Optical Fiber Cable (NFS OFC) laid from one node to the other node as per link details given in Section IV Part E. NFS OFC would be terminated and optical transmission equipment will be installed at selected nodes. The maintenance will be carried out by these agencies package wise.

198.3 The Bidder shall mobilize the respective maintenance team & the equipment within 7 days of commissioning of NLD route / Access OFC.

199. **Engineer-in-Charge (EIC)** shall mean respective Territory Manager of PICG, MoD or his authorized representative. He is responsible for ensuring that all field works covered by the contract are carried out in accordance with approved designs, drawings & specifications and conditions of contract as agreed to.

200. **Description of Work**

200.1 The BIDDER shall be responsible for the maintenance of the said NFS OFC network in the physical layer to ensure the NFS OFC Network availability of highest order, considering there is no failure in the equipment level of the network. This shall include but not limited to undertake all required preventive measures of the NFS OFC route, rectification of faults and restoration jobs required in achieving the NFS OFC link availability of highest order.

200.2 The bidder shall carry out any NFS OFC related works like additional protection works, splicing, termination, tightening of nuts/bolts, provision of complete clamps for supporting the protected work over culverts/bridges and wiring as directed by the PICG, NFS/ Network Manager of the section. No additional payment on account of these technical works will be applicable.

200.3 Any refusal of team for taking up maintenance and preventive maintenance work for NFS OFC and associated equipments shall be treated as failure of team to attend failure in network and penalty shall be imposed accordingly.

200.4 The bidder may be required to replace upto 10% of NFS OFC routes in each year of AMC in all aspects i.e. to cater for the change of cable and accessories from FDMS to FDMS. **The material for these routes shall be provided by PICG and need NOT be catered in the cost of AMC. The cost of services for these 10% route replacement shall also be paid extra over and above the fixed AMC charges. Hence the cost of material as well as services for such 10% route replacement is NOT to be included in the quoted rates for AMC.**

200.5 The maintenance bidder is planned to be fixed for a period of seven years after warranty. However, the contract may be terminated by giving 30 days notice, in case performance of the bidder is not found satisfactory or as and when required by PICG, NFS without assigning any reasons.

201. **Service Level Agreements (SLA's)**

201.1 Maintenance function involves 24x7 duties for operation and maintenance of total passive NFS Optical infrastructure for NLD and access networks.

201.2 Maintenance includes checks and measures that are to be taken at pre-defined periodicity to ensure network availability.

201.3 Approved MTTR shall be adhered to for speedy rectification of faults.

201.4 Maximum individual fiber splice loss of 0.2 db and average fiber splice loss per ribbon should not exceed 0.1dB.

201.5 In order to achieve the above results the successful bidder should mobilize

maintenance teams as defined as part of this tender as given at Appendix 'L', equipped with resources viz, T&M Instruments, Testing Engineers, Technicians, helpers and vehicle as given at clause 203.10 below.

202. **Broad Scope of Work**

202.1 Scope under AMC shall primarily include.

- 202.1.1 Routine inspection, viz, patrolling on the NLD OFC / Access routes, to identify areas where OFC / Duct is exposed due to natural wear and tear etc.
- 202.1.2 Faulty rectification of OFC cuts along NFS NLD OFC / Access routes.
- 202.1.3 Replacement of NFS OFC routes due to non viability of transmission link.
- 202.1.4 Ensure availability of OFC route marker along the route at regular intervals.
- 202.1.5 Maintain proper condition of joint closure.
- 202.1.6 Prevent third party damages viz, theft, damage by other U/G utility bidder etc.
- 202.1.7 Maintain condition of OFC with casing or with special arrangements near critical areas viz, major bridges, railway crossing, pipe line crossing etc.
- 202.1.8 Visual inspection of joint closure to check ingress of water, foreign particles etc.
- 202.1.9 Preventive and regular checks of power plant battery, generator, ac & remote alarm units.
- 202.1.10 Periodic measurement of the link attenuation loss to ensure that the link is free from any splice loss or point loss defects etc.
- 202.1.11 Maintenance and updation of as-built drawing, information along the OFC route.
- 202.1.12 Maintaining history of events, analysis and reporting.
- 202.1.13 Public liasoining with concerned authorities.

203. **Detailed Scope of Work.** The scope of work shall include but not limited to the following for the maintenance of NFS OFC network in the physical layer (up to the FDMS at NFS node) of PICG Optical Fiber Cable Network.

203.1 **Preventive Maintenance for cable protection.** The BIDDER shall undertake all preventive measures with information to respective EIC for maintaining the end-to-end continuity of NFS OFC cable, which shall include but not be limited to the following: -

- 203.1.1 Regular patrolling and surveillance of NFS OFC route to have proactive check to prevent NFS OFC link disruptions. It will be done by dedicated and exclusive team who will not be assigned any other work. There should be at least **one patrolman** on approximately **every 50-60 kms** beat. Each patrolman has to be equipped with a mobile phone number. The successful bidder shall have to give a detailed list of patrolmen along with their mobile numbers before deployment of the team.
- 203.1.2 Patrolling of the entire section has to be done by way of 'Window

Inspection' from any motor vehicle and the entire section has to be covered at least four times a week during daytime. If any activity is observed which may affect the NFS OFC, the patrolling team should get down and reach the suspected spot by foot or by any means and prevent any damage to the NFS OFC. The matter must be reported to the Network Management Officials nominated by PICG. The time-to-time movement of the patrolling team shall be kept informed on daily basis so that they can be contacted during emergencies.

- 203.1.3 Part of the team shall also go on foot/bi-cycle along the entire route so that **minimum two block sections every day** are covered and the condition of the NFS OFC is observed. It is expected that the entire section under the contract will be covered by foot / window patrolling at least 3 times every month. Therefore, for effective patrolling of the entire section by motor vehicle as well as by foot/bicycle, as above, sufficient number of persons are to be engaged by the bidder.
- 203.1.4 Attending to/ safe-guarding against any signs of damage or potential damage of NFS OFC network rolled out as part of this project, which come to light during patrolling.
- 203.1.5 Collecting information & accordingly coordinate with other agencies before the execution of work, who shall carry out any work in the vicinity of NFS OFC route, to safe-guard against the damages to NFS OFC cable. The bidder shall effectively co-ordinate with other agencies working along the NFS OFC route to prevent damage to NFS OFC link.
- 203.1.6 Liaison shall be maintained with other department like NHAI, Municipal corporations, Nagar Palikas, Urban Development Authorities etc regarding the permission being given or shall be given to other parties for any type of construction works along the optical fiber route.
- 203.1.7 The minimum down time shall include time taken in restoration of fault/cut caused by the miscreant activity at day or night, due to work done by Railway or any other organization, due to development of high losses / break at existing joints, fault caused due to rodent, ant etc.
- 203.1.8 In case of partial damage of the cable or development of high loss in the working fiber, the responsibility of repairing the defective fiber lies with the bidder. The preventive maintenance should be carried out with prior approval and during planned shutdown period generally during night time between **00:00 to 05:00** hrs. Additional shutdown is not guaranteed.
- 203.1.9 Daily patrolling schedule shall be sent to the NOC and any unusual incidence shall be reported to NOC immediately. Also, manpower shall be placed at all the places to coordinate the ongoing works of other agencies, to avoid damage/cut to NFS OFC. A report on weekly basis about such works and action taken thereof shall be generated & sent to Manager.

203.2 Route Replacement

- 203.2.1 Upto ten percent of total route kilometer of NFS OFC route including the NLD and Access routes will be replaced by the bidder in each year of the AMC.
- 203.2.2 The links to be replaced will be notified by the representative of PICG every year. In case no communication is received from PICG/ (representative of PICG) by March every year the Bidder will be liable to contact the PICG and take the details of the route.
- 203.2.3 In a situation, where in the vicinity of NFS OFC network any construction activities such as road widening / repair etc going on or are to start and necessitates re-routing through a new safe route of NFS OFC to avoid damage, Bidder shall explore feasibility of alternate routes & provide detailed route plan for new location, where re-routing is proposed. The job of shifting & laying of NFS OFC will be carried out at the discretion of PICG, NFS. **Material for re-routing (as per supply component of this contract) shall be provided by PICG. All services (including accessories not listed in supply component of SoR) shall be supplied by the bidder for which additional Charges (over and above the fixed AMC charges) will be paid as per Clause 206.3.3.**

203.3 Testing of NFS OFC for Preventive Maintenance

- 203.3.1 Bidder shall also carry out testing of existing joints and NFS OFC repairs along with testing of NFS OFC route for improvement in the performance with link margin.
- 203.3.2 All measurements for preventive maintenance shall be carried out as per prior agreed time schedule which is given by the EIC. The testing of all fibers shall be done, as once in three month for each of the block sections and reports shall be submitted. Any defects observed in the Optical Fiber Cable or in any of the associated equipments shall be attended in consultation with the EIC at site. PICG maintenance supervisor will also accompany the teams as and when required.
- 203.3.3 Testing consists of OTDR reading and Power Meter reading of all dark fibers. Node to Node testing is required for spare fibers terminated at nodes in both the directions. Run through fibers may be tested from end to end only. While testing, working fibers shall not be disturbed. The periodicity of testing is once in three month for all block sections, in case the agency fails to complete the measurement schedule and measurement report is not submitted, payment for AMC for that quarter will not be released.
- 203.3.4 **Test Reports.** The reports consist of the following:-
- 203.3.4.1 Section-wise tabulation of all events reported by OTDR of more than 0.1 dB over the section fiber wise for all fibers tested in the given Performa in print and in Excel worksheet.
- 203.3.4.2 Tabulation of power loss from A-B & B-A direction, average and loss per km in both 1310, 1550 & 1625nm for all the fibers tested.
- 203.3.4.3 The OTDR traces should be submitted in both soft and hard copy.

203.4 Fault Restoration Services

- 203.4.1 The bidder shall deploy Maintenance Teams at the designated locations as decided by the PICG. The Maintenance teams shall comprise of manpower, logistics, required tools/tackles/machinery & equipments etc, and shall be placed at NFS Communication Nodes. The exact locations for placement of maintenance teams will be intimated after award of contract before the links are commissioned.
- 203.4.2 The Bidder shall provide NFS OFC maintenance service on round the clock basis for attending & rectifying the NFS OFC fault in minimum downtime (including travel time) from the time of lodging the complaint to the representative of Bidder at their designated office. The maintenance bidder shall provide all assistance including providing manpower, transportation of men and materials etc. if required in the event of link failure due to any other reason.
- 203.4.3 On all working days the members of team with team equipments should be present at NFS communication node responsible and report to Network Manager for maintenance of the section during office period unless assigned work in the section. The movement of team members should be in the knowledge of Network Manager responsible for Maintenance of the section. The attendance of all team members shall be marked in the Performa accordingly. Daily diary of the works and movement of all staff shall be submitted along with the bill duly verified by the Network Manager responsible for maintenance of the section.
- 203.4.4 The list of resources including manpower & tools etc required to constitute maintenance team shall at the minimum scale be maintained as per details given in clause 203.10 below. The supervisor of maintenance team shall make available all the resources to Rep of PICG, NFS for inspection, maintenance and corrective measures as and when required.
- 203.4.5 The Bidder shall provide conveyance facilities for maintenance, for transporting the manpower, tools/tackles, Test/Measuring equipments and consumables like: NFS OFC cable, Joint Closures, Jointing Pit, duct, couplers, etc. Suitable vehicle shall be available round the clock with each of the maintenance team. Vehicle should be in good working condition and shall not be more than five years old.
- 203.4.6 The Bidder shall provide communication facilities to the maintenance teams. This shall include landline phone at office location and mobile phone to members of the maintenance teams for the purpose of contacting on an urgent need basis. The team-in-charge should have mobile phone of mobile operator whose coverage is available in the desired section and it should be always be on.
- 203.4.7 The bidder will be required to carry out maintenance activities which include identification of NFS OFC fault/cut on ground, obtaining permission from local authorities if required, excavation of earth to expose cable, laying of required length of NFS OFC with protection wherever required, splicing of NFS OFC,

installation of Jointing pit & back filling of pit with sand, supply and installation of cable Route Markers and Joint Markers as per specification, testing of NFS OFC and updating of NFS OFC as-built drawings etc.

- 203.4.8 The bidder shall arrange for logistics to provide facilities such as AC/DC power source, lighting arrangement, dewatering facility, DG sets etc, which may be required during the execution of maintenance job at site.
- 203.4.9 Optimum functionality of maintenance teams is a prime necessity to carry out day to day maintenance of NFS OFC links. NFS OFC and accessories spares to cater for repair of at least 10 fiber cuts shall be maintained with each of these teams at all times.
- 203.4.10 Bidder shall take insurance for all the workmen engaged under this contract and as per labour laws applicable from time to time.

203.5 **Methodology for Fault Restoration/Fiber Cuts.** Under NFS OFC link cut condition, the following minimum activities shall have to be taken up by the BIDDER for its restoration for the end-to-end restoration of the network traffic/service:

- 203.5.1 On receipt of information of fault in NFS OFC the team stationed at the NFS Communication Node shall move immediately for locating and rectifying fault as per the response time given below. The working fibers shall be restored first. Sufficient labour shall be engaged for speedy restoration. Adequate care shall be taken not to damage any other cable if laid in the same trench.
- 203.5.2 For the identification of exact fault location on immediate basis, the OTDR measurement of spare fiber shall be made from the nearest telecom station/Node. For better clarity, the OTDR measurement on spare fiber shall be taken at Nodes / nearest NFS OFC joints situated at both ends of cut and using dummy fiber spool of 1km, in case required.
- 203.5.3 After the OTDR measurement, the as-built drawing shall be referred and the physical site of fault on ground shall be located. It may be possible that data in as- built document may not be correct for the accuracy purpose. As-built drawing shall be taken as reference only. No claim of bidder will be entertained on account of this. Accordingly, locating the NFS OFC fault, the job of excavation in all types of soil, identification of NFS OFC, blowing of cable, construction of jointing pits, splicing of NFS OFC, back filling of trench & jointing-pit shall be taken up as per the standard procedure as briefly indicated in Clause 211 below. This should be incorporated in the cable route plan also. The splicing of fibers is to be carried out in line with the installed fiber and measurements are to be taken on spare fibers. In case the active fibers are to be used, precautions are to be taken with regard to the power launched on to the fiber. Restoration of site shall be done to the entire satisfaction of Engineer- in-charge PICG.
- 203.5.4 In case of NFS OFC cut where it is not possible to pull the cable from either end, the bidder has to make two pits/ splicing joints between the required length of new OFC to be laid between the two joints. The spacing of joints/ pits shall be depending up on

- situation at site and shall be as decided by Site Engineer. Remaining NFS OFC has to be coiled in both the pits.
- 203.5.5 Wherever new joint is provided or existing joint is attended for rectification during the maintenance period joint shall be buried to the depth of 1.2 Mtr. from the ground level in joint chamber as per specifications given at Section IV Part B.
- 203.5.6 After the completion of site activities, the BIDDER shall ensure the restoration of the traffic from the associated Fiber Network Operations Center (FNOC) and thereafter fresh OTDR measurement & traces (for 1310nm, 1550nm & 1625nm) shall be taken for all fibers & submitted to PICG representative.
- 203.5.7 After the completion of site activities & hop test, the As-built drawing shall be updated by incorporating the new details like NFS OFC loop used, Joint-pit location, etc. The length of loop in joint pit after fault restoration shall be incorporated in as built drawings.
- 203.5.8 After attending the fault & permanent restoration a Fault-Rectification report, jointly signed by PICG & BIDDER, shall be generated for the closure of the complaint.
- 203.5.9 Any other job required for the restoration of the NFS OFC fault/cut in totality is to be taken up by the Bidder.
- 203.5.10 In case the site condition is not favorable for the immediate restoration of the fault, the temporary restoration of the service fibers shall be taken up immediately with the approval of Rep of PICG. Permanent restoration work will not be considered in breakdown time unless there is again link break during restoration job. Permanent restoration of joint pits is to be carried out by bidder within 48/ 96 hrs from time of fault /NFS OFC cut. In case the site is not conducive for permanent restoration some arrangement of manpower has to be done by bidder for safeguarding exposed NFS OFC till permanent restoration. No extra payment shall be given to bidder on account of deployment of additional manpower. In case of further cuts at exposed NFS OFC location bidder will be accountable for this additional downtime of NFS OFC link.
- 203.5.11 Only the OFC issued by PICG representative to the bidder, for use at NFS OFC fault locations, should be used and must be checked & tested before use at site.
- 203.5.12 It is mandatory for the bidders to install the jointing chambers after permanent restoration is done.
- 203.5.13 In case of any breakdown in the OFC network, Bidder shall be responsible for obtaining approval at his own cost from statutory authorities like Municipal Corporation, Development Authorities, Electricity Department PWD, NHAI and any other concerned authority as required for carrying out the repair.
- 203.5.14 Drains, pipes, cables, overhead wires and similar services encountered in the course of the works shall be guarded by the bidder at his own cost, so that they may continue in full and uninterrupted use to the satisfaction of the Owners thereof.

- 203.5.15 Should any damage be done by the BIDDER to any AC Power mains, utility pipelines cables or lines (whether above or below ground etc) whether or not shown on the drawings, the BIDDER must make good or bear the cost of making good the same without delay to the satisfaction of the Engineer-in-Charge.
- 203.5.16 BIDDER shall observe all national and local laws, ordinances, rules and regulations and requirements pertaining to the work and shall be responsible for extra costs arising from violations of the same.
- 203.5.17 BIDDER shall have at all times during the performance of the WORK, a competent supervisor on the site. Any instruction given to such Supervisor shall be considered as having been given to the BIDDER.
- 203.5.18 The BIDDER shall employ as many personnel as required to comply with the local rules and administrative orders governing the Working Hours of Employment. The bidder shall be responsible for compliance with all statutory requirements including personnel related matters.
- 203.5.19 **Night Work.** The bidder shall also work during night time and is required to complete the work in all respects within the stipulated time. Sufficient lighting arrangements and precautionary steps shall be provided to safeguard the workmen and public assets and to afford adequate facilities for properly placing and inspecting the material and the work when the night work is in progress.
- 203.5.20 In the event of urgency the team has to move to the adjacent section, if desired by Network Manager. However, payment for the work will be made as per respective item of SoR.
- 203.5.21 The minimum down time shall include time taken in restoration of fault/cut caused by any means like miscreant activity at day or night, due to work done by any other organization, due to development of high losses / break at existing joints, fault caused due to rodent, ant etc.
- 203.5.22 In case of partial damage of the cable or development of high loss in the working and spare fiber or cable cut at any time (day/night) by miscreants or by any agency, the responsibility of repairing the defective fiber lies with the bidder.
- 203.5.23 In case bidder fails to completely restore (as per original condition) or submit OTDR & test (power level in live equipments) records to establish completion of work a penalty shall be levied for the work involved at site.
- 203.5.24 **Examination of Finished Work.** When finished work is taken down for the purpose of inspection for any reason, the bidder shall bear the entire expenses incidental thereto in the event that the said work is found to be defective. This situation may be applicable to both planned work as also to emergency restoration.

203.6 Time to Restore Fiber Cuts

- 203.6.1 **Response Time.** The maximum response time is 30 minutes from the time PICG, NFS informs the team about the failure

through any communication means. It is required that the maintenance team should start moving towards the location of fault within this time.

203.6.2 **Restoration Time**

203.6.2.1 The maximum restoration time is response time plus vehicle travel time including 1 hour for localization.

203.6.2.2 In any case, the restoration period including excavation & splicing should not exceed **six hours** where easy approach roads are available and it should not exceed **eight hours** in rural and remote areas where approach roads are difficult.

203.6.2.3 The maximum restoration time, in specific cases, shall be as decided by EIC, if conditions of force majeure are invoked.

203.6.3 **Record of Fault Repair Time.** Time taken by the Bidder from the time of lodging the complaint to the representative of Bidder at their designated office/Head Quarter up to the time of restoration of end-to-end traffic after rectification of NFS OFC cut(s)/fault(s) including the traveling time. The repair time of any fault occurred shall be calculated by collecting data from respective NOCs of PICG, NFS. After restoration of the link, a fault report is to be generated by bidder and obtain signature of PICG, NFS site representative for records.

203.6.4 During the maintenance or fault rectification work, should any damage occur to the other cables, bidder is liable to pay compensation as demanded by the respective authorities

203.7 **Supply of NFS OFC and accessories.** For making good any break/loss in fiber, the NFS OFC and other accessories as included in the supply component of this tender shall be supplied by PICG, NFS to the bidder at the nearest network storage depot. The material shall be picked up by the bidder in advance from nearest depot and shall be accounted with reference to the specific incidence of fiber cuts. All other materials shall be arranged for by the bidder and shall meet the specifications laid down in this tender.

203.8 The detail address of Network stores shall be provided to the successful bidder prior to establishment of maintenance teams. The bidder has to draw the material from designated store, if not available, the same may be arranged from other Network store.

203.9 The material issued to the bidder and remaining unutilized after completion of the job shall be returned back to representative of designated stores at the end of contract period. A monthly material statement shall be submitted to EIC by the bidder.

Taking Over the Section for Maintenance

203.9.1 The bidder shall complete the OTDR measurement of all the block sections for all the fibers and submit a joint statement duly signed by the bidder and PICG, NFS officials indicating the faults to be attended for making good of all the non-working fibers. This process shall be completed within 30 days from the date of

deployment.

203.9.2 The Officer-in-charge shall then advise the bidder of the faults to be attended to make the fibers. This bidder shall make good all such fibers for use by rectifying the faults within 30 days from the date of advice by the officer of PICG.

203.9.3 Subsequently, the maintenance of all the fibers shall be the sole responsibility of the bidder.

203.9.4 On completion of the contract, the OTDR measurement shall be carried out on spare fibers to ascertain the condition of cable, which should be same or better than the condition of the cable taken over by the contract at the beginning of the contract period. Beside this, NFS OFC route drawings handed over to the bidder at the time of award of work shall be updated fully and submitted to PICG, NFS, both in Hard and Soft copy incorporating the various changes occurred during the contract period.

203.10 Minimum Resources to be deployed in a Maintenance Team

203.10.1 Experienced Supervisor. (Preferably Diploma Holder in Electronics or Graduate with relevant experience).

203.10.2 Technician for Splicing & Measurements.

203.10.3 Technician for splicing support, wiring of circuits, testing, fault rectification etc.

203.10.4 Manpower for surveillance, liaison and foot patrolling and train patrolling (one Man for about 50-60 kms beat). However the bidder has to deploy extra manpower for as and when needed during any work or other agencies work in the section (No extra payment will be paid for providing extra manpower for surveillance).

203.10.5 Manpower for surveillance in city area.

203.10.6 Un-skilled manpower for trenching etc.

203.10.7 OTDR for measurement at 1310, 1550 and 1625nm.

203.10.8 1 km length dummy fiber spool.

203.10.9 Fusion Splicing Machines (Ribbon and Single Fiber) with cleavers.

203.10.10 Optical Light Source and Optical Power Meter.

203.10.11 Tata Sumo/Qualis/Scorpio or equivalent Air Conditioned Vehicle for transportation of men, machines and stores. Vehicle shall be in good working condition and should not be more than five years old.

203.10.12 Communication Gadgets: As required (Telephone, Walkie Talkie, Cell phone etc.).

203.10.13 Tool/Tackles kit.

203.10.14 All sorts of patch-cords and connectors for the purpose of measurement.

203.10.15 Cable Splitter for vertical cutting of HDPE sheath.

203.10.16 Duct Cutter.

203.10.17 Rodometer.

203.10.18 NFS Cement and Electronic Route Markers.

203.10.19 NFS OFC electronic route marker detector.

203.10.20 Spare battery with charger for splicing machine.

203.10.21 Blow lamp/ hot air gun for sealing joint closure.

203.10.22 Generator set, lighting arrangement like emergency Light/ Gas Light, Dewatering facilities etc.

203.11 Manpower and equipments should be available with the maintenance teams round the clock as listed above. However bidder can add more manpower & equipments for speedy maintenance & minimizing downtime without extra cost implications to PICG.

204. Conditions of Contract

204.1 While quoting, it is advisable that the prospective bidder shall make themselves fully conversant with the locations, NFS OFC routes and types of jobs in details to be carried out therein as per the tender requirement, so that they clearly understand the scope of work and assess the requirement of resources to complete the work in scheduled time.

204.2 The BIDDER is deemed to have understood the conditions of existing NFS OFC routes like terrains, various crossings, access details, on-route PICG maintenance bases etc., by visiting the sites and collecting first hand information before submission of the offer. In case of any doubt, the clarification may be taken from the PICG before submission of the offer.

204.3 Submission of monthly & emergency report as desired by Network Manager in the Performa specified by PICG, NFS will also be a part of maintenance contract.

204.4 The BIDDER shall be totally responsible for the successful execution of the NFS OFC route maintenance contract.

204.5 The Bidder shall enter into AMC contract with PICG / any Third Party Vendor after expiry of warranty.

204.6 The Bidder shall not sub-contract whole or any part of the work without explicit clearance from PICG.

204.7 The data provided in the Tender document shall be used by the Bidder for reference and information purpose only. It shall be the bidder's responsibility to verify the data & satisfy himself in regard to accuracy of data.

204.8 The BIDDER shall be responsible for making an arrangement at each maintenance station for excavation works, testing, measuring, splicing equipments, unskilled/skilled manpower, transport facilities for their teams & other logistic supports required to maintain end-to-end NFS OFC connectivity in physical layer as per the contract.

204.9 Before deployment of maintenance team the bidder should furnish the details of personnel i.e Name, technical qualification, and experience along with attested signature. No manpower or equipment can be changed without prior ascertaining the suitability by Rep of PICGs approval. Each such change shall be reported in writing prior to changing to Rep of PICG.

204.10 The responsibility of the BIDDER shall include provision of preventive measures of NFS OFC routes to avoid damage and cut, deployment of manpower, supply of required materials, erection, installation, testing,

documentation, including the related civil works necessary for ensuring the complete end-to-end NFS OFC connectivity in physical layer as described in the tender document at no extra cost.

- 204.11 The material used & workmanship shall satisfy the standard specifications given in this tender.
- 204.12 Zonal Network Managers (NFS) shall be entitled to reject the goods, materials and work executed by the bidder, which may not be conforming to the specifications within a reasonable time of installation of the said goods and materials and charge the bidder for all expenses direct and consequential, incurred thereby.
- 204.13 Where it is mentioned in the specifications that the BIDDER shall perform certain work for completing the job in totality, it is understood that the bidder shall do so at his own cost and contract price shall be deemed to have included cost of such performances and provisions so mentioned.
- 204.14 The BIDDER shall be totally responsible for the calibration & functionality of test equipment to be used at site. All the tools & Test instruments shall be duly certified by the authorized agency. Bidder should not shift the test instruments from the site and is liable to be penalized if found so.
- 204.15 The Bidder to provide safety appliances like: dust masks, safety belt, safety shoes, helmet, hand gloves, safety goggles, rain gears etc to their personnel working.
- 204.16 During any construction work in public places, all precautionary caution boards, barricading sheets as per standard laws & rules to be used by the Bidder.
- 204.17 During the course of execution of the work, if any discrepancy or inconsistency, error or omission in any of the provisions of the contract is discovered which needs to be clarified, the matter shall be referred to PICG, NFS who shall give his decision in the matter and his decision shall be final and conclusive.
- 204.18 Entry pass shall be issued to the representatives of the bidder by respective PICG headquarters from the respective maintenance stations for handling all maintenance work in PICG area. The bidder should ensure that the team employed by him shall not move or trespass to areas other than the site(s) required for the execution of the work. Under no circumstances the Bidder should infringe and carry out the work which hamper the Operations and Safety of the PICG, its movements and damage to NFS assets. The bidder is responsible for the safety of team members while executing the work in the PICG areas.
- 204.19 The Bidder shall submit details of personnel who will be available permanently for the maintenance works of PICG network prior to establishment of maintenance teams. This should include details of technical qualification & minimum experience.
- 204.20 The work is subjected to inspection at all times by PICG officials. The BIDDER shall carry out all instructions given by him or his representatives during inspection.
- 204.21 Any work not confirming to the execution plans, standard specification codes or engineering practices shall be rejected forthwith and the BIDDER shall carry out the rectification at his own cost.

- 204.22 Inspection and acceptance of the work shall not relieve the BIDDER from any of his responsibilities under this contract.
- 204.23 With the offer, the BIDDER shall provide the complete details of planning for items/materials, test/measuring instruments, tools/tackles & manpower to be deployed.
- 204.24 By entering into the maintenance contract with PICG, the bidder shall agree to maintain the secrecy of all documents/information/drawings etc provided by PICG during the period of contract and shall handover all the documents back immediately after the termination of the contract.
- 204.25 In case Network Manager feels that the bidder is not able to execute the work to the satisfaction of PICG, then Rep of PICG shall at his own discretion engage other agencies to ensure the smooth execution of the job at the risk and cost of the bidder.
- 204.26 The BIDDER shall depute experienced and competent representative(s) at site during the execution of any job. Any instructions given to such representative(s) shall be construed as having been given to the BIDDER.
- 204.27 The BIDDER shall be solely responsible for making available, all requisite construction equipment, special aids, tools, tackles and testing equipment and appliances. Such construction equipment etc. shall be subject to examination by the PICG representatives and approval for the same. Any discrepancies pointed out by the PICG representatives shall be immediately got rectified, repaired or the equipment replaced altogether, by the BIDDER.
- 204.28 The accessing of PICG network facilities shall be allowed to authorized person from BIDDER'S side with the prior intimation to Network Manager. Within the PICG premises, the representative of the BIDDER shall take care not to tamper with the PICG network installed equipments.
- 204.29 All faults shall be intimated to the BIDDER'S supervisor/ authorized person by network management center or the Engineer-in-charge as indicated through telephonic communication, e-mail or through fax. For this the BIDDER shall provide NOCs/SOCs with the contact number, landline and Mobile & e-mail address / Fax no. 14 days prior to start of maintenance.
- 204.30 The locations of repeater/cable route are indicated on the as-built drawings to be supplied by tender awardee after giving contract to a successful Bidder. However, bidder is advised to visit the sites and ascertain the conditions/route under which the work shall be actually performed.
- 204.31 It is advisable that bidders must visit site to familiarize themselves with all constraints, restrictions, access requirements and available infrastructure. The BIDDER shall not be eligible for any adjustment in cost and time, on account of any lack of data regarding above. The Bidder shall visit the NFS OFC route and satisfy himself before quoting the rate. However, the route details are enclosed for reference in Section IVPart E: OFC Link List.
- 204.32 The as-built drawings of NFS OFC route shall be given to the BIDDER for maintenance. The information contained therein shall be considered as reference only. Any changes found in the as-built with respect to the site condition shall not become a reason for the delay in execution of the job & any extra claim by the BIDDER. As-built drawings of NFS OFC route, handed over to the bidder shall be updated regularly by the bidder. Soft copy shall be submitted every quarter and Hard copy shall be submitted every year to NOC incorporating the various changes occurred during the intervening period.

204.33 While executing the job at site by the BIDDER, penalty claimed against any damage caused to the infrastructure of PICG & other parties shall be borne by the Bidder.

205. **The BIDDER Becomes Defaulter on the Following Conditions**

205.1 If he fails to repair fault and make the NFS OFC link available within 12 hours.

205.2 Improper maintenance resulting in down time/ consumables/ loss of parts.

205.3 Loss or damage to PICG property due to the acts of Bidder.

205.4 In the event PICG receive notice from any statutory authorities or from external agencies on account of loss/damage to their property due to the acts of Bidder.

205.5 During the contract period, if the BIDDER has defaulted more than once or the defaulting case of the Bidder is severe, then PICG has the right to terminate the contract and forfeit the security deposit, if deemed required as per PICG's opinion.

206. **Termination of Contract**

206.1 PICG reserves the right to interrupt and terminate the contract at any time after giving **one month's notice**, should in PICG's opinion, the cessation of work become necessary, owing to paucity of funds of the Bidder, the Bidder's apparent inability to perform, non possession of equipments and tools required for the work or defective and malfunctioning equipments, non-availability of proper/nominated instrumentation, inability to provide men and material, repeated slippages and payment of penalty thereof or for any other cause deemed reasonable .

206.2 **The security deposit will be forfeited & Bank guarantee shall be cashed in such case of termination**, if deemed required as per PICG's opinion.

207. **Payment Terms (After expiry of Warranty)**

207.1 **Fixed Charges**

207.1.1 Annual Maintenance Charges for providing maintenance services for NFS OFC shall be paid in four equal installments at the end of each quarter after deduction of penalties, if any.

207.1.2 The fixed charges for AMC shall be for Patrolling as well as providing Preventive and Corrective Maintenance.

207.1.3 The amount payable against the maintenance charges is dependent upon the MTTR of faults taken by the Bidder for the restoration of all NFS OFC link cut/faults occurred as well as the number of faults that have occurred during each billing period of consecutive three months. Mean repair time does not include the down time taken for planned works like diversion of NFS OFC, re-termination etc.

207.1.4 Quarterly charges will be paid only after the submission of a relevant certificate by the concerned PICG officers stating that the NFS OFC maintenance has been carried out satisfactorily as per the contract agreement during the relevant quarter by the vendor, which shall be further countersigned by the Director, NFS for release of payment.

207.1.5 Performa's to be submitted for claiming fixed charges on a quarterly basis are as given below:-

207.1.5.1 Splice loss / dB loss Vs Km in section.

207.1.5.2 OTDR measurements.

207.1.5.3 Power measurements.

207.1.5.4 Patrolling reports.

207.1.5.5 Attendance report.

207.1.5.6 Material check report.

207.1.5.7 Failure / rectification report (Form-A & B).

207.1.5.8 Availability of essential equipments.

207.1.5.9 While submitting the quarterly bills for fixed charges, the bidder should also submit the following along with the maintenance bill:-

207.1.5.9.1 Payment receipt of each staff deployed.

207.1.5.9.2 Statutory payment to the government authorities like EPF, ESI etc.

207.1.5.9.3 Certificate from each staff in regard to no dues from his employer.

207.1.5.9.4 The bidder should submit copy of WCT registration certificate for the states wherever applicable.

207.2 Spares Charges

207.2.1 A fixed quantity of OFC, PLB pipes and all accessories included as part of the supply component of this tender shall be supplied by the bidder to PICG at the beginning of each year of AMC. The exact quantity (up to a maximum of 10% of the quantity procured as part of this tender) to be supplied will be intimated by PICG prior to commencement of AMC. **Cost of these spares is not to be included as part of AMC charges and shall be paid separately.**

207.2.2 The bidder is required to deliver these spares within 60 days of commencement of AMC period. The spares delivered shall conform to the specifications given in this tender. Payment for delivery of these items with LD charges deducted, if any, shall be paid along with payment for first quarter of fixed charges for AMC.

207.2.3 **In the the first year of AMC, spares shall be supplied to PICG at the rate contracted as part of this tender. From the 2nd year onwards, new rates of spares for the balance six years, will be negotiated and mutually agreed upon based on market survey.**

207.3 Variable Charges

207.3.1 The bidder is required to replace upto a maximum of 10% of OFC routes (NLD / Access OFC) of the quantity being contracted as

part of this tender. The details of route to be replaced shall be explicitly stated by PICG at the start of AMC period.

- 207.3.2 **The bidder is required to provide only services for replacement of NLD OFC / Access route. The OFC, PLB and other accessories included in the supply component of this tender shall be provided by PICG.**
- 207.3.3 **In the first year of AMC charges for the services will be paid as per the rates contracted in this tender. From the 2nd year onwards, new rates for services will be negotiated and mutually agreed upon based on market survey.**
- 207.3.4 Variable charges for the replaced portion will be paid in actual (over and above the fixed AMC charges) along with payment of fixed AMC charges for that quarter provided all concerned documents specified vide this contract are forward 30 days prior to due date.
- 207.3.5 **ROW charges, if any, will be paid on actuals as extra on submission of proof of payment.**
- 207.3.6 The original portion of existing NFS OFC link which underwent replacement will be taken off the ledger charge under the authority of concerned officer.

208. **Rewards Towards Payment of Fixed Charges**

- 208.1 If cuts are less than 6 per 1000 km in a quarter, then reward of Rs 5000 shall be given; reward shall be per 1000 km of route over a period of one quarter.
- 208.2 If cuts are 0 per 1000 km in a quarter, then reward of Rs 10000 shall be given; reward shall be per 1000 km of route over a period of one quarter.
- 208.3 If Restoration Time is less than 4 hrs for all cuts in the quarter, then reward of Rs 5000 shall be given..

209. **Penalties Towards Payment of Fixed Charges**

- 209.1 If cuts are greater than 12 per 1000 km in a quarter, then penalty of Rs 5000 per additional cut shall be charged.
- 209.2 If cuts are greater than 15 per 1000 km in a quarter, then penalty of Rs 10000 per additional cut shall be charged.
- 209.3 In case Restoration Time exceeds the prescribed restoration time for the section (6 Hrs / 8 Hrs.), then penalty for hours exceeding the restoration time shall be imposed at the rate of Rs 5000/- per two hours or part thereof.

210. If the splice loss of all the fibers are not within the prescribed limit, the bidder has to redo the splice till the value is achieved failing which PICG will carry out the work by itself deducting Rs.6000/- from the monthly bills. If any failure/fault occurs in the rectification work done by the bidder within six months from rectification, due to defective workmanship/supply, the Bidder shall make good of the defects at his own cost and it should be done within six hours and no further media outages are permitted.

211. For non – compliance / deficiencies in maintenance activity, penalty will be imposed at the following rate:

Ser No	Description of deficiencies	Penalty
1.	Non-submission / non-modification of As Built Drawing	Rs. 1,000/- per fault
2.	On obtaining no response from maintenance team members on an attempt to contact	Rs 2000/- per incident
3.	Non-provisioning of brick chamber for joints as indicated by PICG	Rs. 3,000/- per joint.
4.	If the contractor has not patrolled a particular stretch	Rs 1000/- per incident
5.	Swapped fibers not restored (involving at least one joint)	Rs. 5,000/-
6.	If any of the resources (manpower/equipment/vehicle) is not available without intimation or replacement	Rs 5000/- per day
7.	Cable laid temporarily which leads to subsequent failure.	Rs. 10,000/-
8.	Unreasonable degradation of OFC parameters in one year	Rs 2,50,000/- per dB per span length of 80 km

212. **Income Tax.** Income Tax at the prevailing rate as applicable from time to time shall be deducted from the BIDDER's bills as per Income Tax Act and quoted Rates shall be deemed to include this.
213. **Taxes, Duties, Octroi, Levies Etc.** The quoted prices shall be inclusive of all taxes, duties, levies, service tax, work contract tax, VAT if any, except octroi tax. till the completion of the contract and the BIDDER shall not be eligible for any compensation on this account. The BIDDER shall furnish the breakup of taxes at the time of submission of Bills so that PICG can claim any credit if applicable.
214. **Escalation.** The maintenance charges quoted by the BIDDER shall be kept firm till the completion of entire period of contract, and no Price Escalation shall be paid on any ground.
215. **Labour License.** Before starting of work, the BIDDER shall obtain a license from concerned authorities if required under the Contract Labor (Abolition and Regulation) Act 1970.
216. **Compliance with Labour, Industrial & Environmental Laws.** The Bidder shall at its expense, ensure due compliance with all applicable and governing Industrial, environmental and Labour Laws, Rules, Regulations and Bye-laws both of the Central and State Govt. and all other local authorities and shall keep PICG harmless and indemnified in respect thereof. The BIDDER shall ensure due compliance with the provisions of the elegant minimum Wage Act, payment of Wages, Contract Labour (Regulations & Abolition) Act, Employees Provident Fund Act and other industrial and environmental laws in force.
217. **Indemnity.** The bidder shall indemnify the Purchaser against all losses or damages, if any, caused to it on account of acts of the personnel deployed by him. The bidder shall ensure regular and effective supervision and control of the personnel deployed by him and gives suitable direction for undertaking the contractual obligations.

SECTION IV
PART E : OFC LINK LIST

1. The OFClink list for each of the seven packages for this project will be issued to the authorized representative of interested bidders separately by Director (NFS), PICG immediately after procurement of tender documents from BSNL and submission of copy of Non Disclosure Agreement and authorization letter from BSNL.
2. In certain cases there will be requirement of routing the NLD OFC through existing BSNL communication nodes en-route (which will act as amplifier nodes for DWDM links being implemented as part of a separate tender). The details of these BSNL communication nodes shall be provided at the time of APO.

SECTION V
SCHEDULE OF REQUIREMENTS
PACKAGE A

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	5334
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	147
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	4014
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9495
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	915
5.2	Splicing Cum Patching Shelf	Nos	83
6.	Electronic Route Locator	Nos	426
7.	Electronic Route Marker	Nos	52226
8.	Joint Closure	Nos	5933
9.	Warning Tape	Km	9495
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing	Kms	5481
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtailed		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route		
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
12.4	Construction of Manholes and Joint Chambers	Kms	4014
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE B**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1087
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	4363
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	2149
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7599
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	704
5.2	Splicing Cum Patching Shelf	Nos	83
6.	Electronic Route Locator	Nos	202
7.	Electronic Route Marker	Nos	41808
8.	Joint Closure	Nos	4753
9.	Warning Tape	Km	7599
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	5450
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtailed		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	2149
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3			
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9			
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE C**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1229
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	6530
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1809
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9568
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	743
5.2	Splicing Cum Patching Shelf	Nos	64
6.	Electronic Route Locator	Nos	230
7.	Electronic Route Marker	Nos	52635
8.	Joint Closure	Nos	5978
9.	Warning Tape	Km	9568
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	7759
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtails		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	1809
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3			
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9			
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE D**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1973
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	6163
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1524
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9660
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	595
5.2	Splicing Cum Patching Shelf	Nos	54
6.	Electronic Route Locator	Nos	136
7.	Electronic Route Marker	Nos	53142
8.	Joint Closure	Nos	6045
9.	Warning Tape	Km	9660
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	8136
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtailed		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	1524
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC		
12.3	round RCC Pipes, and RCC Slabs		
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtailed		
12.8	Link Testing & Acceptance Testing		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE E**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	6541
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	613
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7154
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	292
5.2	Splicing Cum Patching Shelf	Nos	37
6.	Electronic Route Locator	Nos	70
7.	Electronic Route Marker	Nos	39353
8.	Joint Closure	Nos	4469
9.	Warning Tape	Km	7154
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	6541
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtailed		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	613
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3			
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9			
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE F**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	5182
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	839
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	6021
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	306
5.2	Splicing Cum Patching Shelf	Nos	41
6.	Electronic Route Locator	Nos	140
7.	Electronic Route Marker	Nos	33124
8.	Joint Closure	Nos	3767
9.	Warning Tape	Km	6021
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	5182
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtails		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	839
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3			
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9			
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SCHEDULE OF REQUIREMENTS**PACKAGE G**

Note: The information of source and make/model line items mentioned in SoR will be submitted as part of Technical Bid, as per Appendix 'M'. Quantities given in the SoR/Price Schedule are indicative (to be used for the purpose of bidding by the bidder and evaluation by the purchaser); payment would be made based on actuals calculated during acceptance prior to NLD link/ access network commissioning.

Ser No	Item Description	Unit	Total Qty
	Material supply		
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	6470
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1048
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7518
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	427
5.2	Splicing Cum Patching Shelf	Nos	31
6.	Electronic Route Locator	Nos	156
7.	Electronic Route Marker	Nos	41357
8.	Joint Closure	Nos	4703
9.	Warning Tape	Km	7518
10.	Spares	As per Appendix 'H'	

11.	NLD Services inclusive of all of the following : -		
11.1	Route Survey & Documentation of proposed Cable Route	Kms	6470
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs		
11.4	Construction of Joint Chambers		
11.5	Duct Laying / OFC Laying / Blowing		
11.6	Splicing & Jointing		
11.7	Installation of FDMS to include termination with pigtailed		
11.8	Link Testing & Acceptance Testing		
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS		
11.10	Testing Services and Field Trials		
11.11	Project Management Services		

12.	Access Services inclusive of all of the following : -		
12.1	Route Survey & Documentation of proposed Cable Route	Kms	1048
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators		
12.3			
12.4	Construction of Joint Chambers		
12.5	Duct Laying / OFC Laying / Blowing		
12.6	Splicing & Jointing		
12.7	Installation of FDMS to include termination with pigtails		
12.8	Link Testing & Acceptance Testing		
12.9			
12.10	Testing Services and Field Trials		
12.11	Project Management Services		
13.	Training during warranty period	Per Batch	26
14.	AMC for seven years	Lump Sum	

SECTION VI**PART A : DETAILED TECHNICAL SPECIFICATIONS: FIBER AND CABLES****218. Note**

- 218.1 All the equipment/accessories whose technical specifications are not mentioned shall be supplied as per latest TEC GRs of DoT. For items whose specifications/TEC GRs are not available, standard ISI approved products shall be supplied and installed.
- 218.2 The compliance for all clauses of electronic equipments should come from principal OEM. However lead bidder shall still be finally responsible to the purchaser regarding compliance to all specifications during testing.
- 218.3 Source of Optical fiber/cable and its make to be specified as per Appendix 'M'.
- 218.4 All equipment/items mentioned in Section V Schedule of Requirement, Section VI Part A & B, Appendix 'H' (Spare list) and Price Schedule Section VII requiring battery supply will be made fully self sufficient and independent in terms of maintenance free batteries and battery chargers/battery charging sets with forty percent capacity to spare.

219. This part consists of technical specifications of following type of cables:-

Ser No	Type of Optical Fiber
1.	Single Mode Optical Fiber, ITU-T G.655
2.	Single Mode Optical Fiber, ITU-T G.652D
3.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes
4.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes
5.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network
6.	Raw Material

Single Mode Optical Fiber, ITU-T G.655

220. **Scope.** The requirements of fibers within this specification are based on operational needs in conjunction with mission critical applications of Defence forces for different network components of the Project. **ITU-T G.655** based optical fibers are required for this category for Long Haul DWDM transmission applications.

220.1 Refractive Index Characteristics

- 220.1.1 **Fiber refractive index profile.** The refractive index profile shall be measured in accordance with IEC 60793-1-20 Method A. The actual design of the profile and tolerances shall be provided at the product approval stage.
- 220.1.2 **Fiber Group Index.** The group index shall be measured in accordance with IEC 60793-1-22 Method A. The value of effective refractive indices at 1550nm and 1625nm shall be provided at the product approval stage.
- 220.1.3 **Coating Refractive Index.** The refractive index of the coating, n_c and the refractive index of the fiber cladding, n_o shall be related as follows: -
- 220.1.3.1 $n_o < n_c < 1.1 \times n_o$, where the coating is composed of more than one layer, the n_c shall referred to the inner layer. It is desirable for the outer coating layer to have a refractive index that exceeds n_c . The resin manufacturer's data shall be acceptable for this purpose.

220.2 Transmission Characteristics

- 220.2.1 **Mode Field Diameter.** The Mode field diameter shall be measured in accordance with IEC 60793-1-45.

Ser No	Fiber Category	Units	Requirement
1.	Mode Field Diameter at 1550nm	μm	9.6 ± 0.4

- 220.2.2 **Cut-off Wavelength.** The cut-off wavelength shall be measured in accordance with IEC 60793-1-44.

Ser No	Fiber Category	Units	Requirement
1.	Cut-off wavelength, λ_{cc}	nm	≤ 1450

- 220.2.2.1 **Note.** The value predicted for either λ_c or λ_{cc} from the relationship between the two configurations, shall have a probability of 95% or greater. The form of the correlation shall be stated and shall be demonstrated.

- 220.2.3 **Chromatic Dispersion.** The Chromatic dispersion shall be measured in accordance with IEC 60793-1-42.

Ser No	Fiber Category	Units	Requirement
1.	Dispersion at 1530-1565nm	ps/nm.km	2.0 – 6.0
2.	Dispersion at 1565-1625nm	ps/nm.km	4.5 – 11.2

220.2.4 **Polarization Mode Dispersion.** The polarization mode dispersion shall be measured in accordance with IEC 60793-1-48.

Ser No	Fiber Category	Units	Requirement
1.	PMD, Individual Fiber	ps/√km	≤0.20

220.2.5 Attenuation

220.2.5.1 **Attenuation Coefficient.** The spectral attenuation shall be measured in accordance with IEC 60793-1-40. The attenuation coefficient shall be met over the wavelength ranges defined as per below table.

Ser No	Fiber Category	Units	Requirement (at Fiber stage)	Requirement (at Cable stage)
1.	At 1550nm	dB/km	≤0.22	≤0.24
2.	At 1625nm	dB/km	≤0.24	≤0.26
3.	At 1383±3nm (Post- hydrogen aging)	dB/km	≤0.40	-

220.2.5.2 **Point Discontinuities.** The local attenuation coefficient shall not have point discontinuities in excess of 0.1dB.

Ser No	Fiber Category	Units	Requirement
1.	At 1550nm	dB	≤0.1
2.	At 1625nm	dB	≤0.1

220.2.5.3 **Macro-Bend performance.** The Macro-bend loss shall be in accordance with IEC 60793-1-47.

Ser No	Fiber Category	Units	Requirement
1.	100 turns on 60mm diameter mandrel,	dB	≤0.05

	induced attenuation at 1550nm		
2.	100 turns on 60mm diameter mandrel, induced attenuation at 1625nm	dB	≤ 0.1
3.	1 turn on 32mm diameter mandrel, induced attenuation at 1550nm	dB	≤ 0.50

220.3 **Fiber Life Time.** Sufficient data shall be supplied to demonstrate the performance of the fiber over an installed life time of 25 years. This can be based on information obtained from accelerated ageing test programmers. The data shall include fiber loss performance and the mechanical performance of both the fiber and coating materials.

220.4 Geometrical Characteristics

220.4.1 **Fiber.** The geometrical characteristics shall be measured using grey scale method in accordance with IEC 60793-1-20.

Ser No	Fiber Category	Units	Requirement
1.	Cladding Diameter	μm	125 ± 0.7
2.	Cladding Non-circularity	%	≤ 0.80
3.	Core/Cladding Concentricity Error	μm	≤ 0.50

220.4.2 **C Coating.** The coating characteristics shall be measured in accordance with IEC 60793-1-21.

Ser No	Fiber Category	Units	Requirement
1.	Coating Diameter- Uncoloured	μm	245 ± 5
2.	Coating Diameter- Coloured	μm	≤ 265
3.	Cladding/Coating Concentricity Error	μm	10
4.	Coating non Circularity	%	4

220.4.3 **Fiber Curl.** The Fiber curl parameter shall be measured in accordance with IEC 60793-1-34.

Ser No	Fiber Category	Units	Requirement

1.	Fiber Curl	m	≥4

220.5 Mechanical Characteristics

220.5.1 **Proof Test.** This shall be measured in accordance with IEC 60793-1-30.

Ser No	Fiber Category	Units	Requirement
1.	Minimum Proof Test Strain Level	%	1

220.5.2 **Dynamic Tensile Strength.** This shall be measured in accordance with IEC 60793-1-31.

Ser No	Fiber Category	Units	Requirement
1.	Tensile Strength(Median) for 0.5m specimen length – Unaged fibers	Gpa	≥3.80
2.	Tensile Strength(Median) for 0.5m specimen length – Aged fibers	Gpa	≥3.00
3.	Tensile Strength(Median) for 10m specimen length – Unaged fibers	Gpa	≥3.45

220.5.3 **Stripping Force.** This shall be measured in accordance with IEC 60793-1-32.

Ser No	Fiber Category	Units	Requirement
1.	Coating Strip Force (Average)	N	1-5

220.5.4 **Dynamic Stress Corrosion Susceptibility Constant.** This shall be measured in accordance with IEC 60793-1-33.

Ser No	Fiber Category	Units	Requirement
1.	Dynamic Stress Corrosion Susceptibility Constant	-	≥20

220.5.5 **Static Stress Corrosion Susceptibility Constant.** This shall be measured in accordance with IEC 60793-1-33.

Ser No	Fiber Category	Units	Requirement
1.	Static Stress Corrosion Susceptibility Constant.	-	≥ 20

220.6 **Fusion Splice Loss.** This shall be measured in accordance with ANSI/TIA/EIA-455-8.

220.6.1 **Test Conditions.** No. of Splices: 10 (The mean splice loss of all the splices at 1550nm).

Ser No	Fiber Category	Units	Requirement
1.	Splice loss at 1550nm	dB	≤ 0.1

220.7 Environmental Characteristics

220.7.1 **Change of Temperature.** This shall be measured in accordance with IEC 60793-1-52.

220.7.1.1 Test Conditions

220.7.1.1.1	Length	: > 1km
220.7.1.1.2	Pre-Conditioning	: 2hrs at $23^{\circ} \pm 2^{\circ}\text{C}$
220.7.1.1.3	Minimum Temperature	: -60°C
220.7.1.1.4	Maximum Temperature	: $+85^{\circ}\text{C}$
220.7.1.1.5	Dwell time at each temperature	: 2hrs
220.7.1.1.6	Ramp rate	: $1^{\circ}\text{C}/\text{min}$
220.7.1.1.7	No. of cycles	: 10

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤ 0.05
2.	Induced attenuation at 1625nm	dB/km	≤ 0.05

220.7.2 **Water Immersion.** This shall be measured in accordance with IEC 60793-1-53.

220.7.2.1 Test Conditions

220.7.2.1.1	Length	: > 1km
220.7.2.1.2	Temperature	: $23^{\circ} \pm 2^{\circ}\text{C}$
220.7.2.1.3	Water Quality	: Distilled, Demineralised or De-ionised

220.7.2.1.4 Duration : 30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤0.05
2.	Induced attenuation at 1625nm	dB/km	≤0.05

220.7.3 **Dry Heat.** This shall be measured in accordance with IEC 60793-1-51.

220.7.3.1 **Test Conditions**

- 220.7.3.1.1 Length : > 1km
 220.7.3.1.2 Pre-Conditioning : 2hrs at 23°± 2°C
 220.7.3.1.3 Required Temperature : +85°C
 220.7.3.1.4 Ramp rate : 1°C/min
 220.7.3.1.5 Duration : 30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤0.05
2.	Induced attenuation at 1625nm	dB/km	≤0.05

220.7.4 **Damp Heat.** This shall be measured in accordance with IEC 60793-1-50.

220.7.4.1 **Test Conditions**

- 220.7.4.1.1 Length : > 1km
 220.7.4.1.2 Pre-Conditioning : 2hrs at 23°± 2°C
 220.7.4.1.3 Required Temperature : +85°C
 220.7.4.1.4 Relative Humidity : 85%
 220.7.4.1.5 Ramp rate : 1°C/min
 220.7.4.1.6 Duration : 30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤0.05
2.	Induced attenuation at 1625nm	dB/km	≤0.05

220.7.5 **Temperature Humidity Cycling.** This shall be measured in accordance with ANSI/TIA/EIA-455-73.

220.7.5.1 Test Conditions

220.7.5.1.1	Length	: > 1km
220.7.5.1.2	Pre-Conditioning	: 2hrs at 23°± 2°C
220.7.5.1.3	Minimum Temperature	: - 10°C
220.7.5.1.4	Maximum Temperature	: +85°C
220.7.5.1.5	Relative Humidity	: up to 98%
220.7.5.1.6	Ramp rate	: 1°C/min
220.7.5.1.7	No. of cycles	: 7

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤0.05
2.	Induced attenuation at 1625nm	dB/km	≤0.05

220.8 Degree of Surface Cure. This shall be measured on surface of Natural fiber by FTIR technique (Fourier Transform Infrared Spectroscopy).

Ser No	Fiber Category	Units	Requirement
1.	Degree of Curing	%	≥ 90

220.9 Fiber Materials

- 220.9.1 Where applicable materials used for the fiber and its coating shall comply with the RoHS directive.
- 220.9.2 The fiber shall be manufactured using high-silica doped as necessary to provide required transmission performance. The materials used shall be indicated.
- 220.9.3 The substances of which the fiber coatings are made shall be indicated.
- 220.9.4 The coating shall be an inert material, which can be readily removed for splicing purposes without damage to the fiber.

220.10 Colour Fiber Qualification Test

- 220.10.1 **MEK Rub Test (Methyl Ethyl Ketone).** To be tested by using soaked (Solvent) tissue paper for ten strokes unidirectional on 10 cm length of fiber. No colour traces to be observed on the tissue paper.
- 220.10.2 **Water Immersion Test.** This shall be measured in accordance with IEC 0793-1-53. Stripping force & Attenuation values to be measured before and after the test.

220.10.2.1 Test Conditions

220.10.2.1.1	Length	: > 1km
220.10.2.1.2	Temperature	: 23°± 2°C
220.10.2.1.3	Water Quality	: Distilled,

Demineralised or
De-ionised

220.10.2.1.4 Duration

: 30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1550nm	dB/km	≤0.05
2.	Induced attenuation at 1625nm	dB/km	≤0.05
3.	Coating Strip Force (Average)	N	1-5

220.11 **Product Qualification Requirements.** The product shall be complied as per following Qualification Programs.

220.11.1 **Initial Product Qualification (IPQ).** The product manufactured on representative production equipment should be tested for conformance to the requirement. Once testing has shown that the product meets the requirement, it is generally assumed that it should continue to meet the requirement as long as the fiber design, material composition, or manufacturing process that affect functionality of the product are not changed.

220.11.2 **Manufacturing Quality Program (MQP).** A manufacturer's internal quality program that assures the product being produced continues to be of the same high quality that was initially tested and is shown to meet Initial Product Acceptance criteria.

220.12 **Qualification Criteria for Fiber**

Ser No	Test	IPQ	MQP
1.	Fiber Refractive Index Profile	X	
2.	Fiber Group Index	X	
3.	Coating Refractive Index	X	
4.	Mode Field Diameter	X	X
5.	Cable Cutoff Wavelength	X	
6.	Chromatic Dispersion	X	X
7.	Polarization Mode Dispersion	X	X
8.	Attenuation	X	X
9.	Point Discontinuities	X	X
10.	Macrobending	X	
11.	Fiber Geometry	X	X
12.	Coating Geometry	X	X
13.	Fiber Curl	X	
14.	Proof Test	X	X

15.	Dynamic Tensile Strength	X	
16.	Strip Force	X	
17.	Dynamic Stress Corrosion susceptibility	X	
18.	Static Stress Corrosion Susceptibility	X	
19.	Fusion Splice Loss	X	
20.	Change of Temperature	X	
21.	Water Immersion	X	
22.	Dry Heat	X	
23.	Damp Heat	X	
24.	Temperature Humidity Cycling	X	
25.	Degree of Surface cure	X	
26.	Fiber materials	X	
27.	Colour Fiber Qualification	X	

220.13 **Test Results.** The Fiber Test report shall provide following parameters: -

- 220.13.1 Product Name.
- 220.13.2 Fiber Identification No.
- 220.13.3 Fiber Length.
- 220.13.4 Group Refractive Index at 1550 nm & 1625 nm.
- 220.13.5 Attenuation at 1550 nm.
- 220.13.6 Attenuation at 1383±3 nm (Post- hydrogen aging).
- 220.13.7 Attenuation at 1625 nm.
- 220.13.8 Mode Field Diameter at 1550 nm.
- 220.13.9 Cable Cutoff Wavelength.
- 220.13.10 Chromatic Dispersion at 1530-1565 nm.
- 220.13.11 Chromatic Dispersion at 1565-1625 nm.
- 220.13.12 Polarization Mode Dispersion.
- 220.13.13 Cladding Diameter.
- 220.13.14 Core/Cladding Concentricity Error.
- 220.13.15 Cladding Non-circularity.
- 220.13.16 Coating Diameter.
- 220.13.17 Cladding/Coating Concentricity Error.
- 220.13.18 Coating Non-circularity.
- 220.13.19 Fiber Curl.
- 220.13.20 Proof Test Level.

Single Mode Optical Fiber, ITU-T G.652D

221. **Scope.** These specifications provide details of Single Mode optical fibers G.652D that is intended for use in meshed topology in Access Networks based on highly resilient and intelligent Carrier Ethernet technology riding over MPLS in the backbone and connected to DWDM based optical backbone transmission network. **ITU-T G.652D** Fibers in this category are required for Access network applications.

222. Refractive Index Characteristics

222.1 **Fiber refractive index profile.** The refractive index profile shall be measured in accordance with IEC 60793-1-20 Method A. The actual design of the profile and tolerances shall be provided at the product approval stage.

222.2 **Fiber Group Index.** The group index shall be measured in accordance with IEC 60793-1-22 Method A. The value of effective refractive indices at 1310nm and 1550nm shall be provided at the product approval stage.

222.3 **Coating refractive index.** The refractive index of the coating, n_c and the refractive index of the fiber cladding, n_o shall be related as follows: -

222.3.1 $n_o < n_c < 1.1 \times n_o$ Where the coating is composed of more than one layer, the n_c shall refer to the inner layer. It is desirable for the outer coating layer to have a refractive index that exceeds n_o . The resin manufacturer's data shall be acceptable for this purpose.

223. Transmission Characteristics

223.1 **Mode field diameter.** The Mode field diameter shall be measured in accordance with IEC 60793-1-45.

Ser No	Fiber Category	Units	Requirement
1.	Mode Field Diameter at 1310nm	μm	9.2 ± 0.3

223.2 **Cut-off Wavelength.** The cut-off wavelength shall be measured in accordance with IEC 60793-1-44.

Ser No	Fiber Category	Units	Requirement
1.	*Fiber Cut-off wavelength, λ_c	nm	≤ 1320
2.	*Cable Cut-off wavelength, λ_{cc}	nm	≤ 1260

223.2.1 *The value predicted for either λ_c or λ_{cc} from the relationship between the two configurations, shall have a probability of 95% or greater. The form of the correlation shall be stated and shall be demonstrated.

223.3 **Chromatic Dispersion.** The Chromatic dispersion shall be measured in accordance with IEC 60793-1-42.

Ser No	Fiber Category	Units	Requirement
1.	Zero Dispersion Wavelength	nm	1304 - 1322
2.	Zero Dispersion Slope	ps/nm ² .km	≤0.090
3.	Dispersion at 1550nm	ps/nm.km	≤18
4.	Dispersion at 1285-1330nm	ps/nm.km	≤3.5
5.	Dispersion at 1625nm	ps/nm.km	≤22

223.4 **Polarization Mode Dispersion.** The polarization mode dispersion shall be measured in accordance with IEC 60793-1-48.

Ser No	Fiber Category	Units	Requirement
1.	PMD, Individual Fiber	ps/√km	≤0.20

223.5 Attenuation

223.5.1 **Attenuation Coefficient.** The spectral attenuation shall be measured in accordance with IEC 60793-1-40. Attenuation coefficients shall meet the wavelength ranges defined as per the table given below.

Ser No	Fiber Category	Units	Requirement (at Fiber Stage)	Requirement (at Cable Stage)
1.	Max Attenuation in (1285-1330)nm	dB/km	≤0.36	-
2.	At 1310nm	dB/km	≤0.34	≤0.36
3.	At 1550nm	dB/km	≤0.20	≤0.22
4.	At 1625nm	dB/km	≤0.23	≤0.25
5.	At 1383±3nm (Post- hydrogen aging)	dB/km	≤ Attenuation at 1310nm	-

223.5.2 **Point Discontinuities.** The local attenuation coefficient shall not have point discontinuities in excess of 0.1dB.

Ser No	Fiber Category	Units	Requirement
1.	At 1310nm	dB	≤0.1
2.	At 1550nm	dB	≤0.1

3.	At 1625nm	dB	≤ 0.1

223.5.3 **Macro-Bend performance.** The Macrobend loss shall be measured in accordance with IEC 60793-1-47.

Ser No	Fiber Category	Units	Requirement
1.	100 turns on 60mm diameter mandrel, induced attenuation at 1550nm	dB	≤ 0.05
2.	100 turns on 60mm diameter mandrel, induced attenuation at 1625nm	dB	≤ 0.1
3.	1 turn on 32mm diameter mandrel, induced attenuation at 1550nm	dB	≤ 0.1

224. **Fiber Life Time.** Sufficient data shall be supplied to demonstrate the performance of the fiber over an installed life time of 25 years. This can be based on information obtained from accelerated aging test programmes. The data shall include fiber loss performance and the mechanical performance of both the fiber and coating materials.

225. **Geometrical Characteristics**

225.1 **Fiber.** The geometrical characteristics shall be measured using grey scale method in accordance with IEC 60793-1-20.

Ser No	Fiber Category	Units	Requirement
1.	Cladding Diameter	μm	125 ± 0.7
2.	Cladding Non-Circularity	%	≤ 0.80
3.	Core/Cladding Concentricity Error	μm	≤ 0.50

225.2 **Coating.** The coating shall be measured in accordance with IEC 60793-1-21.

Ser No	Fiber Category	Units	Requirement
1.	Coating Diameter - Uncoloured	μm	245 ± 5
2.	Coating Diameter - Coloured	μm	≤ 265
3.	Cladding/Coating Concentricity Error	μm	10
4.	Coating Non-Circularity	%	4

- 225.3 **Fiber Curl.** The Fiber curl parameter shall be measured in accordance with IEC 60793-1-34.

Ser No	Fiber Category	Units	Requirement
1.	Fiber Curl	m	≥4

226. **Mechanical Characteristics**

- 226.1 **Proof Test.** This shall be measured in accordance with IEC 60793-1-30.

Ser No	Fiber Category	Units	Requirement
1.	Minimum Proof Test Strain Level	%	1

- 226.2 **Dynamic Tensile Strength.** This shall be measured in accordance with IEC 60793-1-31.

Ser No	Fiber Category	Units	Requirement
1.	Tensile Strength(Median) for 0.5m specimen length – Unaged fibers	Gpa	≥3.80
2.	Tensile Strength(Median) for 0.5m specimen length – Aged fibers	Gpa	≥3.00
3.	Tensile Strength(Median) for 10m specimen length – Unaged fibers	Gpa	≥3.45

- 226.3 **Stripping Force.** This shall be measured in accordance with IEC 60793-1-32.

Ser No	Fiber Category	Units	Requirement
1.	Coating Strip Force (Average)	N	1-5

- 226.4 **Dynamic Stress Corrosion Susceptibility Constant.** This shall be measured in accordance with IEC 60793-1-33.

Ser No	Fiber Category	Units	Requirement
1.	Dynamic Stress Corrosion Susceptibility Constant, nd	-	≥20

- 226.5 **Static Stress Corrosion Susceptibility Constant.** This shall be measured in accordance with IEC 60793-1-33.

Ser No	Fiber Category	Units	Requirement
1.	Static Stress Corrosion Susceptibility	-	≥20

	Constant, ns		

226.6 **Fusion Splice Loss.** This shall be measured in accordance with ANSI/TIA/EIA-455-8.

226.6.1 **Test Conditions** No. of Splices : 10

Ser No	Fiber Category	Units	Requirement
1.	Mean Splice loss at 1310nm	dB	≤0.1
2.	Mean Splice loss at 1550nm	dB	≤0.1

227. Environmental Characteristics

227.1 **Change of Temperature.** This shall be measured in accordance with IEC 60793-1-52.

227.1.1 **Test Conditions**

227.1.1.1	Length	:	> 1km
227.1.1.2	Pre-Conditioning	:	2hrs at 23°± 2°C
227.1.1.3	Minimum Temperature	:	- 60°C
227.1.1.4	Maximum Temperature	:	+85°C
227.1.1.5	Dwell time at each temperature	:	2hrs
227.1.1.6	Ramp rate	:	1°C/min
227.1.1.7	No. of cycles	:	10

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05

227.2 **Water Immersion.** This shall be measured in accordance with IEC 60793-1-53.

227.2.1 **Test Conditions**

227.2.1.1	Length	:	> 1km
227.2.1.2	Temperature	:	23°± 2°C
227.2.1.3	Water Quality	:	Distilled, De-mineralised or De-ionised
227.2.1.4	Duration	:	30 Days

Ser No	Fiber Category	Units	Requirement

1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05

227.3 **Dry Heat.** This shall be measured in accordance with IEC 60793-1-51.

227.3.1 **Test Conditions**

227.3.1.1	Length	:	> 1km
227.3.1.2	Pre-Conditioning	:	2hrs at 23°± 2°C
227.3.1.3	Required Temperature	:	+85°C
227.3.1.4	Ramp rate	:	1°C/min
227.3.1.5	Duration	:	30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05

227.4 **Damp Heat.** This shall be measured in accordance with IEC 60793-1-50.

227.4.1 **Test Conditions**

227.4.1.1	Length	:	> 1km
227.4.1.2	Pre-Conditioning	:	2hrs at 23°± 2°C
227.4.1.3	Required Temperature	:	+85°C
227.4.1.4	Relative Humidity	:	85%
227.4.1.5	Ramp rate	:	1°C/min
227.4.1.6	Duration	:	30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05

227.5 **Temperature Humidity Cycling.** This shall be measured in accordance with ANSI/TIA/EIA-455-73.

227.5.1 **Test Conditions**

227.5.1.1	Length	:	> 1km
227.5.1.2	Pre-Conditioning	:	2hrs at 23°± 2°C
227.5.1.3	Minimum Temperature	:	- 10°C
227.5.1.4	Maximum Temperature	:	+85°C
227.5.1.5	Relative Humidity	:	up to 98%

227.5.1.6	Ramp rate	:	1°C/min
227.5.1.7	No. of cycles	:	7

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05

227.6 **Degree of Surface Cure.** This shall be measured on surface of Natural fiber by FTIR technique (Fourier Transform Infrared Spectroscopy).

Ser No	Fiber Category	Units	Requirement
1.	Degree of Curing	%	≥ 90

227.7 **Fiber Materials.** Where applicable materials used for the fiber and its coating shall comply with the RoHS directive (The RoHS Directive stands for 'The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment').

227.7.1 The fiber shall be manufactured using high-silica doped as necessary to provide required transmission performance. The materials used shall be indicated.

227.7.2 The substances of which the fiber coatings are made shall be indicated.

227.7.3 The coating shall be an inert material, which can be readily removed for splicing purposes without damage to the fiber.

227.8 **Colour Fiber Qualification Test**

227.8.1 **MEK Rub Test (Methyl Ethyl Ketone).** To be tested by using soaked (Solvent) tissue paper for ten strokes unidirectional on 10 cm length of fiber. No colour traces to be observed on the tissue paper.

227.8.2 **Water immersion Test.** This shall be measured in accordance with IEC 60793-1-53. Stripping force & Attenuation values to be measured before and after the test.

227.8.2.1 **Test Conditions**

227.8.2.1.1	Length	:	> 1km
227.8.2.1.2	Temperature	:	23°± 2°C
227.8.2.1.3	Water Quality	:	Distilled, De-mineralised or De-ionised
227.8.2.1.4	Duration	:	30 Days

Ser No	Fiber Category	Units	Requirement
1.	Induced attenuation at 1310nm	dB/km	≤0.05
2.	Induced attenuation at 1550nm	dB/km	≤0.05
3.	Coating Strip Force (Average)	N	1-5

228. **Product Qualification**

Requirements. The product shall be complied as per following Qualification Programs.

228.1 **Initial Product Qualification (IPQ).** The product manufactured on representative production equipment should be tested for conformance to the requirement. Once testing has shown that the product meets the requirement, it is generally assumed that it should continue to meet the requirement as long as the fiber design, material composition, or manufacturing process that affect functionality of the product are not changed.

228.2 **Manufacturing Quality Program (MQP).** A manufacturer's internal quality program that assures the product being produced continues to be of the same high quality that was initially tested and is shown to meet Initial Product Acceptance criteria.

228.3 **Qualification Criteria for fiber**

Ser No	Test	IPQ	MQP
1.	Fiber Refractive Index Profile	X	
2.	Fiber Group Index	X	
3.	Coating Refractive Index	X	
4.	Mode Field Diameter	X	X
5.	Cable Cutoff Wavelength	X	
6.	Chromatic Dispersion	X	X
7.	Polarization Mode Dispersion	X	X
8.	Attenuation	X	X
9.	Point Discontinuities	X	X
10.	Macrobending	X	
11.	Fiber Geometry	X	X
12.	Coating Geometry	X	X
13.	Fiber Curl	X	
14.	Proof Test	X	X
15.	Dynamic Tensile Strength	X	
16.	Strip Force	X	
17.	Dynamic Stress Corrosion susceptibility	X	
18.	Static Stress Corrosion Susceptibility	X	
19.	Fusion Splice Loss	X	

20.	Change of Temperature	X	
21.	Water Immersion	X	
22.	Dry Heat	X	
23.	Damp Heat	X	
24.	Temperature Humidity Cycling	X	
25.	Degree of Surface cure	X	
26.	Fiber materials	X	
27.	Colour Fiber Qualification	X	

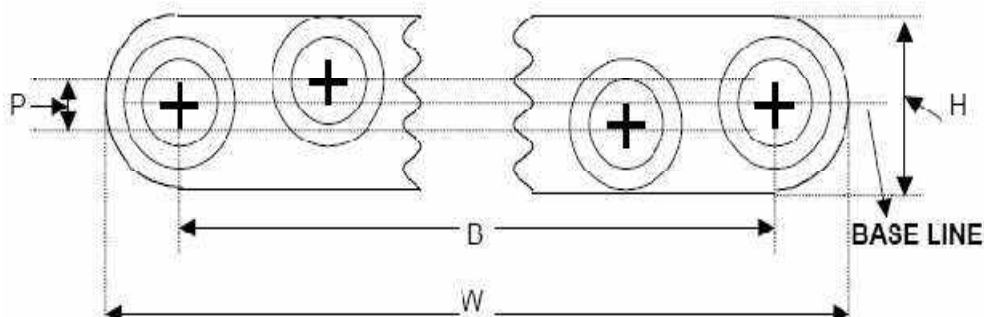
228.4 **Test Results.** The Fiber Test report shall provide following parameters.

- 228.4.1 Product Name.
- 228.4.2 Fiber Identification No.
- 228.4.3 Fiber Length.
- 228.4.4 Group Refractive Index at 1310nm, 1550nm & 1625nm.
- 228.4.5 Attenuation at 1310nm.
- 228.4.6 Attenuation at 1383±3nm (Post- hydrogen aging).
- 228.4.7 Attenuation at 1550nm.
- 228.4.8 Attenuation at 1625nm.
- 228.4.9 Mode Field Diameter at 1310nm.
- 228.4.10 Fiber Cutoff Wavelength.
- 228.4.11 Zero Dispersion Wavelength.
- 228.4.12 Zero Dispersion Slope.
- 228.4.13 Chromatic Dispersion at 1285-1330nm.
- 228.4.14 Chromatic Dispersion at 1550nm.
- 228.4.15 Chromatic Dispersion at 1625nm.
- 228.4.16 Maximum Attenuation in (1285-1330) nm.
- 228.4.17 Polarization Mode Dispersion.
- 228.4.18 Cladding Diameter.
- 228.4.19 Core/Cladding Concentricity Error.
- 228.4.20 Cladding Non-circularity.
- 228.4.21 Coating Diameter.
- 228.4.22 Cladding/Coating Concentricity Error.
- 228.4.23 Coating Non-circularity.
- 228.4.24 Fiber Curl.
- 228.4.25 Proof Test Level.

Type A: 48F Ribbon Type Intrusion Proof Fiber Optic Cable
[24F Ribbon (G.655) + 24F Ribbon (G.652D) + 8F (G.652D) Sensory Fibers]
for NLD Routes

229. **Scope.** This specification gives the requirements of single mode fiber optic cable that is intended for use in Defence networks. The transmission application for these cables are for NLD systems with intrusion proofing to create a secured physical link operating at nominal wavelengths of 1310 and 1550 nm for G.652D and 1550 nm & 1625 nm for G.655 fiber.
230. **Introduction.** The requirements of the cable within this specification are based on operational needs in conjunction with their applications for Long Haul part of the Defence Network. The single mode fiber optic cable shall be of unarmored type and the transmission part of the cable shall meet ITU-T recommendation G.652D and G.655 for Non-Zero Dispersion Shifted Fiber (NZDSF) as well as the best industry practices for DWDM transmission. The cable shall have additional sensory fibers for mounting of Intrusion Proof Systems.
231. **Functional Requirements**
- 231.1 The design and construction of the Ribbon Fiber Optic Cables shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.
 - 231.2 The fiber optic cable supplied shall be blowable inside 40/33 mm PLB ducts.
 - 231.3 The Ribbon optical fiber cables shall be able to work in a saline atmosphere in coastal areas and should be protected against corrosion.
 - 231.4 Life of the cables shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer based upon life of the fiber and other component parts of the cable. The cables shall meet the cable aging test requirements.
 - 231.5 If any special tool required for operating and handling the fiber optic cable, the same shall be provided along with the cable.
 - 231.6 The Ribbon fiber optic cables supplied shall be suitable and compatible to match with the dimensions, fixing, terminating and splicing arrangement of the splice closure supplied along with the cable.
 - 231.7 The manufacturer shall submit an undertaking that the optical and mechanical fiber characteristics shall not change during the life time of the cable against the manufacturing defects.
 - 231.8 It is mandatory that the fiber optic cables supplied in a particular route are manufactured from a single source of optical fibers.
232. **Ribbon Structure**
- 232.1 Twelve primary coated fibers shall be arranged in ribbon structure. The fibers in the structure shall be parallel and shall not cross over each other along the entire length of the ribbon. The dimensions of 12 fiber ribbon shall be as per specifications given below.
 - 232.2 **Ribbon Dimensions.** The maximum dimensions of fiber ribbon shall be as follows and the cross section geometry of the fiber ribbon shall be as shown in the following figure:-

Ser No	Number of Fibers	Ribbon Width (W)	Ribbon height (H)	Extreme Fibers (B)	Planarity (P)
1.	12	3220 μm	360 μm	2882 μm	50 μm



Cross Section of Fiber Ribbon

232.3 Ribbon Material. The ribbon shall be manufactured using single mode optical fibers coloured with UV cured resin and the ribbon shall be encapsulated with a further layer of UV cured acrylate. The fibers and the ribbons shall confirm to the colour requirement as per Clause No. 236.4 below of this specification.

232.4 Ribbon Mechanical Properties

232.4.1 Ribbon Macro-bend. Change in attenuation when wrapped on a 60 mm diameter mandrel for 100 turns at 1310 nm, 1550 nm for G.652D ribbon & 1550 nm, 1625 nm for G.655 ribbon shall be ≤ 0.05 dB at 1310 nm & 1550 nm and ≤ 0.10 dB at 1625 nm.

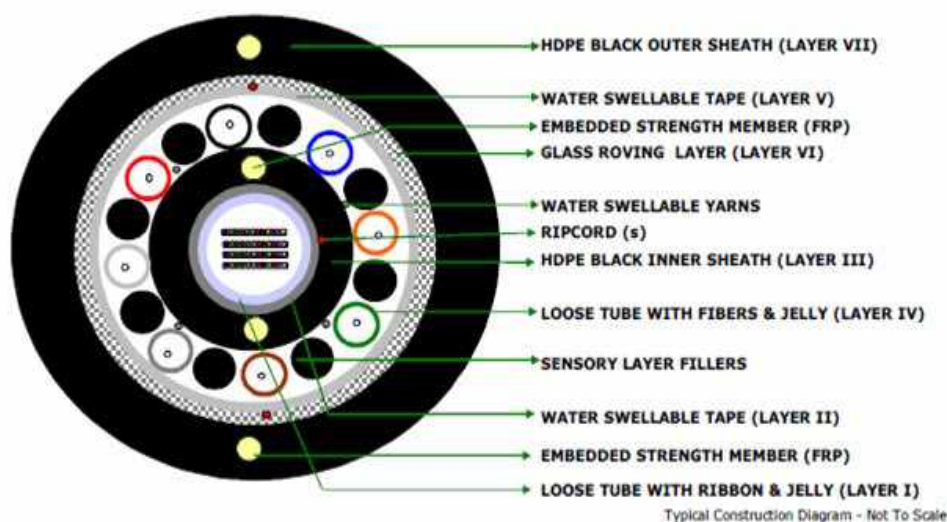
232.4.2 Ribbon Compression Resistance. Change in attenuation when subjected to a compressive load of 500 N for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths shall be ≤ 0.05 dB.

232.4.3 Ribbon Torsion Resistance. Change in attenuation (for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths) shall be ≤ 0.05 dB.

233. Intrusion Proof Cable Specifications

233.1 Fiber Optic Physical Layer Security System. The sensory layer in the fiber optic cable shall be connected to the fiber optic physical layer security system so that the cable shall be intrusion proof. These systems shall be procured separately by BSNL.

233.2 Fiber Optic Cable Construction Specification: Embedded Strength members are required in both sheaths. The manufacturer shall submit the cable design (Refer Figure which is only indicative) with all the parameters. The manufacturer shall submit design calculation and the same shall be studied and checked. (Below is an Indicative drawing)



233.2.1 **Secondary Protection.** The primary coated fibers in the sensory layer (outer core) shall be protected by loose packaging within a tube, which shall be filled with thixo-tropic jelly.

233.2.2 No. of fibers in a ribbon : Twelve (12)

233.2.3 Type and No of ribbons in central tube : 4

233.2.3.1 Ribbon 1 : G.655

233.2.3.2 Ribbon 2 : G.655

233.2.3.3 Ribbon 3 : G.652D

233.2.3.4 Ribbon 4 : G.652D

233.2.4 No of tubes in outer core (sensory layer) : 8

233.2.5 No of fiber in each tube : 1

233.2.6 No of fillers : 8

233.2.7 The loose tubes and fillers to be placed alternatively.

233.2.8 Also refer to the Appendix 'F' of the tender for the detailed manufacturing parameters of the ribbon and cable.

233.2.9 **Strength Member**

233.2.9.1 Minimum Two Solid FRP strength members diametrically opposite to each other shall be embedded within each of the sheaths.

233.2.10 **Cable Core Assembly.** The cable core assembly will be defined as following : -

233.2.10.1 **Primary Cable Core.** Primary coated fibers in ribbon structure shall be protected inside a central tube forming the inner core of the cable. Inner core shall be protected with core wrapping and moisture barrier. Non-metallic moisture barrier sheaths may

be applied over the inner core as per clause No 233.2.13 below. Inner sheath to form primary Cable core.

233.2.10.2 **Secondary Cable Core.** Primary coated fibers in 8 loose tubes with 8 fillers (sensory layer) to be stranded over primary cable core to form the outer secondary cable core with one fiber in each tube (sensory layer). The buffer tubes shall be of different colour as per Appendix 'F' and are required to maintain the fibers mechanical and optical integrity. It shall also protect them from tensile, thermal and vibration loads. The buffer tubes shall be gel filled to block the ingress of water.

233.2.11 **Core Wrapping & Moisture Barrier Protection.** The main cable core containing fibers (including ribbon) shall be wrapped by non-greasy material functioning as water blocking agent when coming into contact with water. The dry block material shall be designed to absorb water upon contact and swell to block further ingress of water. It shall be non-nutritive to fungus and free from dirt and foreign matter. The core wrapping shall not adhere to the secondary fiber coating and shall not leave any kink marks over the loose tubes.

233.2.12 **Filling compound.** The filling compound used in the loose tube shall be compatible to fiber, secondary protection of fiber, etc. The drip point shall not be lower than +70 degree C. The fiber movement shall not be constrained by stickiness and shall be removable easily for splicing. The test method to measure drop point shall be as per ASTM D 556.

233.2.13 **Inner Sheath.** A non-metallic moisture barrier sheath may be applied over and above the cable core with minimum two Nos of solid FRP strength members embedded in the sheath (As per Appendix 'F'). The core shall be covered with tough weather resistant High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). The colour shall conform to Munsell Colour Standards. Thickness of the sheath shall be uniform. The sheath shall be circular, smooth and free from pin holes, joints, mended pieces and other defects.

233.2.13.1 **Note.** In case black colour HDPE material is used, the material from finished product shall also be subjected to following tests (on sample basis).

233.2.13.1.1 Density.

233.2.13.1.2 Melt Flow Index.

233.2.13.1.3 Carbon Black Content.

233.2.13.1.4 Carbon Black Dispersion.

233.2.13.1.5 ESCR.

233.2.13.1.6 Moisture Content.

233.2.13.1.7 Tensile Strength and Elongation at break.

233.2.14 **Outer Sheath.** A non-metallic moisture barrier sheath thickness shall be as per Appendix 'F' and made High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). Thickness of the sheath shall be uniform and minimum two diametrically opposite FRP strength members embedded within the sheath and diameter is as per Appendix 'F'. The sheath shall be circular, smooth and free from pin holes, joints, mended pieces and other defects.

233.2.15 **Cable Diameter.** The manufacturer shall design the cable outer diameter as per Appendix F. The finished cable diameter shall be within $\pm 0.5\text{mm}$ of the nominal cable diameter.

233.2.16 **Cable Weight.** The manufacturer shall design the cable within the weight parameters defined at Appendix 'F'.

233.2.17 **RIP Cord**

233.2.17.1 Minimum two suitable rip cords diametrically opposite to each other shall be provided in the outer Sheath and one rip cord provided in inner sheath of the cable, which shall be used to open the HDPE sheath (both inner and outer sheath). It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The rip cords shall be non wicking type and shall not work as a water carrier.

233.2.17.2 The rip cord used in the cable shall be readily distinguishable from any other components (e.g. Aramid Yarn etc.) utilized in the cable construction.

234. **Mechanical Characteristics and Tests on Fiber Optic Cable**

234.1 **Tensile Strength Test**

234.1.1 **Objective.** This measuring method applies to fiber optic cables which are tested at a particular tensile strength in order to examine the behavior of the attenuation as a function of the load on a cable which may occur during installation.

234.1.2 **Method.** IEC 60794-1-2-E1.

234.1.3 **Test Specs.** The cable shall have sufficient strength to withstand a load of value of minimum 3000 N. The load shall be sustained for 10 minutes and the strain on the fiber and the attenuation shall be monitored.

234.1.4 **Requirement.** The load shall not produce a strain exceeding 0.25 % in the fiber and shall not cause any permanent physical and optical damage to any component of the cable. The attenuation shall be noted before strain and after the release of strain. The change in attenuation of each fiber after the test shall be $< 0.05\text{ dB}$ for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.2 **Abrasion Test**

234.2.1 **Objective.** To test the abrasion resistance of the sheath and

the marking printed on the surface of the cable.

- 234.2.2 **Method.** IEC-60794-1-2-E2 or by any other international test method. The cable surface shall be abraded with needle (wt. 150 gm) having diameter of 1 mm with 500 grams weight (Total weight more than equal to 650 gms.).

234.2.2.1 No. of cycles : 100

234.2.2.2 Duration : One minute (Nominal)

- 234.2.3 **Requirement.** There shall be no perforation and loss of legibility of the marking on the sheath.

234.3 Crush Test (Compressive Test)

- 234.3.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand crushing.

- 234.3.2 **Method.** IEC 60794-1-2-E3.

- 234.3.3 **Test Specs.** The fibers and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 4000 Newtons applied, between the plates of dimension 100 mm x 100 mm. The load shall be applied for 600 seconds. The attenuation shall be noted before and after the completion of the test.

- 234.3.4 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.4 Impact Test

- 234.4.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand impact.

- 234.4.2 **Method.** IEC 60794-1-2-E4.

- 234.4.3 **Test Specs.** The cable shall have sufficient strength to withstand an impact caused by a mass weight of 50 Newtons, which falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. Ten such impacts shall be applied at the same place. The attenuation shall be noted before and after the completion of the test.

- 234.4.4 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.5 Repeated Bending

- 234.5.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand repeated bending.

- 234.5.2 **Method.** IEC 60794-1-2-E6.

- 234.5.3 **Test Specs.** The cable sample shall be of sufficient length (5 m minimum) to permit radiant power measurements as required by this test. Longer lengths may be used, if required.

- 234.5.4 **Test Parameters**

234.5.4.1 Weight : 5 Kg

- 234.5.4.2 Minimum distance from Pulley centre to holding device : 216 mm
- 234.5.4.3 Minimum distance from Wt. to Pulley centre : 457 mm
- 234.5.4.4 Pulley Diameter (D – cable diameter) : 20 D
- 234.5.4.5 Angle of Turning : 90°
- 234.5.4.6 No. of cycles : 10
- 234.5.4.7 Time Required for 10 cycle : 2 min
- 234.5.5 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.
- 234.6 **Torsion Test**
- 234.6.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand torsion.
- 234.6.2 **Method.** IEC 60794-1-2-E7.
- 234.6.3 **Test Specs.** The length of the specimen under test shall be 2 meters and the load shall be 100 N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp, sufficiently tight, to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clockwise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anticlockwise direction for one turn and returned to the starting position. This complete movement constitutes one cycle. The cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.
- 234.6.4 **Requirement.** The cable shall be examined physically for any cracks, tearing on the outer sheath and for the damage to other component parts of the cable. The twist mark shall not be taken as damage. The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.
- 234.7 **Kink Test**
- 234.7.1 **Objective.** The purpose of this test is to verify whether kinking of fiber optic cable results in breakage of any fiber, when a loop is formed of dimension small enough to induce a kink on the sheath.
- 234.7.2 **Method.** IEC 60794-1-2-E10.
- 234.7.3 **Test Specs.** The sample length shall be 10 times the minimum bending radius of the cable. The sample is held in both hands and a loop is made of a bigger diameter i.e. 20 D and by stretching both the ends of the cable in opposite direction, the loop is made to the minimum bend radius, and no kink shall form. The cable is then normalized and attenuation reading is taken.
- 234.7.4 **Requirement.** The kink should disappear after the cable is made normal. The change in attenuation of each fiber after the

test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.8 Cable Bend Test

234.8.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand repeated flexing. The procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.

234.8.2 **Method.** IEC 794-1-2-E11 (Procedure-I).

234.8.3 **Test Specs.** The fiber and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.

234.8.4 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.9 Test of Figure of 8 (Eight) on the cable (Type Test)

234.9.1 **Objective.** Check of easiness in formation of figure of 8 of the cable during installation in the field.

234.9.2 **Test Method.** 1000 meter (approximate) of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8 (eight). The diameter of each loop of the figure of 8 shall be maximum 2 meters.

234.9.3 **Requirement.** It shall be possible to make figure of 8 of minimum 1000 meter length of the cable uncoiled from the cable reel, without any difficulty. No visible damage shall occur.

234.10 Temperature Cycling

234.10.1 **Objective.** To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

234.10.2 **Method.** IEC 60794-1-2-F1 (To be tested on Standard cable length of drum i.e. 2/4 Km $\pm$ 5 %).

234.10.3 **Test Specs.** The permissible temperature range for storage and operation should be from -20°C to +70°C. The rate of change of temperature during the test shall be 1° per minute approx. The cable shall be subjected to temperature cycling for 12 Hrs. at each temperature as given below : -

234.10.3.1 TA2 temp. : - 20°C.

234.10.3.2 TA1 temp. : - 10°C.

234.10.3.3 TB1 temp. : + 60°C.

234.10.3.4 TB2 temp. : + 70°C.

234.10.3.5 The test shall be conducted for 2 cycles at the above temperatures.

234.10.4 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.11 Cable Aging test

234.11.1 **Objective.** To check the cable material change dimensionally as the cable ages.

234.11.2 **Method.** At the completion of temperature cycle test, the test cable shall be exposed to 85 + 2 degree C for 168 hours. The attenuation measurement at 1550 nm & 1625 nm wavelength to be made after stabilization of the test cable at ambient temperature for 24 hours.

234.11.3 **Requirement.** The change in attenuation of each fiber after the test shall be < 0.05 dB for both sensory layer and G.652D ribbon at 1310 nm, 1550 nm wavelengths & for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.11.3.1 **Note.** The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.

234.12 Water Penetration Test

234.12.1 **Objective.** To check that installed cable should not allow the water passage along its length.

234.12.2 **Method.** IEC 794-1-2-F5 (Fig. B) 1992.

234.12.3 **Test Specs.** A circumferential portion of the cable end shall face the water head. The water tight sleeve shall be applied over the cable. The cable shall be supported horizontally and two meter water head for 24 hrs, containing sufficient quantity of water soluble fluorescent dye for the detection of seepage, shall be applied on the HDPE sheath. No other colored dye is permitted.

234.12.4 **Requirement.** No dye shall be detected when the end of the 3 m length of the cable is examined with ultraviolet light detector.

234.13 Cable Jacket Yield Strength And Ultimate Elongation

234.13.1 **Objective.** To check the yield strength and elongation of polyethylene (HDPE) cable sheath.

234.13.2 **Test Method.** FOTP-89 or ASTM D1248 Type III Class.

234.13.3 Test Condition

234.13.3.1 Sample shall be taken from a completed cable. The aged sample shall be conditioned at $100 \pm 2^{\circ}$ C for 120 hours before testing.

234.13.3.2 The cross-head speed shall be 50 mm per minute.

234.13.4 Requirement

Ser No	Jacket Material	Minimum Yield Strength		Minimum Elongation (%)
		(MPa)	(psi)	
1.	HDPE un-aged	16.5	2400	400
2.	HDPE aged	12.4	1800	375

234.14 Ribbon Dimension Measurements test

234.14.1 **Objective.** Check of fibers in ribbon structure and to ensure the transmission performance and the mechanical service life of the fiber in the ribbon structure, check of cross over fibers and the check of fiber identity.

234.14.2 **Test method.** FOTP-123 (Video Gray Scale Analysis (VGSA) or Microscopic method).

234.14.3 **Requirement.** It shall meet the dimensional requirements given in clause No. 232.2 above. The fibers in the entire length of the ribbon shall not cross over at any point.

234.15 Ribbon Resistance to Twist (Robustness) test

234.15.1 **Objective.** To check the robustness of the fiber ribbons to withstand the twist in installed conditions and to check the structural integrity of the ribbon over the deployed length for mid-span entry, maintenance purposes, consideration in rearrangements and housekeeping.

234.15.2 **Test method.** FOTP-141.

234.15.3 **Requirement.** The un-aged and aged (at 85 ± 2 degree C with uncontrolled humidity for a period of 30 days) completed ribbon shall not show any separation of individual fibers from the ribbon structure after completion of the twist test when observed under 5X magnification.

234.16 Ribbon Residual Twist (Flatness) test

234.16.1 **Objective.** To check the dimensional integrity of the ribbon without twisting to allow rearrangements and to limit the potential attenuation increases due to a macro-bending caused by twisting of the fiber ribbon.

234.16.2 **Test Method.** FOTP-131.

234.16.3 **Requirement.** The aged (at $85^{\circ} \pm 2^{\circ}$ C with uncontrolled humidity for a period of 30 days) ribbon residual twist (if any) shall have a pitch: > 400 mm.

234.17 Ribbon Separation Test

234.17.1 Objective

234.17.1.1 To check the separation of individual fibers, separation of sub-unit of fibers and mid span separation from a fiber ribbon.

234.17.1.2 To check the retention of sufficient colorant for identification for any 2.5 cm length of fiber after

separation for individual and sub-unit of fibers.

234.17.2 Test

234.17.2.1 Separation of any single fiber or a multi-fiber subgroup by a tool or by hand from a ribbon for a length of 1 meter. Mid span separation from a 2 meter sample, separated close to middle for at least 0.5 meter (both single fiber and the six fiber sub – units) for un-aged ribbon.

234.17.2.1.1 **Requirement.** The un-aged ribbon of minimum length of a 0.3 meter (1.0 foot) of an individual fiber and a sub group of six fibers shall be separated from the ribbon without breaking the fibers or damaging the fiber coating. The force required to perform separation shall not exceed 4.4 N. The area at the separation shall not show any damage to the fiber coating when examined under 5X magnification.

234.17.2.2 Retention of the Colour and Fiber Identification after separation.

234.17.2.2.1 **Requirement.** Individual fiber colour identification shall be maintained after the separation test. It shall retain sufficient colorant that any 2.5 cm length is readily identifiable.

234.17.2.3 Removal of Ribbon matrix material to access individual fibers.

234.17.2.3.1 **Requirement.** No damage shall occur either to fiber coating or the fibers. The coating shall not sustain any swelling self-stripping, cracking or splitting when examined under 5X magnification.

Note. The manufacturer shall recommend the procedure for the removal of ribbon matrix.

234.18 Ribbon Strippability Test

234.18.1 **Objective.** Checking of removal of the matrix material and the fibers protective coating mechanically with commercial stripping tools from un-aged and aged ribbons.

234.18.2 **Test Method.** ITM-9 (Bell Core GR-20-CORE issue 2, July 1998).

234.18.3 Pre Conditioning

234.18.3.1 **Aged samples.** The humidity of aged ribbons

shall be soaked at 85 ± 2 degree C and a non-condensing humidity of $85 \pm 5\%$ for a period of 30 days.

234.18.3.2 **Water aged samples.** The water aged ribbons shall be soaked in deionized or distilled water at a temperature of 23 ± 5 degree for a period of 14 days. The fiber ribbon strip-ability testing shall be conducted at standard atmospheric conditions. The un-aged, humidity – aged, and water aged ribbons shall be tested within eight hours after aging.

234.18.4 **Requirement.** There shall be no fiber breakage, and any coating residue shall be removable with a single isopropyl alcohol wipe when at least 25 mm of the matrix material and the fiber Protective coating is mechanically removed with commercial stripling tools from un-aged and aged ribbons.

234.19 Ribbon Macro-bend Performance

234.19.1 **Objective** To check the macro-bend performance of a ribbon.

234.19.2 **Method.** One hundred turns of ribbon are wound around a 60 mm diameter mandrel and the loss increase for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths shall be measured.

234.19.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm wavelengths & 0.1 dB at 1625 nm wavelength.

234.20 Torsion Resistance of the ribbon test

234.20.1 **Objective.** To check the torsion resistance of the ribbon.

234.20.2 **Method.** One meter length of ribbon is twisted through five revolutions of 360° and measurement is taken.

234.20.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.21 Crush Resistance of Ribbon

234.21.1 **Objective.** To check the crush resistance of the ribbon.

234.21.2 **Method.** A 50 mm^2 sample is subjected to a load of 500 N and the attenuation measurement taken for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.21.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

234.22 Checking of the quality of the loose tube (containing optical fiber ribbon)

234.22.1 Embrittlement Test of Loose Tube

234.22.1.1 This test method is based on bending by compression and reflects embrittlement much better than the other tensile tests. This test is independent of wall thickness of the loose tube.

- 234.22.1.2 **Sample:** The minimum length of the test sample depends on the outside diameter of the loose tube and should be 85 mm for tubes up to 2.5 mm outside dia. The length of the bigger tubes should be calculated by using the following equation:

$$L_o > 100 \times [(D^2 + d^2)/4]^{1/2} \text{ where,}$$

L_o = Length of tube under test.

D = Outside dia of loose tube.

d = Inside dia of loose tube.

- 234.22.1.3 **Procedure.** Both the ends of a buffer tube test sample may be mounted in a tool, which is clamped in jaws of a tensile machine which exerts a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load, the tube should bend so that it is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading.

- 234.22.1.4 **Requirement.** The tube should not get embrittled. No kink should appear on the tube up to the safe bend diameter of tube (15 D), where D is the outside diameter of the loose tube. There should also not be any physical damage or mark on the tube surface.

234.22.2 Kink Resistance Test on the Loose Tube

- 234.22.2.1 **Objective.** To safeguard the delicate optical fibers, the quality of the loose tube material should be such that no kink or damage to the tube occurs while it is being handled during installation and in splicing operations.

- 234.22.2.2 **Procedure.** To check the kink resistance of the loose tube, a longer length of the loose tube is taken (with fiber and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 15D (where D is the outside diameter of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube.

- 234.22.2.3 **Requirement.** No damage or kink should appear on the surface of the tube.

234.23 Drainage Test for loose Tube

- 234.23.1 **Sample Size.** 30 cm tube length.

234.23.2 Test procedure

- 234.23.2.1 Cut the tube length to 40 cm.

- 234.23.2.2 Fill the tube with the tube filling gel ensuring that there are no air bubbles and the tube is completely

full.

234.23.2.3 Place the filled tube in a horizontal position on a clean worktop and cut 5 cm from either end so that the finished length of the sample is 30 cm.

234.23.2.4 Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs.

234.23.2.5 The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70° C for a period of 24 Hrs.

234.23.2.6 At the end of the 24 hrs period the beaker is checked and weighed to see if there is any gel in the beaker.

234.23.3 Requirement

234.23.3.1 If there is no gel or oil in the beaker the tube has PASSED the drainage test.

234.23.3.2 If there is gel or oil in the beaker the tube has FAILED the drainage test.

234.24 Checking for easy removal of sheath

234.24.1 **Objective.** Checking for easy removal of sheath of the fiber optic cable by using normal sheath removal tool.

234.24.2 **Procedure.** To check easy removal, the sheath shall be cut in circular way and about 300 mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. One should be able to remove the sheath easily.

234.24.3 **Note.** Easy removal of both the outer jacket and the inner sheath shall be checked separately.

234.25 Check of the effect of aggressive media on the cable (Acidic and Alkaline Behavior)

234.25.1 **Procedure.** To check the effect of aggressive media, solution of PH4 and PH10 shall be made. The two test samples of the finished cable, each of 600 mm in length, are taken and the ends of the samples are sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc on the sheath and other markings of the cables.

234.25.2 **Requirement.** The sample should not show any effect of these solutions on the sheath and other marking of the cable.

234.26 Cable Outer Diameter and Jacket Thickness

234.26.1 **Sample Size.** At least three specimens from each cable sample shall be tested to determine conformance to the criteria of this section. Alternatively, compliance to the cable outer diameter and jacket thickness criteria may be verified by a review of test data from the cable manufacturer.

234.26.2 **Procedure.** Cable samples shall be tested in accordance with Sections 6 through 8 of ASTM D 4565.

234.26.2.1 Section 6 for cable diameter.

234.26.2.2 Section 7 for cable jacket thickness.

234.26.2.3 Section 8 for cable jacket eccentricity.

234.26.3 **Requirements.** The average diameter of the cable shall not exceed the specifications given at Appendix 'F'.

235. General Requirements

236. Engineering requirements

236.1 Cable Marking

236.1.1 A long lasting suitable marking shall be applied in order to identify this cable from other cables. The cable marking shall be imprinted (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The accuracy of the sequential marking should be within -0.25% to +0.5% of the actual measured length. The markings on the cable should not rub off during normal installation and in life time of fiber optic cable.

236.1.2 The marking shall be in contrast color to the sheath and shall be done by hot foil indentation method. It should clearly contrast with the surface. The colour used should withstand the environmental influences experienced in the field.

236.1.3 The type of legend marking on fiber cable shall be as follows : -

236.1.3.1 Company Legend.

236.1.3.2 Legend containing telephone mark & international acceptable Laser symbol.

236.1.3.3 Type of cable (Type A)

236.1.3.4 Type of Fibers (G.655+G.652D).

236.1.3.5 Number of Fibers(48+8).

236.1.3.6 Year of manufacture.

236.1.3.7 Sequential length marking.

236.1.3.8 User's identification : NFS OFC

236.1.3.9 Cable ID.

236.2 Cable Ends

236.2.1 Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall be accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The drum (conforming to GR No G/CBD-01/02 Nov 94 and subsequent amendments if any) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti twist device (free head hook). The diameter of the cable shall also be marked on the cable drum. The wooden drum shall be properly treated against

termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

- 236.2.2 An anti-twist device (Free head hook) shall be provided attached to the front end of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system, along with the anti twist system, shall withstand the prescribed tensile load applicable to the cable.

236.3 Nominal Drum Length

- 236.3.1 Length of OFC in each drum shall be $2/4 \text{ Km} \pm 5 \%$ and shall be supplied as per the order. The variation in length of fiber optic cable, as specified above (in each drum), shall be acceptable.
- 236.3.2 In order to avoid wastage of OFC, the supplier is permitted to supply upto two drums per NLD link, of shorter length, to cater for fractional link lengths finalized after completion of route survey.
- 236.3.3 The fibers in cable length shall not have any joint.
- 236.3.4 The drum shall be marked with arrows to indicate the direction of rotation.
- 236.3.5 Packing list supplied with each drum shall have at least the following information:
- 236.3.5.1 Drum No.
 - 236.3.5.2 Type of cable.
 - 236.3.5.3 Physical Cable length.
 - 236.3.5.4 No. of fibers.
 - 236.3.5.5 Length of each fiber as measured by OTDR.
 - 236.3.5.6 The Cable factor - ratio of fiber / cable length.
 - 236.3.5.7 Attenuation per Km. for G.652D fibers at 1310 nm, 1550 nm and 1625 nm and Attenuation per Km. for G.655 fibers at 1550 nm and 1625 nm.
 - 236.3.5.8 User's / Consignee's Name.
 - 236.3.5.9 Manufacturer's Name, Month, Year and Batch No.
 - 236.3.5.10 Group refractive index of fibers.
 - 236.3.5.11 Purchase Order No.
 - 236.3.5.12 Cable ID.

236.4 Colour Coding and Ribbon identification in Optical Fiber Cables

- 236.4.1 The colorant applied to individual fibers shall be readily identifiable throughout the life time of the cable and shall match and conform to the MUNSSELL color standards (For EIA standard EIA-359-A) or IEC Publication 304 (4).
- 236.4.2 **Colour Coding Scheme.** When the loose tubes are placed in circular format, the marking to indicate the loose tube No "1" shall be in blue colour followed by loose tube No 2 of orange and so on for other tubes as per the colour scheme given below and complete the circular format by placing the dummy /fillers at the end. The colour of the fibers are serially chosen from the column

No. III of the following **Table 6.1** .

Ser No	No of Fibers	Fiber Identification
(I)	(II)	(III)
1.	1	Blue
2.	2	Orange
3.	3	Green
4.	4	Brown
5.	5	Slate / Grey
6.	6	White
7.	7	Red
8.	8	Black
9.	9	Yellow
10.	10	Violet
11.	11	Pink / Rose
12.	12	Aqua

Table 6.1 Colour coding scheme of the Optical Fibers & Loose tube

236.4.3 Identification of Ribbon

Ser No	No. of Fibers in a cable	No. of tubes	No. of ribbons per tube	Marking on Ribbon
1.	48	One	4	1 RIBBON 1 2 RIBBON 2 3 RIBBON 3 4 RIBBON 4

236.4.4 **Note.** The printing shall be at regular interval of every 200 mm on natural color ribbon and shall be legible. The printing on the ribbon shall also be of durable quality and shall be compatible with coating of the ribbon and Thixotropic Jelly (filled in the loose tube of the cable).

237. **Quality Requirements.** The cable shall be manufactured in accordance with the international quality standards ISO 9001-2008 for which the manufacturer should be duly accredited. A quality plan followed by the manufacturer shall be required to be submitted.
238. **Cable Material Compatibility.** Optical fiber, buffers/core tubes, and other core components shall meet the requirements of the compatibility with buffer/core tube filling material(s) and/or water-blocking materials that are in direct contact with identified components within the cable structure.

239. **Documentation**

239.1 Complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions and test data and other details of the cable shall be provided.

239.2 All aspects of installation, operation, maintenance shall also be covered in the handbook. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall be also be submitted. A hard as well as soft copy of the manuals shall be provided.

240. **Safety Requirement.** The material used in the manufacturing of the single mode fiber optic cables shall be non toxic and dermatologically safe in its life time and shall not be hazardous to health. The manufacturer shall submit MSDS (Material Safety Data Sheet) for all the material used in manufacturing of fiber optic cable to substantiate the statement.

241. **Product Qualification Requirements.** The product shall be complied as per following Qualification Programs.

241.1 **Initial Product Qualification (IPQ).** The product manufactured on representative production equipment should be tested for conformance to the requirement. Once testing has shown that the product meets the requirement, it is generally assumed that it should continue to meet the requirement as long as the fiber design, material composition, or manufacturing process that affect functionality of the product are not changed.

241.2 **Manufacturing Quality Program (MQP).** A manufacturer's internal quality program that assures the product being produced continues to be of the same high quality that was initially tested and is shown to meet Initial Product Acceptance criteria.

241.3 **Qualification Program for Cable**

Ser No	Test	IPQ	MQP
1.	Cable Outer Diameter & Jacket	X	X
2.	Cable Marking	X	X
3.	Cable Ends	X	X
4.	Cable Drum Length	X	X
5.	Cable Tensile Strength	X	X
6.	Cable Abrasion	X	
7.	Cable Crush	X	X
8.	Cable Impact	X	X
9.	Cable Repeated Bending	X	X
10.	Cable Torsion	X	X
11.	Cable Kink	X	
12.	Cable Bend	X	
13.	Cable Figure of Eight	X	

14.	Cable Temperature Cycling	X	X
15.	Cable Aging	X	
16.	Cable Water Penetration	X	
17.	Cable jacket yield strength and ultimate elongation	X	X
18.	Cable Loose Tube Drainage	X	
19.	Cable Sheath Removal	X	
20.	Cable Acidic Alkaline Behaviour	X	
21.	Ribbon Dimension	X	
22.	Ribbon Resistance to Twist	X	
23.	Ribbon Residual Twist	X	
24.	Ribbon Separation	X	
25.	Ribbon Strippability	X	
26.	Ribbon Macro Bend Performance	X	
27.	Ribbon Torsion Resistance	X	
28.	Ribbon Crush Resistance	X	
29.	Ribbon Loose Tube Quality	X	

241.4 **Test Results.** The Fiber Test report shall provide following parameters: -

- 241.4.1 Product Name.
- 241.4.2 Fiber Identification No.
- 241.4.3 Fiber Length.
- 241.4.4 Group Refractive Index at 1310 nm, 1550 nm & 1625 nm.
- 241.4.5 Attenuation at 1310 nm for G.652D fiber.
- 241.4.6 Attenuation at 1550 nm for G.652D and G.655 fibers
- 241.4.7 Attenuation at 1383±3 nm (Post- hydrogen aging).
- 241.4.8 Attenuation at 1625 nm for G.652D and G.655 fibers.
- 241.4.9 Mode Field Diameter at 1310 nm for G.652D fiber.
- 241.4.10 Mode Field Diameter at 1550 nm for G.655 fiber.
- 241.4.11 Cable Cutoff Wavelength.
- 241.4.12 Chromatic Dispersion at 1285-1330 nm, 1550nm, 1625 nm for G.652D fiber.
- 241.4.13 Chromatic Dispersion at 1530-1565 nm, 1565-1625 nm for G.655 fiber.
- 241.4.14 Polarization Mode Dispersion.
- 241.4.15 Cladding Diameter.
- 241.4.16 Core/Cladding Concentricity Error.
- 241.4.17 Cladding Non-circularity.

- 241.4.18 Coating Diameter.
- 241.4.19 Cladding/Coating Concentricity Error.
- 241.4.20 Coating Non-circularity.
- 241.4.21 Fiber Curl.
- 241.4.22 Proof Test Level.

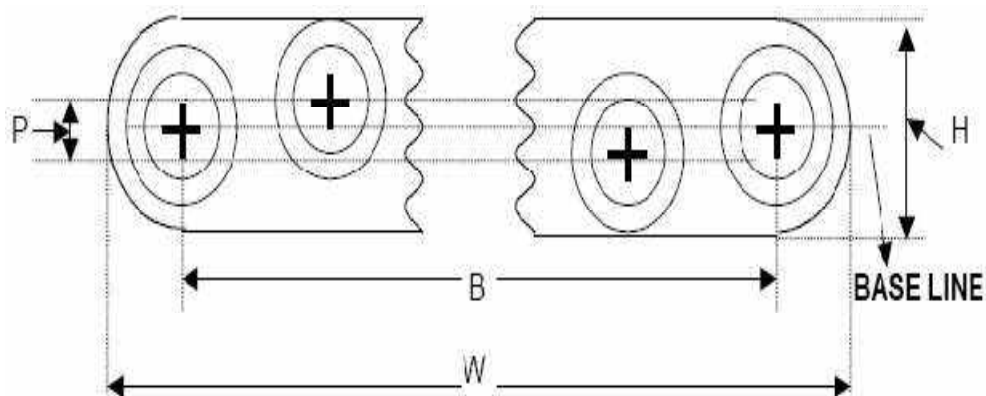
242. **Inspection at different stages.** As per [Appendix G](#).

BSNL

Type B : 48F Ribbon Fiber Optic Cable (24F G.655 + 24F G.652D)
For NLD Routes

243. **Scope.** These specifications provide the requirements of single mode fiber optic cable that is intended for use in Defence application network. The transmission application for this cable is for systems operating at nominal wavelengths of 1310 and 1550 nm for G.652D and 1550 nm & 1625 nm for G.655 fiber.
244. **Introduction.** The requirements of the cable within this specification are based on operational needs in conjunction with their applications for Long Haul part of the Defence Network. The single mode fiber optic cable shall be of unarmored type and shall meet ITU-T recommendation G.652D and G.655 for Non-Zero Dispersion Shifted Fiber (NZDSF) as well as the best industry practices for DWDM transmission.
245. **Functional Requirements**
- 245.1 The design and construction of the fiber optic cables shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.
 - 245.2 The fiber optic cable supplied shall be blowable inside 40/33 mm PLB ducts.
 - 245.3 The fiber optic cables shall be able to work in a saline atmosphere in coastal areas and should be protected against corrosion.
 - 245.4 Life of the cables shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer based upon life of the fiber and other component parts of the cable. The cables shall meet the cable aging test requirements.
 - 245.5 If any special tool required for operating and handling the fiber optic cable, the same shall be provided along with the cable.
 - 245.6 The fiber optic cables supplied shall be suitable and compatible to match with the dimensions, fixing, terminating and splicing arrangement of the splice closure supplied along with the cable.
 - 245.7 The manufacturer shall submit an undertaking that the optical and mechanical fiber characteristics shall not change during the life time of the cable against the manufacturing defects.
 - 245.8 It is mandatory that the fiber optic cables supplied in a particular route are manufactured from a single source of optical fibers.
246. **Ribbon Structure**
- 246.1 Twelve primary coated fibers shall be arranged in ribbon structure. The fibers in the structure shall be parallel and shall not cross over each other along the entire length of the ribbon. The dimensions of 12 fibers ribbon shall be as per the Bell Core document No. GR-20-Core issue 2, July 1998 and as given below.
 - 246.2 **Ribbon Dimensions.** The maximum dimensions of fiber ribbon shall be as follows and the cross section geometry of the fiber ribbon shall be as shown in the following figure : -

Ser No	Ribbon Width (W)	Ribbon height (H)	Extreme Fibers (B)	Planarity (P)
1.	3220 μm	360 μm	2882 μm	50 μm



Cross section of Fiber Ribbon

246.3 **Ribbon Material.** The ribbon shall be manufactured using single mode optical fibers coloured with UV cured resin and the ribbon shall be encapsulated with a further layer of UV cured acrylate. The fibers and the ribbons shall confirm to the colour requirement as per clause No. 236.4 above of this specification.

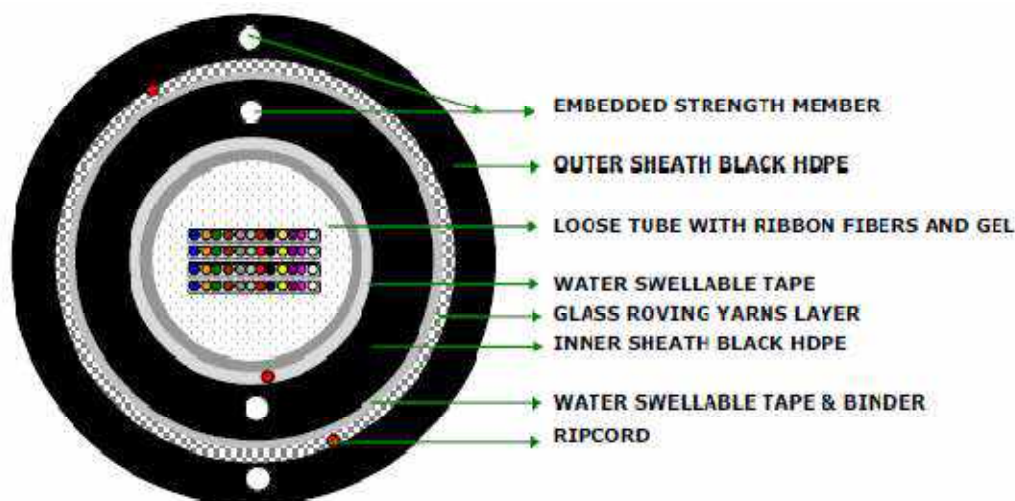
246.4 **Ribbon Mechanical Properties**

246.4.1 **Ribbon Macro-bend.** Change in attenuation when wrapped on a 60 mm diameter mandrel for 100 turns at 1310 nm, 1550 nm for G.652D ribbon & 1550 nm, 1625 nm for G.655 ribbon shall be ≤ 0.05 dB at 1310 nm, & 1550 nm and ≤ 0.10 dB at 1625 nm.

246.4.2 **Ribbon Compression Resistance.** Change in attenuation when subjected to a compressive load of 500 N for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths shall be ≤ 0.05 dB.

246.4.3 **Ribbon Torsion Resistance.** Change in attenuation (for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths) shall be ≤ 0.05 dB.

247. **Fiber Optic Cable Construction Specifications.** The manufacturer shall submit the cable design with the parameters as per the specifications. The manufacturer shall submit designed calculation and the same shall be studied and checked. The figure below is only indicative.



Indicative Drawing

247.1 Fiber Details

247.1.1	No. of fibers in a ribbon	: Twelve (12)
247.1.2	No of ribbons in Central Tube	: 4
247.1.2.1	Ribbon 1	: G.655
247.1.2.2	Ribbon 2	: G.655
247.1.2.3	Ribbon 3	: G.652D
247.1.2.4	Ribbon 4	: G.652D
247.1.3	No. of fibers in a cable	: 48

247.2 Strength Member. Solid FRP strength member as per Appendix 'F' shall be used in the inner and outer sheath of the cable. The strength member in the cable shall be for strength and flexibility of the cable and shall have anti buckling properties. The FRP shall keep the fiber strain within permissible values.

247.3 Cable Core Assembly. Primary coated fibers in ribbon structure shall be protected inside a central tube. The central tube shall also protect the ribbon fibers from tensile, thermal and vibration loads.

247.4 Core Wrapping & Moisture Barrier Protection. The main cable core containing fibers (including ribbon) shall be wrapped by non-greasy material functioning as water blocking agent when coming into contact with water. The dry block material shall be designed to absorb water upon contact and swell to block further ingress of water. It shall be nonnutritive to fungus and free from dirt and foreign matter. The core wrapping shall not adhere to the secondary fiber coating and shall not leave any kink marks over the loose tubes.

247.5 Sheath. A non-metallic moisture barrier sheath may be applied over and above the cable core. The core shall be covered with tough weather resistant High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). The colour shall conform to Munsell Colour Standards. Thickness of the sheath as per Appendix 'F' shall be uniform. The sheath shall be circular, smooth, free from pin holes, joints, mended pieces and other defects.

247.5.1 **Note.** In case black colour HDPE material is used, the material from finished product shall also be subjected to following tests (on sample basis):

247.5.1.1 Density.

247.5.1.2 Melt Flow Index.

247.5.1.3 Carbon Black Content.

247.5.1.4 Carbon Black Dispersion.

247.5.1.5 ESCR.

247.5.1.6 Moisture Content.

247.5.1.7 Tensile Strength and Elongation at break.

247.6 **Cable Diameter.** The manufacturer shall design the cable diameter as per Appendix F. The finished cable diameter shall be within ± 0.5 mm of the nominal cable diameter.

247.7 **Cable Weight.** The manufacturer shall design the cable weight as per Appendix F.

247.8 **RIP Cord**

247.8.1 Two suitable rip cords shall be provided in the cable which shall be used to open the HDPE sheath of the cable. The rip cords shall be placed diametrically opposite to each other. It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The rip cords shall be properly waxed to avoid wicking action and shall not work as a water carrier.

247.8.2 The rip cord used in the cable shall be readily distinguishable from any other components (e.g. Glass Roving/Aramid Yarn etc.) utilized in the cable construction.

248. **Mechanical Characteristics and Tests on Fiber Optic Cable**

248.1 **Tensile Strength Test**

248.1.1 **Objective.** This measuring method applies to fiber optic cables which are tested at a particular tensile strength in order to examine the behavior of the attenuation as a function of the load on a cable which may occur during installation.

248.1.2 **Method.** IEC 60794-1-2-E1.

248.1.3 **Test Specs.** The cable shall have sufficient strength to withstand a load of value of minimum 3000 N. The load shall be sustained for 10 minutes and the strain on the fiber and the attenuation shall be monitored.

248.1.4 **Requirement.** The load shall not produce a strain exceeding 0.25 % in the fiber and shall not cause any permanent physical and optical damage to any component of the cable. The attenuation shall be noted before strain and after the release of strain. The change in attenuation of each fiber after the test shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.2 **Abrasion Test**

- 248.2.1 **Objective.** To test the abrasion resistance of the sheath and the marking printed on the surface of the cable.
- 248.2.2 **Method.** IEC-60794-1-2-E2 or by any other international test method. The cable surface shall be abraded with needle (wt. 150 gm) having diameter of 1 mm with 500 grams weight (Total weight more than equal to 650 gms.).
- 248.2.2.1 No. of cycles: 100
- 248.2.2.2 Duration : One minute (Nominal)
- 248.2.3 **Requirement.** There shall be no perforation and loss of legibility of the marking on the sheath.

248.3 Crush Test (Compressive Test)

- 248.3.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand crushing.
- 248.3.2 **Method.** IEC 60794-1-2-E3.
- 248.3.3 **Test Specs.** The fibers and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 4000 Newtons applied, between the plates of dimension 100 mm x 100 mm. The load shall be applied for 600 seconds. The attenuation shall be noted before and after the completion of the test.
- 248.3.4 **Requirement.** The change in attenuation of the fiber after the test shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.4 Impact Test

- 248.4.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand impact.
- 248.4.2 **Method.** IEC 60794-1-2-E4.
- 248.4.3 **Test Specs.** The cable shall have sufficient strength to withstand an impact caused by a mass weight of 50 Newton's, which falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. Ten such impacts shall be applied at the same place. The attenuation shall be noted before and after the completion of the test.
- 248.4.4 **Requirement.** The change in attenuation of the fiber after the test shall be <0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.5 7.5 Repeated Bending

- 248.5.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand repeated bending.
- 248.5.2 **Method.** IEC 60794-1-2-E6.
- 248.5.3 **Test Specs.** The cable sample shall be of sufficient length (5 m minimum) to permit radiant power measurements as required by this test. Longer lengths may be used, if required.
- 248.5.4 **Test Parameters**

248.5.4.1	Weight : 5 Kg	
248.5.4.2	Minimum distance from Pulley centre to holding device	: 216 mm
248.5.4.3	Minimum distance from Wt. to Pulley centre	: 457 mm
248.5.4.4	Pulley Diameter (D – cable diameter)	: 20 D
248.5.4.5	Angle of Turning	: 90°
248.5.4.6	No. of cycles	: 10
248.5.4.7	Time Required for 10 cycles	: 2 min

248.5.5 **Requirement.** During the test no fiber shall break and the attenuation shall be noted before and after the completion of the test. The change in attenuation of the fiber after the test shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.6 Torsion Test

248.6.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand torsion.

248.6.2 **Method.** IEC 60794-1-2-E7.

248.6.3 **Test Specs.** The length of the specimen under test shall be 2 meters and the load shall be 100 N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp, sufficiently tight, to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clockwise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anticlockwise direction for one turn and returned to the starting position. This complete movement constitutes one cycle. The cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.

248.6.4 **Requirement.** The cable shall be examined physically for any cracks, tearing on the outer sheath and for the damage to other component parts of the cable. The twist mark shall not be taken as damage. The change in attenuation of the fiber after the test shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.7 Kink Test

248.7.1 **Objective.** The purpose of this test is to verify whether kinking of a fiber optic cable results in breakage of any fiber, when a loop is formed of dimension small enough to induce a kink on the sheath.

248.7.2 **Method.** IEC 60794-1-2-E10.

248.7.3 **Test Specs.** The sample length shall be 10 times the minimum bending radius of the cable. The sample is held in both hands. A loop is made of a bigger diameter i.e. 20D and by stretching both the ends of the cable in opposite direction, the loop is made to the

minimum bend radius, and no kink shall form. The cable is then normalized and attenuation reading is taken.

- 248.7.4 **Requirement.** The kink should disappear after the cable is made normal. The change in attenuation of the fiber after test shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.8 Cable Bend Test

- 248.8.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand repeated flexing. The procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.

- 248.8.2 **Method.** IEC 794-1-2-E11 (Procedure-I).

- 248.8.3 **Test Specs.** The fiber and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.

- 248.8.4 **Requirement.** The change in attenuation of the fiber after the test shall be < 0.05 dB, both for 1550 nm and 1625 nm wavelength. Sheath shall not show any cracks visible to the naked eye, when examined whilst still wrapped on the mandrel.

248.9 Test of Figure of 8 (Eight) on the cable (Type Test)

- 248.9.1 **Objective.** Check of easiness in formation of figure of 8 of the cable during installation in the field.

- 248.9.2 **Test Method.** 1000 meter (approximate) of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8 (eight). The diameter of each loop of the figure of 8 shall be maximum 2 meters.

- 248.9.3 **Requirement.** It shall be possible to make figure of 8 of minimum 1000 meter length of the cable uncoiled from the cable reel, without any difficulty. No visible damage shall occur.

248.10 Temperature Cycling

- 248.10.1 **Objective.** To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

- 248.10.2 **Method.** IEC 60794-1-2-F1 (To be tested on Standard cable length of drum i.e. 2 Km $\pm$ 5 %).

- 248.10.3 **Test Specs.** The permissible temperature range for storage and operation should be from -20°C to +70°C. The rate of change of temperature during the test shall be 1° per minute approx. The cable shall be subjected to temperature cycling for 12 Hrs. at each temperature as given below : -

248.10.3.1 TA2 temp. : - 20°C.

248.10.3.2 TA1 temp. : - 10°C.

248.10.3.3 TB1 temp. : + 60°C.

248.10.3.4 TB2 temp. : + 70°C.

248.10.3.5 The test shall be conducted for 2 cycles at the above temperatures.

248.10.4 **Requirement.** The change in attenuation of the fiber under test shall be <0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths for the entire range of temperature.

248.11 Cable Aging test

248.11.1 **Objective.** To check the cable material change dimensionally as the cable ages.

248.11.2 **Method.** At the completion of temperature cycle test, the test cable shall be exposed to 85 ± 2 degree C for 168 hours. The attenuation measurement for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths to be made after stabilization of the test cable at ambient temperature for 24 hours.

248.11.3 **Requirement.** The increase in attenuation allowed is < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.11.4 **Note.** The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.

248.12 Water Penetration Test

248.12.1 **Objective.** To check the installed cable shall not allow the water passage along its length.

248.12.2 **Method.** IEC 794-1-2-F5 (Fig. B) 1992.

248.12.3 **Test Specs.** A circumferential portion of the cable end shall face the water head. The water tight sleeve shall be applied over the cable. The cable shall be supported horizontally and two meter water head for 24 Hrs, containing sufficient quantity of water soluble fluorescent dye for the detection of seepage, shall be applied on the HDPE sheath. No other colored dye is permitted.

248.12.4 **Requirement.** No dye shall be detected when the end of the 3 m length of the cable is examined with ultraviolet light detector.

248.13 Cable Jacket Yield Strength And Ultimate Elongation

248.13.1 **Objective.** To check the yield strength and elongation of polyethylene (HDPE) cable sheath.

248.13.2 **Test Method.** FOTP-89 or ASTM D1248 Type III Class.

248.13.3 Test Condition

248.13.3.1 Sample shall be taken from a completed cable. The aged sample shall be conditioned at $100 \pm 2^{\circ}$ C for 120 hours before testing.

248.13.3.2 The cross-head speed shall be 50 mm per minute.

248.13.4 Requirement

Ser No	Jacket Material	Minimum Yield Strength		Minimum Elongation (%)
		(MPa)	(Psi)	
1.	HDPE un-aged	16.5	2400	400
2.	HDPE aged	12.4	1800	375

248.14 Ribbon Dimension Measurements test

248.14.1 **Objective.** Check of fibers in ribbon structure and to ensure the transmission performance and the mechanical service life of the fiber in the ribbon structure, check of cross over fibers and the check of fiber identity.

248.14.2 **Test method.** FOTP-123 (Video Gray Scale Analysis (VGSA) or Microscopic method).

248.14.3 **Requirement.** It shall meet the dimensional requirements given in clause No. 246.2 above. The fibers in the entire length of the ribbon shall not cross over at any point.

248.15 Ribbon Resistance to Twist (Robustness) test

248.15.1 **Objective.** To check the robustness of the fiber ribbons to withstand the twist in installed conditions and to check the structural integrity of the ribbon over the deployed length for mid-span entry, maintenance purposes, consideration in rearrangements and housekeeping.

248.15.2 **Test method.** FOTP-141.

248.15.3 **Requirement.** The un-aged and aged (at 85 ± 2 degree C with uncontrolled humidity for a period of 30 days) completed ribbon shall not show any separation of individual fibers from the ribbon structure after completion of the twist test when observed under 5X magnification.

248.16 Ribbon Residual Twist (Flatness) test

248.16.1 **Objective.** To check the dimensional integrity of the ribbon without twisting to allow rearrangements and to limit the potential attenuation increases due to a macro-bending caused by twisting of the fiber ribbon.

248.16.2 **Test Method.** FOTP-131.

248.16.3 **Requirement.** The aged (at $85^{\circ} \pm 2^{\circ}$ C with uncontrolled humidity for a period of 30 days) ribbon residual twist (if any) shall have a pitch: > 400 mm.

248.17 Ribbon Separation Test

248.17.1 Objective

248.17.1.1 To check the separation of individual fibers, separation of sub-unit of fibers and mid span separation from a fiber ribbon.

- 248.17.1.2 To check the retention of sufficient colorant for identification for any 2.5 cm length of fiber after separation for individual and sub-unit of fibers.

248.17.2 Test

- 248.17.2.1 Separation of any single fiber or a multi-fiber subgroup by a tool or by hand from a ribbon for a length of 1 meter. Mid span separation from a 2 meter sample, separated close to middle for at least 0.5 meter (both single fiber and the six fiber sub – units) for un-aged ribbon.

- 248.17.2.2 **Requirement.** The un-aged ribbon of minimum length of a 0.3 meter (1.0 foot) of an individual fiber and a sub group of six fibers shall be separated from the ribbon without breaking the fibers or damaging the fiber coating. The force required to perform separation shall not exceed 4.4 N. The area at the separation shall not show any damage to the fiber coating when examined under 5X magnification.

- 248.17.2.3 Retention of the Colour and Fiber Identification after separation.

- 248.17.2.4 **Requirement.** Individual fiber colour identification shall be maintained after the separation test. It shall retain sufficient colorant that any 2.5 cm length is readily identifiable.

- 248.17.2.5 Removal of Ribbon matrix material to access individual fibers.

- 248.17.2.6 **Requirement.** No damage shall occur either to fiber coating or the fibers. The coating shall not sustain any swelling self-stripping, cracking or splitting when examined under 5X magnification.

- 248.17.3 **Note.** The manufacturer shall recommend the procedure for the removal of ribbon matrix.

248.18 Ribbon Strippability Test

- 248.18.1 **Objective.** Checking of removal of the matrix material and the fibers protective coating mechanically with commercial stripping tools from un-aged and aged ribbons.

- 248.18.2 **Test Method.** ITM-9 (Bell Core GR-20-CORE issue 2, July 1998)

248.18.2.1 Pre Conditioning

- 248.18.2.1.1 **Aged samples.** The humidity of aged ribbons shall be soaked at 85 ± 2 degree C and a non-condensing humidity of $85 \pm 5\%$ for a period of 30 days.

248.18.2.1.2 **Water aged samples.** The water aged ribbons shall be soaked in deionized or distilled water at a temperature of 23 ± 5 degree for a period of 14 days.

248.18.2.1.3 The fiber ribbon strip-ability testing shall be conducted at standard atmospheric conditions. The un-aged, humidity – aged, and water aged ribbons shall be tested within eight hours after aging.

248.18.3 **Requirement.** There shall be no fiber breakage, and any coating residue shall be removable with a single isopropyl alcohol wipe when at least 25 mm of the matrix material and the fiber Protective coating is mechanically removed with commercial stripping tools from un-aged and aged ribbons.

248.19 **Ribbon Macro-bend Performance**

248.19.1 **Objective** To check the macro-bend performance of a ribbon.

248.19.2 **Method.** One hundred turns of ribbon are wound around a 60 mm diameter mandrel and the loss increase for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths shall be measured.

248.19.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm wavelengths & 0.1 dB at 1625 nm wavelength.

248.20 **Torsion Resistance of the ribbon test**

248.20.1 **Objective.** To check the torsion resistance of the ribbon.

248.20.2 **Method.** One meter length of ribbon is twisted through five revolutions of 360° and measurement is taken.

248.20.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.21 **Crush Resistance of Ribbon**

248.21.1 **Objective.** To check the crush resistance of the ribbon.

248.21.2 **Method.** A 50 mm^2 sample is subjected to a load of 500 N and the attenuation measurement taken for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.21.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB for G.652D ribbon at 1310 nm, 1550 nm and for G.655 ribbon at 1550 nm, 1625 nm wavelengths.

248.22 **Checking of the quality of the loose tube (containing optical fiber ribbon)**

248.22.1 **Embrittlement Test of Loose Tube**

248.22.1.1 This test method is based on bending by compression and reflects embrittlement much better

than the other tensile tests. This test is independent of wall thickness of the loose tube.

- 248.22.1.2 **Sample.** The minimum length of the test sample depends on the outside diameter of the loose tube and should be 85 mm for tubes up to 2.5 mm outside diameter. The length of the bigger tubes should be calculated by using the following equation:

$$248.22.1.2.1 \quad L_o > 100 \times [(D^2 + d^2)]^{1/2}/4 \text{ where,}$$

L_o = Length of tube under test.

D = Outside dia of loose tube.

d = Inside dia of loose tube.

- 248.22.1.3 **Procedure.** Both the ends of a buffer tube test sample may be mounted in a tool, which is clamped in jaws of a tensile machine which exerts a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load, the tube should bend so that it is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading.

- 248.22.1.4 **Requirement.** The tube should not get embrittled. No kink should appear on the tube up to the safe bend diameter of tube (15 D), where D is the outside diameter of the loose tube. There should also not be any physical damage or mark on the tube surface.

248.22.2 Kink Resistance Test on the Loose Tube

- 248.22.2.1 **Objective.** To safeguard the delicate optical fibers, the quality of the loose tube material should be such that no kink or damage to the tube occurs while it is being handled during installation and in splicing operations.

- 248.22.2.2 **Procedure.** To check the kink resistance of the loose tube, a longer length of the loose tube is taken (with fiber and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 15 D (where D is the outside diameter of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube.

- 248.22.2.3 **Requirement.** No damage or kink should appear on the surface of the tube.

248.23 Drainage Test for loose Tube

- 248.23.1 **Sample Size.** 30 cm tube length.

248.23.2 Test procedure

- 248.23.2.1 Cut the tube length to 40 cm.
- 248.23.2.2 Fill the tube with the tube filling gel ensuring that there are no air bubbles and the tube is completely full.
- 248.23.2.3 Place the filled tube in a horizontal position on a clean worktop and cut 5 cm from either end so that the finished length of the sample is 30 cm.
- 248.23.2.4 Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs.
- 248.23.2.5 The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70° C for a period of 24 Hrs.
- 248.23.2.6 At the end of the 24 hrs period the beaker is checked and weighed to see if there is any gel in the beaker.

248.23.3 Requirement

- 248.23.3.1 If there is no gel or oil in the beaker the tube has PASSED the drainage test.
- 248.23.3.2 If there is gel or oil in the beaker the tube has FAILED the drainage test.

248.24 Checking for easy removal of sheath

- 248.24.1 **Objective.** Checking for easy removal of sheath of the fiber optic cable by using normal sheath removal tool.
- 248.24.2 **Procedure.** To check easy removal, the sheath shall be cut in circular way and the about 300 mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. One should be able to remove the sheath easily.
- 248.24.3 **Note.** Easy removal of both the outer jacket and the inner sheath shall be checked separately.

248.25 Check of the effect of aggressive media on the cable (Acidic and Alkaline Behavior)

- 248.25.1 **Procedure.** To check the effect of aggressive media, solution of PH4 and PH10 shall be made. The two test samples of the finished cable, each of 600 mm in length, are taken and the ends of the samples are sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc on the sheath and other markings of the cables.
- 248.25.2 **Requirement.** The sample should not show any effect of these solutions on the sheath and other marking of the cable.

248.26 Cable Outer Diameter and Jacket Thickness

- 248.26.1 **Sample Size.** At least three specimens from each cable sample shall be tested to determine conformance to the criteria of this section. Alternatively, compliance to the cable outer diameter and jacket thickness criteria may be verified by a review of test data from the cable manufacturer.
- 248.26.2 **Procedure.** Cable samples shall be tested in accordance with Sections 6 through 8 of ASTM D 4565.
- 248.26.2.1 Section 6 for cable diameter.
- 248.26.2.2 Section 7 for cable jacket thickness.
- 248.26.2.3 Section 8 for cable jacket eccentricity.
- 248.26.3 **Requirements.** The average diameter of the cable shall not exceed the specifications.

249. General Requirements**250. Engineering requirements****250.1 Cable Marking**

- 250.1.1 A long lasting suitable marking shall be applied in order to identify this cable from other cables. The cable marking shall be imprinted (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The accuracy of the sequential marking should be within -0.25% to +0.5% of the actual measured length. The markings on the cable should not rub off during normal installation and in life time of fiber optic cable.
- 250.1.2 The marking shall be in contrast colour to the sheath and shall be done by hot foil indentation method. It should clearly contrast with the surface. The colour used should withstand the environmental influences experienced in the field.
- 250.1.3 The type of legend marking on Optical Fiber Cable shall be as follows : -
- 250.1.3.1 Company Legend.
- 250.1.3.2 Legend containing telephone mark & international acceptable Laser symbol.
- 250.1.3.3 Type of cable (Type B)
- 250.1.3.4 Type of Fibers (G.655+G.652D).
- 250.1.3.5 Number of Fibers (48).
- 250.1.3.6 Year of manufacture.
- 250.1.3.7 Sequential length marking.
- 250.1.3.8 User's identification : NFS OFC
- 250.1.3.9 Cable ID.

250.2 Cable Ends

- 250.2.1 Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall be accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The drum (conforming to GR No G/CBD-01/02 Nov 94 and subsequent

amendments if any) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti twist device (free head hook). The diameter of the cable shall also be marked on the cable drum. The wooden drum shall be properly treated against termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

- 250.2.2 An anti-twist device (Free head hook) shall be provided attached to the front end of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system, along with the anti twist system, shall withstand the prescribed tensile load applicable to the cable.

250.3 **Nominal Drum Length**

- 250.3.1 Length of OFC in each drum shall be 2/4 Kms $\pm$ 5% and shall be supplied as per the order. The variation in length of fiber optic cable, as specified above (in each drum), shall be acceptable. The fibers in cable length shall not have any joint.

- 250.3.2 In order to avoid wastage of OFC, the supplier is permitted to supply upto two drums per NLD link, of shorter length, to cater for fractional link lengths finalized after completion of route survey...

- 250.3.3 The drum shall be marked with arrows to indicate the direction of rotation.

- 250.3.4 Packing list supplied with each drum shall have at least the following information:-

- 250.3.4.1 Drum No.
- 250.3.4.2 Type of cable.
- 250.3.4.3 Physical Cable length.
- 250.3.4.4 No. of fibers.
- 250.3.4.5 Length of each fiber as measured by OTDR.
- 250.3.4.6 The Cable factor - ratio of fiber / cable length.
- 250.3.4.7 Attenuation per Km. of each fiber at 1310 nm for G.652D, and at 1550 nm, 1625 nm for both G.652D & G.655.
- 250.3.4.8 User's / Consignee's Name.
- 250.3.4.9 Manufacturer's Name, Month, Year and Batch No.
- 250.3.4.10 Group refractive index of fibers.
- 250.3.4.11 Purchase Order No.
- 250.3.4.12 Cable ID.

250.4 **Colour Coding and Ribbon identification in OFCs**

- 250.4.1 The colorant applied to individual fibers shall be readily identifiable throughout the life time of the cable and shall match and conform to the MUNSELL color standards (For EIA standard EIA-359-A) or IEC Publication 304 (4).

- 250.4.2 **Colour Coding Scheme.** When the loose tubes are placed in circular format, the marking to indicate the loose tube No. "1" shall be in blue colour followed by loose tube No.2 of orange and so on for other tubes as per the colour scheme given below and complete the circular format by placing the dummy /fillers at the end. Depending upon the number of fibers in a Ribbon (which depends on the cable capacity), the colour of the fibers are serially chosen from the column No. III of the following **Table- 6.2**.

Ser No	No. of Fibers	Fiber Identification
(I)	(II)	(III)
1.	1	Blue
2.	2	Orange
3.	3	Green
4.	4	Brown
5.	5	Slate / Grey
6.	6	White
7.	7	Red
8.	8	Black
9.	9	Yellow
10.	10	Violet
11.	11	Pink / Rose
12.	12	Aqua

Table- 6.2 Colour coding scheme of the Optical Fibers

- 250.4.3 **Identification of Ribbon**

Ser No	No. of Fibers in a cable	No. of tubes	No. of Ribbons per tube	Marking on Ribbon
1.	48	One	4	1 RIBBON 1 2 RIBBON 2 3 RIBBON 3 4 RIBBON 4

251. **Quality Requirements.** The cable shall be manufactured in accordance with the international quality standards ISO 9001-2008 for which the manufacturer should be

duly accredited. A quality plan followed by the manufacturer shall be required to be submitted.

252. **Cable Material Compatibility.** Optical fiber, buffers/core tubes, and other core components shall meet the requirements of the compatibility with buffer/core tube filling material(s) and/or water-blocking materials that are in direct contact with identified components within the cable structure.
253. **Documentation**
- 253.1 Complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions and test data and other details of the cable shall be provided.
- 253.2 All aspects of installation, operation, maintenance shall also be covered in the handbook. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall be also be submitted. A hard as well as soft copy of the manuals shall be provided.
254. **Safety Requirement.** The material used in the manufacturing of the single mode fiber optic cables shall be non toxic and dermatologically safe in its life time and **shall** not be hazardous to health. The manufacturer shall submit MSDS (Material Safety Data Sheet) for all the material used in manufacturing of fiber optic cable to substantiate the statement.
255. **Product Qualification Requirements.** The product shall be complied as per following Qualification Programs.
- 255.1 **Initial Product Qualification (IPQ).** The product manufactured on representative production equipment should be tested for conformance to the requirement. Once testing has shown that the product meets the requirement, it is generally assumed that it should continue to meet the requirement as long as the fiber design, material composition, or manufacturing process that affect functionality of the product are not changed.
- 255.2 **Manufacturing Quality Program (MQP).** A manufacturer's internal quality program that assures the product being produced continues to be of the same high quality that was initially tested and is shown to meet Initial Product Acceptance criteria.
- 255.3 **Qualification Program for Cable**

Ser No	Test	IPQ	MQP
1.	Cable Outer Diameter & Jacket	X	X
2.	Cable Marking	X	X
3.	Cable Ends	X	X
4.	Cable Drum Length	X	X
5.	Cable Tensile Strength	X	X
6.	Cable Abrasion	X	
7.	Cable Crush	X	X

8.	Cable Impact	X	X
9.	Cable Repeated Bending	X	X
10.	Cable Torsion	X	X
11.	Cable Kink	X	
12.	Cable Bend	X	
13.	Cable Figure of Eight	X	
14.	Cable Temperature Cycling	X	X
15.	Cable Aging	X	
16.	Cable Water Penetration	X	
17.	Cable jacket yield strength and ultimate elongation	X	X
18.	Cable Loose Tube Drainage	X	
19.	Cable Sheath Removal	X	
20.	Cable Acidic Alkaline Behaviour	X	
21.	Ribbon Dimension	X	
22.	Ribbon Resistance to Twist	X	
23.	Ribbon Residual Twist	X	
24.	Ribbon Separation	X	
25.	Ribbon Strippability	X	
26.	Ribbon Macro Bend Performance	X	
27.	Ribbon Torsion Resistance	X	
28.	Ribbon Crush Resistance	X	
29.	Ribbon Loose Tube Quality	X	

255.4 **Test Results.** The Fiber Test report shall provide following parameters: -

255.4.1 Product Name.

255.4.2 Fiber Identification No.

255.4.3 Fiber Length.

255.4.4 Group Refractive Index at 1310 nm, 1550 nm for G.652D&1550 nm, 1625 nm for G.655.

255.4.5 Attenuation at 1310 nm for G.652D.

255.4.6 Attenuation at 1550 nm for both G.652D & G.655.

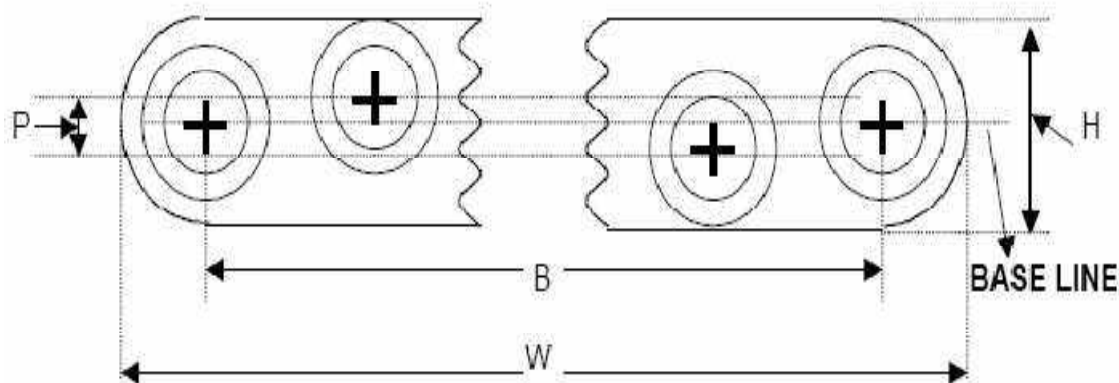
- 255.4.7 Attenuation at 1383±3 nm (Post- hydrogen aging.
- 255.4.8 Attenuation at 1625 nm for both G.652D & G.655.
- 255.4.9 Mode Field Diameter at 1310 nm for G.652D.
- 255.4.10 Mode Field Diameter at 1550 nm for G.655.
- 255.4.11 Cable Cutoff Wavelength.
- 255.4.12 Chromatic Dispersion at 1285-1330 nm, 1550nm, 1625 nm for G.652D only
- 255.4.13 Chromatic Dispersion at 1530-1565 nm, 1565-1625 nm for G.655 only.
- 255.4.14 Polarization Mode Dispersion.
- 255.4.15 Cladding Diameter.
- 255.4.16 Core/Cladding Concentricity Error.
- 255.4.17 Cladding Non-circularity.
- 255.4.18 Coating Diameter.
- 255.4.19 Cladding/Coating Concentricity Error.
- 255.4.20 Coating Non-circularity.
- 255.4.21 Fiber Curl.
- 255.4.22 Proof Test Level.

256. **Inspection at different stages.** As per [Appendix G](#).

Type C : 48F Ribbon Intrusion Proof Fiber Optic Cable for Access Networks
[48F Ribbon (G.652D) + 8F (G.652D) Sensory Fibers]

257. **Scope.** This specification gives the requirements of single mode fiber optic cable that is intended for use in Defence network. The transmission application for these cables are for access network with intrusion proofing to create a secured physical link operating at nominal wavelengths of 1310 nm and 1550 nm.
258. **Introduction.** The requirements of the cable are based on operational needs in conjunction with their applications for access part of the Defence Network. The single mode fiber optic cable shall be of unarmored type and the transmission part of the cable shall meet ITU-T recommendation G652D fiber. The cable shall be intrusion proof to provide a secured optical link for the defence network.
259. **Functional Requirements**
- 259.1 The design and construction of the fiber optic cables shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.
 - 259.2 The fiber optic cable supplied shall be blow able inside 40/33 mm PLB ducts.
 - 259.3 The fiber optic cables shall be able to work in a saline atmosphere in coastal areas and should be protected against corrosion.
 - 259.4 Life of the cables shall be at least 25 years. Necessary statistical calculations shall be submitted by the manufacturer based upon life of the fiber and other component parts of the cable. The cables shall meet the cable aging test requirements.
 - 259.5 Any special tool required for operating and handling the fiber optic cable, the same shall be provided along with the cable.
 - 259.6 The fiber optic cables supplied shall be suitable and compatible to match with the dimensions, fixing, terminating and splicing arrangement of the splice closure supplied along with the cable.
 - 259.7 The manufacturer shall submit an undertaking that the optical and mechanical fiber characteristics shall not change during the life time of the cable against the manufacturing defects.
 - 259.8 It is mandatory that the fiber optic cables supplied in a particular route are manufactured from a single source of optical fibers.
260. **Ribbon Structure**
- 260.1 Twelve primary coated fibers shall be arranged in ribbon structure. The fibers in the structure shall be parallel and shall not cross over each other along the entire length of the ribbon. The dimensions of 12 fibers ribbon shall be as per the Bell Core document No. GR-20-Core issue 2, July 1998 and as given below:-
 - 260.1.1 **Ribbon Dimensions.** The maximum dimensions of fiber ribbon shall be as follows and the cross section geometry of the fiber ribbon shall be as shown in the following figure: -

Ser No	Number of Fibers	Ribbon Width (W)	Ribbon height (H)	Extreme Fibers (B)	Planarity (P)
1.	12	3220 μm	360 μm	2882 μm	50 μm



Cross section of Fiber Ribbon

260.2 **Ribbon Material.** The ribbon shall be manufactured using single mode optical fibers coloured with UV cured resin and the ribbon shall be encapsulated with a further layer of UV cured acrylate. The fibers and the ribbons shall confirm to the colour requirement as per clause No. 264.4 below of this specification.

260.3 **Ribbon Mechanical Properties**

260.3.1 **Ribbon Macro-bend.** Change in attenuation when wrapped on a 60 mm diameter mandrel for 100 turns at 1310 & 1550 nm shall be ≤ 0.05 dB.

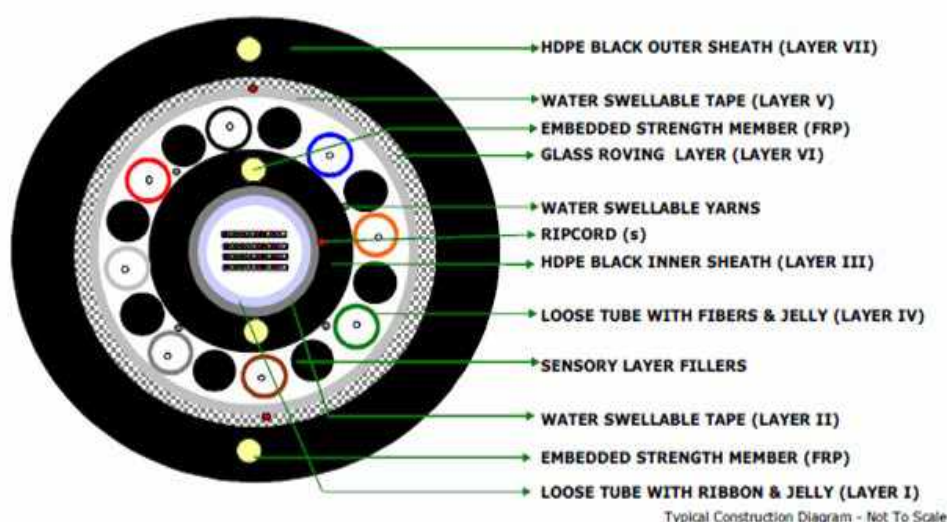
260.3.2 **Ribbon Compression Resistance.** Change in attenuation when subjected to a compressive load of 500 N at 1310 nm & at 1550 nm) shall be ≤ 0.05 dB.

260.3.3 **Ribbon Torsion Resistance.** Change in attenuation (At 1310 nm & 1550 nm) shall be: ≤ 0.05 dB

261. **Intrusion Proof Cable Specifications**

261.1 **Fiber Optic Physical Layer Security System Specification.** The sensory layer in the fiber optic cable shall be connected to the fiber optic physical layer security system so that the cable shall be intrusion proof. These systems shall be procured separately by BSNL.

261.2 **Fiber Optic Cable Construction Specification.** The manufacturer shall submit the cable design with the parameters. The manufacturer shall submit designed calculation and the same shall be studied and checked. Embedded strength members are required in both sheaths. Note that the diagram below is only indicative.



Indicative Drawing

261.2.1 **Secondary Protection.** The primary coated fibers in the sensory layer (outer core) shall be protected by loose packaging within a tube, which shall be filled with thixo-tropic jelly.

261.2.1.1 No. of fibers in a ribbon : Twelve (12)

261.2.1.2 No. of ribbons in central tube : 4

261.2.1.3 No. of tube in the outer core (sensory layer) : 8

261.2.1.4 No of fiber in each tube : 1

261.2.1.5 Number of Fillers :8

261.2.1.6 Loose Tubes and fillers to be placed alternatively.

261.2.1.7 Or a better design will be suggested by the bidder to be approved by the BSNL and PICG.

261.2.1.8 As per specifications given at Appendix 'F' to know about the detailed manufacturing parameters of the ribbon and cable.

261.2.2 **Strength Member**

261.2.2.1 Minimum Two Solid FRP strength members (non metallic) diametrically opposite to each other shall be embedded within each of the sheaths to meet the requirements of the tensile strength etc., Embedded strength members are required in both sheaths.

261.2.3 **CableCore Assembly.** Any other design suggested will have to be approved by the CACT and the user representatives. Cable core assembly will be defined as: -

261.2.3.1 **Primary Cable Core.** Primary coated fibers in ribbon structure shall be protected inside a central tube forming the inner core of the cable. Inner core shall be protected with core wrapping & moisture barrier and non metallic moisture barrier sheath may be applied over inner core as per point 261.2.6 below. Inner Sheath to form Primary cable core.

261.2.3.2 **Secondary Cable Core.** Primary coated fibers in 8 loose tubes with 12 fillers (sensory layer) to be stranded over Primary cable core to form the outer secondary cable core with 1 F in each tube (sensory layer). The buffer tubes shall be of different color (As per Appendix 'F') and shall maintain the fiber's mechanical & optical integrity. It shall also protect them from tensile, thermal and vibration loads. The buffer tubes shall be gel filled to block the ingress of water.

261.2.4 **Core Wrapping & Moisture Barrier Protection.** The main cable core containing fibers (including ribbon) shall be wrapped by non-greasy material functioning as water blocking agent when coming into contact with water. The dry block material shall be designed to absorb water upon contact and swell to block further ingress of water. It shall be nonnutritive to fungus and free from dirt and foreign matter. The core wrapping shall not adhere to the secondary fiber coating and shall not leave any kink marks over the loose tubes.

261.2.5 **Filling compound.** The filling compound used in the loose tube shall be compatible to fiber, secondary protection of fiber, etc. The drip point shall not be lower than +70 degree C. The fiber movement shall not be constrained by stickiness and shall be removable easily for splicing. The test method to measure drop point shall be as per ASTM D 556.

261.2.6 **Inner Sheath.** A non-metallic moisture barrier sheath may be applied over and above the cable core with two nos. of Non metallic solid strength members shall be embedded in the sheath (As per Appendix 'F'). The core shall be covered with tough weather resistant High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). The colour shall conform to Munsell Colour Standards. Thickness of the sheath shall be as per

Appendix 'F'. The sheath shall be uniform, circular, smooth, free from pin holes, joints, mended pieces and other defects.

261.2.6.1 **Note.** In case black colour HDPE material is used, the material from finished product shall also be subjected to following tests (on sample basis).

261.2.6.1.1 Density.

261.2.6.1.2 Melt Flow Index.

261.2.6.1.3 Carbon Black Content.

261.2.6.1.4 Carbon Black Dispersion.

261.2.6.1.5 ESCR.

261.2.6.1.6 Moisture Content.

261.2.6.1.7 Tensile Strength and Elongation at break.

261.2.7 **Outer Sheath.** A non-metallic moisture barrier sheath thickness shall be as per Appendix 'F' and tough weather resistant made High Density Polyethylene (HDPE) sheath, black in colour (UV Stabilized). Thickness of the sheath shall be uniform and minimum 2 diametrically opposite non metallic strength members embedded within the sheath and diameter shall be as per Appendix 'F'. The sheath shall be circular, smooth, free from pin holes, joints, mended pieces and other defects.

261.2.8 **Cable Diameter.** The manufacturer shall design the cable diameter as given at Appendix F. The finished cable diameter shall be within ± 0.5 mm of the nominal cable diameter.

261.2.9 **Cable Weight.** The cable weight shall be designed as per the specifications given at Appendix 'F'.

261.2.10 **RIP Cord**

261.2.10.1 Minimum two suitable rip cords diametrically opposite to each other shall be provided in the cable, which shall be used to open the HDPE sheath. A single rip cord shall be provided for the inner sheath. It shall be capable of consistently slitting the sheath without breaking for a length of 1 meter at the installation temperature. The rip cords shall be non wicking type and shall not work as a water carrier.

261.2.10.2 The rip cord used in the cable shall be readily distinguishable from any other components (e.g. Glass Roving / Aramid Yarn etc.) utilized in the cable construction.

262. Mechanical Characteristics and Tests on Fiber optic cable

262.1 Tensile Strength Test

262.1.1 **Objective.** This measuring method applies to fiber optic cables which are tested at a particular tensile strength in order to examine the behavior of the attenuation as a function of the load on a cable which may occur during installation.

- 262.1.2 **Method.** IEC 60794-1-2-E1.
- 262.1.3 **Test Specs.** The cable shall have sufficient strength to withstand a load value of minimum 3000 N. The load shall be sustained for 10 minutes and the strain on the fiber and the attenuation shall be monitored.
- 262.1.4 **Requirement.** The load shall not produce a strain exceeding 0.25 % in the fiber and shall not cause any permanent physical and optical damage to any component of the cable. The attenuation shall be noted before strain and after the release of strain. The change in attenuation of each fiber after the test shall be < 0.05 dB, both for 1310 nm and 1550 nm wavelength.

262.2 Abrasion Test

- 262.2.1 **Objective.** To test the abrasion resistance of the sheath and the marking printed on the surface of the cable.
- 262.2.2 **Method.** IEC-60794-1-2-E2 or by any other international test method. The cable surface shall be abraded with needle (wt. 150 gm) having diameter of 1 mm with 500 grams weight (Total weight more than equal to 650 gms.).
- 262.2.2.1 No. of cycles: 100
- 262.2.2.2 Duration : One minute (Nominal)
- 262.2.3 **Requirement.** There shall be no perforation and loss of legibility of the marking on the sheath.

262.3 Crush Test (Compressive Test)

- 262.3.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand crushing.
- 262.3.2 **Method.** IEC 60794-1-2-E3.
- 262.3.2.1 The fibers and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 4000 Newtons applied, between the plates of dimension 100 mm x 100 mm. The load shall be applied for 600 seconds. The attenuation shall be noted before and after the completion of the test.
- 262.3.3 **Requirement.** The change in attenuation of the fiber after the test shall be < 0.05 dB, both for 1310 nm and 1550 nm wavelength.

262.4 Impact Test

- 262.4.1 **Objective.** The purpose of this test is to determine the ability of fiber optic cable to withstand impact.
- 262.4.2 **Method.** IEC 60794-1-2-E4.
- 262.4.3 **Test Specs.** The cable shall have sufficient strength to withstand an impact caused by a mass weight of 50 Newtons, which falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. Ten such impacts shall be applied at the same place. The attenuation shall be noted before and after the completion of the test.

262.4.4 **Requirement.** The change in attenuation of the fiber after the test shall be <0.05 dB, both for 1310 nm and 1550 nm wavelength.

262.5 Repeated Bending

262.5.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand repeated bending.

262.5.2 **Method.** IEC 60794-1-2-E6.

262.5.3 **Cable Sample.** The cable sample shall be of sufficient length (5 m minimum) to permit radiant power measurements as required by this test. Longer lengths may be used, if required.

262.5.4 Test Parameters

262.5.4.1 Weight : 5 Kg

262.5.4.2 Minimum distance from Pulley : 216 mm
centre to holding device

262.5.4.3 Minimum distance from Wt. to Pulley centre : 457 mm

262.5.4.4 Pulley Diameter (D – cable diameter) : 20 D

262.5.4.5 Angle of Turning : 90°

262.5.4.6 No. of cycles : 10

262.5.4.7 Time Required for 10 cycles : 2 min

262.5.5 **Requirement.** During the test no fiber shall break and the attenuation shall be noted before and after the completion of the test. The change in attenuation of the fiber after the test shall be < 0.05 dB, both for 1310 nm and 1550 nm wavelength.

262.6 Torsion Test

262.6.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand torsion.

262.6.2 **Method.** IEC 60794-1-2-E7.

262.6.3 **Test Specs.** The length of the specimen under test shall be 2 meters and the load shall be 100 N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp, sufficiently tight, to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clockwise direction for one turn. The sample shall then be returned to the starting position and then rotated in an anticlockwise direction for one turn and returned to the starting position. This complete movement constitutes one cycle. The cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.

262.6.4 **Requirement.** The cable shall be examined physically for any cracks, tearing on the outer sheath and for the damage to other component parts of the cable. The twist mark shall not be taken as damage. The change in attenuation of the fiber after the test shall be < 0.05 dB, both for 1310 nm and 1550 nm wavelength.

262.7 Kink Test

- 262.7.1 **Objective.** The purpose of this test is to verify whether kinking of a fiber optic cable results in breakage of any fiber, when a loop is formed of dimension small enough to induce a kink on the sheath.
- 262.7.2 **Method.** IEC 60794-1-2-E10.
- 262.7.3 **Test Specs.** The sample length shall be 10 times the minimum bending radius of the cable. The sample is held in both hands. a loop is made of a bigger diameter i.e. 20 D and by stretching both the ends of the cable in opposite direction, the loop is made to the minimum bend radius, and no kink shall form the cable is then normalized and attenuation reading is taken.
- 262.7.4 **Requirement.** The kink should disappear after the cable is made normal. The change in attenuation of the fiber after test shall be < 0.05 dB, both for 1310 nm & 1550 nm wavelength.

262.8 Cable Bend Test

- 262.8.1 **Objective.** The purpose of this test is to determine the ability of a fiber optic cable to withstand repeated flexing. The procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.
- 262.8.2 **Method.** IEC 794-1-2-E11 (Procedure-I).
- 262.8.3 **Test Specs.** The fiber and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.
- 262.8.4 **Requirement.** The change in attenuation of the fiber after the test shall be < 0.05 dB, both for 1310 nm and 1550 nm wavelength. Sheath shall not show any cracks visible to the naked eye, when examined whilst still wrapped on the mandrel.

262.9 Test of Figure of 8 (Eight) on the cable (Type Test)

- 262.9.1 **Objective.** Check of easiness in formation of figure of 8 of the cable during installation in the field.
- 262.9.2 **Test Method.** 1000 meter (approximate) of the cable shall be uncoiled from the cable reel and shall be arranged in figure of 8 (eight). The diameter of each loop of the figure of 8 shall be maximum 2 meters.
- 262.9.3 **Requirement.** It shall be possible to make figure of 8 of minimum 1000 meter length of the cable uncoiled from the cable reel, without any difficulty. No visible damage shall occur.

262.10 Temperature Cycling

- 262.10.1 **Objective.** To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

262.10.2 **Method.** IEC 60794-1-2-F1 (To be tested on Standard cable length of drum i.e. 2 Km $\pm$ 5 %).

262.10.3 **Test Specs.** The permissible temperature range for storage and operation should be from -20°C to +70°C. The rate of change of temperature during the test shall be 1° per minute approx. The cable shall be subjected to temperature cycling for 12 Hrs. at each temperature as given below : -

262.10.3.1 TA2 temp. : - 20°C.

262.10.3.2 TA1 temp. : - 10°C.

262.10.3.3 TB1 temp. : + 60°C.

262.10.3.4 TB2 temp. : + 70°C.

262.10.3.5 The test shall be conducted for 2 cycles at the above temperatures.

262.10.4 **Requirement.** The change in attenuation of the fiber under test shall be <0.05 dB, for 1310 nm and 1550 nm wave length for the entire range of temperature.

262.11 Cable Aging test

262.11.1 **Objective.** To check the cable material change dimensionally as the cable ages.

262.11.2 **Method.** At the completion of temperature cycle test, the test cable shall be exposed to 85 $\pm$ 2 degree C for 168 hours. The attenuation measurement at 1310 nm & 1550 nm wave length to be made after stabilization of the test cable at ambient temperature for 24 hours.

262.11.3 **Requirement.** The increase in attenuation allowed is < 0.05 dB at 1310 nm & 1550 nm.

262.11.4 **Note.** The attenuation changes are to be calculated with respect to the base line attenuation values measured at room temperature before temperature cycling.

262.12 Water Penetration Test

262.12.1 **Objective.** To check that the installed cable shall not allow the water passage along its length.

262.12.2 **Method.** IEC 794-1-2-F5 (Fig. B) 1992.

262.12.3 **Test Specs.** A circumferential portion of the cable end shall face the water head. The water tight sleeve shall be applied over the cable. The cable shall be supported horizontally and two meter water head for 24 hrs, containing sufficient quantity of water soluble fluorescent dye for the detection of seepage, shall be applied on the HDPE sheath. No other colored dye is permitted.

262.12.4 **Requirement.** No dye shall be detected when the end of the 3 m length of the cable is examined with ultraviolet light detector.

262.13 Cable Jacket Yield Strength and Ultimate Elongation

262.13.1 **Objective.** To check the yield strength and elongation of polyethylene (HDPE) cable sheath.

262.13.2 **Test Method.** FOTP-89 or ASTM D1248 Type III Class.

262.13.3 **Test Condition**

262.13.3.1 Sample shall be taken from a completed cable. The aged sample shall be conditioned at $100 \pm 2^{\circ}$ C for 120 hours before testing.

262.13.3.2 The cross-head speed shall be 50 mm per minute.

262.13.4 **Requirement**

Ser No	Jacket Material	Minimum Yield Strength		Minimum Elongation (%)
		(MPa)	(psi)	
1.	HDPE un-aged	16.5	2400	400
2.	HDPE aged	12.4	1800	375

262.14 Ribbon Dimension Measurements Test

262.14.1 **Objective.** Check of fibers in ribbon structure and to ensure the transmission performance and the mechanical service life of the fiber in the ribbon structure, check of cross over fibers and the check of fiber identity.

262.14.2 **Test method.** FOTP-123 (Video Gray Scale Analysis (VGSA) or Microscopic method).

262.14.3 **Requirement.** It shall meet the dimensional requirements given in clause No 260.1.1 above. The fibers in the entire length of the ribbon shall not cross over at any point.

262.15 Ribbon Resistance to Twist (Robustness) Test

262.15.1 **Objective.** To check the robustness of the fiber ribbons to withstand the twist in installed conditions and to check the structural integrity of the ribbon over the deployed length for mid-span entry, maintenance purposes, consideration in rearrangements and housekeeping.

262.15.2 **Test method.** FOTP-141.

262.15.3 **Requirement.** The un-aged and aged (at 85 ± 2 degree C with uncontrolled humidity for a period of 30 days) completed ribbon shall not show any separation of individual fibers from the ribbon structure after completion of the twist test when observed under 5X magnification.

262.16 Ribbon Residual Twist (Flatness) Test

262.16.1 **Objective.** To check the dimensional integrity of the ribbon without twisting to allow rearrangements and to limit the potential attenuation increases due to a macro-bending caused by twisting of the fiber ribbon.

262.16.2 **Test Method.** FOTP-131.

262.16.3 **Requirement.** The aged (at $85^{\circ} \pm 2^{\circ}$ C with uncontrolled humidity for a period of 30 days) ribbon residual twist (if any) shall have a pitch: > 400 mm.

262.17 Ribbon Separation Test

262.17.1 Objective

- 262.17.1.1 To check the separation of individual fibers, separation of sub-unit of fibers and mid span separation from a fiber ribbon.
- 262.17.1.2 To check the retention of sufficient colorant for identification for any 2.5 cm length of fiber after separation for individual and sub-unit of fibers.

262.17.2 Test

262.17.2.1 Separation of any single fiber or a multi-fiber subgroup by a tool or by hand from a ribbon for a length of 1 meter. Mid span separation from a 2 meter sample, separated close to middle for at least 0.5 meter (both single fiber and the six fiber sub – units) for un-aged ribbon.

262.17.2.2 **Requirement.** The un-aged ribbon of minimum length of a 0.3 meter (1.0 foot) of an individual fiber and a sub group of six fibers shall be separated from the ribbon without breaking the fibers or damaging the fiber coating. The force required to perform separation shall not exceed 4.4 N. The area at the separation shall not show any damage to the fiber coating when examined under 5X magnification.

262.17.2.2.1 Retention of the Colour and Fiber Identification after separation.

262.17.2.3 **Requirement.** Individual fiber colour identification shall be maintained after the separation test. It shall retain sufficient colorant that any 2.5 cm length is readily identifiable.

262.17.2.3.1 Removal of Ribbon matrix material to access individual fibers.

262.17.2.4 **Requirement.** No damage shall occur either to fiber coating or the fibers. The coating shall not sustain any swelling self-stripping, cracking or splitting when examined under 5X magnification.

262.17.3 **Note.** The manufacturer shall recommend the procedure for the removal of ribbon matrix.

262.18 Ribbon Strippability Test

262.18.1 **Objective.** Checking of removal of the matrix material and the fibers protective coating mechanically with commercial stripping tools from un-aged and aged ribbons.

262.18.2 **Test Method.** ITM-9 (Bell Core GR-20-CORE issue 2, July 1998)

262.18.3 **Pre Conditioning**

262.18.3.1 **Aged samples.** The humidity of aged ribbons shall be soaked at 85 ± 2 degree C and a non-condensing humidity of $85 \pm 5\%$ for a period of 30 days.

262.18.3.2 **Water aged samples.** The water aged ribbons shall be soaked in deionized or distilled water at a temperature of 23 ± 5 degree for a period of 14 days.

262.18.3.3 The fiber ribbon strip-ability testing shall be conducted at standard atmospheric conditions. The un-aged, humidity – aged, and water aged ribbons shall be tested within eight hours after aging.

262.18.4 **Requirement.** There shall be no fiber breakage, and any coating residue shall be removable with a single isopropyl alcohol wipe when at least 25 mm of the matrix material and the fiber Protective coating is mechanically removed with commercial stripping tools from un-aged and aged ribbons.

262.19 **Ribbon Macro-bend Performance**

262.19.1 **Objective.** To check the macro-bend performance of a ribbon.

262.19.2 **Method.** One hundred turns of ribbon are wound around a 60 mm diameter ribbon and the loss increase at 1310 nm & 1550 nm shall be measured.

262.19.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB, for 1310 nm and 1550 nm wave lengths.

262.20 **Torsion Resistance of the ribbon test**

262.20.1 **Objective.** To check the torsion resistance of the ribbon.

262.20.2 **Method.** One meter length of ribbon is twisted through five revolutions of 360° and measurement is taken.

262.20.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB, for 1310 nm and 1550 nm wave lengths.

262.21 **Crush Resistance of Ribbon**

262.21.1 **Objective.** To check the crush resistance of the ribbon.

262.21.2 **Method.** A 50 mm^2 sample is subjected to a load of 500 N and the attenuation measurement taken for both 1310 nm & 1550 nm wave lengths.

262.21.3 **Requirement.** The change in attenuation of the fiber shall be < 0.05 dB, for 1310 nm and 1550 nm wave lengths.

262.22 **Checking of the quality of the loose tube (containing optical fiber ribbon)**

262.22.1 **Embrittlement Test of Loose Tube**

262.22.1.1 This test method is based on bending by compression and reflects embrittlement much better than the other tensile tests. This test is independent of wall thickness of the loose tube.

262.22.1.2 **Sample.** The minimum length of the test sample depends on the outside diameter of the loose tube and should be 85 mm for tubes up to 2.5 mm outside diameter. The length of the bigger tubes should be calculated by using the following equation:

$$262.22.1.2.1 \quad L_o > 100 \times [(D^2 + d^2)]^{1/2} / 4 \text{ where,}$$

L_o = Length of tube under test.

D = Outside dia of loose tube.

d = Inside dia of loose tube.

262.22.1.3 **Procedure.** Both the ends of a buffer tube test sample may be mounted in a tool, which is clamped in jaws of a tensile machine which exerts a constant rate of movement. The movable jaw may move at a rate of 50 mm per minute toward the fixed jaw. Under load, the tube should bend so that it is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading.

262.22.1.4 **Requirement.** The tube should not get embrittled. No kink should appear on the tube up to the safe bend diameter of tube (15 D), where D is the outside diameter of the loose tube. There should also not be any physical damage or mark on the tube surface.

262.22.2 Kink Resistance Test on the Loose Tube

262.22.2.1 **Objective.** To safeguard the delicate optical fibers, the quality of the loose tube material should be such that no kink or damage to the tube occurs while it is being handled during installation and in splicing operations.

262.22.2.2 **Procedure.** To check the kink resistance of the loose tube, a longer length of the loose tube is taken (with fiber and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 15 D (where D is the outside diameter of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube.

262.22.2.3 **Requirement.** No damage or kink should appear on the surface of the tube.

262.23 Drainage Test for loose Tube

262.23.1 **Sample Size.** 30 cm tube length.

262.23.2 Test procedure

- 262.23.2.1 Cut the tube length to 40 cm.
- 262.23.2.2 Fill the tube with the tube filling gel ensuring that there are no air bubbles and the tube is completely full.
- 262.23.2.3 Place the filled tube in a horizontal position on a clean worktop and cut 5 cm from either end so that the finished length of the sample is 30 cm.
- 262.23.2.4 Leave the filled tube in a horizontal position at an ambient temperature for 24 hrs.
- 262.23.2.5 The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70° C for a period of 24 Hrs.
- 262.23.2.6 At the end of the 24 hrs period the beaker is checked and weighed to see if there is any gel in the beaker.

262.23.3 Requirement

- 262.23.3.1 If there is no gel or oil in the beaker the tube has PASSED the drainage test.
- 262.23.3.2 If there is gel or oil in the beaker the tube has FAILED the drainage test.

262.24 Checking for Easy Removal of Sheath

- 262.24.1 **Objective.** Checking for easy removal of sheath of the fiber optic cable by using normal sheath removal tool.
- 262.24.2 **Procedure.** To check easy removal, the sheath shall be cut in circular way and about 300 mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. One should be able to remove the sheath easily.
- 262.24.3 **Note.** Easy removal of both the outer jacket and the inner sheath shall be checked separately.

262.25 Check of the Effect of Aggressive Media on the Cable (Acidic and Alkaline Behaviour)

- 262.25.1 **Procedure.** To check the effect of aggressive media, solution of PH4 and PH10 shall be made. The two test samples of the finished cable, each of 600 mm in length, are taken and the ends of the samples are sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc on the sheath and other markings of the cables.
- 262.25.2 **Requirement.** The sample should not show any effect of this solution on the sheath and other marking of the cable.

262.26 Cable Outer Diameter and Jacket Thickness

- 262.26.1 **Sample Size.** At least three specimens from each cable sample shall be tested to determine conformance to the criteria of this section. Alternatively, compliance to the cable outer diameter and jacket thickness criteria may be verified by a review of test data from the cable manufacturer.
- 262.26.2 **Procedure.** Cable samples shall be tested in accordance with Sections 6 through 8 of ASTM D 4565.
- 262.26.2.1 Section 6 for cable diameter.
- 262.26.2.2 Section 7 for cable jacket thickness.
- 262.26.2.3 Section 8 for cable jacket eccentricity.
- 262.26.3 **Requirements.** The average diameter of the cable shall not exceed the manufacturer's stated maximum.

263. **General Requirements**

264. **Engineering requirements**

264.1 **Cable Marking**

- 264.1.1 A long lasting suitable marking shall be applied in order to identify this cable from other cables. The cable marking shall be imprinted (indented). The marking on the cable shall be indelible of durable quality and at regular intervals of one meter length. The accuracy of the sequential marking should be within -0.25% to +0.5% of the actual measured length. The markings on the cable should not rub off during normal installation and in life time of fiber optic cable.
- 264.1.2 The marking shall be in contrast colour to the sheath and shall be done by hot foil indentation method. It should clearly contrast with the surface. The colour used should withstand the environmental influences experienced in the field.
- 264.1.3 The type of legend marking on Optical Fiber cable shall be as follows :-
- 264.1.3.1 Company Legend.
- 264.1.3.2 Legend containing telephone mark & international acceptable Laser symbol.
- 264.1.3.3 Type of cable (Type C)
- 264.1.3.4 Type of Fibers (G.652D).
- 264.1.3.5 Number of Fibers (48+8).
- 264.1.3.6 Year of manufacture.
- 264.1.3.7 Sequential length marking.
- 264.1.3.8 User's identification: NFS OFC.
- 264.1.3.9 Cable ID.

264.2 **Cable Ends**

- 264.2.1 Both cable ends (the beginning end and end of the cable reel) shall be sealed and readily accessible. Minimum 5 meter of the cable of the beginning end of the reel shall be accessible for testing. Both ends of the cable shall be kept inside the drums and shall be located so as to be easily accessible for the test. The

drum (conforming to GR No G/CBD-01/02 Nov 94 and subsequent amendments if any) should be marked to identify the direction of rotation of the drum. Both ends of cable shall be provided with cable pulling (grip) stocking and the anti twist device (free head hook). The diameter of the cable shall also be marked on the cable drum. The wooden drum shall be properly treated against termites and other insects during transportation and storage. The manufacturer shall submit the methodology used for the same.

- 264.2.2 An anti-twist device (Free head hook) shall be provided attached to the front end of the cable pulling arrangement. The arrangement of the pulling eye and its coupling system, along with the anti twist system, shall withstand the prescribed tensile load applicable to the cable.

264.3 The Nominal Drum Length

- 264.3.1 Length of OFC in each drum shall be $2/4 \text{ Km} \pm 5 \%$ and shall be supplied as per the order. In order to avoid wastage of OFC, the supplier is permitted to provide upto one drum per access station, of shorter length, to cater for fractional link lengths finalized after completion of route survey.

- 264.3.2 The fibers in cable length shall not have any joint..

- 264.3.3 The drum shall be marked with arrows to indicate the direction of rotation.

- 264.3.4 Packing list supplied with each drum shall have at least the following information.

264.3.4.1 Drum No.

264.3.4.2 Type of cable.

264.3.4.3 Physical Cable length.

264.3.4.4 No. of fibers.

264.3.4.5 Length of each fiber as measured by OTDR.

264.3.4.6 The Cable factor - ratio of fiber / cable length.

264.3.4.7 Attenuation per Km. of each fiber at 1310 nm, 1550 nm and 1625 nm.

264.3.4.8 User's / Consignee's Name.

264.3.4.9 Manufacturer's Name, Month, Year and Batch No.

264.3.4.10 Group refractive index of fibers.

264.3.4.11 Purchase Order No.

264.3.4.12 Cable ID.

264.4 Colour Coding and Ribbon Identification in OFCs

- 264.4.1 The colorant applied to individual fibers shall be readily identifiable throughout the life time of the cable and shall match and conform to the MUNSSELL color standards (For EIA standard EIA-359-A) or IEC Publication 304 (4).

- 264.4.2 **Colour Coding Scheme.** When the loose tubes are placed in circular format, the marking to indicate the loose tube No. 1 shall

be in blue colour followed by loose tube No.2 of orange and so on for other tubes as per the colour scheme given below and complete the circular format by placing the dummy /fillers at the end. Depending upon the number of fibers in a Ribbon (which depends on the cable capacity), the colour of the fibers are serially chosen from the column No. III of the following **Table 6.3** .

Ser No	No. of Fibers	Fiber Identification
1.	1	Blue
2.	2	Orange
3.	3	Green
4.	4	Brown
5.	5	Slate / Grey
6.	6	White
7.	7	Red
8.	8	Black
9.	9	Yellow
10.	10	Violet
11.	11	Pink / Rose
12.	12	Aqua

Table 6.3 Colour Coding Scheme of the Optical Fibers & Loose Tube

264.4.3 Identification of Ribbon

Ser No	No. of Fibers in a cable	No. of tubes	No. of ribbons per tube	Marking on Ribbon
1.	48	One	4	1 RIBBON 1 2 RIBBON 2 3 RIBBON 3 4 RIBBON 4

264.4.3.1 Note. The printing shall be at regular interval of every 200 mm on natural color ribbon and shall be legible. The printing on the ribbon shall also be of durable quality and shall be compatible with coating of the ribbon and Thixotropic Jelly (filled in the loose tube of the cable).

265. **Quality Requirements.** The cable shall be manufactured in accordance with the international quality standards ISO 9001-2008 for which the manufacturer should be duly accredited. A quality plan followed by the manufacturer shall be required to be submitted.
266. **Cable Material Compatibility.** Optical fiber, buffers/core tubes, and other core components shall meet the requirements of the compatibility with buffer/core tube filling material(s) and/or water-blocking materials that are in direct contact with identified components within the cable structure.
267. **Documentation**
- 267.1 Complete technical literature in English with detailed cable construction diagram of various sub-components with dimensions and test data and other details of the cable shall be provided.
- 267.2 All aspects of installation, operation, maintenance shall also be covered in the handbook. The pictorial diagrams of the accessories (with model no. and manufacturer name) supplied along with the cable as package shall be also be submitted. A hard as well as soft copy of the manuals shall be provided.
268. **Safety Requirement.** The material used in the manufacturing of the single mode fiber optic cables shall be non toxic and dermatologically safe in its life time and shall not be hazardous to health. The manufacturer shall submit MSDS (Material Safety Data Sheet) for all the material used in manufacturing of fiber optic cable to substantiate the statement.
269. **Product Qualification Requirements** The product shall be complied as per following Qualification Programs.
- 269.1 **Initial Product Qualification (IPQ).** The product manufactured on representative production equipment should be tested for conformance to the requirement. Once testing has shown that the product meets the requirement, it is generally assumed that it should continue to meet the requirement as long as the fiber design, material composition, or manufacturing process that affect functionality of the product are not changed.
- 269.2 **Manufacturing Quality Program (MQP).** A manufacturer's internal quality program that assures the product being produced continues to be of the same high quality that was initially tested and is shown to meet Initial Product Acceptance criteria.
- 269.3 **Qualification Program**

Ser No	Test	IPQ	MQP
1.	Cable Outer Diameter & Jacket	X	X
2.	Cable Marking	X	X
3.	Cable Ends	X	X
4.	Cable Drum Length	X	X
5.	Cable Tensile Strength	X	X
6.	Cable Abrasion	X	

7.	Cable Crush	X	X
8.	Cable Impact	X	X
9.	Cable Repeated Bending	X	X
10.	Cable Torsion	X	X
11.	Cable Kink	X	
12.	Cable Bend	X	
13.	Cable Figure of Eight	X	
14.	Cable Temperature Cycling	X	X
15.	Cable Aging	X	
16.	Cable Water Penetration	X	
17.	Cable jacket yield strength and ultimate elongation	X	X
18.	Cable Loose Tube Drainage	X	
19.	Cable Sheath Removal	X	
20.	Cable Acidic Alkaline Behaviour	X	
21.	Ribbon Dimension	X	
22.	Ribbon Resistance to Twist	X	
23.	Ribbon Residual Twist	X	
24.	Ribbon Separation	X	
25.	Ribbon Strippability	X	
26.	Ribbon Macro Bend Performance	X	
27.	Ribbon Torsion Resistance	X	
28.	Ribbon Crush Resistance	X	
29.	Ribbon Loose Tube Quality	X	

269.4 **Test Results.** The Fiber Test report shall provide following parameters.

269.4.1 Product Name.

269.4.2 Fiber Identification No.

269.4.3 Fiber Length.

269.4.4 Group Refractive Index at 1310nm, 1550nm & 1625nm.

269.4.5 Attenuation at 1310nm

269.4.6 Attenuation at 1383±3nm (Post- hydrogen aging).

- 269.4.7 Attenuation at 1550nm.
- 269.4.8 Attenuation at 1625nm.
- 269.4.9 Mode Field Diameter at 1310nm.
- 269.4.10 Fiber Cutoff Wavelength.
- 269.4.11 Zero Dispersion Wavelength.
- 269.4.12 Zero Dispersion Slope.
- 269.4.13 Chromatic Dispersion at 1285-1330nm.
- 269.4.14 Chromatic Dispersion at 1550nm.
- 269.4.15 Chromatic Dispersion at 1625nm.
- 269.4.16 Maximum Attenuation in (1285-1330) nm.
- 269.4.17 Polarization Mode Dispersion.
- 269.4.18 Cladding Diameter.
- 269.4.19 Core/Cladding Concentricity Error.
- 269.4.20 Cladding Non-circularity.
- 269.4.21 Coating Diameter.
- 269.4.22 Cladding/Coating Concentricity Error.
- 269.4.23 Coating Non-circularity.
- 269.4.24 Fiber Curl.
- 269.4.25 Proof Test Level.

270. **Inspection at Different Stages.** As per [Appendix G](#).

RAW MATERIAL SPECIFICATIONS

271. The raw material sourced for manufacture of Optical Fiber and Cable shall be as per TEC GR No TEC/GR/TX/ORM-01/04/Sep 2009 or latest, if any.

BSNL

SECTION VI**PART B : DETAILED TECHNICAL SPECIFICATIONS: ACCESSORIES**

272. **Note.** The make and model of line items to be specified as per **Appendix `M`**. Vendors are required to offer **Single Option** in terms of Make/Model as part of the Technical Bid; **Bids offering more than one option will be rejected.**

273. This section contains the following Accessories Specifications.

Ser No	Type of Accessories
1.	PLB HDPE Ducts
2.	FDMS
3.	Joint Closures
4.	Electronic Route Markers
5.	Electronic Route Locaters
6.	Warning Tape

PLB HDPE DUCTS

274. **Eligibility Conditions for Duct & Duct Accessories Manufacturer.** The bidder should procure the duct, duct accessories and equivalent items only from the vendors having the following capabilities:-
- 274.1 **Manufacturing capacities in India.** Minimum manufacturing capability for 15000 Km of Standard Ducts per annum. The bid should be accompanied by manufacturer certificate and BSNL assessed manufacturing infrastructure assessment advice.
 - 274.2 **ISO: 9000 Certification/ international certification.** The quality manual is also required to be appended and any additional certificate if any shall be provided along with bid.
 - 274.3 Compliance with TEC specification no. G/CDS-08/02 Nov 2004 with amendments and approved with valid certificate TAC along with specifications provided in this tender.
 - 274.4 Experience of supply 20,000 km in last 5 financial years. The PLB HDPE Duct Manufacturer should have supplied their ducts to atleast three Telecom Service Providers in India.
 - 274.5 The PLB manufacturer should not be blacklisted for Telecom business by any Central/ State Government/ PSU or Telecom operator in India, at the time of submission of bid.
275. The bidder shall supply PLB HDPE duct as per TEC GR No GR/CDS-08/02 Nov 2004 or latest, if any. The colour of duct shall be sky blue.

FIBER DISTRIBUTION MANAGEMENT SYSTEM

276. **Introduction.** FDMS shall provide management of large volume of optical fibers of a cable, with flexibility and reliability. It shall provide management of fibers in a consistent and structured manner. It should also facilitate reconfiguration and testing of fibers, cables and network. Communication equipment is to be placed at an indoor location. The location would have multiple cables converging and hence requires a system to handle the large number of fibers. These cables shall be routed through race ways either from the bottom (under floor) or overhead. The FDMS at each of these locations along the NLD Route and the Access Network would be installed to provide interconnection along routes at regenerator locations, provide terminal connectivity to equipment and shall enable testing of installed fiber.
277. **Functional Requirements**
- 277.1 The FDMS shall be able to accommodate all types of optical fiber cable structures including ribbonised optical fiber cable having 12 fibers per ribbon, adopting different construction practices. i.e. the Unitube, Multi loose tube design, Intrusion Proof Cable Design, besides Aerial & other Underground optical Fibers cables.
 - 277.2 The FDMS shall provide positive Fiber management i.e. facilities to carry out the expansion, reconfiguration & maintenance etc. without disturbing or affecting the existing fibers already in use or inflicting any damage to pig tails, patch cords, optical fibers (individual & ribbon), optical fiber cables, fiber splices (individual & ribbon) during normal cable and element handling. It shall provide well engineered bend radius control throughout the system.
 - 277.3 The FDMS would be mounted on a floor fitted rack of height 42U. Each full rack should be capable of handling at least six separate Splicing Cum Patching Shelves with Cable Management System. The width of the rack should conform to standard specifications for mounting of 19" wide equipment. The rack should have suitable raceways for guiding cables in/out from the rack.
 - 277.4 Each Splicing cum Patching Shelf would have inbuilt splicing trays and patch panels integrated into a single unit of not more than 4U. It would cater for at least six separate trays, each capable of splicing a single ribbon fiber (each ribbon having 12 Fibers). An additional splicing tray for at least 12 single sensory fibers shall also be catered.
 - 277.5 The Patch Panel, as part of the Splicing cum Patching Shelf shall be supplied with 84 adapters with fully terminated 6 Nos. of 12F Ribbon Fan-out pigtails and 12 Nos. of SM 0.9mm Pigtails. The patch panel shall be supplied Pre-assembled with E2000-APC adapters with adequate spacing. Authorization Certificate from E2000 OEM should be submitted along with TSEC certification.
 - 277.6 The FDMS shall have provision for slack management for storing the extra length of optical Fibers and ribbonised optical fibers & pigtails, which shall not experience bend below the critical bend radius.
 - 277.7 The FDMS shall be easily opened and closed without any degradation in the performance of Fibers. The shelves should have slides upon which the Splice Tray Assembly & Patch Panel shall be mounted and when required can be slid out for operation and pushed back and door closed with Knob Screws, after use.

- 277.8 The FDMS shall have arrangement to hold the optical fiber cable.
- 277.9 Identification mechanism of incoming and outgoing cables/pigtails/patch cords/ ribbon fibers and adaptors shall be provided.
- 277.10 The system shall be suitable for Optical Fiber Cables having single mode fibers (individual Fiber & Ribbon Fiber) as per ITU-T Rec. G. 652D for transmission at wavelengths of 1310nm and 1550nm; and for up-gradation at 1625 nm wavelength without modification. It shall also be suitable for optical fibers as per ITU-T Rec. G. 655.
- 277.11 The FDMS shall have facility for splicing of Individual Fibers (non-ribbon type) to Individual Fibers and Ribbon Fibers to Ribbon Fiber. The facility for splicing of Individual Fibers (non-ribbon type) with Ribbon type of Fibers shall also be provided.
- 277.12 The components of FDMS to include splicing cum patching shelves, shall be provided as per the requirement at all fiber terminations.

278. **Technical Requirements for FDMS.** The FDMS at Communication Nodes shall be located in the fiber termination room for NLD routes and in user premises as part of the Access Network. It shall be modular type of construction having the facility of handling large volume of Optical Fibers for configuration, relocation and testing. The different modules to include FDMS and Cable Management System for Patch Cords shall be housed in a single rack, as per the requirements.

278.1 Each FDMS shall consist of the following: -

- 278.1.1 1 x Floor Mounted Rack.
- 278.1.2 2 x Splicing cum Patching Shelf.
- 278.1.3 1 x Horizontal Patch Cord Management Shelf.
- 278.1.4 4 x Duplex Patch Cords per Splicing cum Patching Shelf (length 3 mtr each). Specification for patch cord are given at **Annexure II**.

278.2 **Rack Specifications**

278.2.1 **Dimensions of the Rack**

- 278.2.1.1 Height : 2200 mm $\pm$ 2%.
- 278.2.1.2 Width : 900 mm $\pm$ 5%.
- 278.2.1.3 Depth : 600 mm $\pm$ 5%.
- 278.2.1.4 Side Ducts : 2 (one on side of the both 19" Mounting Rails).
- 278.2.1.5 Width of side ducts : 150 mm each $\pm$ 5%.
- 278.2.1.6 The thickness of the metal sheet used to fabricate the system shall not be less than 1.5 mm.

278.2.2 **Capacity of the Rack**

- 278.2.2.1 No. of Optical Fiber Splicing cum Patching shelves: 6 (Six)
- 278.2.2.2 No. of Horizontal Patch Cord Managers: 6 (Six)

278.2.3 **The main rack shall have provision for the following: -**

- 278.2.3.1 Suitable holes on the Base plate (for fixing the rack on the floor) with adjustable feet. The rack could be fitted on the floor with anchor fasteners.
- 278.2.3.2 It shall have facility and arrangement for fixing, holding and leading-in for 6 Nos. of outdoor cables of 12-22 mm diameter, from the top of the rack. The entry holes shall normally be closed and opened as and when required. The entry holes should be fitted with cable glands of appropriate size.
- 278.2.3.3 It should have provision for mounting the shelves from the front.
- 278.2.3.4 It should also contain vertical patch cord management system on the right side duct of the rack. It shall contain plastic half round drums with D type projection for securing the patch cords.
- 278.2.3.5 The rack shall have three doors with removable hinges and appropriate locking system. The doors shall include 2 x side duct doors and one main central door made of glass with metallic frame.

278.2.4 **Cable Layout within rack**

- 278.2.4.1 Cable entry from Left Top side of the rack.
- 278.2.4.2 Patch cord exit arrangement from the Right Top side of the rack.
- 278.2.4.3 The rack shall contain 6 x breakout units, so that each cable entering into the rack is guided to the Splicing cum Patching Shelf using transportation tubes. Self lock slots shall be provided along the sides so that the tubes do not slide out.
- 278.2.4.4 The rack shall also have 6 x sheath clamps to secure the cables after they enter the rack.

278.3 **Horizontal Patch Cord Management system.**

- 278.3.1 **Horizontal Patch Cord Management (HPM)** system shall be fitted to store extra lengths of Patch cords for patching within the same rack. It should be 19" rack mountable. Half round drums shall be used to guide patch cords entering from the left side of the duct.

278.4 **Splicing cum Patching Shelf Specifications:**

278.4.1 **Dimensions:**

- 278.4.1.1 Width : 485 mm $\pm$ 2 %.
- 278.4.1.2 Depth : 360 mm $\pm$ 2 %.
- 278.4.1.3 Height : 177mm $\pm$ 2%(4U).

278.4.2 **Capacity of Splicing cum Patching shelf**

- 278.4.2.1 Total of Seven Number of Splice Trays shall be provided – Six Nos. for splicing 6 Nos. of 12F ribbon

Fibers and One No. for Splicing 12 Nos. Single sensory optical Fibers.

278.4.2.2 The Patch Panel shall have 84 Nos. of E2000-APC Adaptors, in 7 horizontal rows with columns of 12 Nos each.

278.4.2.3 The Splice Trays shall be of clipped on and hinged design.

278.4.3 **Features of Splicing cum Patching shelf**

278.4.3.1 It shall be a metal chassis with pull out drawer mounted on telescopic slides. The pull out length of the drawer shall be 10 inches.

278.4.3.2 Patch cord guides shall be provided for guiding patch cords as they exit the shelf.

278.4.3.3 It shall be possible to fix the fiber splicing cum patching shelf on the 19" Rack, with mounting screws and nuts. A hinged/ removable shelf cover with fiber glass face shall be provided.

278.4.3.4 The splicing cum patching shelf shall have 84 Nos. of E2000-APC Adaptors, pre-assembled, which shall have 6 Nos. of 12F Ribbon Fan-Out E2000-APC Pigtails & 12 Nos. of 1.5 mtr E2000-APC Pigtails installed.

278.4.3.5 A Tray wedge shall be provided in each shelf to enable working on any Splice Tray.

278.4.3.6 Splice Trays shall be easily flipped at an angle of minimum 80 degrees based on the hinge clip.

278.4.3.7 4 x Single mode fiber Patch Cords shall be provided with each shelf as per specifications given at Annexure II.

278.4.4 **Capacity of Fiber Splice Tray Assembly**

278.4.4.1 Ribbon FiberSpliceTray : 1 Ribbon (12F) per Tray.

278.4.4.2 Individual Fiber Splice Tray: 12F per Tray.

278.4.5 **Type of Splice Trays**

278.4.5.1 **Single Fiber Splice Tray.** The single fiber Splice Tray shall be able to accommodate 12 Fibers. This Splice Tray shall assemble with other hinging Splice Trays. It shall be possible to store 900-1500 mm of Fibers and pigtails in each Tray maintaining a minimum bend radius of 35 mm. It shall have following features: -

278.4.5.1.1 Slots of the splice Tray shall be able to fix the splice protection sleeves in such a way that they will not shift or move inside the splice tray or come into conflict with the Fiber coils, once

fixed in a slot of the tray. The slots shall not cause any stress or strain neither on splice protection sleeves nor on the optical fibers.

278.4.5.1.2 The fastening arrangements for entry of the fibers into the splice Tray shall be suited to secondary coated fibers and primary coated fibers in tubes, without there being any risk of bending loss or damage to the fibers or the secondary tubes.

278.4.5.1.3 It shall be possible to take any individual fiber out of the splice tray for repair during normal operation, without damaging the remaining fibers.

278.4.5.2 **Ribbon Fiber Organizer Tray for Splicing shelf.**
The Ribbon Fiber Organizer Tray shall accommodate One No. of the ribbon type of splice with fan-out unit (for 12 Fibers). It shall provide network flexibility point for the expansion and reconfiguration of the network. It shall have following features:-

278.4.5.2.1 The ribbon splicing Tray shall be non-metallic and made of ABS Blend material and the material shall conform to the requirements as mentioned in **Annexure-I**.

278.4.5.2.2 It shall be possible to store extra length of up-to 1500mm of 12F Fiber Ribbons and pigtails in each tray maintaining a minimum bend radius of 35 mm and mounting of fan out unit.

278.4.5.2.3 Slots on the splice tray shall be able to fix the splice protection sleeves in such a way that they will not shift or move inside the splice tray or come into conflict with the fiber ribbon coils, once fixed in a slot of the tray. The slots shall not cause any stress or strain neither on splice protection sleeves nor on the optical fibers.

278.4.5.2.4 The fastening arrangements for entry of the fiber ribbon and the pigtails etc. into the splice tray shall be suited to the fiber ribbon from cable having loose tube design, without there being any risk of

bending loss or damage to the fibers or to the fiber ribbon.

278.5 Splice Protection Sleeves

278.5.1 **Type - 1 (For Single Fiber).** 15 Nos. (including spare) of Heat-shrinkable splice protection Sleeves of 60mm length, as per the TEC GR No. GR/PTS-01/02. APR 2006, shall be supplied with each Splicing & Patching Shelf.

278.5.2 **Type - 2 (For Ribbon).** 9 Nos. (including spare) of heat-shrinkable splice protection sleeves as per the TEC GR No. GR/PTS-02/01. JAN 2001, shall be supplied with each Splicing & Patching Shelf.

278.6 **E2000-APC- Pre Connectorized Fan out Pigtail.** 6 Nos. of 12F E2000-APC Pre-connectorised Fan Out Pigtail shall be supplied with each Splicing & Patching Shelf. This shall meet the following requirements:

278.6.1 **Fiber type.** Single mode Fibers conforming to G652D and G655 (Three fanout each) for transmission at 1310 nm and 1550nm wavelengths and for up-gradation at 1625 nm wavelength without any modification.

278.6.2 **Connector Type.** 12 Nos. of E2000-APC type optical connectors connected to 900µm secondary Fiber. The E2000-APC connectors and adapters supplied should conform to the following specifications:

278.6.2.1 **Insertion Loss** : 0.1dB (Typical) & 0.15dB (Max).

278.6.2.2 **Return Loss** : >80dB.

278.6.3 **Length.** 1.5 meter of 12 Fiber ribbon for splicing to ribbon fiber of outdoor OF cable on one side of the Fan out unit and suitable length of individual connectorized fibers for mounting on the Patch Panel.

278.6.4 **Type of Ribbon.** As per Bell core document GR - 20 Issue - 2; July 1998.

278.6.5 The Fan out unit supplied shall bear Make, Model and Sl. No. The insertion loss shall be ≤ 0.1 dB typical and 0.15dB Maximum. for each connectorized fiber in the ribbon.

278.7 **E2000-APC -Pre Connectorized Pigtail.** 12 Nos. of E2000-APC Pre-connectorised Pigtail shall be supplied with each Splicing & Patching Shelf. This shall meet the following requirements:

278.7.1 **Fiber type.** Single mode Fibers conforming to G.652D for transmission at 1310 nm and 1550nm wavelengths and for up-gradation at 1625 nm wavelength without any modification.

278.7.2 **Connector Type.** E2000-APC type optical connector connected to 900um secondary Fiber. The E2000-APC connectors and adapters supplied should conform to the following specifications:

278.7.2.1 **Insertion Loss** : 0.1dB (Typical) & 0.15dB (Max).

278.7.2.2 **Return Loss** : <80dB.

278.7.3 **Length.** 1.5 meter length of individual connectorized 0.9mm fiber for mounting on the Patch Panel.

278.7.4 The E2000-APC Pigtail shall be preassembled..

278.8 **Cable entry Kit.**

278.8.1 A complete kit to accommodate incoming and outgoing cable, as per the requirement of clause No 278.2.2.1 above, shall be provided.

278.8.2 Velcro strap or roll (5 meter long & 25 mm wide) shall be provided to secure the Patch Cords.

278.9 **Accessories.** The manufacturer shall provide list and all accessories and spares shall be required for complete termination/installation of the rack to its full capacity and give the details for the future procurements of the required accessories and spares shall be needed during reconfiguration and re-arrangement of the system.

279. **Performance Test Requirements.** The FDMS shall meet the following test requirements:

279.1 **Visual Examination.** The system shall be examined physically for the workmanship, design and technology employed. It shall be checked for any flaws, defects, cracks etc. visible to the naked eye.

279.2 **Variation in attenuation (Residual Loss)**

279.2.1 **Objective.** To check the effect of use of the Fiber Splice Tray Assembly, on the transmission characteristics of optical fiber in assembled condition.

279.2.2 **Requirement**

279.2.2.1 Wavelength of operation : 1310 nm & 1550 nm

279.2.2.2 Change in attenuation : ± 0.10 dB

279.2.2.3 **Note.** The Fiber attenuation shall be measured.

279.2.2.3.1 Leaving the Fiber un-looped,

279.2.2.3.2 After the arrangement on the Tray and stabilization time of one hour

279.3 **Patch cord retention test**

279.3.1.1 **Objective.** It is required to check the holding mechanism and the effect of the accidental pull on the Patch Cords. An axial load shall be applied longitudinally on Patch Cords, which shall not cause any damage.

279.3.1.2 **Requirement**

279.3.1.2.1 Tension applied longitudinally : 75 N

279.3.1.2.2 Test Time : 10 minutes

279.3.1.2.3 Variation in attenuation (Residual Loss) shall be checked after the completion of test and the variation in attenuation shall be < 0.1 dB at

1310 nm & 1550 nm. There shall be no visible flaws or defects after the test.

279.4 Environmental cycle

279.4.1 **Objective.** To determine the working capability of Splicing and Patching Shelf for climatic conditions.

279.4.2 Requirement

- 279.4.2.1 Lowest temperature : -15° C
- 279.4.2.2 Highest temperature : 60° C
- 279.4.2.3 Dwell Time : 4 hrs
- 279.4.2.4 Transition time : 2 hrs
- 279.4.2.5 Cycle duration : 10 and 1/2 hrs.
- 279.4.2.6 Number of cycles : 10
- 279.4.2.7 Variation in attenuation (Residual Loss) shall be checked after the completion of test and the variation in attenuation shall be as < 0.2 dB at 1310 nm & 1550 nm. There shall be no visible flaws or defects after the test.

279.5 Vibration Test

279.5.1 **Objective.** To check the effect of vibration on Splicing and patching shelf.

- 279.5.1.1 Planes : 3 (X - axis, Y - axis & Z - axis)
- 279.5.1.2 Sweep : (10-300) Hz $\pm 2\%$ at 1 octave $\pm 10\%$ per mm.
 - 279.5.1.2.1 Sine sweep (10-28) ± 1 Hz 0.1" (2.5 mm) double amplitude.
 - 279.5.1.2.2 Sine sweep (28-300) Hz $\pm 2\%$ max. 4 g acceleration
- 279.5.1.3 Time : 2 hours each axis

279.5.2 There shall be no visible flaws or defects after the test.

279.6 **Shelf Endurance Test.** This test checks the mechanical performance of a shelf after several opening /closing operations.

- 279.6.1 The front plate of the shelf shall be removed and the shelf opened by sliding the drawer tray with the fiber management system to its extreme position.
- 279.6.2 The shelf shall then be closed again by sliding the drawer tray into the shelf until it locks.
- 279.6.3 This sequence shall be repeated 100 times.
- 279.6.4 After completion of the test specimens shall be examined with the unaided eye for damage which would impair functionality.

- 279.7 **Shelf Performance Test.** This test checks the optical performance of a shelf when opened.
- 279.7.1 The optical signal shall first be measured & the value shall be recorded.
 - 279.7.2 The front plate of the shelf shall then be opened and the drawer Tray with the Fiber management system shall be made to slide out, to its extreme position.
 - 279.7.3 Optical measurements shall be made again and recorded as before.
 - 279.7.4 The shelf shall then be closed again by sliding the drawer tray into the shelf until it locks.
 - 279.7.5 Optical measurements shall be made again and recorded as below.
 - 279.7.6 This whole sequence is carried out once.
 - 279.7.7 The residual loss should be less than 0.1 dB.
280. **Marking.** The marking on the system shall be indelible and carry the following minimum information:
- 280.1 Manufacturer's name & date/year of production.
 - 280.2 Model No.
 - 280.3 Capacity i.e. No. of cables and the fibers.
 - 280.4 Identification details/cable/fiber/ labeling facility.
281. **Documentation.** The technical literature in English language, along with detailed drawings of all the assemblies and parts, shall be provided. All the aspects of Installation, Operation, Maintenance, and Repair including illustration of external and internal parts shall be covered in the manual. The manual shall include the following: -
- 281.1 Safety measures to be observed.
 - 281.2 Precautions.
 - 281.3 Illustration of internal and external parts.
 - 281.4 List of the parts including their source and ordering information for all the replaceable parts.
282. **Spares and accessories.** The manufacturer shall mention and supply the required accessories and spares for FDMS.
283. **Wall Mount FDMS.** A Wall Mount Outdoor type FDMS, as per specific site requirements for access / regenerator sites etc, with all above applicable features shall be offered for approval and supplied, as per Site Requirements, as determined during Survey, at No extra cost. They shall be supplied as wall mountable, as per requirement. All Wall Mount Outdoor FDMS shall be provisioned with splice tray assembly, Patch Panel, Pigtails, 12F Ribbon Fan-outs, and all other accessories as applicable, as described above, with same capacity and features.
- 283.1 The Wall Mount FDMS shall be suitable for outdoor conditions, water resistant, corrosion resistant, robust construction and shall allow bottom entry for three Optical Fiber Cables and Bottom Exit for Patch Cords.

- 283.2 The Wall Mount FDMS shall meet ingress protection class IP-66 specifications. IP66 rated glands for patchcords & OSP cables should be provided with the box.
- 283.3 The Wall Mount FDMS Body shall be a rectangular Box, fabricated from Steel Sheet, Epoxy Powder Coated in Matt Siemens gray Color, and Gasketed for protection from environment and long life. All hardware used shall be in Plated Steel, for trouble free maintenance and long life. All Plastic Components assembled within the FDMS shall be molded in ABS with smooth finish.
- 283.4 The Wall Mount FDMS Cover shall be hinged, lockable and fully openable to provide room for easy access to the Cable Fibers, Pigtails & Splice Tray Assembly inside the FDMS.
- 283.5 Suitable design of the Wall Mount FDMS shall be incorporated to ensure that the area containing the splice tray shall not be disturbed while accessing the patch cord area during routing maintenance.
- 283.6 **Fiber Splicing Tray Assembly.** As per description at Paras 278.4.4 and 278.4.5 above
- 283.7 **Patch Panel.** 84 Nos. of E2000-APC type Adapters shall be mounted inside on the Patch Panel of the FDMS. The inner sides of the Adapters are assembled with connectors of the Pigtails/12F Ribbon Fan-outs. The Outer side of the Adapters is to be assembled with Patch Cords (four patch cords to be supplied per wall mount shelf). The FDMS shall be supplied with E2000-APC type Adapters, for Single Mode Applications. The max. Insertion Loss in any Coupler/Adapter is 0.15 dB at 1310/1550nm.
- 283.8 **Dimensions**
- 283.8.1 Width : 550 mm $\pm$ 2 % max.
- 283.8.2 Depth : 200 mm $\pm$ 2 %max.
- 283.8.3 Height : 600 mm $\pm$ 2 % max.
- 283.9 **Marking.** The marking on the Wall Mount FDMS shall be indelible and carry the following minimum information:
- 283.9.1 Manufacturer's name & date/year of production.
- 283.9.2 Model No.
- 283.9.3 Capacity i.e. No. of cables and the fibers.
- 283.9.4 Identification details/cable/Fiber/ labeling facility.
- 283.10 **Documentation.** The technical literature in English language, along with detailed drawings of all the assemblies and parts, shall be provided. All the aspects of Installation, Operation, Maintenance, and Repair including illustration of external and internal parts shall be covered in the manual. The manual shall include the following: -
- 283.10.1 Safety measures to be observed.
- 283.10.2 Precautions.
- 283.10.3 Illustration of internal and external parts.
- 283.10.4 List of the parts including their source and ordering information for all the replaceable parts.
- 283.11 **Spares and accessories.** The manufacturer shall mention and supply the required accessories and spares for Wall Mount FDMS.

Annexure-I

(Refer Para 278.4.5.2.1
above of Section VI
Part B)

284. The Material for Fiber Splice Trays

284.1 The Optical Fiber Splice Trays shall be made of ABS/ABS blend material having following characteristics :

284.2 **For ABS material**

284.2.1 Specific gravity :1.01-1.21 gm/cc ASTM-D-792

284.2.2 Tensile strength : ≥ 0.002 Kg/sq.mm ASTM-D638

284.2.3 Elongation : $< 50\%$ ASTM-D638

284.2.4 Water absorption : $\leq 0.4\%$ ASTM-D-57-59

284.2.5 Rock well hardness :R81-R111 ASTM-D785A

284.3 (The hardness may also be checked by Ball indentation method BS EN ISO 2039-1:1996. The test load shall be 961 N $\pm 1\%$ and the diameter of the ball shall be 5.0 ± 0.05 mm with initial load of 9.8 N).

284.4 **Note.** A certificate from recognized laboratory is acceptable, if the manufacturer does not have the test facility.

Annexure II
(Refer Para 278.1.4 of
Section VI Part B)

SINGLE MODE OPTICAL FIBER PATCH CORDS AND THE PIGTAILS

285. General Requirements

- 285.1 The optical fiber patch cords shall be manufactured with secondary coated optical fiber reinforced with aramid yarn equally distributed over the periphery and with overall protective LSZH sheathing.
- 285.2 The mechanical design and construction of the component parts of each subassembly shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.
- 285.3 The detail of the source of the components/ accessories, from where these have been procured shall be submitted by the Supplier.
- 285.4 The component parts which shall be available from multiple sources shall be used.

286. Quality Requirements

- 286.1 The Optical Fiber Patch Cords shall be manufactured in accordance with the International Quality standards ISO 9001-2008.
- 286.2 The Optical Fiber Patch Cords and Adaptors shall conform to the requirements for environment test specified in IEC document No. 60874-1 (1993-02), IEC 60874-1 (1994-03) and IEC 60794-1 and Telcordia GR 326.

- 287. Safety Requirements.** Test reports will be provided with actual Insertion loss, Return loss mentioned and sufficient information to alert the user about the potential hazard and shall indicate the required precautions and working practice.

288. Specification of Optical Fiber

- 288.1 The Optical Patch Cords shall be fitted with E2000-APC connectors at both ends.
- 288.2 Single mode Optical Fiber used in manufacturing Optical Patch Cords and Pigtailes shall have the following characteristics
 - 288.2.1 Type of Fiber : Single mode as per ITU-T G.652D.
 - 288.2.2 Wavelength Band Optimized : 1310/1550 nm
 - 288.2.3 Nominal mode Field Diameter : 8.8-9.8 um
 - 288.2.4 Nominal Cladding Diameter : 125 ± 1 micron
 - 288.2.5 Cladding non circularity : ≤ 1%
 - 288.2.6 Primary coating material : UV Acrylate
 - 288.2.7 Secondary coating Diameter : 900 micron
 - 288.2.8 Secondary coating material : LSZH
 - 288.2.9
- 288.3 **Transmission & Dispersion Characteristics.** The optical characteristics of the fiber used in the patch cord shall conform to the fiber specifications given in Section VI Part A and shall be tested accordingly.

289. Tests to be Conducted

289.1 Ferrule Geometry Test

289.1.1 Test method using Interferometer as per IEC 61300-3-15, 3-16, 3-17, 3-23.

289.1.1.1 Parameters

289.1.1.1.1 Apex offset: $\leq 50 \mu\text{m}$

289.1.1.1.2 Radius of curvature (mm): $5 \leq \text{ROC} \leq 25$

289.1.1.1.3 Spherical height: $\pm 100 \text{nm}$.

289.1.1.1.4 APC angle = $8^\circ \pm 0.3^\circ$

289.1.2 Visual Inspection of Connector Surface Test

289.1.2.1 Test Method. IEC 61300-3-1.

289.1.2.1.1 Magnification : 200 x using Video scope.

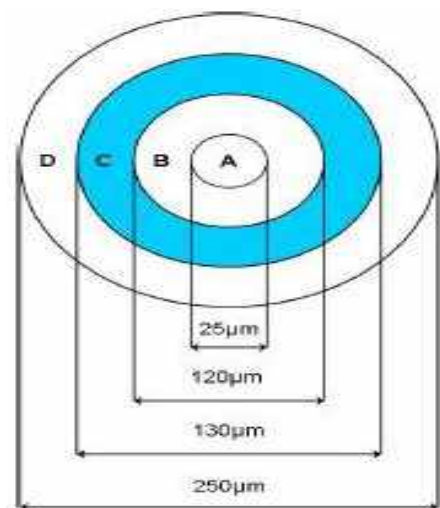
289.1.2.2 Requirements

289.1.2.2.1 Zone A –No scratches, pits or debris allowed.

289.1.2.2.2 Zone B – Max one scratch (≤ 0.5 micron and 3 pits ≤ 0.5 micron allowed).

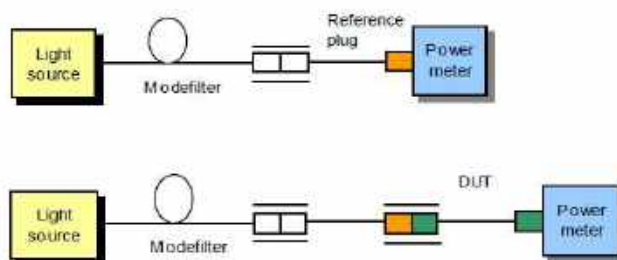
289.1.2.2.3 Zone C – Adhesive ($2 \mu\text{m}$) at the rim over 1/3 of circumference accepted. Scratch and pit $\leq 1 \mu\text{m}$ allowed.

289.1.2.2.4 Zone A to D – Clean and free of residues.



289.2 Insertion Loss Test

289.2.1 **Method.** IEC 61300-3-4, Method B



289.2.2 Requirement

289.2.2.1 Change in Insertion Loss : $\leq 0.1\text{dB}$

289.2.2.2 Test Samples : Patch cords terminated with E2000-APC simplex SM Fiber 2900/900/125/9 μ

289.2.2.3 Total number of test samples : 100%

289.2.2.4 Reference : 2 taken from test samples

289.2.2.5 Wavelength : 1310/1550 nm

289.2.2.6 Mating Adaptor : Simplex SM E2000-APC

289.3 Return Loss Test

289.3.1 **Method.** IEC 61300- 3-6.

289.3.2 Requirement

289.3.2.1 Return Loss : $\geq 80\text{ dB}$.

289.3.2.2 Test Samples : Patch cords terminated with Simplex SM E2000-APC Fibers 2900/900/125/9 μ .

289.3.2.3 Total number of tested samples : 100%.

289.3.2.4 Reference : 1 according to IEC standards.

289.3.2.5 Wavelength : 1310/1550 nm

289.4 Vibration Test

289.4.1 **Method.** IEC 61300-2-1

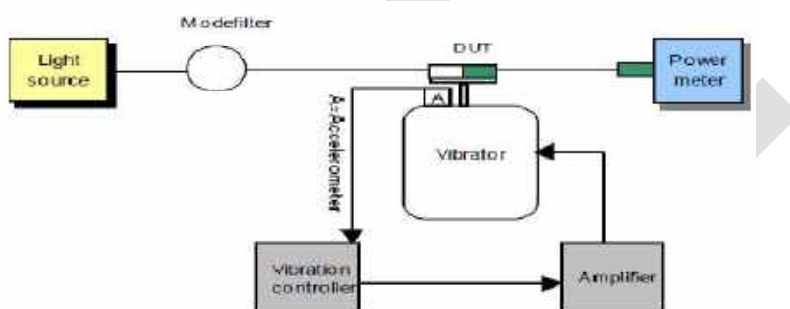
289.4.2 Requirement

289.4.2.1 Change in Insertion loss : $\leq 0.1\text{ dB}$.

289.4.2.2 Sample Types : During the test 2 patch cords terminated with Simplex SM E2000-APC

Cable 2900/900/125/9
shall be used.

289.4.2.3	Total number of tested samples	: 4
289.4.2.4	Reference	: 1 according to IEC standards
289.4.2.5	Duration/axis	: 30 min
289.4.2.6	Wavelength	: 1310/1550 nm
289.4.2.7	Frequency	: 10-55HZ
289.4.2.8	Amplitude	: 0.75mm
289.4.2.9	Number of Sweep	: 15
289.4.2.10	Mating Adaptor	: Simplex SM E2000-APC



289.5 Mating Durability

289.5.1 Method Manual

289.5.2 Requirement

289.5.2.1	Change in Insertion loss	: ≤ 0.1 dB before and after the test
289.5.2.2	Test samples	: 1 Patch cord terminated with Simplex SM E2000-APC Cable 2900/900/125/ 9 μ
289.5.2.3	Total number of tested samples	: 1/Batch
289.5.2.4	Number of cycles (connecting/ disconnecting)	: 1000.
289.5.2.5	Wavelength	: 1310/1550 nm
289.5.2.6	Mating adaptor	: Simplex SM E2000-APC

289.6 Cable Retention Test

289.6.1	Method	: IEC 61300-2-4.
289.6.2	Test samples	: Patch cords terminated with Simplex SM E2000-APC Cables 2900/900/125/9 μ
289.6.3	Total number of tested samples	: 1
289.6.4	References	: 1 taken from the test sample

289.6.5 Force(during installation): 1.5 Kg for 900 micron,
and 7.5 Kg for 3mm jacketed cable.

289.7 **Repeated Bending Test**

289.7.1 **Method.** IEC 60794-1-E6.

289.7.2 Cycles : 0°, -90°, 0°, + 90°

289.7.3 Change in attenuation : <0.2dB

289.8 **Drop Test**

289.8.1 **Method.** IEC 61300-2-12.

289.8.2 Number of drops : 5

289.8.3 Drop height : 1500mm

289.8.4 Change in attenuation : <0.2dB

289.9 **Change of Temperature Test**

289.9.1 **Method.** IEC 61300-2-22.

289.9.2 High temperature : +70° C

289.9.3 Load temperature : -25°C

289.9.4 Duration at extreme temperatures : 60 min

289.9.5 Temperature rate of change : 1°C/min

289.9.6 Number of cycles : 12

289.9.7 Change in attenuation : <0.2dB

289.9.8 **Note.** Before and after the test specimen shall be maintained at room temperature for 2 hours.

290. **Packing Requirements**

290.1 Ensure that the coiling diameter is minimum 40 times diameter of the cable.

290.2 Ensure that the cable is packed in a neat and clean polyethylene cover.

290.3 Ensure the availability of test certificate.

290.4 Always maintain the SPQ and packing method mentioned in work instruction to avoid any kind of damages due to handling and transit.

JOINT CLOSURES

291. The Optical Fiber Joint closure will provide management of optical cables in a consistent and structured manner. It shall provide interface between the duct optical fiber cables and shall be installed in the joint chamber. It shall also provide facilities for reconfiguration and expansion of Outdoor Fiber Cable Network.

292. **General Requirements**

- 292.1 The Joint Closure will be manufactured as per the latest state of art technology and its construction should be robust & rigid for all conditions of operation, adjustment, replacement, storage and transport.
- 292.2 The Joint Closure will be protected against the entry of dust, air, water and insects etc. It should conform to protection standards as defined in IP-68 specifications.
- 292.3 The Joint Closure shall be able to work in a saline atmosphere in coastal areas.
- 292.4 The Joint Closure shall be re-accessible for operation, testing and easy handling.
- 292.5 The Joint Closure shall be installed with the tools mentioned in the GR No. GR/OFT-01/03. If any special tool is required, the same shall be supplied along with each Joint Closure.

293. **Features**

- 293.1 The Joint Closure will have a Base and Dome shaped body. The Dome shall be placed on the Base. The Dome shaped body should cover the entire junction while the Base shall enable the entries of the optical Fiber cables. The Base and Dome shall be made of thermoplastic/high density polyethylene/ polypropylene material and shall have the desired characteristics to meet the performance requirements. The material used should be termite proof. The Base and Dome shall be impact resistant. The body may have ribs as strength members, if required.
- 293.2 The closure must be suitable for the same installation conditions as for the installation of the following types of cables:
 - 293.2.1 Underground cables, inside manholes, tunnels and galleries.
 - 293.2.2 Directly buried cables in all type of soils and for installation in cabinets and pillars.
 - 293.2.3 The Closure should be suitable for all types of cable structures proposed to be used on this network, for splicing the optical fiber cables adopting different construction practices.
 - 293.2.4 **Note. Each Joint Closure supplied to have complete provision of jointing of twelve (8+4) sensory Fibers along with six (4+2) Nos. of 12 Fiber Ribbons, and accommodate up to 4 such Optical Fiber Cables.**
 - 293.2.5 Each Joint Closure shall also be supplied with suitable Pneumatic Valve, pre-assembled for pressurizing the Joint Closure to 1.5 Bar.
- 293.3 The closure should mechanically hold all constituent parts of the cables.

- 293.4 The closure should contain Fiber Splice Trays assembly where the extra length of Fibers and splices shall be stored in a systematic and secured manner.
- 293.5 The closure shall allow an easy opening and re-closing without degradation in the performance of splice closure. Access to the inner junctions should be possible without damaging the existing cables and fibers.
- 293.6 It shall provide transient free operation such that there shall be no change in optical loss when tray is moved on its hinges.
- 293.7 The joint closure shall provide fiber management system to ensure safe traversal of ribbon/single fiber up to the splice trays, after the sheath has been removed.

294. **Mechanical Dimensions**

- 294.1 The nominal external dimensions of the closure i.e of the main body (Base and Dome), shall be as shown below:
 - 294.1.1 Length (Dome and Base Assembled without Ports) :540mm
±5%.
 - 294.1.2 Dome DiameterID (excluding Collar) :210mm
±10%
- 294.2 Splice Tray Dimensions (Ribbon and Single Fiber)
 - 294.2.1 Length : 230mm +/- 5%.
 - 294.2.2 Width : minimum 123.5 mm
 - 294.2.3 Thickness : Minimum 10.5 mm
- 294.3 Capacity for splicing.
 - 294.3.1 No of splicing : 72 Fibers from 6 Nos. of 12F Ribbons and 12 individual sensory Fibers.

295. **Fiber Arrangement System (FAS)**

- 295.1 The sub-assembly should be installed on the Base. The design features should ensure a snap fit mounting of Splice Trays and also should ensure that the fibers shall be routed positively to the selected tray.
- 295.2 Transportation tubing to guide and protect the Fibers/Ribbons from the cable to FAS should be provided. It should also have the facility to store dark as well as live fibers.
- 295.3 A Clamping unit for Sheath Clamp/Aramid yarn to provide strain relief should be provided.

296. **Splice Trays**

- 296.1 Fiber arrangement system should be fully loaded with a total of Seven Splice Trays to accommodate total 72 Fibers from 6 nos. of 12F Ribbons of 12 Fibers each (6 Trays) and up to 12 sensory Fibers (one Tray).
- 296.2 It should be made of non metallic and made of ABS blend material.
- 296.3 The Splice Trays shall have following functions and features:-
 - 296.3.1 Total Fiber management.
 - 296.3.2 Modularity.
 - 296.3.3 Commonality.

- 296.3.4 Ease of installation.
- 296.3.5 High reliability.
- 296.3.6 Snap fit arrangement.

297. **Cable Entry and its Sealing Arrangement**

- 297.1 The Base should have the following Cable Entry ports.
 - 297.1.1 Oval : 1No. for Looped Cables
 - 297.1.2 Round : 4 Nos. for Add/Drop Cables
- 297.2 It should be possible to terminate all cables having outer diameter from 12 mm to 22 mm, in any Cable Entry Port.

298. **Splice Protection Sleeves**

- 298.1.1 **Type - 1 (For Single Fiber).** 15 Nos. (including spare) of Heat-shrinkable splice protection sleeves of 60mm length, as per the TEC GR No. GR/PTS-01/02. APR 2006, shall be supplied with each Splicing Shelf.
- 298.1.2 **Type -2 (For Ribbon).** 9 Nos. (including spare) of heat-shrinkable splice protection Sleeves as per the TEC GR No. GR/PTS-02/01. JAN 2001, shall be supplied with each Splicing Shelf.

299. **Sealing Arrangements of Base and Dome Assembly**

- 299.1 The splice closure Base and Dome should be sealed by mechanical sealing, using a mechanical clamping clamp. A proper Clamping system should be provided which shall include the facility to lock the assembly to prevent unauthorized entry.
- 299.2 The screw type of sealing system shall not be accepted wherein the Base is attached to the Dome using screws.

300. **Sealing Arrangements of Optical Fiber Cables and Base**

The Optical Fiber cable Sealing shall utilize an Adhesive Coated Heat Shrink Sleeve of suitable dimensions, which when shrunk on to Base Cable Entry Port and Cable, shall provide Water & Dust Ingress Protection for 25 years, as per performance standards prescribed for Joint Closure. Four such sleeves shall be supplied with each Joint Closure for use along with the round ports and an additional sleeve shall be provided for the oval port. Sealing Washers for the round and oval ports shall be provided.

301. **Tests to be Conducted**

- 301.1 **Visual Examination.** The system shall be examined physically for the workmanship, design and technology employed. It shall be checked for any flaws, defects, cracks etc. visible to naked eye.
- 301.2 **Gas (AIR) Tightness Test**
 - 301.2.1 **Objective.** To determine the effectiveness of sealing arrangement.
 - 301.2.2 **Test Conditions**
 - 301.2.2.1 Internal pressure : 1.5Kg/sq. cm.
 - 301.2.2.2 Temperature : Ambient

- 301.2.2.3 Test Time : 24 Hours
- 301.2.2.4 Change in pressure : The fall in pressure in a period of 24 hours shall be ≤ 0.05 Kg /sq cm. at the end of test.
- 301.2.2.5 Gas : Dry Air.
- 301.2.2.6 Change in Pressure allowed : 0.05 kg/sq.cm

301.2.3 Requirements

- 301.2.3.1 The pressure shall not fall more than specified limit at the end of the test. Arrangement of fiber organization shall be checked after the completion of test.
- 301.2.3.2 Variation in attenuation (Residual Loss, Fiber Organisation) shall be checked after the completion of the test. There shall be no visible flaws or defects after the test.
- 301.2.3.3 Change in attenuation allowed
 - 301.2.3.3.1 For Single Fiber : ± 0.10 dB
 - 301.2.3.3.2 For Ribbon Fiber : ± 0.20 dB

301.3 Variation in attenuation (Residual Loss)

- 301.3.1 **Objective.** To check the effect of use of the fiber organiser and other arrangement, on the transmission characteristics of optical fiber in assembled condition.

301.3.2 Requirement

- 301.3.2.1 Wavelength of operation : 1310 nm & 1550 nm
- 301.3.2.2 Change in attenuation : ± 0.10 dB (for Single fiber)
: ± 0.20 dB (for Ribbon fiber)

- 301.3.3 **Note.** The fiber attenuation shall be measured under the following conditions:-

- 301.3.3.1 Leaving the fiber un-looped,
- 301.3.3.2 After the arrangement on the tray and stabilization time of one hour

301.4 Axial Tension (Sheath Retention)

- 301.4.1 **Objective.** To check the cable holding mechanism and the axial tension of the joint closure. An axial load, when individually applied to each cable, shall not cause any damage to the cable or the clamping hardware.

301.4.2 Test Conditions

- 301.4.2.1 Tension applied longitudinally on cables : 50 Kg

301.4.2.2 Test Time : 30 minutes

301.4.3 **Requirement**

301.4.3.1 Gas Tightness Test and Variation in attenuation (Residual Loss, Fiber organisation) shall be checked after the completion of the test. Arrangement of fiber organization shall also be checked after the completion of test. There shall not be any fall in the pressure more than specified and the variation in attenuation shall be as specified in Clause No 301.3 above. There shall be no visible flaws or defects after the test.

301.5 **Torsion Test**

301.5.1 **Objective.** To check the effect of torque on the cables of the joint closure.

301.5.2 **Test Conditions**

301.5.2.1 Torque : $10 \times D$ [Nm], where D is the external diameter of the cable in mm (Max. 50 Nn)

301.5.2.2 Internal pressure : 0.5 Kg/sq. cm.

301.5.2.3 Distance from the entry port : 250 mm

301.5.2.4 Rotation Max : 90 Degrees.

301.5.2.5 Temperature : Ambient

301.5.2.6 Number of cycles : 5

301.5.2.7 Holding Time : 5 minutes at each rotation

301.5.2.8 Change in pressure allowed : 0.05kg/sq cm.

301.5.3 **Requirement**

301.5.3.1 It shall be checked for the prescribed torque or the rotation as given above. The extending cable shall be clamped rigidly at specified distance. Only one cable shall be clamped at a time but the test shall be repeated with each extending cable. The closure shall be axially rotated through 90degrees and retained for five minutes. It shall be rotated to normal position and then towards to the opposite direction.

301.5.3.2 It shall be checked for any flaws, defects, cracks visible to naked eye and the gas tightness. Gas Tightness Test shall be checked after the

completion of the test and there shall not be any fall in the pressure more than specified.

301.6 Flexure Test

301.6.1 **Objective.** To test the flexure strength of the Joint Closure

301.6.2 Test Conditions

- 301.6.2.1 Test pressure : 0.5 Kg/sq.cm
- 301.6.2.2 Change in pressure allowed : 0.05 Kg/sq. cm
- 301.6.2.3 Force : Max. 500 N and 30° degree bending force application 10xD from the end of cable seal sleeve(where D is the dia. of cable)
- 301.6.2.4 No. of cycle :5
- 301.6.2.5 Holding time :5 minutes

301.6.3 Requirement

- 301.6.3.1 The sample shall be checked for gas tightness.

301.7 Impact Test

301.7.1 **Objective.** To determine the ability of joint closure to withstand impacts likely to occur during installation.

301.7.2 Test Conditions

- 301.7.2.1 Striking Force : 5 Kg
- 301.7.2.2 Dropping height : 500 mm
- 301.7.2.3 Radius of spherical weight : 50mm
- 301.7.2.4 Location and Number of impacts :3 Impacts along the length of each closure, at 3 different points located at 120° along the Circumference (Total 9 impacts). At least 3 impacts on the mouth line.

301.7.3 Requirement

- 301.7.3.1 The sample shall be checked for any cracks, permanent deformed or fractures and gas tightness.

301.8 Static Load Test

301.8.1 **Objective.** To determine the mechanical strength capability of joint closure under the action of static load.

301.8.2 Test Conditions

301.8.2.1 Static Load : 250 kg

301.8.2.2 Duration for keeping load : 24 hours

301.8.3 Requirement

301.8.3.1 The sample shall be checked for any cracks, permanent deformation or fractures and gas tightness test after completion of test.

301.9 Environmental cycle

301.9.1 **Objective.** To determine the working capability of joint closure for climatic conditions.

301.9.2 Test Conditions

301.9.2.1 Lowest temperature : -15° C

301.9.2.2 Highest temperature : 60° C

301.9.2.3 Dwell Time : 4 hrs

301.9.2.4 Transition time : 2 hrs

301.9.2.5 Cycle duration : 10 and 1/2 hrs.

301.9.2.6 Number of cycles : 10

301.9.2.7 Closed system pressure : 0.5 kg/sq.cm.

301.9.2.8 Change in pressure allowed: 0.05kg/ sq.cm.

301.9.3 Requirement

301.9.3.1 Gas Tightness Test and Variation in attenuation (Residual Loss, Fiber Organisation) shall be checked after the completion of test and the variation in attenuation shall be as specified in Clause No301.3 above. There shall be no visible flaws or defects after the test.

301.10 Salt Spray (Mist) Test

301.10.1 **Objective.** To determine the suitability of the joint closure for use or storage and / or transport in salt laden atmosphere.

301.10.2 **Requirements.** It shall meet the requirements of salt mist test and shall be tested as per QM - 333 (latest issue) document issued by QA, BSNL.

301.11 Vibration Test

301.11.1 **Objective.** To check the effect of vibration on Joint closure and itaccessories.

301.11.2 Test Conditions

301.11.2.1 Planes : 3 (X -axis, Y - axis and Z - axis)

- 301.11.2.2 Sweep : (10-300) Hz $\pm 2\%$ at 1 octave $\pm 10\%$ per min.
- 301.11.2.2.1 Sine sweep (10-28) ± 1 Hz 0.1" (2.5 mm) double amplitude.
- 301.11.2.2.2 Sine sweep (28-300) Hz $\pm 2\%$ max. 4 g acceleration
- 301.11.2.3 Time : 2 hours each axis.
- 301.11.2.4 Internal pressure : 0.5 kg/sq cm.
- 301.11.2.5 Change in pressure : 0.05 kg/sq cm.

301.11.3 Requirement

- 301.11.3.1 There shall be no visible flaws or defects after the test and pressure shall be within prescribed limit.

301.12 Water ingress Test

- 301.12.1 **Objective.** To determine the water tightness of the joint closure when subjected to immersion in water.

301.12.2 Requirement

- 301.12.2.1 Immersion tank : 2 meters (water head)
- 301.12.2.2 Duration of immersion : 7 days.
- 301.12.2.3 Temperature : Ambient.
- 301.12.2.4 The sample shall be checked for any water vapor present inside the Splice Closure.

301.13 Aggressive Media Test

301.13.1 Resistance to Aggressive Media Test

- 301.13.1.1 Test conditions
 - 301.13.1.1.1 Internal pressure: 0.5kg/sqcm.
 - 301.13.1.1.2 Change in pressure allowed: 0.05kg/sq cm.
- 301.13.1.2 Solution
 - 301.13.1.2.1 pH 2 : 5days
 - 301.13.1.2.2 pH 12 : 5 days
 - 301.13.1.2.3 Kerosene : 5 days
 - 301.13.1.2.4 Petroleum jelly : 5 days
 - 301.13.1.2.5 Fuel Oil : 5 days

301.13.2 Resistance to Stress Cracking Test

- 301.13.2.1 Test temperature : 50 $\pm 2^\circ$ C

301.13.2.2	Test medium	:10% Igepal (Alkaline or soap solution)
301.13.2.3	Internal pressure	: 0.5 kg/sq cm.
301.13.2.4	Change in pressure allowed	: 0.05 kg/sq cm.
301.13.2.5	Test time	:7 days

301.13.3 The sample shall be checked for the resistivity of joint closure in the given media.

301.14 Drop and Topple Test

301.14.1 **Objective.** To determine the ability of splice closure to withstand the knocks and jolts likely to occur during installation, repair work or rough handling in its use.

301.14.2 The test may be taken as per the requirement in document QM-333 (Cat-C) and the results may be compared with the original specification.

302. Quality Requirements

302.1 The Closure will be checked as per the guidelines given in the respective process plan.

302.2 Each shipment shall accompany the instruction manual with the product.

302.3 All Closures will undergo 100% visual inspection at final stage.

303. **Packing Requirements.** The Joint closure shall be packed in a carton with all required accessories, as required for 12 Sensory Fibers & 6 Nos. of 12F Ribbons each for 4 Optical Fiber Cables, for splicing process. This packaging shall provide adequate protection during transportation & storage.

ELECTRONIC ROUTE MARKERS AND LOCATORS

304. Electronic Route Markers

304.1 **General Description.** The passive Electronic markers are to be placed at every 200 meters all along the route. The location of the marker will be specified by the purchaser. The frequency to be used in the electronic marker will have to be unique for the project, which is not being used worldwide and **the bidder as well as the manufacturer will have to sign a Non Disclosure Agreement for not disclosing the frequency used for this project** Unique frequency will be intimated after issue of PO. However, for purpose of obtaining TSEC certificate standard telecom frequency (101.4 khz) may be used.

304.2 Specifications

Ser No	Parameters	Requirement
1.	Design & Shape	Made of High Density Plastic, Ball type with floating coil or spherical orthogonal field.
2.	Frequency Range & Color	Will be unique and mutually decided between purchaser and bidder
3.	Depth Range	5 ft.
4.	Dimension	<15 cm diameter
5.	Weight	< 0.5 kg
6.	Usage	Every 200m in addition to Joints, road crossing and bridge location
7.	Operating Temperature Range	-20 ⁰ C to 50 ⁰ C

305. **Electronic Route Locators.** Electronic marker locator should meet the following functional application requirements:-

- 305.1 It should be able to locate markers in the vicinity at the frequency defined by the purchaser.
- 305.2 It should be able to locate the buried electronic marker and shall provide signal strength bar graph.
- 305.3 It should be able to locate the live power cables (50 Hz). It should use the passive power frequency of 50/60 Hz available in live buried power cables to locate them.
- 305.4 The receiver should meet the detailed technical specifications given below.

305.4.1 Locating Modes

305.4.1.1 Peak/Null Directional Peak

305.4.2 Response Frequencies

- 305.4.2.1 Frequency : Unique
- 305.4.2.2 Power : Standard Freqs (50/60 Hz)
- 305.4.3 **Type of Display**
 - 305.4.3.1 Liquid crystal display
 - 305.4.3.2 Night readable, with backlight.
 - 305.4.3.3 Daylight Readable
- 305.4.4 **Indications on Display**
 - 305.4.4.1 Gain adjust / receiver
 - 305.4.4.2 Gain Level Indicator
 - 305.4.4.3 Signal Level Indication
 - 305.4.4.4 Absolute signal strength
 - 305.4.4.5 Depth Value
- 305.4.5 **Receiver Capability**
 - 305.4.5.1 Marker Depth Accuracy : 0-5 Ft $\pm$ 3% or $\pm$ 2"
 - 305.4.5.2 Power Cable Depth : Upto 10 feet
 - 305.4.5.3 Receiver should have inbuilt Automatic Receiver Self Test.
 - 305.4.5.4 Receiver weight with batteries : Less than 4 kgs
 - 305.4.5.5 Receiver batteries : Type AA with more than typical 30 hour life
 - 305.4.5.6 Should have battery check feature.

WARNING TAPE

306. Warning Tape shall be laid as per construction practices of BSNL as per TEC GR/CIM-03/01 Sep 2000. Specifications for warning tape to be deployed during OFC route construction are as given below:-

306.1 Physical Attributes of Warning Tape

306.1.1 Thickness : 200µm minimum.

306.1.2 Width : 200mm minimum.

306.1.3 Weight : 40g per m +/- 5%.

306.1.4 Std Length : 200+/- 2m.

306.2 Other specifications of the warning tape

306.2.1 Material Composition : LDPE.

306.2.2 Density : 0.913 to 0.950 g/cc at 27 deg C.

306.2.3 Colour : Orange as per IS 9938.

306.2.4 Expected Life : 25 years after laying.

306.3 Printing on Warning Tape

306.3.1 Print Text : "CAUTION NFS OFC BELOW".

306.3.2 Letter Size : 40x25x5mm.

306.3.3 Marking Colour : Black.

306.3.4 Marking Gap : 100mm.

306.3.5 Manufacturer Details : ID, Batch No, Month/Year.

306.3.6 Manufacturer Details Gap : 10m.

SECTION VII
PART I : BID FORM

Tender No. _____

Dated _____

To

DGM (MMT)
Bharat Sanchar Nigam Limited,
(Corporate Office)
2nd Floor, Bharat Sanchar Bhawan,
Janpath , New Delhi – 110 001.

Dear Sir,

1. Having examined the conditions of contract and specifications including addenda Nos.....the receipt of which is hereby duly acknowledged, we, undersigned, offer to supply and deliver in conformity with the said drawings, conditions of contract and specifications for the sum shown in the schedule of prices attached herewith and made part of this Bid.
2. We undertake, if our Bid is accepted, to commence deliveries as per the schedule given as part of this tender.
3. If our Bid is accepted, we will obtain the performance guarantees of a Scheduled Bank for a sum @ 5% of the contract value for the due performance of the contract.
4. We agree to abide by this Bid for a period of 180 days from the date fixed for Bid opening and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
5. Until a formal Purchase Order of Contract is prepared and executed, this Bid together with your written acceptance thereof in your notification of award shall constitute a binding contract between us.
6. Bid submitted by us is properly sealed and prepared so as to prevent any subsequent alteration and replacement.
7. We understand that you are not bound to accept the lowest or any bid, you may receive.
8. We understand that the Bid document so submitted is the true copy of BSNL tender documents available on BSNL website www.bsnl.co.in. Any deviation will result in the rejection of the bid.

Dated this day of 20

Name and Signature -----

In the capacity of -----

Duly authorised to sign the bid for and on behalf of:

Witness:

Address:

Signature

SECTION VII
PART II : PRICE SCHEDULE FOR ITEMS
PACKAGE – A

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any(Service tax etc)	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT - able on Unit Price	Unit price excluding Duties and taxes CENVAT - able (13 -14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tarrif Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	5334																		
2.	Type B: Non Intrusion	Km	147																		

	Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																		
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	4014																
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9495																
5.	Fiber Distribution Management System (FDMS) consisting of																		
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	915																
5.2	Splicing Cum Patching Shelf	Nos	83																
6.	Electronic Route Locator	Nos	426																
7.	Electronic Route Marker	Nos	52226																
8.	Joint Closure	Nos	5933																
9.	Warning Tape	Km	9495																
10.	Cost of Spares	As per Appendix 'H'																	
A	Total (Material)																		

	Services																		
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	5481																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	4014																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D+ E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IV Part E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – B**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tarrif Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1087																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F	Km	4363																		

	Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	2149																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7599																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	704																	
5.2	Splicing Cum Patching Shelf	Nos	83																	
6.	Electronic Route Locator	Nos	202																	
7.	Electronic Route Marker	Nos	41808																	
8.	Joint Closure	Nos	4753																	
9.	Warning Tape	Km	7599																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

Services																			
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	5450																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	2149																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D+ E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IVPart E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IVPart E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – C**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tariff Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1229																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable	Km	6530																		

	[24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1809																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9568																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	743																	
5.2	Splicing Cum Patching Shelf	Nos	64																	
6.	Electronic Route Locator	Nos	230																	
7.	Electronic Route Marker	Nos	52635																	
8.	Joint Closure	Nos	5978																	
9.	Warning Tape	Km	9568																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

Services																			
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	7759																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs	Km	1809																	
12.4	Construction of Joint Chambers																			
12.5	Duct Laying / OFC Laying / Blowing																			
12.6	Splicing & Jointing																			
12.7	Installation of FDMS to include termination with pigtails																			
12.8	Link Testing & Acceptance Testing																			
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
12.10	Testing Services and Field Trials																			
12.11	Project Management Services																			
C	Total (Access Services)																			
13.	Training	Per Batch	26																	
D	Total of Material and Services	Ser (A + B+ C + 13)																		

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D + E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IVPart E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form `C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – D**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tariff Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	1973																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable	Km	6163																		

	[24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1524																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	9660																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	595																	
5.2	Splicing Cum Patching Shelf	Nos	54																	
6.	Electronic Route Locator	Nos	136																	
7.	Electronic Route Marker	Nos	53142																	
8.	Joint Closure	Nos	6045																	
9.	Warning Tape	Km	9660																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

Services																				
11.	NLD Services inclusive of all of the following : -																			
11.1	Route Survey & Documentation of proposed Cable Route																			
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																			
11.4	Construction of Joint Chambers																			
11.5	Duct Laying / OFC Laying / Blowing																			
11.6	Splicing & Jointing																			

11.7	Installation of FDMS to include termination with pigtails	Km	8136																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	1524																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D + E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IV Part E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – E**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tariff Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable	Km	6541																		

	[24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	613																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7154																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	292																	
5.2	Splicing Cum Patching Shelf	Nos	37																	
6.	Electronic Route Locator	Nos	70																	
7.	Electronic Route Marker	Nos	39353																	
8.	Joint Closure	Nos	4469																	
9.	Warning Tape	Km	7154																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

Services																			
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	6541																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	613																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D + E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IV Part E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – F**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tariff Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable	Km	5182																		

	[24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	839																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	6021																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	306																	
5.2	Splicing Cum Patching Shelf	Nos	41																	
6.	Electronic Route Locator	Nos	140																	
7.	Electronic Route Marker	Nos	33124																	
8.	Joint Closure	Nos	3767																	
9.	Warning Tape	Km	6021																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

Services																			
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	5182																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	839																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D + E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IV Part E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

PRICE SCHEDULE FOR ITEMS**PACKAGE – G**

Note: Performa. The bidder will submit the details of items to be supplied as per the Appendix 'M' attached.

Ser No	Item Description	Unit	Total Qty	Basic Unit Rate exclusive of all levies and charges	Excise Duty (ED)		Sales Tax(ST)		F F packing & I		Other Levies and Charges if any	Unit Price All Inclusive (5+7+9+11+12)	Duties and Taxes CENVAT- able on Unit Price	Unit price excluding Duties and taxes CENVAT- able (13 - 14)	Total Price inclusive of all levies and charges including duties and taxes (4 x 13)	Discount offered if any	Total Discounted Price including Duties and Taxes CENVAT-able (16-17)	E.D Tariff Head	Import Content	% of Customs duty	Customs Tarrif Head
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Material																					
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-																		
2.	Type B: Non Intrusion Proof Fiber Optic Cable	Km	6470																		

	[24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes																			
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	1048																	
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	7518																	
5.	Fiber Distribution Management System (FDMS) consisting of																			
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	427																	
5.2	Splicing Cum Patching Shelf	Nos	31																	
6.	Electronic Route Locator	Nos	156																	
7.	Electronic Route Marker	Nos	41357																	
8.	Joint Closure	Nos	4703																	
9.	Warning Tape	Km	7518																	
10.	Cost of Spares	As per Appendix 'H'																		
A	Total (Material)																			

	Services																		
11.	NLD Services inclusive of all of the following : -																		
11.1	Route Survey & Documentation of proposed Cable Route																		
11.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																		
11.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
11.4	Construction of Joint Chambers																		
11.5	Duct Laying / OFC Laying / Blowing																		
11.6	Splicing & Jointing																		

11.7	Installation of FDMS to include termination with pigtails	Km	6470																	
11.8	Link Testing & Acceptance Testing																			
11.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																			
11.10	Testing Services and Field Trials																			
11.11	Project Management Services																			
B	Total (NLD Services)																			
12.	Access Services inclusive of all of the following : -																			
12.1	Route Survey & Documentation of proposed Cable Route																			
12.2	Excavation, Backfilling, Reinstatement, Compaction & Installation of all materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, RCC Slabs and RCC Route/Joint Indicators																			

12.3	Road / Bridge Crossing including materials such as GI Pipes & clamps, DWC with couplers, Full/Half round RCC Pipes, and RCC Slabs																		
12.4	Construction of Joint Chambers																		
12.5	Duct Laying / OFC Laying / Blowing																		
12.6	Splicing & Jointing																		
12.7	Installation of FDMS to include termination with pigtails	Km	1048																
12.8	Link Testing & Acceptance Testing																		
12.9	Documentation of installed Cable route including As Built Diagram (ABD) data for updation and integration with GIS based Optical Fiber NMS																		
12.10	Testing Services and Field Trials																		
12.11	Project Management Services																		
C	Total (Access Services)																		
13.	Training	Per Batch	26																
D	Total of Material and Services	Ser (A + B+ C + 13)																	

14.	AMC for seven years at a discount rate of 12 % per year as per Clause 197 mentioned in Section IV Part D																			
14.1	1 st Year	Lump Sum																		
14.2	2 nd Year	Lump Sum																		
14.3	3 rd year	Lump Sum																		
14.4	4 th Year	Lump Sum																		
14.5	5 th Year	Lump Sum																		
14.6	6 th Year	Lump Sum																		
14.7	7 th Year	Lump Sum																		
E	AMC Total																			
F	Grand Total	Ser (D+ E)																		

Note

1. Quantities given in the SoR/Price Schedule are indicative and payment would be made based on actuals calculated during acceptance prior to link commissioning.
2. We hereby declare that in quoting the above prices, we have taken into account the entire credit on inputs available under the MODVAT SCHEME introduced w.e.f. 1st Mar 1986 and further extended on more items till date.
3. "We hereby certify that E.D/Customs Tariff Head shown in column 19/22 are correct & CENVAT Credit for the amount shown in column 14 above are admissible as per CENVAT Credit Rules 2004".
4. The bidder submitted the offer with concessional E.D/sales tax shall submit the proof of applicable concessional ED/Sales Tax.
5. Route length may vary depending upon site situations and route survey conducted by the bidder. Bidder should access route length by making the site survey on own before bidding. BSNL will not be responsible for variation in the route length at the time of execution.
6. Prices are to be quoted drop line item wise.
7. The details of optical NLD routes have been produced in OFC link list given in Section IV Part E: OFC Link List. Payment will be done as per routes mentioned.
8. Payment for access networks will be released on completion of respective Access Network as mentioned OFC link list given in Section IV Part E: OFC Link List.
9. RoW Charges will be paid as per actuals on submission of proof of payment.
10. Form 'C' will be issued by BSNL.
11. If Annual maintenance Contract charges are required to be quoted as per SoR, basic charges should be shown in column-5 & the service tax in column 12 & 14.
12. Unit rate for calculation of spares cost (As per Appendix 'H') will be the same as for main material supply.

SECTION VIII
BID SECURITY FORM

Whereas (hereinafter called "the Bidder") has submitted its bid dated.....for the supply of vide Tender No. Dated KNOW ALL MEN by these presents that WE OF having our registered office at(hereinafter called "the Bank") are bound unto Bharat Sanchar Nigam Limited (hereinafter called "the Purchaser") in the sum of Rs..... for which payment will and truly to be made of the said Purchaser, the Bank binds itself, its successors and assigns by these present.

THE CONDITIONS of the obligation are:

1. If the Bidder withdraws his bid during the period of bid validity specified by the Bidder on the Bid form or
2. If the Bidder, having been notified of the acceptance of his bid by the Purchaser during the period of bid validity
 - 2.1 **fails or refuses to execute the Contract, if required; or**
 - 2.2 **fails or refuses to furnish the Performance Security, in accordance with the instructions to Bidders.**
3. We undertake to pay to the Purchaser up to the above amount upon receipt of its first written demand, without the purchaser having to substantiate its demand, provided that in its demand, the purchaser will note that the amount claimed by it is due to it owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.
4. This guarantee will remain in force as specified in clauses 27 and 42.2 above of section II of the Bid Document upto and including 210 days from the tender opening date and any demand in respect thereof should reach the Bank not later than the specified date/dates.

Signature of the Bank Authority
Name
Signed in Capacity of

Name & Signature of Witness

Full address of Branch

Address of witness

Tel No. of Branch
Fax No. of Branch

TENDERER / BIDDER'S PROFILE & QUESTIONNAIRE

(To be filled in and submitted by the bidder)

A) Tenderer's Profile

1. Name of the Individual/ Firm:
2. Present Correspondence Address
-
-
- Telephone No. Mobile No.
- FAX No.
3. Address of place of Works/ Manufacture
-
- Telephone No. Mobile No.
4. State the Type of Firm: Sole proprietor-ship/ partnership firm / (Tick the correct choice): Private limited company.
5. Name of the sole proprietor/ partners/ Director(s) of Pvt. Ltd Co.:

S. No.	Name	Father's Name	Designation
1.			
2.			
3.			
4.			
5.			

6. Name of the person authorized to enter into and execute contract/ agreement and the capacity in which he is authorized (in case of partnership/ private Ltd company):

.....

7. Permanent Account No. :

8. Whether the firm has Office/ works (i.e. manufacture of the tendered item) in Delhi? If so state its Address

.....

B) Questionnaire

1. Do you think any other detail/ material is required to complete the work specified in the specification? Yes/ No.

- 1.1 If Yes, Give details

.....

2. Do you think any other item of work need be included in tender form to complete the work specified in the specification? Yes/ No.

- 2.1 If Yes, Give details

.....

3. Suggestion for improvement of the tender document.

.....

Place.....

Signature of contractor

Date

Name of Contractor

SECTION IX
PERFORMANCE SECURITY GUARANTEE BOND

1. In consideration of the CMD, BSNL (hereinafter called 'BSNL') having agreed to exempt _____ (hereinafter called 'the said contractor(s)') from the demand under the terms and conditions of an agreement/Advance Purchase Order No _____ dated _____ made between _____ and _____ for the supply of _____ (hereinafter called "the said agreement"), of security deposit for the due fulfillment by the said contractor (s) of the terms and conditions contained in the said Agreement, on production of the bank guarantee for _____ we, (name of the bank) _____ (hereinafter refer to as "the bank") at the request of _____ (contractor(s)) do hereby undertake to pay to BSNL an amount not exceeding _____ against any loss or damage caused to or suffered or would be caused to or suffered by BSNL by reason of any breach by the said Contractor(s) of any of the terms or conditions contained in the said Agreement.
2. We (name of the bank) _____ do hereby undertake to pay the amounts due and payable under this guarantee without any demure, merely on a demand from BSNL by reason of breach by the said contractor(s)' of any of the terms or conditions contained in the said Agreement or by reason of the contractors(s)' failure to perform the said Agreement. Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee where the decision of BSNL in these counts shall be final and binding on the bank. However, our liability under this guarantee shall be restricted to an amount not exceeding _____.
3. We undertake to pay to BSNL any money so demanded notwithstanding any dispute or disputes raised by the contractor(s)/supplier(s) in any suit or proceeding pending before any court or tribunal relating thereto our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be valid discharge of our liability for payment there under and the contractor(s)/supplier(s) shall have no claim against us for making such payment.
4. We (name of the bank) _____ further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of BSNL under or by virtue of the said Agreement have been fully paid and its claims satisfied or discharged or till _____ (office/Department) BSNL certifies that the terms and conditions of the said Agreement have been fully or properly carried out by the said contractor(s) and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before the expiry of TWO/TWO AND HALF/THREE YEARS (as specified in P.O) from the date hereof, we shall be discharged from all liabilities under this guarantee thereafter.
5. We (name of the bank) _____ further agree with BSNL that BSNL shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Agreement or to extend time of performance by the said contractor(s) from

time to time or to postpone for any time or from time to time any of the powers exercisable by BSNL against the said Contractor(s) and to forbear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act or omission on the part of BSNL or any indulgence by BSNL to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s)/supplier(s).
7. We (name of the bank) _____ lastly undertake not to revoke this guarantee during its currency except with the previous consent of BSNL in writing.

Dated the _____ day of _____

for _____

(Indicate the name of bank)

SECTION X**LETTER OF AUTHORISATION FOR ATTENDING BID OPENING**

(To reach Jt DDG (MMT) before date of bid opening)

To

The DGM (MMT),
 Bharat Sanchar Nigam Limited,
 (Corporate Office),
 2nd Floor, Bharat Sanchar Bhawan,
 Janpath, New Delhi – 110 001

Subject: Authorisation for attending bid opening on
 _____ (date) in the Tender of
 _____.

The following persons are hereby authorised to attend the bid opening for the
 tender mentioned above on behalf of
 _____ (Bidder) in order of preference
 given below.

Order of Preference	Name	Specimen Signatures
1.		
2.		

Alternate Representative

Signatures of bidder

Or

Officer authorized to sign the bid
 Documents on behalf of the bidder

Note

- Maximum of two representatives will be permitted to attend bid opening. In case where it is restricted to one, first preference will be allowed. Alternate representative will be permitted when regular representatives are not able to attend.
- Permission for entry to the hall where bids are opened may be refused in case authorization as prescribed above is not received.

Appendix 'A'
(Refer Para 19.3
of Section II)

DOCUMENTS FORMAT

1. Supply Record for OFC Manufacturer

Ser No	Client Name with Contact Details	Contract Date	Contract Value	Contract Completion Date	Description of Items Supplied	Qty Supplied in Kms	Remarks if any
1.	Loose Fiber						
1.1							
1.2							
1.3	Total						
2.	Ribbon Fiber						
2.1							
2.2							
	Total						

2. Supply Record for PLB HDPE Duct

Ser No	Client Name with Contact Details	Contract Date	Contract Value	Contract Completion Date	Description of Items Supplied	Qty Supplied in Kms	Remarks if any
1.							
2.							
3.							
4.							
	Total						

3. Experience of OFC Laying of EPC

Ser No	Client Name with Contact Details	Contract Date	Contract Value	Contract Completion Date	Cable Type	Total Cable Laid in Kms	Remarks if any
1.	OFC Under Ground						
1.1							
1.2							
2	OFC Over Head						
2.1							
2.2							
	Total						

4. Executed Projects/Work Orders by the EPC

Ser No	Brief Details of Project/ Work Order	Contract Date	Contract Value	Contract Completion Date	Average km per day executed	Remarks if any
1.						
2.						
3.						
4.						
5.						
	Total					

5. Financial Eligibility of OFC manufacturer (for last three financial years)

Ser No	Description	Financial Year	Financial Year	Financial Year	Total
		(In Rupees Crores)	(In Rupees Crores)	(In Rupees Crores)	
1.	Annual Turnover				

6. Financial Eligibility of EPC(for last three financial years)

Ser No	Description	Financial Year	Financial Year	Financial Year	Total
		(In Rupees Crores)	(In Rupees Crores)	(In Rupees Crores)	
2.	Annual Turnover				

Appendix 'B'

(Refer Para 19.3 of Section II)

**INFORMATION AND DOCUMENTS REQUIRED
TO BE SUBMITTED AS A PART OF RESPONSE TO THE TENDER**

Ser No	Document	Reference
1.	General Eligibility	
1.1	Certificate of Incorporation from Registrar of Companies.	Section- II Clause No- 16.2.1.1 above
1.2	Articles and Memorandum of Association.	Section- II Clause No- 16.2.1.2 above
1.3	ISO 9001:2008 certification with no prior history of withdrawal.	Section- II Clause Nos-16.3.2.4 above, 167.2, Error! Reference source not found. , and 274.2
1.4	Documentary Evidence (Form 32) for registration with Proof of Management and Control of Company with resident Indian Nationals.	Section- II Clause No- 16.2.1.4 above
1.5	Copy of Permanent Account Number.	Section- II Clause No- 16.2.3 above
1.6	Excise/ Service/Permanent Sales Tax Registration Number (if applicable).	Section- II Clause No- 16.2.4 above
1.7	Power of Attorney for Signing Authorities to be submitted along with the MoU.	Section- II Clause No- 29.5 above to 29.7 above
1.8	Registration Certificate from State Director of Industries or from Secretariat for Industrial Approval (SIA), Ministry of Industries, Government of India (if applicable).	Section- II Clause No- 25.1.3
1.9	Teaming Agreements	Section- II Clause No- 25.1.9
1.10	Undertaking Certificate by the Company Secretary for not being blacklisted by any Central/State Government/ PSU or Telecom Operator.	Section- II Clause No-16.4.1.3 above, 16.4.2.3 above and 274.5

1.11	Undertaking Certificate from the bidder which certifies that none of his/her near relative is working in BSNL units as per format given.	Section-II Clause No- 48

2.	Technical Eligibility	
2.1	Detailed Technical Specifications for all items mentioned in the SoR.	Section- II Clause No- 83.1
2.2	Documentary proof of Infrastructure Assessment Certificate,TSEC, QF 103	Section- II Clause No- 16.3.2.2 above
2.3	Documentary proof of manufacturing capacity per annum of PLB HDPE Duct supplier.	Section VI Part B Clause No 274.1
2.4	Copies of CACT Approval Certificate for Indigenous CACT approved optical fiber sources.	Section- II Clause No- 25.1.8
2.5	Self certified Certificate of origin mentioning that the OFC manufacturing unit of fiber optic cable is located in India.	Section II Clause No 16.3.2.1 above
2.6	Self certified Certificate of origin mentioning that the manufacturing unit of PLB HDPE Duct is located in India.	Section VI Part B Clause No 274.1
2.7	Documentary evidence about technical and implementation capability necessary to execute the contract by EPC.	Section II Clause No 25.3
2.8	Proof of submission to obtain Type Approval Certificate (TAC) from Technical Specification Evaluation Certificate (TSEC) from QA circle, BSNL, Bangalore for all items mentioned in the SoR.	Section IV Part A Clause No 80.5
2.9	Nil Deviation Certificate from Bidder.	Section II Clause No45.4&Section IV Part A Clause No 80.4
2.10	Undertaking Certificate of capability for trenching and OFC laying for at least 25 km per day per package.	Section- II Clause No- 16.4.2.1 above
2.11	Detailed Implementation Plan and Project Management Organisation Structure for the project.	Section IV Part C Clause No 148.1
2.12	Details of test facilities those are available for conduct of tests for items being supplied as part of the tender.	Section II Clause No 16.3.2.5 above

2.13	Comprehensive test plan with schedules and test procedures for all tests shall be provided.	Section IV Part A Clause No 117

3.	Experience Eligibility	
3.1	Documentary Proof of supply of OFC as per format given at Appendix A for last five years.	Section II Clause No 16.4.1.1 above&16.4.1.2 above
3.2	Documentary Proof of supply of PLB HDPE Duct as per format given at Appendix A for last five years.	Section VI Part B Clause No 274.4
3.3	Documentary proof for OFC Laying as per format given at Appendix A.	Section II Clause No 16.4.2.2 above

4.	Financial Eligibility	
4.1	Audited financial statements for last three financial years to be submitted.	Section II Clause 16.5 above and 25.2
4.2	Bankers Solvency Certificate as applicable.	Section II Clause No 16.5 above
4.3	Approval from Reserve Bank of India/SIA, in case of foreign collaboration.	Section II Clause 25.1.4

Note.

1. The work covered under the mentioned scope of project this tender is extremely skilled and technical in nature and only the firms having sufficiently skilled and experienced staff with them and who have carried out tight targeted Telecom works shall submit their responses against this invitation.
2. Any other documents, as deemed required by the bidder, to support his claim with regards to eligibility, specification, experience etc should also be submitted.

BSNL

Appendix 'C'
 (Refer Para 66.7
 of Section III)

Appendix C to clause 66.7 above of Section III

**MODEL AMENDMENT LETTER INTIMATING CONDITIONS
 FOR EXTENSION OF DELIVERY PERIOD**

Registered Acknowledgement Due

Address of the purchaser

To
 M/s

Sub: This office contract No..... dated placed on you for supply of

Ref : Your letter No..... dated

You have failed to deliver the goods/work/ entire quantity of the goods/work/ execution/ construction/ commissioning of the entire project within the contract delivery period/ delivery period as agreed schedule or last extended up to _____. In your above referred letter, you have asked for extension/ further extension of time for delivery/ execution/ construction/ commissioning. In view of the circumstances stated in your above referred letter, the time of delivery can be extended from _____ (original/ last delivery period) to _____ (presently agreed delivery period) subject to your unconditional acceptance of the following terms and conditions:

1. That, liquidated damages shall be levied in accordance with agreed clause 67.2 to 67.6 above of Section III of terms and conditions of the tender/ PO.
2. That, notwithstanding any stipulation in the contract for increase in price on any ground, no such increase, whatsoever, which takes place after zzz shall be admissible on such of the said goods/work as are delivered after the said date as per clause 63 above of Section III.
3. That, the prices during this extended delivery period shall be provisional and shall be governed as per agreed clauses 63 above and 73 above of Section III and

shall be finalized in accordance with the current PO price or the current PO price with latest budget/ duty impact or the prices in the new tender (T.E. No.) from the date of its opening, on whichever is lower basis.

4. An additional BG of Rs. _____ in accordance with clauses 66.3 to 66.8 of Section III of the contract with validity upto _____.

5. An undertaking as required vide clause 73 above, Section III.

Please intimate your unconditional acceptance of this letter alongwith the additional BG within ten days of the issue of this letter failing which the contract will be cancelled at your risk and expense without any further reference to you. This letter shall form part and parcel of the agreement/ contract/ APO/ PO and all other terms & conditions of the contract remain unaltered.

Yours faithfully,

(.....)

for and on behalf of.....

zzz Original delivery date or the last extended/ re-fixed delivery period (as the case may be)

NB: The entries which are not applicable for the case under consideration are to be deleted.

Appendix 'D'
(Refer Para 66.8
of Section III)

Appendix D to Clause No 66.8 above of Section III

MODEL AMENDMENT LETTER FOR EXTENSION OF DELIVERY PERIOD

Registered Acknowledgement Due

Address of the purchaser

M/s
.....

Sub: This office contract No..... Dated placed on you for supply of
.....

Ref

1. Your letter No..... Dated requesting DP extension.
2. This office letter No. Dated intimating conditions for DP extension.
3. Your letter No..... Dated accepting the conditions for DP extension.

You have failed to deliver the goods/work/ entire quantity of the goods/work/ execution/ construction/ commissioning of the entire project within the contract delivery period/ delivery period as agreed schedule or last extended up to _____. In your above letter under reference (1), you have asked for extension/ further extension of time for delivery/ execution/ construction/ commissioning. The terms and conditions for extension of delivery period were conveyed to you vide this office letter under reference (2). In view of the circumstances stated in your above referred letter, and upon your unconditional acceptance of the terms and conditions of this extension vide your letter under reference (3), the time of delivery is hereby extended from _____ (last delivery period) to _____ (presently agreed delivery period) on the terms and conditions in letter under reference (2) above and agreed by you vide letter under reference (3) i.e.:

1. Liquidated damages shall be levied in accordance with agreed clauses 67.2 to 67.6 above of Section III of terms and conditions of the tender/ PO.
2. Notwithstanding any stipulation in the contract for increase in price on any ground, no such increase, whatsoever, which takes place after zzz shall be admissible on such of the said goods/work as are delivered after the said date as per clause 63 above of Section III.
3. The prices during this extended delivery period shall be provisional and shall be governed as per clauses 63 and 73 above of Section III and shall be finalized in

accordance with current PO price or the current PO price with latest budget/ duty impact or the prices in the new tender (T.E. No.) from the date of its opening, on whichever is lower basis.

The letters under reference above and this letter shall form part and parcel of agreement/ contract/ APO/ PO and all other terms & conditions of the contract remain unaltered.

Yours faithfully,
(.....)
for and on behalf of.....

Copy to :

.....
.....
.....

(All concerned)

zzz Original delivery date or the last unconditionally re-fixed delivery date (as the case may be)

NB : The entries which are not applicable for the case under consideration are to be deleted.

INTEGRITY PACT

Between

Bharat Sanchar Nigam Limited (BSNL) / PICG, Ministry of Defence hereinafter referred to as "The Principal"

and

.....hereinafter referred to as "The Bidder/Contractor"

Preamble

The Principal intends to award, under laid down organizational procedures, contract/s for ----- . The Principal values full compliance with all relevant laws and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder/s and Contractor/s.

In order to achieve these goals, the Principal will appoint an Independent External Monitor who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

1. The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -
 - (a) No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to.
 - (b) The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
 - (c) The Principal will exclude from the process all known prejudiced persons.
2. If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the relevant Anti-Corruption Laws of India, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder(s)/Contractor(s)

1. The Bidder(s)/Contractor(s) commits itself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
 - (a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
 - (b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelisation in the bidding process.
 - (c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant Anti-corruption Laws of India; further the Bidder(s)/Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
 - (d) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
2. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/Contractor(s), before contract award or during execution has committed a transgression through a violation of Section 2, above or in any other form such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process or take action as per the defined procedure.

Section 4 – Compensation for Damages

1. If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit / Bid Security.

2. If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor the amount equivalent to Security Deposit / Performance Bank Guarantee in addition to any other penalties/ recoveries as per terms and conditions of the tender.

Section 5 – Previous transgression

1. The Bidder declares that no previous transgression occurred in the last 3 years with any other Company in any country conforming to the Anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or action can be taken as per the defined procedure.

Section 6 – Equal treatment of all Bidders/Contractors/Subcontractors

1. The principal will enter into agreements with identical conditions as this one with all Bidders/Contractors.
2. The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact.
3. The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidder(s)/Contractor(s)/Subcontractor(s)

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor, which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Corporate Vigilance Office.

Section 8 – External Independent Monitor/Monitors

1. Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
2. The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD of BSNL.
3. The Bidder(s)/Contractor(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/Contractor(s)/Subcontractor(s) with confidentiality.

4. Notwithstanding anything contained in this Section, the Bidder(s)/Contractor(s) shall have no obligation whatsoever to provide any internal costing mechanisms or any internal financial or commercial data pursuant to any audit or review conducted by or on behalf of the Principal. Further, the Bidder(s)/Contractor(s) shall not be required to provide any data relating to its other customers, or any personnel or employee related data.
5. The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.
6. As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.
7. The Monitor will submit a written report to the Chairperson of the Board of the Principal within 8 to 10 weeks from the date of reference or intimation to him by the 'Principal' and, should the occasion arise, submit proposals for correcting problematic situations.
8. If the Monitor has reported to the CMD of BSNL, a substantiated suspicion of an offence under relevant Anti-Corruption Laws of India, and BSNL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Corporate Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
9. The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

1. This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the contract, and for all other Bidders 6 months after the contract has been awarded.
2. If any claim is made/ lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/determined by CMD, BSNL.

Section 10 – Other provisions

1. This agreement is subject to Indian Law. Place of performance and jurisdiction is the Registered Office of the Principal, i.e. New Delhi. The arbitration clause provided in the tender document / contract shall not be applicable for any issue /dispute arising under Integrity Pact.
2. Changes and supplements as well as termination notices need to be made in writing.
3. If the Contractor is a partnership or a consortium, this agreement must be, signed by all partners or consortium members.

4. Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

For the Principal

For the Bidder/Contractor

Place.....

Witness 1 :

Date

Witness 2 :

Appendix 'F'(Refer Para 233.2.8
of Section VI Part A)**MANUFACTURING SPECIFICATIONS****Type A: Intrusion Proof Fiber Optic Cable****[(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers]
for NLD Routes**

Ser No	Parameter	Unit	Measures/Description	Remarks
1.	Type of Fiber	-	G.655 & G.652D	
2.	No of Fibers per Ribbon	Nos	12	-
3.	Ribbon Width (Maximum)	µm	3220	
4.	Ribbon Height (Maximum)	µm	360	
5.	Extreme Fibers (Maximum)	µm	2882	
6.	Planarity (Maximum)	µm	50	
7.	No of Ribbons in Central Tube	Nos.	4	-
8.	Ribbon 1	-	G.655	
9.	Ribbon 2	-	G.655	
10.	Ribbon 3	-	G.652D	
11.	Ribbon 4	-	G.652D	
12.	Ribbon Loose Tube (PBTP) ID	mm	5.5	± 5%
13.	Ribbon Loose Tube (PBTP) OD	mm	6.5	± 5%
14.	Identification of Ribbon	-	Printed as 1 Ribbon1, 2 Ribbon 2, 3 Ribbon 3, 4 Ribbon 4 in interval of 200 mm	
15.	Ribbon Loose Tube Color	-	White	-
16.	Water Blocking Tape	-	1 below Inner Sheath and 1 Over Sensory Layer	
17.	Diameter of Inner Sheath FRP Strength Member (minimum 2 Nos)	mm	0.7	± 0.1mm
18.	Rip Cord below Inner Sheath	Nos	1	
19.	Inner Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥1.3	-

20.	Type of Fiber for Sensory Use	-	G.652D	-
21.	No of Sensory Fibers	Nos	8	-
22.	Sensory Fiber Loose Tube (PBTP) ID	mm	1.4	±0.1mm
23.	Sensory Fiber Loose Tube (PBTP) OD	mm	2.0	±0.1mm
24.	No of Sensory Fiber Loose Tube	Nos.	8	-
25.	Sensory Fiber Loose Tube Color	-	Blue, Orange, Green, Brown, Slate, White, Red, Black.	-
26.	Sensory Layer Sequence	-	Blue, Filler, Orange, Filler, Green, Filler, Brown, Filler, Slate, Filler, White, Filler, Red, Filler, Black, Filler	-
27.	No of Sensory Fiber per Loose Tube	Nos.	1	-
28.	Sensory Fiber Color	-	Natural	-
29.	No of PE Fillers	Nos.	8	-
30.	PE Filler Color	-	Black	-
31.	Rip Cord below Outer Sheath Diagonally Opposite with Each other	Nos	2	-
32.	Diameter of Outer Sheath Embedded FRP Strength Member (minimum 2 Nos)	mm	1	± 0.1mm
33.	Peripheral Strength Member	-	Aramid/Glass Roving yarn over cable Core helical wound with full Coverage	-
34.	Outer Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥1.8	-
35.	Nominal Cable Outer Diameter	mm	19	± 0.5mm
36.	Nominal Cable Weight	Kg/Km	260	± 8%
37.	Cable to be designed to sustain fiber strain value of	%	0.1	-
38.	Cable to be tested at defined load for fiber strain value of	%	0.25	-

Type B: Non Intrusion Proof Fiber Optic Cable
[24F Ribbon G.655 + 24F Ribbon G.652D]
for NLD Routes

Ser No	Parameter	Unit	Measures/Description	Remarks
1.	Type of Fiber	-	G.655	
2.	No of Fibers per Ribbon	Nos	12	-
3.	Ribbon Width (Maximum)	µm	3220	
4.	Ribbon Height (Maximum)	µm	360	
5.	Extreme Fibers (Maximum)	µm	2882	
6.	Planarity (Maximum)	µm	50	
7.	No of Ribbons in Central Tube	Nos.	4	-
8.	Ribbon 1	-	G.655	
9.	Ribbon 2	-	G.655	
10.	Ribbon 3	-	G.652D	
11.	Ribbon 4	-	G.652D	
12.	Ribbon Loose Tube (PBTP) ID	mm	5.5	± 5%
13.	Ribbon Loose Tube (PBTP) OD	mm	6.5	± 5%
14.	Identification of Ribbon	-	Printed as 1 Ribbon1, 2 Ribbon 2, 3 Ribbon 3, 4 Ribbon 4 in interval of 200 mm	
15.	Ribbon Loose Tube Color	-	White	-
16.	Water Blocking Tape	-	1 below Inner Sheath and 1 Over inner sheath	
17.	Rip Cord below Inner Sheath	Nos	1	
18.	Diameter of Inner Sheath FRP Strength Member (minimum 2 Nos)	mm	0.7	± 0.1mm
19.	Inner Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥1.3	-
20.	Rip Cord Below Outer Sheath Diagonally Opposite with Each other	Nos	2	
21.	Diameter of Outer Sheath Embedded FRP Strength Member (minimum 2 Nos)	mm	1	± 0.1mm
22.	Peripheral Strength Member	-	Aramid/Glass Roving yarn over cable Core helical wound with full Coverage	-

23.	Outer Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥ 1.8	-
24.	Nominal Cable Outer Diameter	mm	15.5	$\pm 0.5\text{mm}$
25.	Nominal Cable Weight	Kg/Km	200	$\pm 5\%$
26.	Cable to be designed to sustain fiber strain value of	%	0.1	-
27.	Cable to be tested at defined load for fiber strain value of	%	0.25	-

Type C: Intrusion Proof Fiber Optic Cable
[48F Ribbon G.652D + 8F G.652D Sensory Fibers]
for Access Network

Ser No	Parameter	Unit	Measures/Description	Remarks
1.	Type of Fiber	-	G.652D	
2.	No of Fibers per Ribbon	Nos	12	-
3.	Ribbon Width (Maximum)	µm	3220	
4.	Ribbon Height (Maximum)	µm	360	
5.	Extreme Fibers (Maximum)	µm	2882	
6.	Planarity (Maximum)	µm	50	
7.	No of Ribbons in Central Tube	Nos.	4	-
8.	Ribbon 1	-	G.652D	
9.	Ribbon 2	-	G.652D	
10.	Ribbon 3	-	G.652D	
11.	Ribbon 4	-	G.652D	
12.	Ribbon Loose Tube (PBTP) ID	mm	5.5	± 5%
13.	Ribbon Loose Tube (PBTP) OD	mm	6.5	± 5%
14.	Identification of Ribbon	-	Printed as 1 Ribbon1, 2 Ribbon 2, 3 Ribbon 3, 4 Ribbon 4 in interval of 200 mm	
15.	Ribbon Loose Tube Color	-	White	-
16.	Water Blocking Tape	-	1 below Inner Sheath and 1 Over Sensory Layer	
17.	Diameter of Inner Sheath FRP Strength Member (minimum 2 Nos)	mm	0.7	± 0.1mm
18.	Rip Cord below Inner Sheath	Nos	1	
19.	Inner Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥1.3	-
20.	Type of Fiber for Sensory Use	-	G.652D	-
21.	No of Sensory Fibers	Nos	8	-
22.	Sensory Fiber Loose Tube (PBTP) ID	mm	1.4	± 0.1mm
23.	Sensory Fiber Loose Tube (PBTP) OD	mm	2.0	± 0.1mm

24.	No of Sensory Fiber Loose Tube	Nos.	8	-
25.	Sensory Fiber Loose Tube Color	-	Blue, Orange, Green, Brown, Slate, White, Red, Black.	-
26.	Sensory Layer Sequence	-	Blue, Filler, Orange, Filler, Green, Filler, Brown, Filler, Slate, Filler, White, Filler, Red, Filler, Black, Filler	-
27.	No of Sensory Fiber per Loose Tube	Nos.	1	-
28.	Sensory Fiber Color	-	Natural	-
29.	No of PE Fillers	Nos.	8	-
30.	PE Filler Color	-	Black	-
31.	Rip Cord below Outer Sheath	Nos	2	-
32.	Diameter of Outer Sheath Embedded FRP Strength Member (minimum 2 Nos)	mm	1	± 0.1mm
33.	Peripheral Strength Member	-	Aramid/Glass Roving yarn over cable Core helical wound with full Coverage	-
34.	Outer Sheath (HDPE Black, UV Stabilized) Thickness	mm	≥1.8	-
35.	Nominal Cable Outer Diameter	mm	19	±0.5mm
36.	Nominal Cable Weight	Kg/Km	260	± 8%
37.	Cable to be designed to sustain fiber strain value of	%	0.1	-
38.	Cable to be tested at defined load for fiber strain value of	%	0.25	-

Appendix 'G'(Refer Para 117.2
of Section II)**TEST PLAN****Note**

1. Acceptance Test for all items as well as services mentioned in SoR will be conducted in accordance with the details given at Clause 112.7 and 119 to 124. Test plan for FAT and Site AT (SAT) is given below.

2. Visual Examination conducted by inspection teams during SAT shall include assessment of quality of packing, occurrence of damages (if any) during transit and verification of lot as per documentation received through FAT teams.

3. For any ex import items third party inspection documentation shall be acceptable in lieu of FAT.

4. Abbreviations.

MTS - Manufacturer's Test Setup

MPoC - Manufacturer's Proof of Compliance (Documentary Evidence)

PTI - Purchaser's Test Inspection

FIBER G.655

Ser No	Characteristics/ Specification	Clause	FAT		SAT	
			Method	Sample Size	Method	Sample Size
1	Refractive Index Characteristics					
1.1	Fiber refractive index profile	219.1.1	MPoC	-	-	-
1.2	Fiber Group Index	219.1.2	MPoC	-	-	-
1.3	Coating Refractive Index	219.1.3	MPoC	-	-	-
2	Transmission Characteristics					
2.1	Mode Field Diameter	219.2.1	MTS	As per BSNL QA Bulk Test Schedule	-	-

APPENDIX 'G' READ, UNDERSTOOD AND COMPLIED WITH- SIGNATURE OF THE BIDDER

2.2	Cut-off Wavelength	219.2.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.3	Chromatic Dispersion	219.2.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.4	Polarization Mode Dispersion	219.2.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.5	Attenuation Coefficient	219.2.5.1	MPoC	-	-	-
2.6	Point Discontinuities	219.2.5.2	MPoC	-	-	-
2.7	Macro-Bend performance	219.2.5.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.8	Cladding Diameter	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.9	Cladding Non-Circularity	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.10	Mode Field Concentricity	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.11	Diameter over Primary Coating	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
3	Fiber Life Time	219.3	MPoC	-	-	-
4	Geometrical Characteristics					
4.1	Fiber	219.4.1	MPoC	-	-	-
4.2	Coating	219.4.2	MPoC	-	-	-
4.3	Fiber Curl	219.4.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
5	Mechanical Characteristics					
5.1	Proof Test	219.5.1	MPoC	-	-	-
5.2	Dynamic Tensile Strength	219.5.2	MPoC	-	-	-
5.3	Stripping Force	219.5.3	MPoC	-	-	-
5.4	Dynamic Stress Corrosion Susceptibility Constant	219.5.4	MPoC	-	-	-
5.5	Static Stress	219.5.5	MPoC	-	-	-

	Corrosion Susceptibility Constant					
6	Fusion Splice Loss	219.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
7	Environmental Characteristics					
7.1	Change of Temperature	219.7.1	MPoC	-	-	-
7.2	Water Immersion	219.7.2	MPoC	-	-	-
7.3	Dry Heat	219.7.3	MPoC	-	-	-
7.4	Damp Heat	219.7.4	MPoC	-	-	-
7.5	Temperature Humidity Cycling	219.7.5	MPoC	-	-	-
8	Degree of Surface Cure	219.8	MPoC	-	-	-
9	Fiber Materials	219.9	MPoC	-	-	-
10	Colour Fiber Qualification Test					
10.1	MEK Rub Test (Methyl Ethyl Ketone)	219.10.1	MPoC	-	-	-
10.2	Water Immersion Test	219.10.2	MPoC	-	-	-
11	Product Qualification Requirements					
11.1	Initial Product Qualification (IPQ)	219.11.1	MPoC	-	-	-
11.2	Manufacturing Quality Program (MQP)	219.11.2	MPoC	-	-	-

FIBER G.652D

S. No.	Characteristics/ Specification	Clause Ref	FAT		SAT	
			Method	Sample Size	Method	Sample Size
1	Refractive Index Characteristics					
1.1	Fiber refractive index profile	221.1	MPoC	-	-	-
1.2	Fiber Group Index	221.2	MPoC	-	-	-
1.3	Coating Refractive Index	221.3	MPoC	-	-	-
2	Transmission Characteristics					
2.1	Mode Field Diameter	222.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.2	Cut-off Wavelength	222.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.3	Chromatic Dispersion	222.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.4	Polarization Mode Dispersion	222.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.5	Attenuation Coefficient	222.5.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.6	Point Discontinuities	222.5.2	MPoC	-	-	-
2.7	Macro-Bend performance	222.5.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.8	Cladding Diameter	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.9	Cladding Non-Circularity	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.10	Mode Field Concentricity	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.11	Diameter over Primary Coating	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
3	Fiber Life Time	223	MPoC	-	-	-

4	Geometrical Characteristics					
4.1	Fiber	224.1	MPoC	-	-	-
4.2	Coating	224.2	MPoC	-	-	-
4.3	Fiber Curl	224.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
5	Mechanical Characteristics					
5.1	Proof Test	225.1	MPoC	-	-	-
5.2	Dynamic Tensile Strength	225.2	MPoC	-	-	-
5.3	Stripping Force	225.3	MPoC	-	-	-
5.4	Dynamic Stress Corrosion Susceptibility Constant	225.4	MPoC	-	-	-
5.5	Static Stress Corrosion Susceptibility Constant	225.5	MPoC	-	-	-
6	Fusion Splice Loss	225.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
7	Environmental Characteristics					
7.1	Change of Temperature	226.1	MPoC	-	-	-
7.2	Water Immersion	226.2	MPoC	-	-	-
7.3	Dry Heat	226.3	MPoC	-	-	-
7.4	Damp Heat	226.4	MPoC	-	-	-
7.5	Temperature Humidity Cycling	226.5	MPoC	-	-	-
8	Degree of Surface Cure	226.6	MPoC	-	-	-
9	Fiber Materials	226.7	MPoC	-	-	-
10	Colour Fiber Qualification Test					
10.1	MEK Rub Test (Methyl Ethyl Ketone)	226.8.1	MPoC	-	-	-

10.2	Water Immersion Test	226.8.2	MPoC	-	-	-
11	Product Qualification Requirements					
11.1	Initial Product Qualification (IPQ)	227.1	MPoC	-	-	-
11.2	Manufacturing Quality Program (MQP)	227.2	MPoC	-	-	-

OFC TYPE A (48+8F) Intrusion Proof for NLD

S. No.	Characteristics/Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Ribbon Specifications	231	MPoC	-	-	-
2	Cable Design Specifications	232	MPoC	-	-	-
3	Cable Mechanical Tests					
3.1	Tensile Strength Test	233.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.2	Abrasion Test	233.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.3	Crush Test	233.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.4	Impact Test	233.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.5	Repeated Bending	233.5	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.6	Torsion Test	233.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.7	Kink Test	233.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.8	Cable Bend Test	233.8	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.9	Test of Figure of 8	233.9	MPoC	-	-	-
3.10	Temperature Cycling	233.10	MPoC	-	-	-
3.11	Cable Aging Test	233.11	MPoC	-	-	-
3.12	Water Penetration Test	233.12	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.13	Cable Jacket Yield Strength And Ultimate Elongation	233.13	MPoC	-	-	-
4	Ribbon Tests					
4.1	Ribbon Dimension	233.14	MPoC	-	-	-
4.2	Ribbon Resistance to Twist	233.15	MPoC	-	-	-
4.3	Ribbon Residual Twist	233.16	MPoC	-	-	-
4.4	Ribbon Separation	233.17	MPoC	-	-	-
4.5	Ribbon Strippability	234.18	MPoC	-	-	-
4.6	Ribbon Macro-bend Performance	233.19	MPoC	-	-	-
4.7	Torsion	233.20	MPoC	-	-	-

	Resistance of Ribbon					
4.8	Crush Resistance of Ribbon	233.21	MPoC	-	-	-
5	Cable Tests					
5.1	Quality of the loose tube	233.22	MPoC	-	-	-
5.2	Drainage Test for loose Tube	233.23	MPoC	-	-	-
5.3	Easy removal of sheath	233.24	MTS	As per BSNL QA Bulk Test Schedule	-	-
5.4	Aggressive Media on the cable	233.25	MPoC	-	-	-
5.5	Cable Outer Diameter and Jacket Thickness	233.26	MTS	As per BSNL QA Bulk Test Schedule	-	-
6	Functional Tests					
6.1	Cable Marking	235.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.2	Cable Ends	235.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.3	Drum length	235.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.4	Attenuation per Km. of each fiber	235.3.5.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.5	Splice Loss	241.4	MTS	1%	-	-
6.6	Chromatic Dispersion	241.5	MTS	1%	-	-
6.7	Polarization Mode Dispersion	240.4.15	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.8	Colour Coding & Ribbon Identification	235.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.9	Drum Inspection to include Length (To be verified by cable marking inspection at the two loose ends), Sealing & Packing	-	PTI	100%	PTI	100%
7	Quality Tests					
7.1	Cable / Raw Material	270	MPoC	-	-	-
7.2	Documentation	238	MPoC	-	-	-
7.3	Material Safety	239	MPoC	-	-	-
7.4	Product Qualification	240	MPoC	-	-	-

OFC TYPE B (48F) Non Intrusion Proof for NLD

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Ribbon Specifications	245	MPoC	-	-	-
2	Cable Design Specifications	246	MPoC	-	-	-
3	Cable Mechanical Tests	247				
3.1	Tensile Strength Test	247.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.2	Abrasion Test	247.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.3	Crush Test	247.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.4	Impact Test	247.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.5	Repeated Bending	247.5	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.6	Torsion Test	247.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.7	Kink Test	247.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.8	Cable Bend Test	247.8	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.9	Test of Figure of 8	247.9	MPoC	-	-	-
3.10	Temperature Cycling	247.10	MPoC	-	-	-
3.11	Cable Aging Test	247.11	MPoC	-	-	-
3.12	Water Penetration Test	247.12	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.13	Cable Jacket Yield Strength And Ultimate Elongation	247.13	MPoC	-	-	-
4	Ribbon Tests					
4.1	Ribbon Dimension	247.14	MPoC	-	-	-
4.2	Ribbon Resistance to Twist	247.15	MPoC	-	-	-
4.3	Ribbon Residual Twist	247.16	MPoC	-	-	-
4.4	Ribbon	247.17	MPoC	-	-	-

	Separation					
4.5	Ribbon Strippability	247.25	MPoC	-	-	-
4.6	Ribbon Macro-bend Performance	247.19	MPoC	-	-	-
4.7	Torsion Resistance of Ribbon	247.20	MPoC	-	-	-
4.8	Crush Resistance of Ribbon	247.21	MPoC	-	-	-
5	Cable Tests					
5.1	Quality of the loose tube	247.22	MPoC	-	-	-
5.2	Drainage Test for loose Tube	247.23	MPoC	-	-	-
5.3	Easy removal of sheath	247.24	MTS	As per BSNL QA Bulk Test Schedule	-	-
5.4	Aggressive Media on the cable	247.25	MPoC	-	-	-
5.5	Cable Outer Diameter and Jacket Thickness	247.26	MTS	As per BSNL QA Bulk Test Schedule	-	-
6	Functional Tests					
6.1	Cable Marking	249.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.2	Cable Ends	249.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.3	Drum length	249.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.4	Attenuation per Km. of each fiber	249.3.4.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.5	Splice Loss	255.4	MTS	1%	-	-
6.6	Chromatic Dispersion	255.5	MTS	1%	-	-
6.7	Polarization Mode Dispersion	254.4.15	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.8	Colour Coding & Ribbon Identification	249.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.9	Drum Inspection to include Length (To be verified by cable marking inspection at the two loose ends), Sealing & Packing	-	PTI	100%	PTI	100%

7	Quality Tests					
7.1	Cable / Raw Material	251	MPoC	-	-	-
7.2	Documentati on	252	MPoC	-	-	-
7.3	Material Safety	253	MPoC	-	-	-
7.4	Product Qualification	254	MPoC	-	-	-

OFC TYPE C (48+8F) Intrusion Proof for Access

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Ribbon Specifications	259	MPoC	-	-	-
2	Cable Design Specifications	260	MPoC	-	-	-
3	Cable Mechanical Tests					
3.1	Tensile Strength Test	261.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.2	Abrasion Test	261.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.3	Crush Test	261.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.4	Impact Test	261.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.5	Repeated Bending	261.5	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.6	Torsion Test	261.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.7	Kink Test	261.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.8	Cable Bend Test	261.8	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.9	Test of Figure of 8	261.9	MPoC	-	-	-
3.10	Temperature Cycling	261.10	MPoC	-	-	-
3.11	Cable Aging Test	261.11	MPoC	-	-	-
3.12	Water Penetration Test	261.12	MTS	As per BSNL QA Bulk Test Schedule	-	-
3.13	Cable Jacket Yield Strength And Ultimate Elongation	261.13	MPoC	-	-	-
4	Ribbon Tests					
4.1	Ribbon Dimension	261.14	MPoC	-	-	-
4.2	Ribbon Resistance to Twist	261.15	MPoC	-	-	-
4.3	Ribbon Residual Twist	261.16	MPoC	-	-	-
4.4	Ribbon Separation	261.17	MPoC	-	-	-

4.5	Ribbon Strippability	261.18	MPoC	-	-	-
4.6	Ribbon Macro-bend Performance	261.19	MPoC	-	-	-
4.7	Torsion Resistance of Ribbon	261.20	MPoC	-	-	-
4.8	Crush Resistance of Ribbon	261.21	MPoC	-	-	-
5	Cable Tests					
5.1	Quality of the loose tube	261.22	MPoC	-	-	-
5.2	Drainage Test for loose Tube	261.23	MPoC	-	-	-
5.3	Easy removal of sheath	261.24	MTS	As per BSNL QA Bulk Test Schedule	-	-
5.4	Aggressive Media on the cable	261.25	MPoC	-	-	-
5.5	Cable Outer Diameter and Jacket Thickness	261.26	MTS	As per BSNL QA Bulk Test Schedule	-	-
6	Functional Tests					
6.1	Cable Marking	263.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.2	Cable Ends	263.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.3	Drum length	263.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.4	Attenuation per Km. of each fiber	263.3.4.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.5	Splice Loss	269.4	MTS	1%	-	-
6.6	Chromatic Dispersion	269.5	MTS	1%	-	-
6.7	Polarization Mode Dispersion	269.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.8	Colour Coding & Ribbon Identification	263.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
6.9	Drum Inspection to include Length (To be verified by cable marking inspection at the two loose ends), Sealing & Packing	-	PTI	100%	PTI	100%
7	Quality Tests					
7.1	Cable / Raw	270	MPoC	-	-	-

	Material					
7.2	Documentation	266	MPoC	-	-	-
7.3	Material Safety	267	MPoC	-	-	-
7.4	Product Qualification	268	MPoC	-	-	-

PLB HDPE 40/33

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Material Characteristics	(TEC GR No GR/CDS-08/02 Nov 2004)				
1.1	Material - Outer Layer		MPoC	-	-	-
1.2	Material - Inner Layer		MPoC	-	-	-
2	Physical Characteristics					
2.1	Visual Inspection		MTS	As per BSNL QA Bulk Test Schedule	PTI	100%
2.2	Colour		MTS	As per BSNL QA Bulk Test Schedule	-	-
2.3	Dimensions		MTS	As per BSNL QA Bulk Test Schedule	-	-
3	Mechanical Characteristics					
3.1	Tensile Strength & Elongation		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.2	Reversion Test		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.3	Environmental Stress Crack Resistance		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.4	Impact Strength		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.5	Crush Resistance		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.6	Mandrel Test		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.7	Ovality Test		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.8	Coil Set		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.9	Oxidation Induction Test		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.10	Hydraulic Characteristics		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.11	Internal Co-efficient of Friction		MTS	As per BSNL QA Bulk Test Schedule	-	-
3.12	Identification Markings		MTS	As per BSNL QA Bulk Test Schedule	-	-

3.13	OFC Blowing Test		MPoC	-	-	-
3.14	Density		MT S	As per BSNL QA Bulk Test Schedule	-	-
3.15	Melt Flow Rate		MT S	As per BSNL QA Bulk Test Schedule	-	-
3.16	Ash Content		MT S	As per BSNL QA Bulk Test Schedule	-	-
3.17	Fading of Colours		MT S	As per BSNL QA Bulk Test Schedule	-	-
3.18	UV Stabilizer Test		MPoC	-	-	-
4	Accessories Inspection & Test					
4.1	Plastic Coupler (Push-fit type / Compression type)		MT S	As per BSNL QA Bulk Test Schedule	-	-
4.2	End Plug		MPoC	-	-	-
4.3	Cable Sealing Plug		MPoC	-	-	-
4.4	End Cap		MPoC	-	-	-
4.5	Pulling Force Test for Coupler		MT S	As per BSNL QA Bulk Test Schedule	-	-
4.6	Ageing Test for Accessories		MT S	As per BSNL QA Bulk Test Schedule	-	-
5	Miscellaneous					
5.1	Storage		PTI	100%	-	-
5.2	Packing & Delivery		PTI	100%	-	-

JOINT CLOSURE

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Specifications					
1.1	General Requirements & Features	293-294	MPoC	-	-	-
1.2	Dimensions	295	MTS	As per BSNL QA Bulk Test Schedule	-	-
1.3	Sub Components	296-301	MTS	As per BSNL QA Bulk Test Schedule	-	-
2	Tests					
2.1	Visual Examination	302.1	MTS	As per BSNL QA Bulk Test Schedule	PTI	100%
2.2	Gas (AIR) Tightness Test	302.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.3	Variation in attenuation	302.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.4	Axial Tension	302.4	MPoC	-	-	-
2.5	Torsion Test	302.5	MPoC	-	-	-
2.6	Flexure Test	302.6	MPoC	-	-	-
2.7	Impact Test	302.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.8	Static Load Test	302.8	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.9	Environmental cycle	302.9	MPoC	-	-	-
2.10	Salt Spray (Mist) Test	302.10	MPoC	-	-	-
2.11	Vibration Test	302.11	MPoC	-	-	-
2.12	Water ingress Test	302.12	MTS	As per BSNL QA Bulk Test Schedule	-	-
2.13	Aggressive Media Test	302.13	MPoC	-	-	-
2.14	Drop and Topple Test	302.14	MTS	As per BSNL QA Bulk Test Schedule	-	-
3	Miscellaneous					
3.1	Packing & Storing	303-304	PTI	100%	-	-

FDMS RACK WITH SHELVES INCLUDING WALL MOUNT FDMS & PATCH CORDS

S. No.	Characteristics / Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Generic Requirements	277, 284.1-284.5	MP oC	-	-	-
2	Functional Requirements	278	MP oC	-	-	-
3	Technical requirements	279	MP oC	-	-	-
4	Specifications					
4.1	Rack	279.2	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.2	Horizontal Patch Cord Mgmt System	279.3	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.3	Splicing cum Patching Shelf	279.4, 284.6-284.7	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.4	Splice Trays	279.4.5	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.5	Splice Protection Sleeves	279.5	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.6	Pre Connectorized Fan out Pigtail	279.6	MT S	As per BSNL QA Bulk Test Schedule	-	-
4.7	Cable Entry Kit & Accessories	279.8-279.9	MT S	As per BSNL QA Bulk Test Schedule	-	-
5	Tests					
5.1	Visual Examination	280.1	MT S	As per BSNL QA Bulk Test Schedule	PTI	100%
5.2	Variation in Attenuation	280.2	MT S	As per BSNL QA Bulk Test Schedule	-	-
5.3	Patch Cord Retention Test	280.3	MT S	As per BSNL QA Bulk Test Schedule	-	-
5.4	Environmental cycle	280.4	MP oC	-	-	-
5.5	Vibration Test	280.5	MP oC	-	-	-
5.6	Shelf Endurance Test	280.6	MP oC	-	-	-

APPENDIX 'G' READ, UNDERSTOOD AND COMPLIED WITH- SIGNATURE OF THE BIDDER

5.7	Shelf Performance Test	280.7	MT S	As per BSNL QA Bulk Test Schedule	-	-
5.8	Marking	281, 284.9	MT S	As per BSNL QA Bulk Test Schedule	-	-
6	Miscellaneous					
6.1	Material	285	MP oC	-	-	-
6.2	Documentation	282	PTI	-	-	-
6.3	Spares	283	PTI	-	-	-
6.5	Packing	291	MTS	As per BSNL QA Bulk Test Schedule	PTI	100%
7	Optical Patch Cords	286-291				
7.1	General Requirements	286.1	MPoC	-	-	-
7.2	Quality Requirements	287	MPoC	-	-	-
7.3	Safety Requirements	288	MPoC	-	-	-
7.4	Fiber Requirements	289.2	MPoC	-	-	-
7.5	Tests					
7.5.1	Ferrule Geometry Test	290.1	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.2	Visual Inspection of Connector Surface Test	290.1.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.3	Insertion Loss Test	290.2	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.4	Return Loss Test	290.3	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.5	Vibration Test	290.4	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.6	Mating Durability	290.5	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.7	Cable Retention Test	290.6	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.8	Repeated Bending Test	290.7	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.9	Drop Test	290.8	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.10	Change of Temperature Test	290.9	MPoC	-	-	-
7.5.11	Radius of Curvature	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-

7.5.12	Attenuation	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.13	Offset	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.14	Concentricity	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-
7.5.15	Fiber height	As per TEC GR	MTS	As per BSNL QA Bulk Test Schedule	-	-

ELECTRONIC ROUTE MARKER

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Specifications					
1.1	Design	305.2.1	MP oC	-	-	-
1.2	Functional	305.2.2- 305.2.3	MT S	1%	-	-
1.3	Dimension	305.2.4	MT S	1%	-	-
1.4	Weight	305.2.5	MT S	1%	-	-
1.5	Operating Temperature	305.2.7	MP oC	-	-	-
2	Tests	TEC GR No G/TIE- 07/01 Jun 98 or later				
2.1	Tensile Strength & Elongation Test	12.17.1	MT S	1%	-	-
2.2	Thermal Stress Crack Resistance Test	12.17.2	MP oC	-	-	-
2.3	Hot Cold Cycle Test	12.17.3	MP oC	-	-	-
2.4	Seal Test	12.17.4	MT S	1%	-	-
3	Miscellaneous					
3.1	Visual Inspection	-	PTI	1%	PTI	10%
3.2	Packing	-	PTI	1%	PTI	10%

ELECTRONIC ROUTE LOCATOR

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Specifications					
1.1	Capability to locate markers upto required depth	306.1	MT S	1%	-	-
1.2	Capability to detect User Defined Frequencies	306.5.2.1	MT S	1%	-	-
1.3	Battery Life Check	306.5.5.5	MT S	1%		
1.4	Conformity to Specifications	306.2-306.5	MT S	1%	-	-
2	Miscellaneous					
2.1	Visual Inspection	-	PTI	10%	PTI	100%
2.2	Packaging & Storing	-	PTI	10%	PTI	100%

WARNING TAPE

S. No.	Characteristics/ Specification	Clause Ref	FAT (Based on Lot)		SAT (Based on Lot)	
			Method	Sample Size	Method	Sample Size
1	Specifications					
1.1	Dimensions	307.1	MT S	1%	-	-
1.2	Material	307.2	MT S	1%	-	-
1.3	Marking	307.3	MT S	1%	-	-
1.4	Packing	-	PTI	10%	PTI	100%

Appendix 'H'
(Refer Para 60 of
Section III)

PACKAGEWISE SPARES LIST

SPARES LIST: PACKAGE 'A'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	534
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	15
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	402
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	950
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	92
5.2	Splicing Cum Patching Shelf	Nos	9
6.	Electronic Route Locator	Nos	43
7.	Electronic Route Marker	Nos	5223
8.	Joint Closure	Nos	594
9.	Warning Tape	Km	950

SPARES LIST: PACKAGE 'B'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	109
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	437
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	215
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	760
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	71
5.2	Splicing Cum Patching Shelf	Nos	9
6.	Electronic Route Locator	Nos	21
7.	Electronic Route Marker	Nos	4181
8.	Joint Closure	Nos	476
9.	Warning Tape	Km	760

SPARES LIST: PACKAGE 'C'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	123
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	653
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	181
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	957
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	75
5.2	Splicing Cum Patching Shelf	Nos	7
6.	Electronic Route Locator	Nos	23
7.	Electronic Route Marker	Nos	5264
8.	Joint Closure	Nos	598
9.	Warning Tape	Km	957

SPARES LIST: PACKAGE 'D'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	198
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	617
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	153
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	966
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	60
5.2	Splicing Cum Patching Shelf	Nos	6
6.	Electronic Route Locator	Nos	14
7.	Electronic Route Marker	Nos	5315
8.	Joint Closure	Nos	605
9.	Warning Tape	Km	966

SPARES LIST: PACKAGE 'E'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	655
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	62
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	716
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	30
5.2	Splicing Cum Patching Shelf	Nos	4
6.	Electronic Route Locator	Nos	7
7.	Electronic Route Marker	Nos	3936
8.	Joint Closure	Nos	447
9.	Warning Tape	Km	716

SPARES LIST: PACKAGE 'F'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	519
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	84
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	603
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	31
5.2	Splicing Cum Patching Shelf	Nos	5
6.	Electronic Route Locator	Nos	14
7.	Electronic Route Marker	Nos	3313
8.	Joint Closure	Nos	377
9.	Warning Tape	Km	603

SPARES LIST: PACKAGE 'G'

Ser No	Item Description	Unit	Total Qty
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes	Km	-
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes	Km	647
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network	Km	105
4.	Permanently Lubricated HDPE duct along with associated accessories	Km	752
5.	Fiber Distribution Management System (FDMS) consisting of	Nos	
5.1	Standard 42U Rack with 2 x Splicing Cum Patching Shelf	Nos	43
5.2	Splicing Cum Patching Shelf	Nos	4
6.	Electronic Route Locator	Nos	16
7.	Electronic Route Marker	Nos	4136
8.	Joint Closure	Nos	471
9.	Warning Tape	Km	752

Appendix 'J'

(Refer Para
112.1 and 77.1 of
of Section IV)

ENGINEERING INSTRUCTIONS FOR OFC LAYING PRACTICES

Engineering Instructions by BSNL for OFC laying as given below or subsequent amendments, if any, shall be adhered to as part of the OFC construction practices.

CONTENTS

Ser No	Name of Engineering Instruction	Reference No
1.	Laying Practices of Optical Fibre Cable Local Area Network Optical fiber Cable	D – 001 Issue No IV Dated 31 Jan 2007
2.	Installation Practice of Self Supporting Metal Free Aerial Optical Fibre Cable	TR/COFC/I-001 Issue No 01 Dated 10 Jun 2011
3.	Laying Practices of Optical Fibre Cable by HDD (Horizontal Directional Drilling) Method	TR/OFC/A-001 Issue No 01 Dated 31 Jan 2007
4.	Provision of Hand Hole in Case of HDD on OFC Laying	TR/COFC/I-004 Issue No 1 04 Oct 2011
5.	Micro-Tunnelling for Laying of O.F.Cable	TR/COFC/A-002 Issue No 01 Dated 22 Feb 2010

यांत्रिक अनुदेश ENGINEERING INSTRUCTION

LAYING PRACTICES OF OPTICAL FIBRE CABLE LOCAL AREA NETWORK, OPTICAL FIBRE CABLE

(NO. D – 001)

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All efforts have been made to incorporate all relevant up to date information available, any discrepancies or need for addition or deletion is felt necessarily may please be intimated to this office for further improvement, on E-Mail Id agmnt1_tnd@rediffmail.com.



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LAYING PRACTICES OF OPTICAL FIBER CABLE

1. **Scope.** This Engineering instruction deals with the methods to be adopted in laying of HDPE pipes for Optical Fiber Cable and laying of optical Fiber Cable. The following laying practices are adopted by the field units.
2. **General.** BSNL Network has already introduced. Optical Fibre Transmission system for local junctions and for long distance routes. Various types of Cables such as 24 & 12 fibre non-metallic, 8 fibre nonmetallic 8 fibre with metallic strength member and 6 fibre non metallic, have been already introduced. Wherever, O.F. Cable with metallic conductors are to be used, they will fall within the purview of PTCC code and should be referred to PTCC.
3. **Detailed Survey**
 - 3.1 Following alternative should be considered after techno economic evaluation to meet the planned objectives of the scheme.
 - 3.1.1 Minimum possible route length vis - a - vis on a route having maximum number of towns with potential growth on O.F routes.
 - 3.1.2 Keeping various small exchange on the route under planned systems as against by-passing some of these exchanges by routing the Optical Fiber Cable on main road without leading in, in congested towns.
 - 3.1.3 Linking of small exchanges a little away from main road and routing the main cable itself via such small town.
 - 3.1.4 Linking intermediate main or repeater stations by spur routes vis-à-vis that from joint box nearest to the concerned exchange.
 - 3.1.5 Having new building for repeaters on main route or housing the repeaters in the existing exchange buildings on the routes.
 - 3.2 After deciding above mentioned issues a detailed measurement of lengths of cable route along with details of rail/road crossings, culverts, causeways etc. may be recorded in the detailed survey register. The probable location of joints, terminations and repeaters may also be decided and marked on the road map.
 - 3.3 On the basis of surveys, general permission from road and rail authorities for laying the Optical Fiber Cable along the suitable roads and at particular rail / road crossings will have to be obtained. Generally OFC may preferably be laid straight as far as possible along the road near the boundaries, away from the burrow pits. When the OFC is laid along the National Highways, Cable should run along the road land boundary or at a minimum distance of 15 meters from the center line of the road where the road land is wider. In special cases where it may be necessary to avoid burrow pits or low lying areas, the Cable may be run underneath the shoulders at a distance of 0.6 meter from the outer edge of the road embankment provided the same is located at least 4.5 meters away from centre line of road and 1.2 meter below the road surface.

4. General

- 4.1 **Soil Categorization.** Soil is categorized only under two broad categories i.e. "Rocky" and "Non Rocky", for purpose of deciding the depth at & which the cable is to be laid. The soil is categorized as rocky if the cable trench cannot be dug without blasting and / or chiseling. All other types of soils shall be categorized as "Non rocky" including Murrum & soil mixed with stone or soft rock. However for the purpose of execution of trenching contracts, project authorities may classify the soil in more than one group and decide contractual obligations suitably.
- 4.2 **Types of pipe to be used for Optical Fiber Cable.** Optical Fiber Cables should be blown through Permanently Lubricated HDPE Duct of 40 mm-OD and 33 mm ID Pipe in 500/1000 Meter Coil. Which meets the specification as given in G/R No-G/CDS-08/01 Dec 99 with latest amendments shall only be used for laying the OFC. Wherever DWC pipe or GI pipes or R.C.C. pipes are used for protection, the two ends of the pipe should be properly sealed to protect HDPE pipe from sharp edge of GI pipe and to bar the entry of rodents. For providing additional protection Split RCC/GI pipes should be used from top instead of full RCC/GI pipes. Use of normal duty DWC (Double walled corrugated) HDPE pipe – ISI marked and anti-rodent conforming to IS 14930 (Part - II) can also be utilized as preferable choice due to economic consideration for protection of optical fiber cable (choosing suitable DWC from nominal OD/ID dia 50/38,63/50,77/ 63,90/ 76,120/103,145/126,160/136,175/148 mm). It is recommended that where ever OFC is passing over the ground surface (exposed outside) and more prone to damage, GI pipe may be used preferably. Depending upon the site conditions and cost consideration one of the protection viz DWC / GI / RCC pipe may be used.
- 4.3 All Depths should be measured from the top of pipe. However the depth is considered acceptable if it is not less by more than 8 cm from the specified depth of 1.5 m in non rocky soil and 0.9 m in case of rocky soil. This margin of 8 cm is not applicable for the minimum depth prescribed for providing protection i.e. 1.2 m in non rocky / rocky soil and 0.5 m in case of rocky soil.

5. Trenching. Major specifications for trenching are: -

- 5.1 Normally depth of the trench should be more by 10 cm with respect to the depth which is required to be attained as prescribed in Para 6.
- 5.1.1 Top and bottom width of the trench should normally be 45 cm and 30 cm respectively. In loose soils it may be necessary to increase the width at the top to avoid collapsing of trench.
- 5.1.2 Trenching wherever possible, should be at the road boundary and as far as possible, straight.
- 5.1.3 Whenever curves or deviations are encountered it should be a very smooth curve, the radius of curvature should be more than 50cm. at least.
- 5.1.4 Bottom of the trenches should be at uniform level without any abrupt ups and downs. After the trenching is done for sufficient length, the bottom leveling should be inspected

for uniformity to ensure that pipe should be laid without sharp bends.

- 5.1.5 In exceptional cases, the depth of the trench could be much more than 1.60 m due to undulating terrain as shown in figure (1).
- 5.1.6 In certain cases, in a uniform terrain a sudden burrow pit of short length might be encountered as in fig (2). In such cases, the HDPE pipe can be further protected by DWC / GI / RCC pipes of suitable size.
- 5.1.7 In water logged area digging should be done in shorter sections and dewatering should be got done before pipe laying.
- 5.1.8 When trenching is done close to power cables precautions detailed in EI lines & cables underground should be observed.
- 5.1.9 When trenching is undertaken along streets and railway lines, safety precautions given in EI lines & Cables underground. A 0005 should be observed.
- 5.1.10 Caution boards should be provided at each end of the trench to caution the traffic. Red flags may also be planted at suitable intervals throughout the trench. If trench is to remain open at night red lamps or luminous caution boards on either ends should be provided.
- 5.1.11 After the trench is ready, bed of trench is prepared by even & soft layer of 5.0 cm sleeved earth and properly leveled. Now the trench is ready for laying the HDPE pipe.

6. Laying/Construction practices

6.1 In cross - country routes

- 6.1.1 Optical Fiber cables shall be laid through HDPE pipes at a depth of 1.5M as measured from top of HDPE pipe. Taking into account the diameter of the HDPE pipe and provision of soft soil below HDPE pipe, it will be desirable to have the trench dug to depth better than, 1.60 meters. In case of obstructions etc, the cables can be laid at a lesser depth provided.

- 6.1.1.1 **A minimum depth of 0.90 is achieved in case of rocky soil.** In case of non-rocky soil where due to any obstructions in built up areas it is not possible to dig deeper, a minimum depth of 1.00 meter from top of pipe shall be maintained. Wherever the minimum depth of 0.9M in rocky soil cannot be adhered to, depth can further be reduced up to 0.5M but for such cases CGM project should grant relaxation on specific recommendation of GM (Proj) and GM (Maintenance) concerned who have jointly visited the sites. In all such cases where the depth is less than 0.9m, mechanical protection by reinforced concrete casing 4" round should

be provided.

6.1.1.2 Suitable mechanical protection by using DWC/ RCC/ GI pipes to be provided for all cables laid at a depth less than 1.2m. No protection, however, need be given if the cable depth is more than 1.2m.

6.1.1.3 The reasons for not laying the cable at stipulated depth of 1.5m are recorded "and certified by the D. E. I / C of cable laying.

Note. Where rocky soil is encountered for a distance of 50 meters or less, the cable depth will be maintained at 1.5m as in case of adjoining non-rocky soil.

6.2 In hilly areas (With reference to BSNL C.O. Decision vide letter No. 35-9/04-TPL (OF) (Pt.) Dated 16.10.06)

6.2.1 Optical Fiber cables shall be laid on the valley side where depth may be achievable, if the permission for laying the OF Cable on the valley side is available. If the permission for laying the OFC is not available, then OFC shall be laid on the hill side. The PLB pipe laid, in hilly areas at depths lower than one meter can be protected by direct concreting instead of using GI pipe and concreting thereafter. Laying of overhead OFC may be the third option. Laying of cable on valley side or overhead should be approved by GM concerned if the deviated trench is not more than 1km and in case stretches longer than 1km, CGM should approve it.

6.2.2 Normal standard of 25X25 cm of concreting cannot be followed in the hilly terrain as the groove/trench made in the rocks are generally are not of standard size of 25X25 cm. Hence the PLB pipe may be laid in the trench/groove of the requisite pipe width and at least 20 cm of concreting may be done above the pipe covering the entire width of the trench at 20 cm above the pipe.

6.3 In built up areas

6.3.1 City / Town, urban areas falling within municipal / Corporation limits shall normally fall under this category where the following laying/Construction practices shall be adopted. For other inhabited villages/towns etc. not falling under any municipal/ corporation limits suitable cable depth/protection is to be decided jointly by Dy. GM (Project) and Director Dy. GM.

6.3.2 **On Ducted Routes.** Optical fiber cables may .be laid through the existing ducts wherever the ducts are available. As far as possible the cable may be diverted to the new ducts laid subsequently. When the cables are laid in ducts, no particular depth is prescribed. End of the ducts should be properly sealed and necessary protection by way of DWC/ G. I. pipe / RCC pipe should be provided at the entry and exit of the duct till the cable is buried to a depth of 1.5m. The above is applicable in town or 'any other' ducts laid cross country.

6.3.3 On Non-ducted Routes. As the non-ducted routes in built up areas are more vulnerable to faults due to cables/pipes of other services laid close to DOT Cables, it is essential to take special care while laying optical fiber cables on these route. The OF cable shall be laid through HDPE pipes at a depth of 1.5m, and additional protection by using DWC/RCC/GI pipes shall be provided. If need be the OF cable can be laid below the cables and pipes of other agencies including local telephone cables and if required cable may be laid via alternate longer route. Only in exceptional cases the depth of cable laying may be relaxed to 1.00m in non rocky soil and 0.9m in rocky soil as in case of cross country routes, provided the reasons for not laying the cables at a stipulated depth of 1.5m are recorded and certified by D.G.M, I/c of cable laying, The minimum depth of 0.9m in rocky soil may further relaxed to 0.5m for location where permission for blasting is not granted by local authorities even after taking up for the same at G.M. (Project) level. In all such cases mechanical protection by reinforced concrete casing 4" round shall be provided.

6.4 On Culverts / bridges Nullahs

6.4.1 Nullahs dry for nine months in a year. The Cable shall be laid at 1.5m depth below the bed of nullah through HDPE pipe and protection provided by using DWC of suitable dia / RCC pipe of minimum internal dia of 100mm. The DWC / RCC pipe shall extend 2M minimum beyond the end Nullah on either side. Depth of 1.5m can further be reduced depending on nature of soil & other conditions in accordance with Para 6.1 & 6.2 with a view to minimize the damage to the OFC during flood season the cable should be laid on upstream side of causeway at an approximate distance of about 4 times than depth of the flow during high floods.

6.4.2 On culverts / bridges over other nallahs. Various options are available as depicted in figures 3a, 3b, 3c, 3d & 3e for laying the O. F. Cable along the parapet wall of the culverts / bridges. One of these option, may be adopted depending upon site conditions. On approach roads to these bridges / culverts also, protection by using DWC / RCC pipes shall be provided for 2M on both sides.

6.4.3 On rail bridges / crossings. On rail bridges/crossings the optical fiber cables shall be laid through HDPE pipe which shall be encased in suitable cast iron / RCC pipe as prescribed by Railway authorities.

6.4.4 On road crossings. The optical fiber cable shall be laid at a depth of 1.5m through HDPE pipe encased in DWE/RCC pipes which shall extend three meters on either side of the end road to take care of any future expansion. Depth of 1.5M can further be reduced depending on nature of soil & other conditions in accordance with Para 6.1 & 6.2.

7. **Pipe Laying.** For pulling the cable manually through the pipes, it is necessary to have suitable manhole of about 02 x 02m² made at every 200M length and at suitable bends and corners. The construction of manhole & jointing manhole is shown in fig. 4a and 4b. The pipes are laid for 200M or less, at a time, depending upon the distance between two manholes. For a 200M trench Single HDPE 40/33 mm is required. The HDPE pipe shall be sign written with indelible red paint as 'ITD' with a mark of telephone. In addition, for closing the ends of the two extreme end pipes 2 special types of caps are also needed (fig.4c). A 4m m polypropylene rope could be drawn through the pipes and safely tied to the caps at either end with hooks. These 4mm ropes are, to be provided throughout the route which could, serve to pull the 12mm rope which is ultimately required to pull the cable. Single HDPE duct of 40/33 mm of 200 M length with 2 caps and 210M of 4mm polypropylene rope drawn through them and safely tied as shown in fig. (5) Would complete 200M of pipe laying. After the pipes are laid as mentioned above with ropes and leaving gaps for manholes, indicators are to provided at the 200M gap locations to identify the manholes. Necessary offset diagrams are also required indicating the distance from the centre of the road. The depth of the trench is also to be recorded.

7.1 **Laying of pipes on bridges, culverts, etc.**

- 7.1.1 In small bridges and culverts across canals, different methods as given below could be followed.
- 7.1.2 If the bridge or culvert is broad and is having sufficient cushioning, the pipes can be buried inside, the cushioning as shown in fig. (6).
- 7.1.3 If the bridge/culvert is provided with raised and hollow foot - path or wheel guard, the pipe encased in GI can be buried inside the hollow foot - path or can be laid over the wheel guard and chambered as shown in fig. (7) and (8).
- 7.1.4 If the 'supporting pillars are having projections and between pillars the distance is less, then the pipes (HDPE with GI encasing could be laid over the pillar projections as shown in fig. (9)
- 7.1.5 If none of the solutions is possible, then outside the parapet wall, GI troughs can be fitted with suitable clamps. For smaller bridges, the HDPE pipes can be laid inside the trough. However, for long bridges, HDPE pipes need not be laid inside the trough. While laying the cable, glasswool or other cushioning items may be used. In either case, the gaps between two troughs after putting the lids should be thoroughly covered to prevent entry of rodents.
- 7.1.6 Special type of bridges such as cantilever type requires special type of troughs to be locally manufactured to withstand the vertical and horizontal movement of the joints of cantilever bridge.

- 7.2 **Route Indicators.** The G.I. indicators embedded in concrete of Trapezium shape with base of 30 x 30 cm and top of 15 x 15 cm may be provided at every 200 M or at suitable bends and corners as may be required. A minimum of 30 cm of its top portion should be kept above the ground level. The route indicators may be painted yellow

and may be put along the road at a suitable distance away from the cable trench such that they are clearly visible from road side. In future electronic markers shall be used for route indicators.

- 7.3 **Joint Indicators.** The G. I. joint indicators embedded in concrete similar to that of RI may be provided at joint locations & may be buried in ground with at least 30 cm of it above the ground level. The joint indicator may be kept along the road side clearly visible from road and may be painted red. In future electronic markers shall be used for joint indicators.

8. Depth A/T

- 8.1 Before the cable is actually pulled through the pipe, the project circle should offer the route for A/T of the depth and position of the cable and correctness of the route diagram. The best way should be to offer it in stretches of 10-20 kms soon after the HDPE pipe is buried.
- 8.2 The route diagram should be prepared and made over to the A/T unit in advance. The A/T unit will specify the spots roughly two per km for checking of depth and position of the cable, sound laying practice and prescribed protection. Wherever depths are prescribed the tolerance upto minus 8 cm is permissible. For checking accuracy of the route diagram and position of the cable, the permissible tolerance will be ± 0.5 meter. For checking position of the cable, standard survey tapes will be used.
- 8.3 If the pipe is found to be at depth than prescribed, OFC should not be drawn through HDPE pipe and pipe should be lowered to the proper depth at the locations where necessary relaxation of competent authority as mentioned in earlier Paras is not available.

9. General Precautions

9.1 Handling of cable drums

- 9.1.1 The optical fiber cable drums should be handled with utmost care. The drums should not be subjected to shocks by dropping etc. The drum should not be rolled along the road for long distances and when rolled, should be in the direction indicated by the arrow. The covering planks should be removed only at the time of actual laying.
- 9.1.2 The previously laid pipes manholes and portion of bends etc. on the cable route as records maintained at the time of laying pipes, should be got cleaned of earth and the pipes may be cleaned thoroughly before blowing of cable is started.
- 9.1.3 Depending upon the length of the drum ($2/4 \pm 5\%$ Kms) and coiling required for jointing purposes, chain measurement is taken from the starting end of section and exact joint location is marked. If it does not fall at the existing man hole location, a separate manholes of 2M x 2M is to be made to accommodate the joint box as well as coil.. All the joint locations are fixed in a similar manner. The intermediate manholes of 2M x 2M are also to be kept ready for blowing purposes.
- 9.1.4 As the drums are standardized for $2/4 \pm 5\%$ Kms for highways, it is preferable to lay the cable by placing the cable drum at the manhole point nearest to 1 km from the joint

locations.

- 9.1.5 The standard practice to keep the clock wise end of the cable to the 'A' side of the route and the anti clock wise end to 'B' side. Also, it is the practice to have the clockwise end on top and anti clock wise at the bottom of ' the drum . With the above in view, cable drum is to be mounted on the jack and wheel with drum shaft (Axle) in horizontal position.
- 9.1.6 The rope end is to be fixed at one end of a swivel (Anti twist device) permanently or by means of a shackle. The other end of the swivel is tied to the pulling eye of the cable. If a pulling eye is not available, then a cable grip is to be used.
- 9.1.7 As the cable length is 4 km, during cable laying work, proper communication is to be established. This can be done with walkie talkies or magneto telephones with drop wire.

10. **Precaution against Damage by Termites & Rodents.** In the rodent prone areas Optical fiber cable joint closures should be applied with BHC 10% dust (Benzene Hydro chloride 10%) to prevent rodent & termite dam age. The method suggested is "BHC 10% dust of 1Kg. is to be mixed in an approximate 2 Kg of sand and applied around the optical fiber cable joint enclosures".

11. **Norms for Ribbon Optical Fiber Cable - being used in Overlay Access Network (With reference to BSNL C.O. Decision vide letter no. 35-15/2004-TPL (OF) Dated: 06.10.06)**

11.1 **Limit of average splice loss for sections up to 15 Kms may be increased from 0.2 db to 0.3 db. The maximum number of splices that can have loss more than 0.3 db in a section, should not be more than 10% (from existing 5%) of total splices subject to the condition that per KM loss should not exceed the prescribed limit. However, no change in present A/T limit is recommended for distance exceeding 15 Kms.**

11.2 **Section length may be increased from 10 Kms to 15 Kms to overcome the difficulties being faced by the field units in commissioning of OAN. Since the time taken to splice ribbon OF cable is much longer, the same should not be used as a part of long distance network. Long distance cable presently carries up to 80 GB on DWDM and hence long outages cannot be tolerated.**

12. **Cable Laying**

12.1 List of tools & other items required for cable laying is given below.

12.2 This can be taken as a check list.

- 12.2.1 Jack - one pair
- 12.2.2 Rope for unloading/loading. Metallic ramp for loading / unloading.
- 12.2.3 Cable winch.
- 12.2.4 Nylon rope drums of 1250M (For machine pulling).
- 12.2.5 4mm rope.
- 12.2.6 Swivel and Shackle.
- 12.2.7 Pulling socks or cable grip.

- 12.2.8 Lubricant. .
- 12.2.9 Plastic bowls for lubricant.
- 12.2.10 Sponge.
- 12.2.11 Walkie-Talkie 6 Nos.
- 12.2.12 Magneto Telephone 6
- 12.2.13 Drop wire 2 kms. (for magneto).
- 12.2.14 Rubber 2/manhole.
- 12.2.15 Half round (split) pipes 2/manhole.
- 12.2.16 Polythene tape 5m/manhole.
- 12.2.17 Clamps 4/prs/manhole.
- 12.2.18 Cleaning brush for cleaning pipes.
- 12.2.19 Mandrill.
- 12.3 Sometimes there is considerable lapse of time between the pipe laying and cable laying. This intervening period could have heavy rains too. Therefore there is possibility of entering dissolved muddy water into the HDPE pipes. This dissolved muddy water may transform into a thick paste or solid mud. Cleaning of the pipes before the cable laying is absolutely necessary to remove any such obstructions. A 4 mm nylon rope is already laid in HDPE pipe. One end of this rope is connected to Mandrill. The other end of mandrill is connected to another rope of 4 mm size and suitable length to cover the distance between two manholes. The existing 4 mm rope is pulled from other manhole and thus the mandrill will clear the pipes. Similar operation is then done by replacing mandrill with nylon brush and rugs.
- 12.4 The pulling of the cable can be done in three ways:
 - 12.4.1 By Cable winch
 - 12.4.2 By cable winch assisted by manual pulling at inter. mediate manholes.
 - 12.4.3 By manual pulling at all the manholes.
- 12.5 For manual pulling, the rope may be attached to 9 diameter and then to the pulling eye which is fixed to the cable end by supplier. The pulling may be done either manually under close supervision watching all the time. The pulling tension or by means of .winch with automatic cut off at set tension monitored through dynamometer fitted in the pulling winch.
- 12.6 To 'reduce the friction between the cable and HDPE, a suitable lubricant may be continuously applied with a sponge to the cable surface during pulling at every intermediate manhole. The types of Lubricants with their frictional co-efficient are given in the table.
- 12.7 As soon as 1km cable or so is pulled towards one side of the route, sufficient overlap of cable may be kept at splicing location so that the ends may be taken into the Air conditioned splicing van placed at a convenient and nearby place. 15 meter cable may be the maximum requirement.
- 12.8 **Laying the Remaining Half of the Cable**
 - 12.8.1 Take out the winch to the other end if, machine pulling is done.

- 12.8.2 Uncoil the cable and make the formation of 8. This should be done manually with sufficient care and minimum bending radius.
- 12.8.3 Repeat the process of connecting the end of the cable with eye or pulling grip to the swivel to which the pulling rope is attached.
- 12.8.4 Repeat the process of pulling the cable by winch or manual with special attention to lubricant super vision and coiling the overlapping length in the pit. .
- 12.8.5 The mouth of the HDPE pipes at every man hole is closed by rubber bushing as shown in fig. (10). this is mainly required for prevention of rodent entry.
- 12.8.6 The cable at the intermediate man holes are to be covered by split 65mm OD 10kg/cm HDPE, 2 pipes, covered with polythene tapes and clamped at 4 places, as shown in fig. 4a. Thereafter re-instatement of the man holes is to be done.

Note. All Figures appearing in the document correspond to 40/33 mm size Permanently Lubricated HDPE Duct (in place of 50 mm OD HDPE Pipe) mentioned in the drawing/figures.

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BIBLIOGRAPHY: 1- Transmission Maintenance Handbook
2- DOT Rulings.

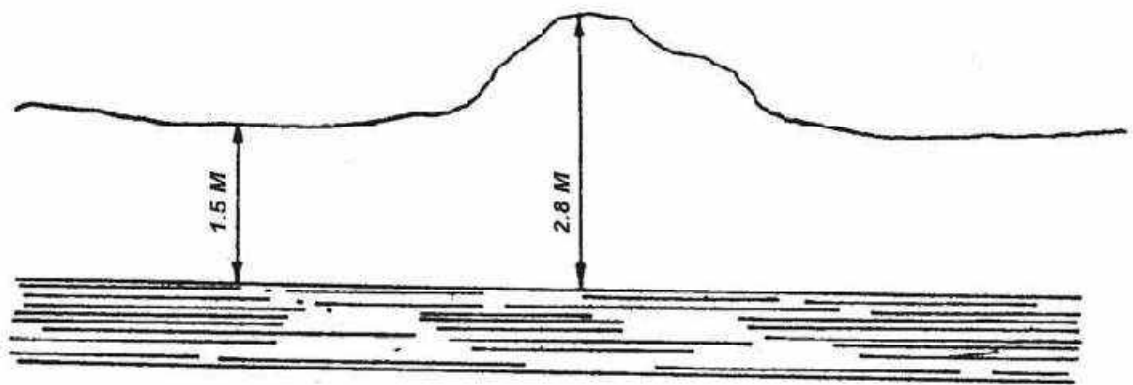


FIG - 1

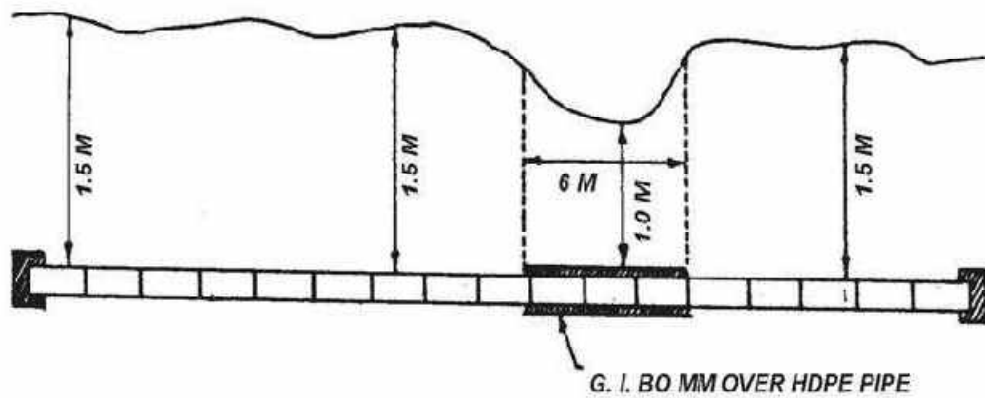
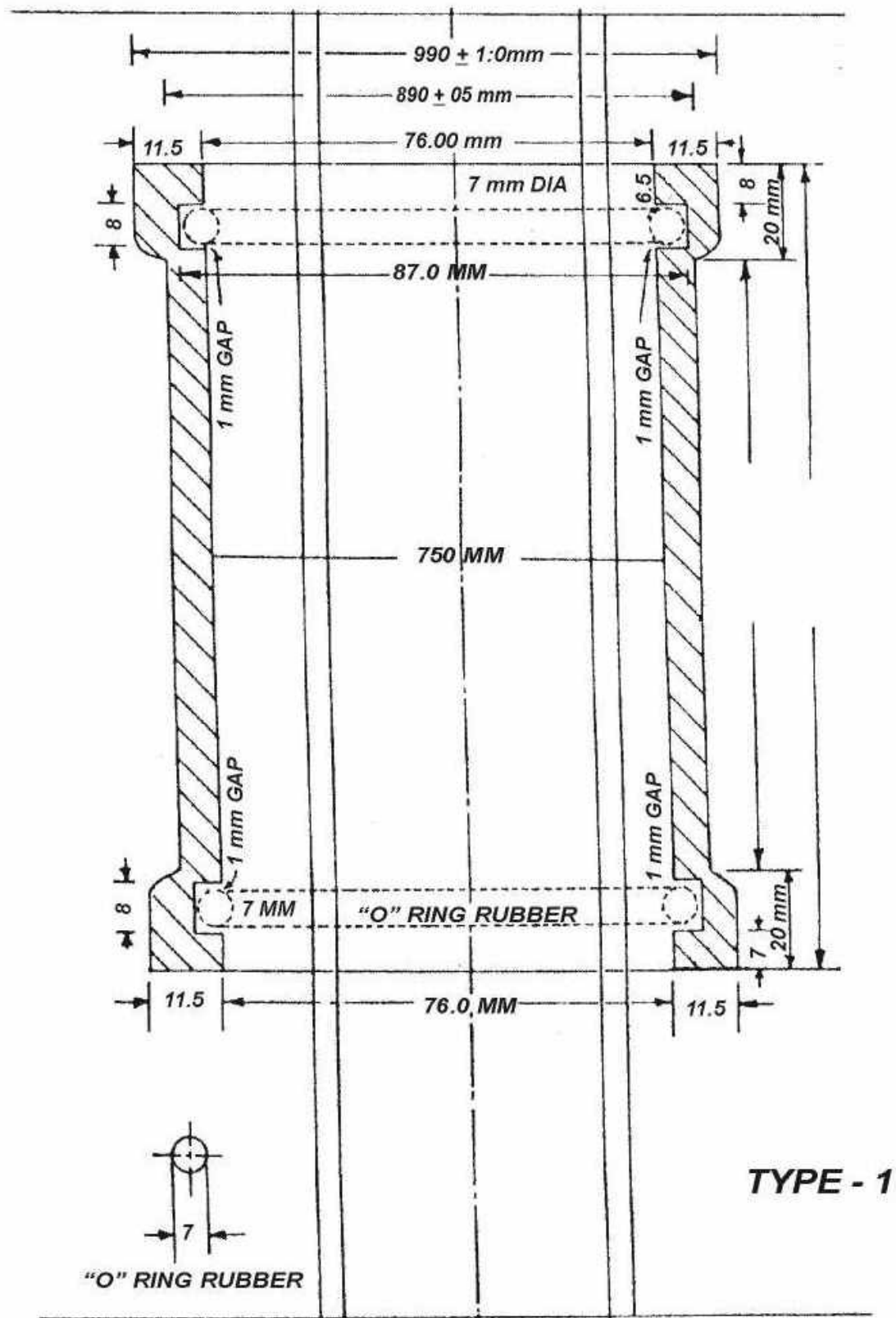
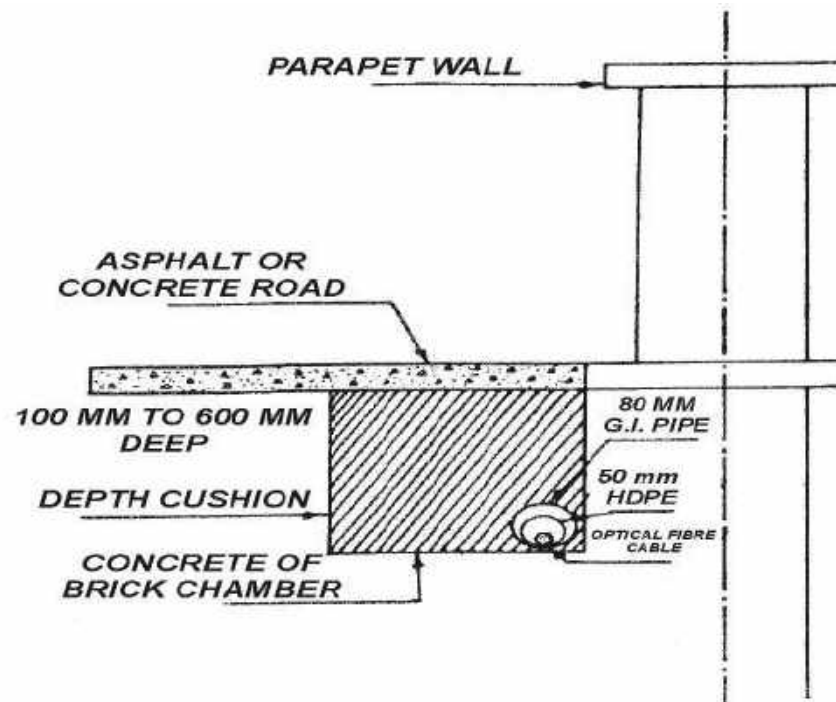
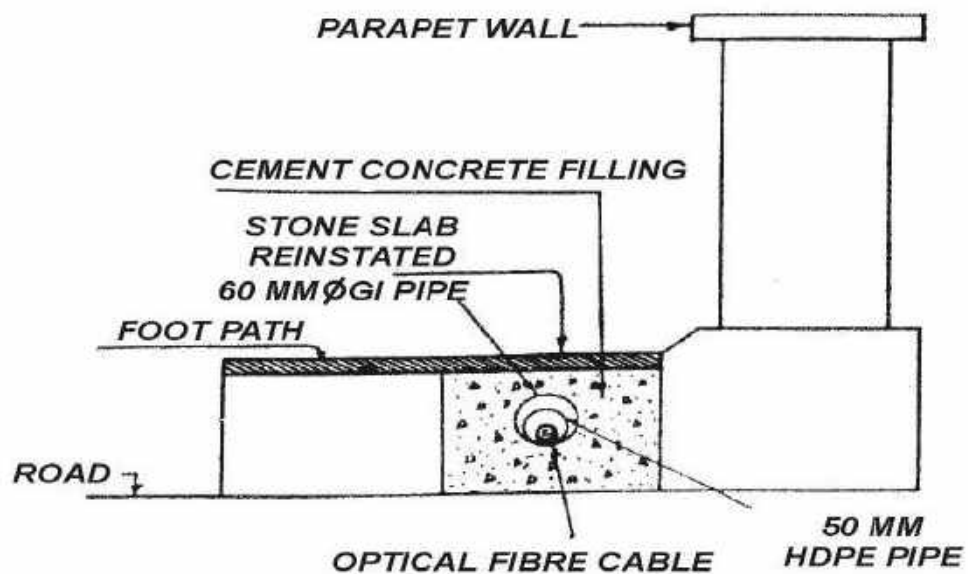


FIG - 2

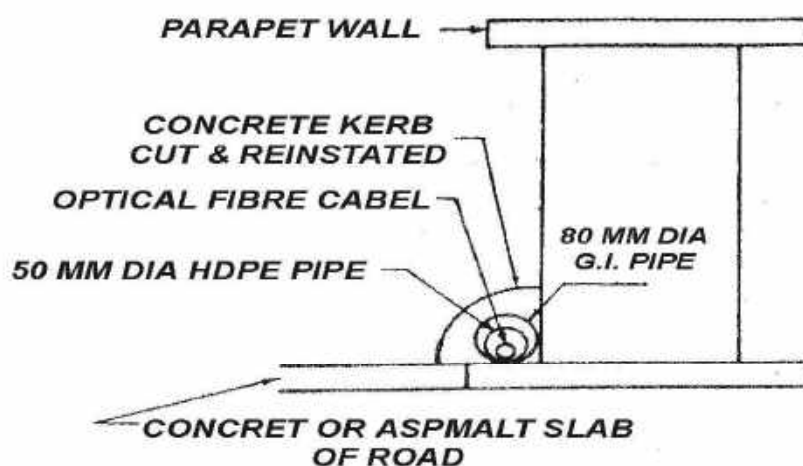




LAYING OPTICAL FIBRE CABLE IN 80 MM DIA G.I. PIPE IN EARTH CUSHION OF THE BRIDGE
FIG - 3 (a)

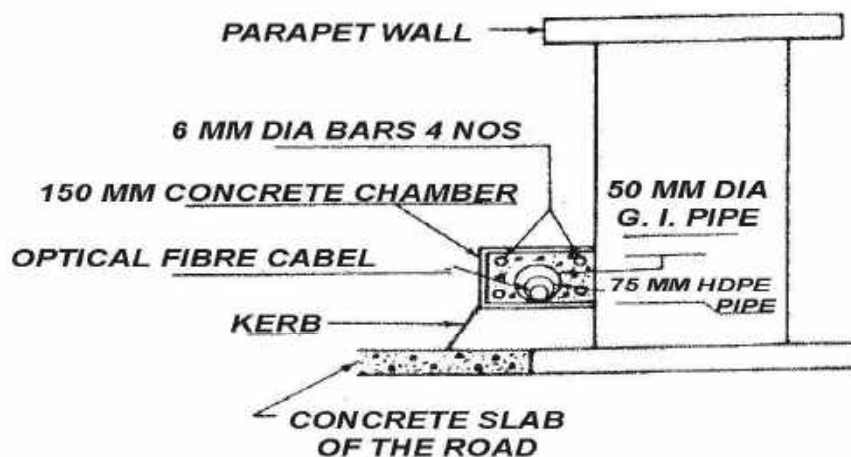


LAYING OPTICAL FIBRE CABLE IN G.I. PIPE 80 MM BELOW FOOT PATH OF THE BRIDGE
FIG - 3 (b)



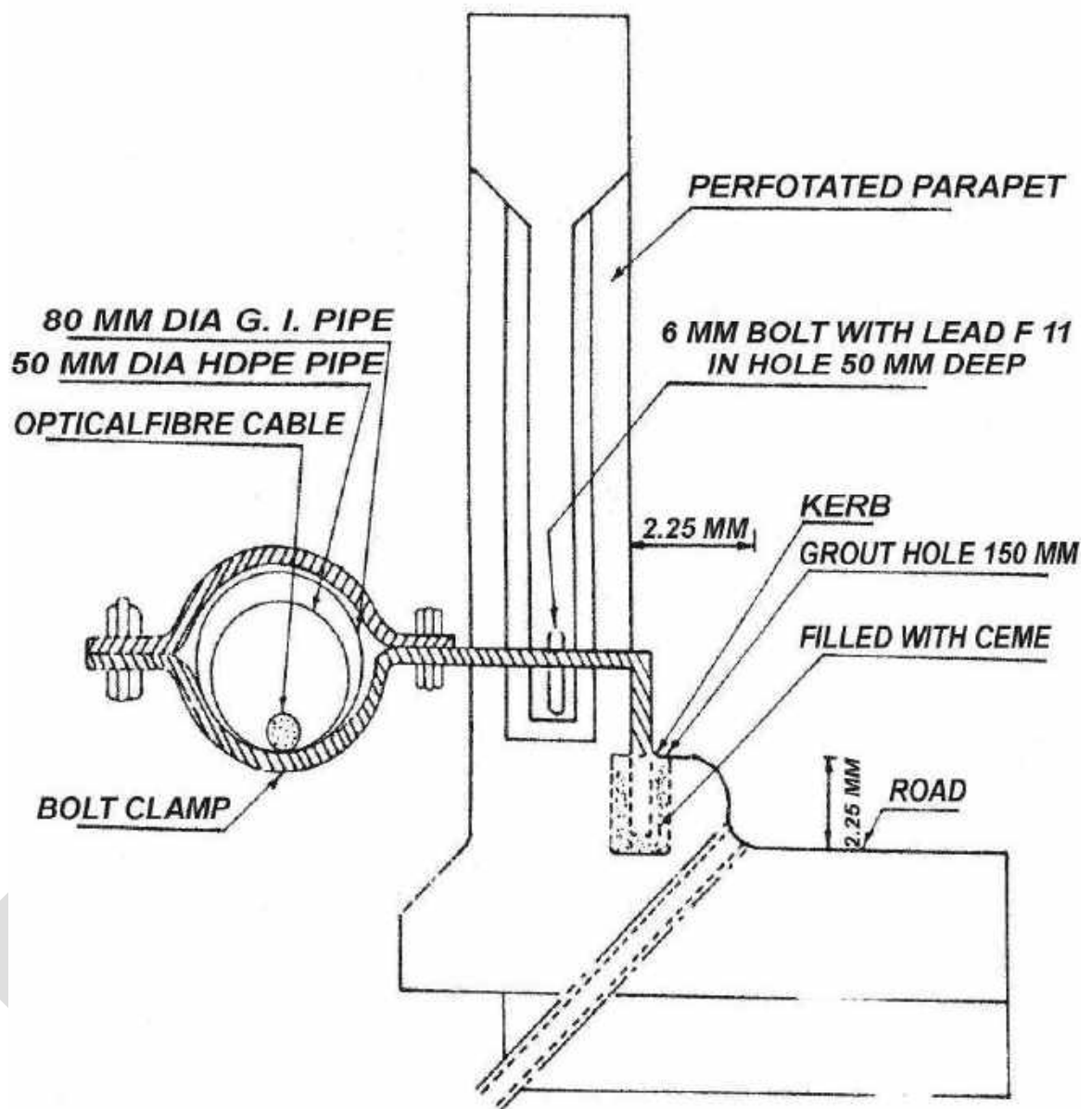
**LAYING OPTICAL FIBRE CABEL
IN G. I. PIPE BY CUTTING THE EXISTING KERB
OF THE BRIDGE**

FIG - 3 (c)



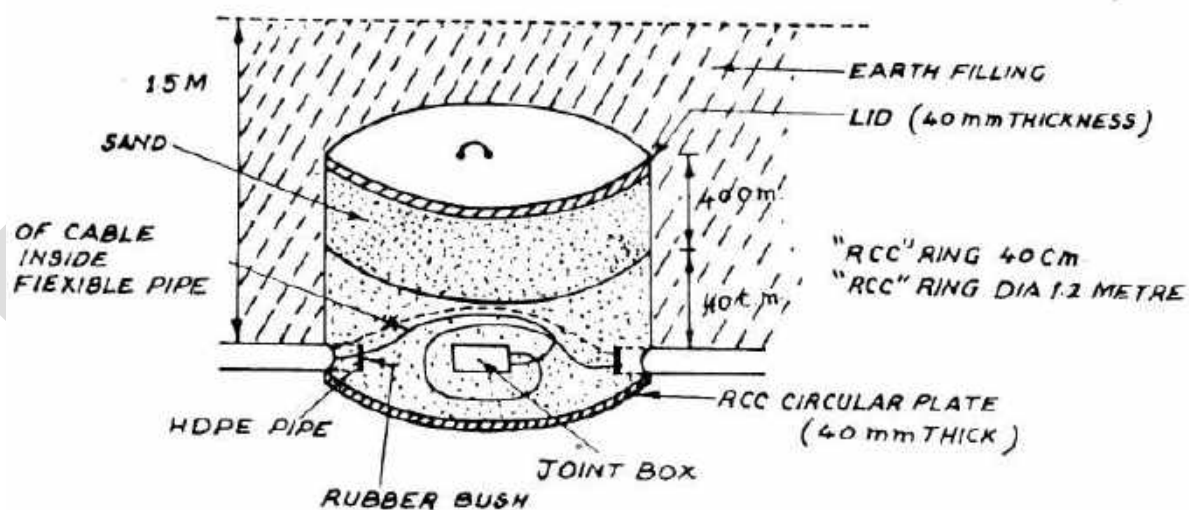
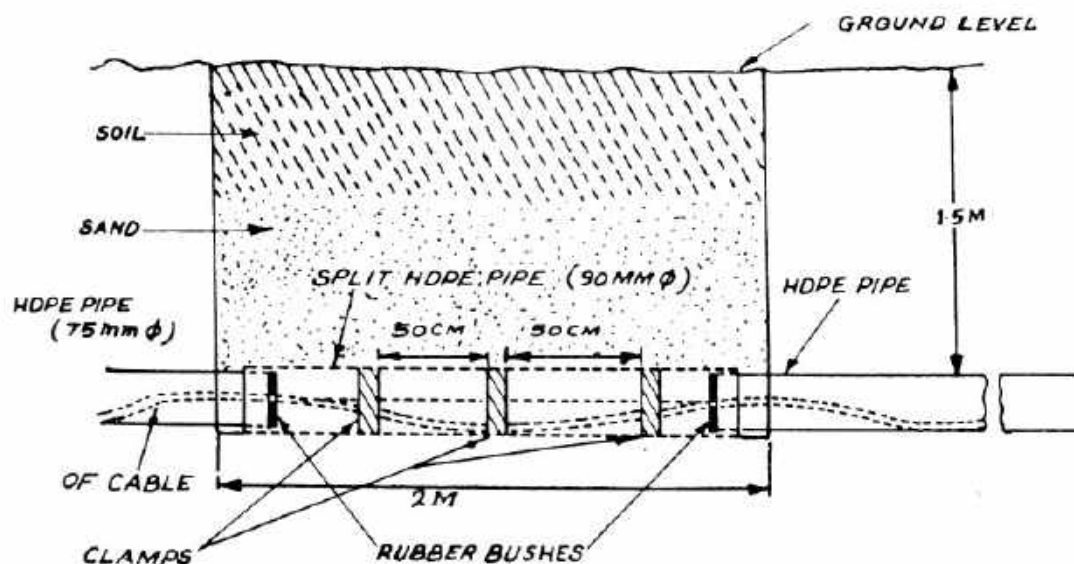
**LAYING OPTICAL FIBRE CABEL
(IN G. I. PIPE PLACED ON THE KERB OF THE BRIDGE)**

FIG - 3 (d)



LAYING OPTICAL FIBRE CABLE
DIA G. I. PIPE SUSPENDED BY MEANS OF CLAMPS
OUT SIDE THE PARAPET WALL

FIG - 3 (e)



NOTE:- AT SOME PLACES ONLY ONE RCC RING OF HEIGHT 1' IS USED INSTEAD OF TWO RINGS AS SHOWN IN ABOVE FIGURE.

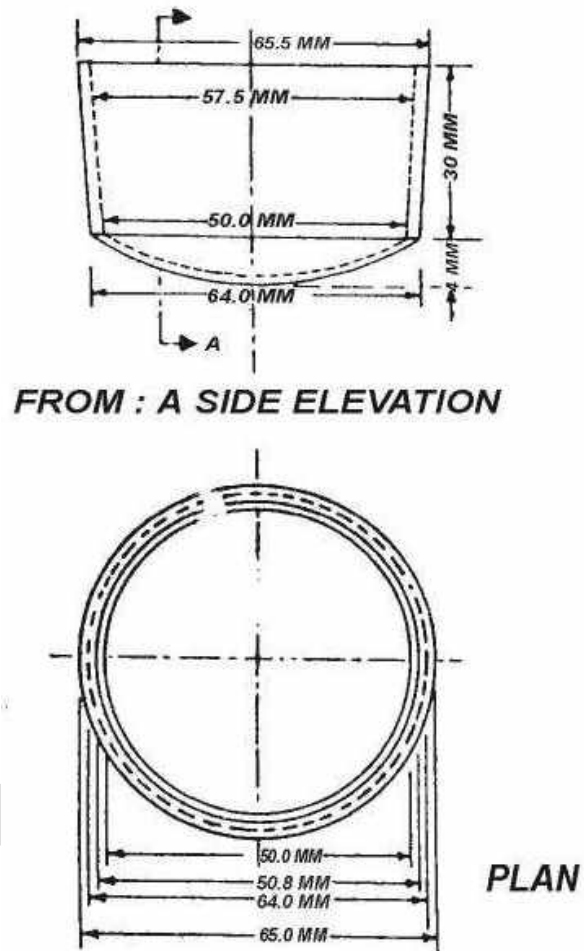


FIG - 4 C

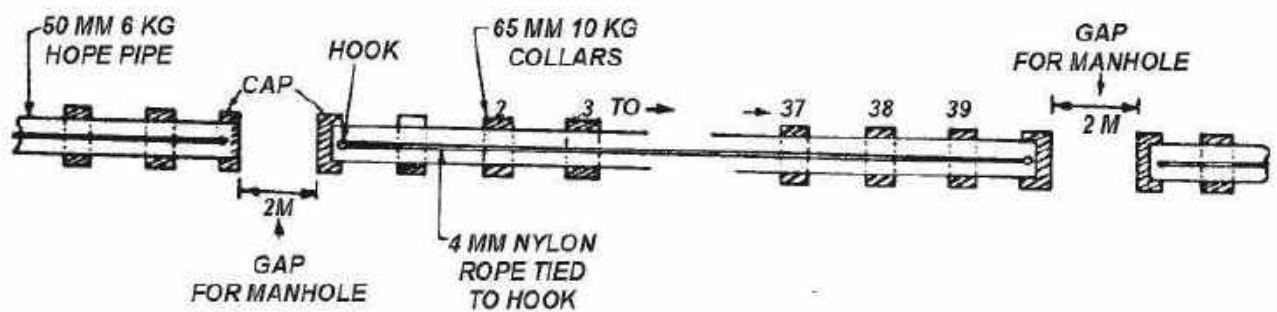


FIG - 5

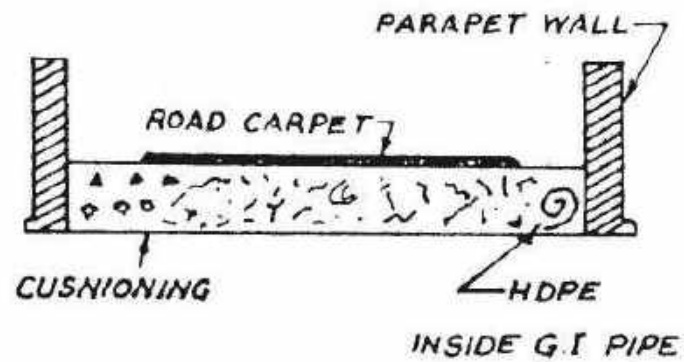


FIG - 6

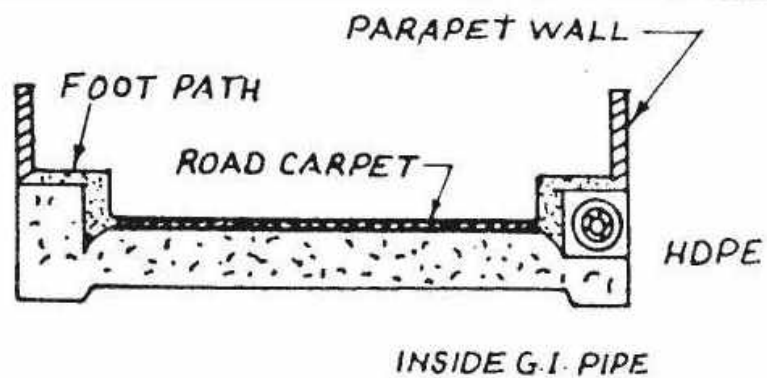


FIG - 7

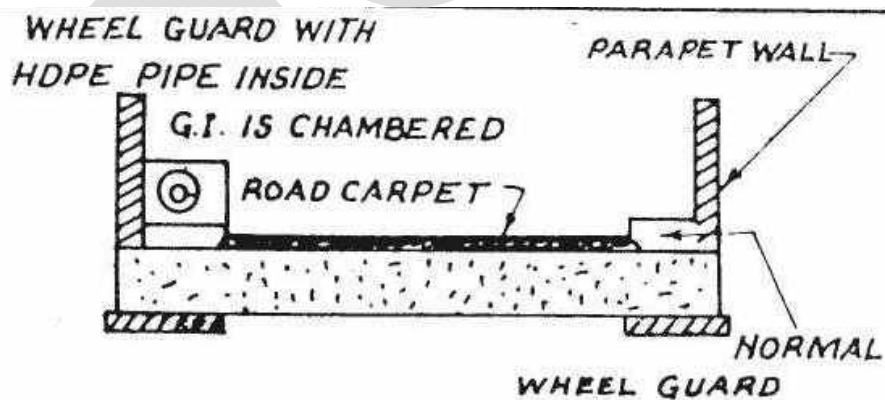
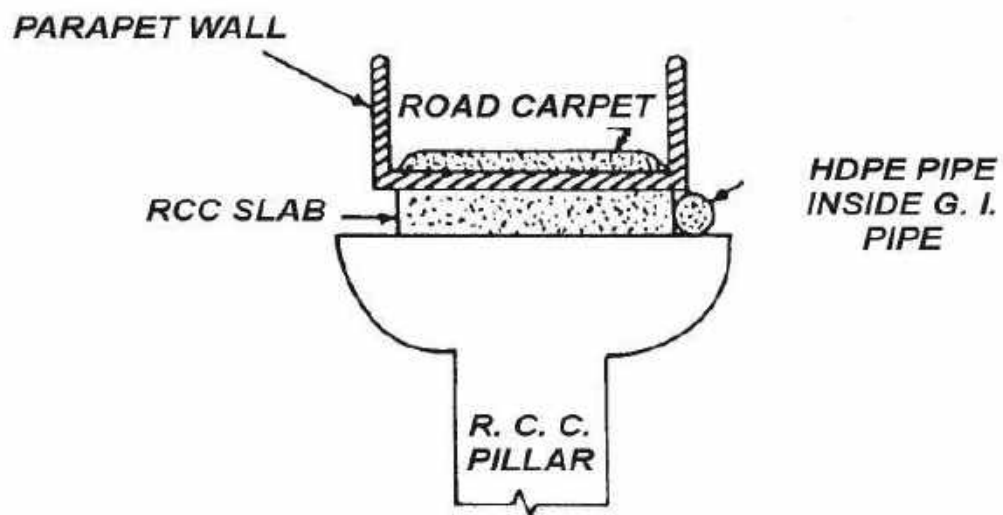
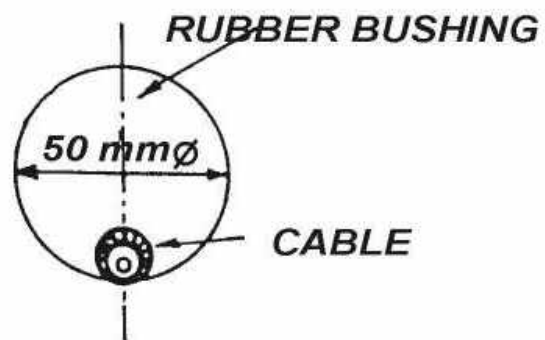


FIG - 8

**FIG. 9****FIG. 10**

यांत्रिक अनुदेश

ENGINEERING INSTRUCTION

सेल्फ सपोर्टिंग मेटल फ्री एरिअल ओ.एफ.सी. केबिल की संस्थापन प्रक्रिया INSTALLATION PRACTICE OF SELF SUPPORTING METAL FREE AERIAL OPTICAL FIBRE CABLE

क्रमांक : टी.आर./ सी.ओ.एफ.सी./आई-001
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केवल भारत संचार निगम कर्मचारियों के उपयोग हेतु
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INSTALLATION PRACTICE OF SELF SUPPORTING METAL FREE AERIAL OPTICAL FIBRE CABLE

1. **Scope.** This engineering Instruction (EI) deals with the guidelines and the installation practice for installing self supporting metal free aerial optical fibre cable.
2. **General.** Department Of Telecommunication has already introduced self supporting metal free aerial optical fibre cable for local junctions and short haul trunk working. This is particularly useful in situations where underground cable laying is not possible. It is also recommended for short term working.
3. **Route Survey.** The route should be inspected before the actual installation of optical fibre cables. Survey of the aerial route should be carried out pole by pole.
4. **Over Head Alignment.** The existing route alignment wherever available should be used. On new routes, alignment should be erected. The span length must not exceed above 90 metres.
5. **Line Diagram.** A line diagram should be prepared to mark the poles & the actual distance between the poles in a splice section (Normally 15 poles per km are recommended). Additional poles should be erected if required to keep the span length within the specified limits. Care should be taken that the alignment is easily accessible from the road. It is necessary to keep a clear head way (Ground clearance) of 12 to 15 feet in a section. A complete line diagram should be prepared i.e. from station A to station B. The number of road crossings, canals or nallahs, electric lines should be clearly marked in the route diagram.
6. **Hilly Regions.** Line erection rules must be strictly followed. Additional poles may be erected for better support to optical fibre cable & to avoid sharp curves & bends. Span lengths should be reduced to avoid sags in case of steep slopes.
7. **Tension Poles.** Tension poles are dead end or termination poles. The tension poles shall have dead end fittings. The dead end fittings offer a continuous run of the aerial optical fibre cable. These fittings relieve the optical fibre cable of its compressive, bending & clamping stresses. The performed dead end fittings are suitably gritted for excellent tensile holding strength.
 - 7.1 **Selection of Tension Poles.** Selection of tension poles depends upon the actual site location of the route. Every fifth pole should be a tension pole in straight alignment. Splicing location poles should be tension poles or wherever alignment takes a sharp turn (more than 15 degrees) should also be a tension pole.
8. **Suspension Poles.** The suspension pole assembly is designed to offer cushion to aerial optical fibre cable against the dynamic stress of Aeolian vibration at the suspension point. They also reduce static stresses at the Support point.
 - 8.1 **Selection Poles.** Selection of suspension poles also depends upon actual site location of route. All the intermediate poles between two tension poles will be suspension poles.
9. **Selection of Splice Location.** The splice box of the aerial optical cable should be buried underground. Therefore it is necessary to fix & determine the splicing location as per the designated cable drum length.

10. Aerial Optical Fibre Cable Specifications

Ser No	Description	Specifications
1.	Maximum span length	100metres
2.	Maximum ice loading	1 Kg per meter
3.	Operational wind velocity	75Kms per hour
4.	Maximum sag allowed(without excess load)	2% of span length
5.	Maximum sag allowed(with excess load)	3% of span length
6.	Temperature range	
7.	operation & storage	-30 to +70 degree C
8.	installation	-15 to +50 degree C
9.	Minimum bend radius	2D (D-Dia of cable)
10.	Tensile force (where w is the mass of 1 km length of cable, in kg)	
11.	During installation	9.81 x 1.3 x w
12.	Permanent with ice & wind load	9.81 x 3 x w

11. Types of Accessories and Fixtures

11.1 **Formed OFC Dead End and Termination Fittings.** These fittings are used at tension/termination poles (dead end poles), or poles where splices are located and the poles where the overhead alignment takes a turn, (angle exceeding more than 15 degrees) as shown in fig. 1.

11.1.1 **J-Shaped Tension Hook.** J-Shaped tension hook is for the installation on cross arm channel C (C-Bracket) of the poles as shown in fig. 2.

11.1.2 **Turn Buckle.** Galvanized forged steel turn - buckle is used at the dead end and at tension positions (for adjusting the sag & tension) as shown in fig. 3.

11.1.3 **Extension Link.** Galvanized steel extension link is used along with turn buckle as shown in fig. 4.

11.1.4 **Clevis Thimble.** Aluminium alloy die cast thimble is used to attach the extension link and for accommodating the loop of the helically formed terminating helix at the other and its smooth internal contour as shown in fig.5.

11.1.5 **Protective Helix (T).** Set of aluminium alloy helically formed protective helix having predetermined spiral shape is used & making them conveniently applied on the optical fibre cable without excessive clamping pressure at any point. See fig. 6.

11.1.6 **Terminating Helix.** Helically formed terminating helix of Aluminized steel having a prefabricated loop shall be to fit into

the grooved contour of the thimble and for fixing over protective helix over the optical fibre cable. See fig. 7.

- 11.1.7 **Jumper Cable Clamp.** Galvanized steel jumper cable clamp is used to support the through length of optical fibre cable at the intermediate tension poles as shown in fig. 8.
- 11.1.8 **Pole Mounted Stay Clamp (Tubular) OR Pole Mounted Stay Clamp (Rail).** Galvanized mild steel pole mounted stay clamp should be used at the pole for the fixing with a twisted eye & turn buckle; see figs. 9 & 10. The selection of the type of stay clamp will depend upon the type of poles.
- 11.2 **OFC Suspension Fittings.** Helically formed suspension fittings along with the elastomeric pads inserts strapped by a galvanized steel eye-band is used to hang from the twisted eye-link connected to a pole mounted stay clamp or on the tension hook (J-shaped) installed on the C bracket at the intermediate poles as shown in fig. 11.
 - 11.2.1 **Pole Mounted Stay Clamp (Tubular) OR Pole Mounted Stay Calmp (Rail).** Galvanized mild steel pole mounted stay clamp shall be for use at the pole for the fixing with a twisted eye & turn buckle. See figs. 9 & 10.
 - 11.2.2 **Tiwsted Eye Link.** The twisted eye link is used for installing suspension fitting on stay clamp or on tension hook as shown in fig. 12.
 - 11.2.3 **Protective Helix(S).** Set of aluminium alloy helically formed protective helix having predetermined spiral shape is used & making them conveniently applied on the optical fibre cable without excessive clamping pressure at any point. See fig. 13.
 - 11.2.4 **Armour Grip Helix.** Set of aluminium alloy armour grip helix is used or fixing on the profile shaped elastomer pad for proper strut action, grip & bird caging as shown in fig, 14.
 - 11.2.5 **Suspension Clipper With Elastomer Pad.** Set of suspension clipper (made of aluminium alloy permanent mould die cast split type clamp) is used to support the elastomer pad inserts & is strapped by a galvanised steel eye-band in order to hang from a twisted eye-link connected to a pole mounted stay clamp or tension hook as shown in fig. 14.
 - 11.2.6 **Spiral Vibration Damper (SVD).** Helically formed spiral vibration dampers are used on both sides of suspension fittings as shown in fig. 15.
- 12. **Demountable Pulley.** Demountable pulleys are used during the installation of aerial optical fibre cables see fig.16. These are made from mild steel & the contour of the wheel is coated with rubber or any other suitable material for free movement of cable.

13. Material Requirement of Installation Accessories and Fixtures

13.1 For Double Tension Poles

Ser No	Description	Quantity
1.	J-shaped tension hook (For C-bracket)	2
2.	Turn buckle	2
3.	Extension link	2
4.	Clevis thimble	2
5.	Protective helix (T)	2 sets
6.	Terminating helix	2 sets
7.	Jumper cable clamp	
8.	a) Pole mounted stay clamp(Tubular)	1 (Pole having C-bracket)
	b) Pole mounted stay clamp (Tubular)	2(Pole without C-bracket)
	OR	
	a) Pole mounted stay clamp (Rail)	1(Pole having C- bracket)
	b) Pole mounted stay clamp (Rail)	2 (pole having C-bracket)

13.2 For Suspension (Intermediate Poles)

Ser No	Description	Quantity
1.	a) Pole mounted stay clamp(Tubular)	
	b) Pole mounted stay clamp (Tubular)	
	OR	
	a) Pole mounted stay clamp (Rail)	
	b) Pole mounted stay clamp (Rail)	
2.	Twisted eye link	
3.	Suspension clamp consisting of the following	
3.1	Protective Helix (S)	1 set
3.2	Armour grip helix	1 set
3.3	Suspension clipper with elastomer pad etc.	1 set
3.4	Spiral vibration damper	2
3.5	J-shaped tension hook	1 (Pole with C-

		bracket)
4.	Demountable pulley	One per pole in the splice section

14. **Entry of the O.F. Cable in the Building.** Normal methods for leading in and precautions recommended for leading-in of the optical fibre cable should be followed. A conduit pipe should be laid for leading-in the O.F. cable. Inside the building; the cable may also be taken directly from the nearby O/H pole to inside of the building for termination.
15. **Preparation**
- 15.1 Before the installation the O.F. cable should be tested.
 - 15.2 As per requirement install the additional new poles.
 - 15.3 Each pole should be checked for its strength. Provide extra stays if more strength is required.
 - 15.4 The Aerial O.F. Cable is recommended to be installed on the outermost hole of bracket towards road on the existing bracket/new bracket on the poles.
 - 15.5 Replace weak and other poles for clear ground clearance and strength as per the field conditions.
 - 15.6 Provide ground clearance of 12 feet in non-obstructing areas.
 - 15.7 Raise the height to minimum 16 feet at all the road crossings.
 - 15.8 Maintain the alignment as straight as possible.
 - 15.9 Construct splice chambers.
16. **Splice Locations** The field splices should be buried underground. The cable should be brought down through a 40mm dia GI pipe clamped on the pole. Proper bends (120-135 degree) are recommended for negotiating the bend. Wooden/hard rubber bushes shall be used at the entry and exit points of the GI pipe to avoid damage to the cable. A splice chamber as per the standard practice shall be made. The selection of the splice point shall depend upon the availability of space and the cable length.
17. **Calculation of Section Length.** Aerial O.F. cable is supplied as per TEC GR in a length of 2 Kms + 10%. To arrive at the section length and allocating a particular reel of the cable to a particular section following consideration are required.
- 17.1 **Section Length**
 - 17.1.1 Actual section length measured.
 - 17.1.2 Allowance for sag 2% for each span length.
 - 17.1.3 Cable at each through tension pole (4 meters).
 - 17.1.4 Drop length.
 - 17.1.5 Extra spare cable for coiling at the splice location (10 meters).

18. Installation Material Required During Installation

Ser No	Description	Requirement
1.	Demountable pulleys	1 each for each pole in the installation section
2.	Jack for cable drum	1 set
3.	Ladders	For each pole
4.	Tools	Screw drivers C&T pliers Spanner set & hammer etc.
5.	Manila rope 12 mm dia	250 meters
6.	Cable pulling winch machine with tension monitoring device	1
7.	Anti twist device	1
8.	Cable pole fork	10
9.	Flat twin open type cable grip	2
10.	Communication link to connect feeding, pulling and intermediate points.	
11.	40 mm 61 pipe, bends, bushes & clamps for fixing the pipe at the splice location.	
12.	First aid box.	

19. Installation of Aerial Optical Fibre Cable. The following steps are recommended: -

- 19.1 Install the accessories and fixtures as per the requirement of the individual poles it tension and suspension fittings.
- 19.2 Install the demountable pulley on all the poles in the section before pulling the cable.
- 19.3 Keep the cable drum over the jack near the 1st pole at the beginning of the section.
- 19.4 Attach anti twist device and the shackle hook along with the rope to the front and of the cable on pulling eye or on the cable grip. Carry the attached rope over the demountable pulleys for pulling the cable.
- 19.5 Depute one person at each pole to monitor and in case it is required to guide the cable over the demountable pulley during pulling operation.
- 19.6 The cable should be pulled till the cable reaches the last pole of the section.
- 19.7 Wherever in the pulling section; through pulling is difficult; half section or one fourth, action pulling method may be adopted by using figure of a techniques.
- 19.8 The feeding and pulling of the cable should be synchronized by using communication link. Care is required to be taken so that the cable is not accumulated at any one point during pulling operation and sharp bends are avoided.
- 19.9 Once the cable reaches the other end actual tensioning of the cable and fixing the installation of the accessories and fixtures shall be taken up

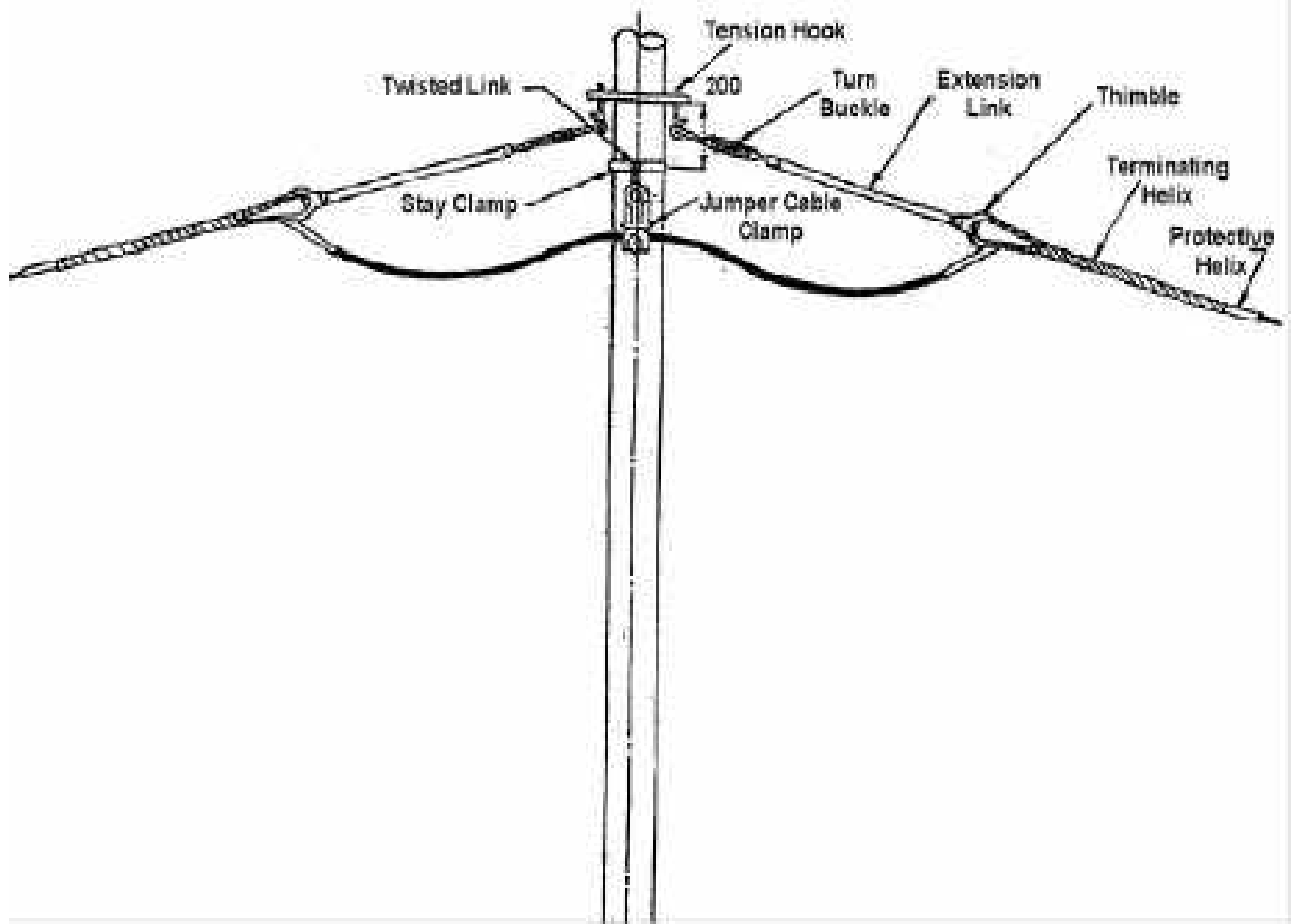
with the help of cable pulling winch. The pulling tension must be monitored during tensioning.

- 19.10 Install the tension fittings and accessories at the 1st pole.
- 19.11 Fix a flat twin open type cable grip on the cable after tension pole for tensioning the cable in the preceding tension section.
- 19.12 The cable shall be tensioned to a tension of 1-3 to 1-6 times of the cable weight. The sag shall be monitored and kept between 0.25 to 0.5% of the span length.
- 19.13 The cable should be lifted between two poles by using cable pole fork during tensioning and fixing of the cable.
- 19.14 During the fixing operation the cable shall remain under required tension for minimizing the sag in the splice section.
- 19.15 Now install tension fitting and accessories at the all tensioned pole at the end of the tension section.
- 19.16 Install the suspension fitting and accessories on the intermediate poles in the tensioned section.
- 19.17 Similarly installation should be carried out in each tension pole in the entire section and the tension and suspension fittings are installed.
- 19.18 At the Through tension poles the cable shall be kept loose and shall be supported by cable jumper clamp.
- 19.19 At the end pole where the cable reel is kept; the cable to be taken through GI pipe (fixed to the pole) to the splice location. Extra care for the aerial O.F. cable may be taken at the bends and at entry and at the exit of the pipe. About 10 meters of cable shall be kept at the splice location for coiling (spare cable) and jointing requirement.
- 19.20 Test the installed OF cable.
- 19.21 Coil the OF cable and keep it safe in the splice location for splicing.

20. **Precautions**

- 20.1 Provide display boards.
- 20.2 Provide sufficient number of road sign and traffic cones.
- 20.3 Avoid sharp bending of the OF cable during installation.
- 20.4 The OF cable should not be given extra tension than the permissible tension limits.
- 20.5 While crossing the overhead electric installations, safety measures should be taken. Also provide guard wire.
- 20.6 To avoid man made damages, safety measures should be taken for each pole.

- 21. **Reference.** TEC GR on Planning Guidelines and the Installation Practices for the installation of self-supporting metal free aerial optical fiber cable.

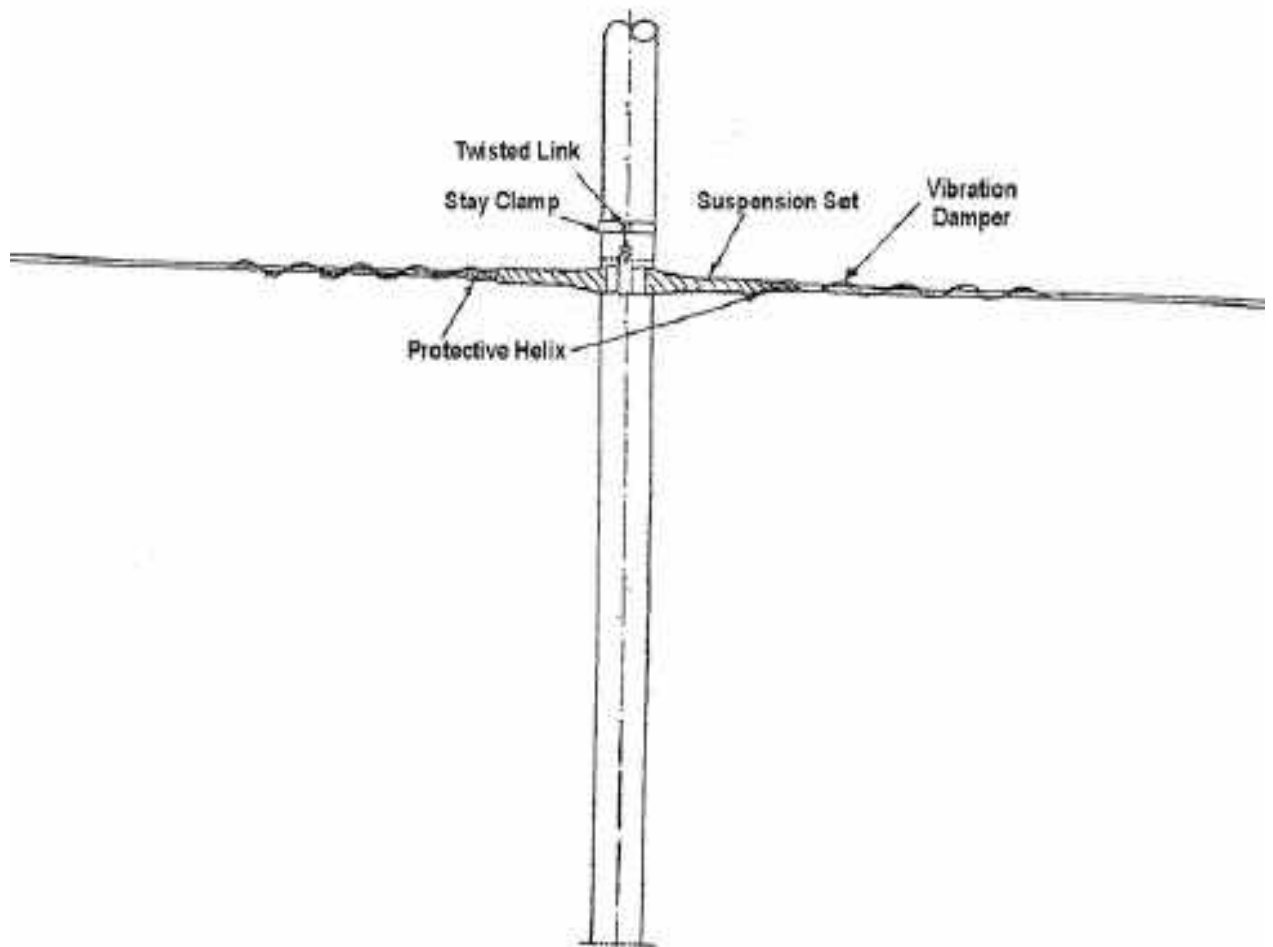


SUSPENSION POLE ASSEMBLY

NOT TO SCALE

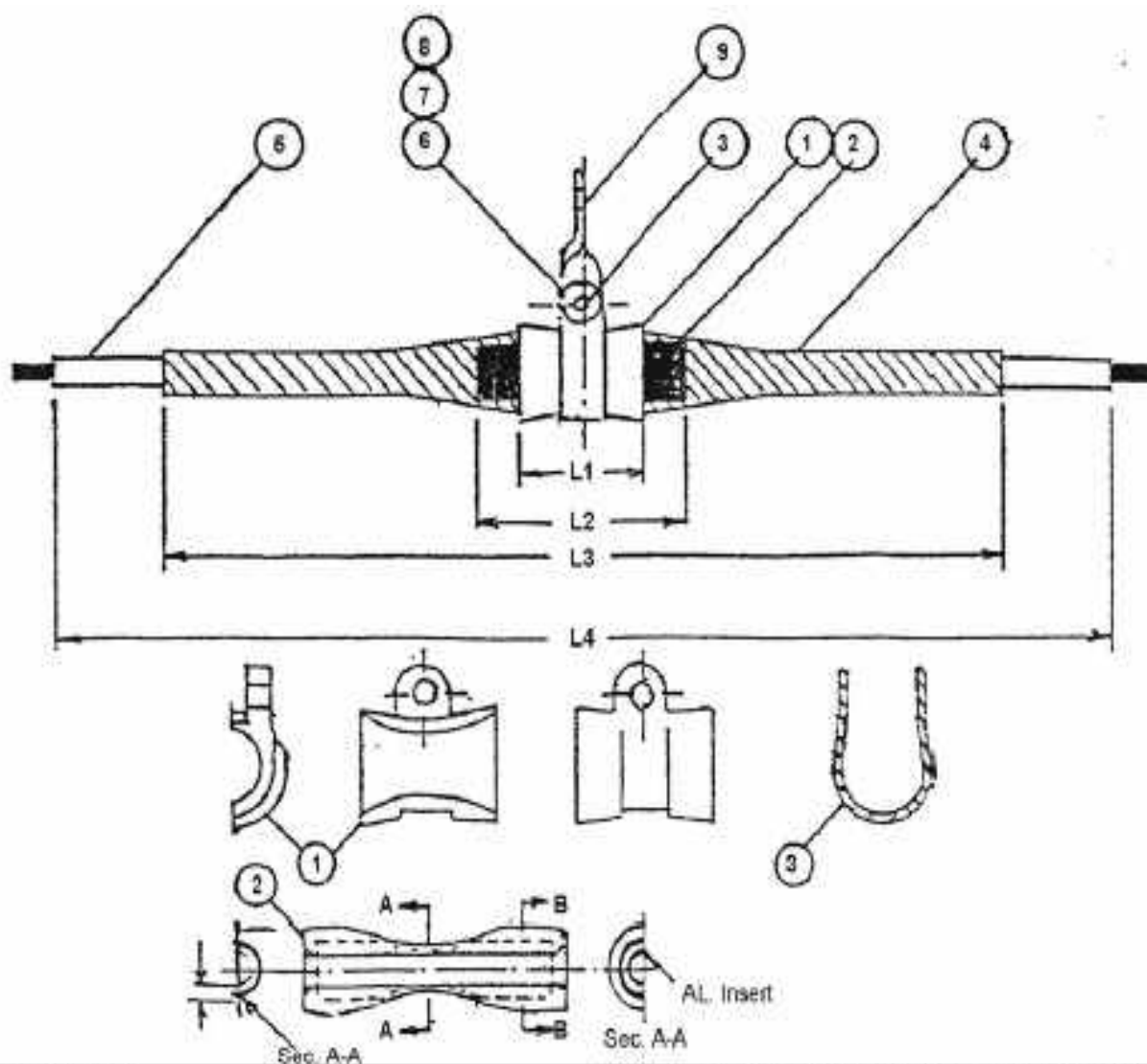
UNIT - MM

FIG-1



SUSPENSION POLE ASSEMBLY	
NOT TO SCALE	UNIT - MM

FIG - 2



(FOR EXAMPLE)
DIMENSIONS - CABLE SIZE - 14.4 MM DIA.

CABLE DIA	L1	L2	L3	L4	COLOUR CODE	DIA AGS ROD
14.4	115	200	800	1400	BROWN	4.25±0.1

NOTE :- DIMENSIONS FOR DIFFERENT CABLE SIZES TO BE DECIDED AFTER TYPE TEST APPROVAL.

INSERT DIMENSIONS IN MM

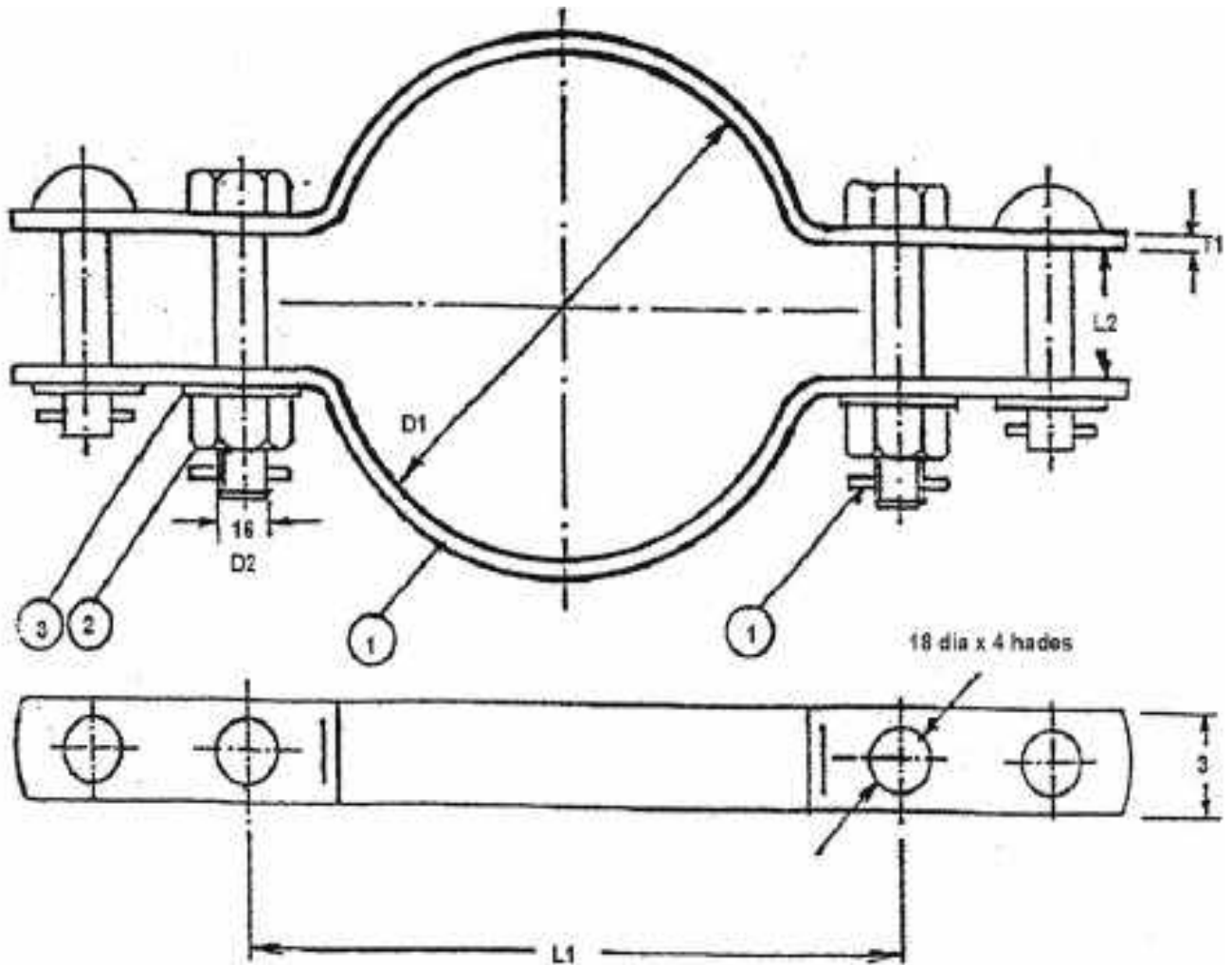
INNER DIA.	AT - A - A	AT - B - B
	22	22
OUTER DIA.	33	60

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1 (CLAMP)	ALUMINIUM ALLOY 8061	IS : 817	1 SET
2 (INSERTS) SUSPEN. CLIPPER	POLYCHLOROPRENE COMPOUNDED		1 PAIR
3 (STRAP)	ALUMINIUM ALLOY	IS : 817	1
4 AGS HELIX	ALUMINIUM ALLOY 8061		1 SET
5 PROTECTIVE HELIX	ALUMINIUM ALLOY 8061		1 SET
6 RIVET M 16	MILD STEEL GALVANISED	IS : 2062	1
7 FLAT WASHER	MILD STEEL GALVANISED	IS : 2016	1
8 SPLIT PIN	STAINLESS STEEL	IS : 2549	1
9 TWISTED EYE	MILD STEEL GALVANISED	IS : 2062	1

ARMOUR GRIP SUSPENSION SET

NOT TO SCALE UNIT - MM

FIG - 3



POLE MOUNTED STAY CLAMP (RAIL)

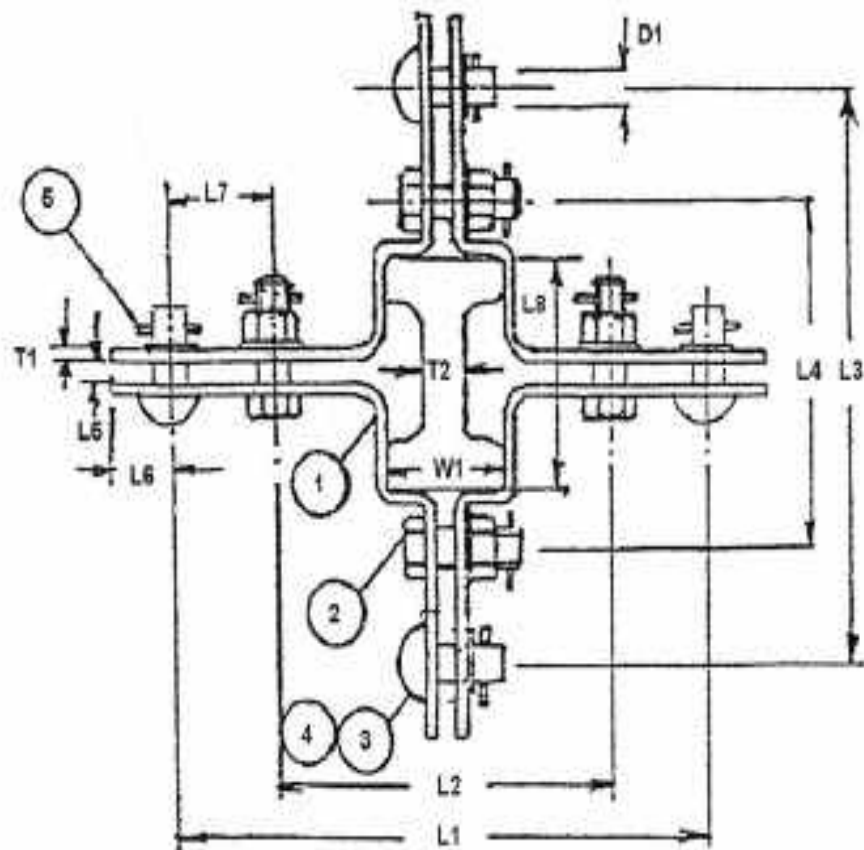
L1	L2	L3	L4	L5	L6	L7	L8	T1	T2	D1	W1
270	170	251	151	20	32	50	120	5	20	16	60

NOTE :- TOLERANCE SHALL BE AS PER IS : 2102
 (DETAIL AS PER GR UNLESS UNTILL SPECIFIED)
 HOT DIP Galvanised as per is : 2629

DESCRIPTION	MATERIAL	REF. Spec	Qty
1 CLAMP	MILD STEEL GALVANISED	IS : 2062	1 SET
2 BOLT & NUT M 16	MILD STEEL GALVANISED	IS : 1363	2
3 RIVET 16	MILD STEEL GALVANISED	IS : 2016	2
4 WASHER	MILD STEEL GALVANISED	IS : 2016	4
5 SPILT PIN	STAINLESS STEEL	IS : 549	4

POLE COLLAR CLAMP	
NOT TO SCALE	UNIT - MM

FIG - 4



DIMENSIONS IN MM :
POLE MOUNTED STAY CLAMP TUBULAR

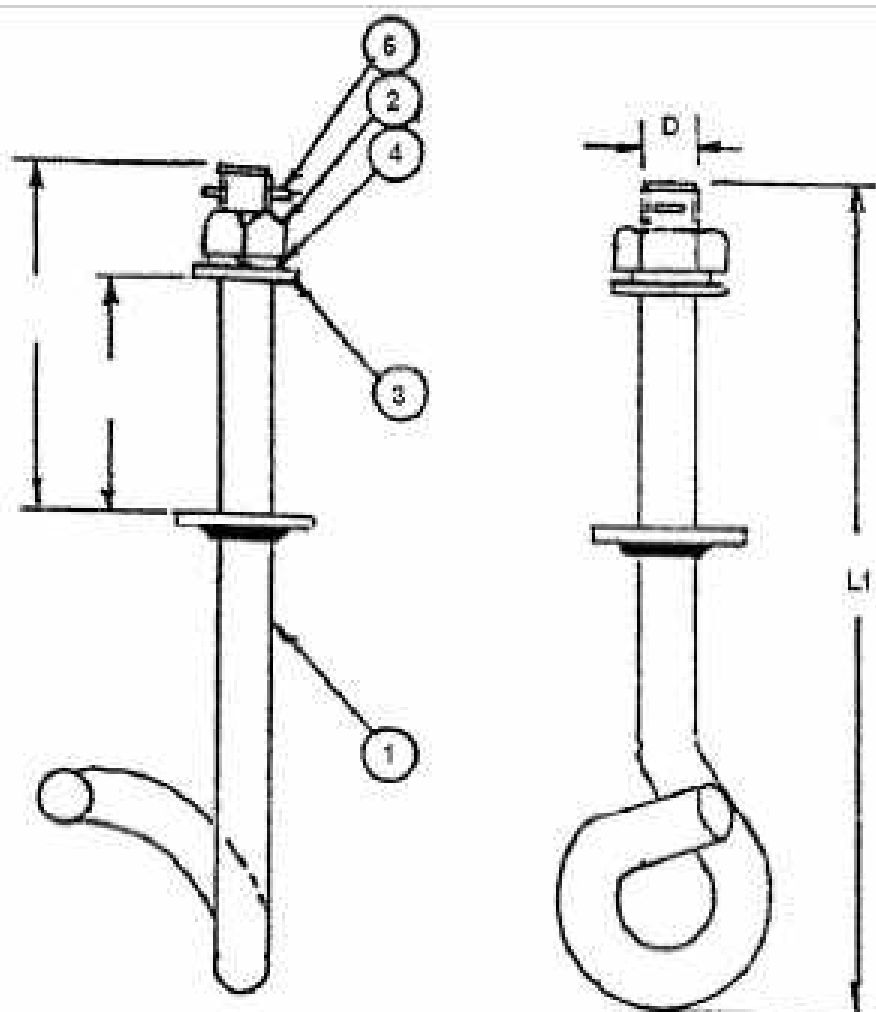
L1	L2	D1	D2	T1	W
210	20	150	16	5	30

NOTE :- TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR UNLESS UNTILL SPECIFIED)
HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1 CLAMP	MILD STEEL GALVANISED	IS : 2062	1 SET
2 BOLT & NUT M 16	MILD STEEL GALVANISED	IS : 1963	4
3 RIVET 16	MILD STEEL GALVANISED	IS : 2016	4
4 WASHER	MILD STEEL GALVANISED	IS : 2016	8
5 SPLIT PIN	STAINLESS STEEL	IS : 549	8 SET

POLE COLLAR CLAMP (R)	
NOT TO SCALE	UNIT - MM

FIG - 5



DIMENSIONS IN MM :

L1	L2	L3	D
177	75	50	12

NOTE :- TOLERANCE SHALL BE AS PER IS : 2102

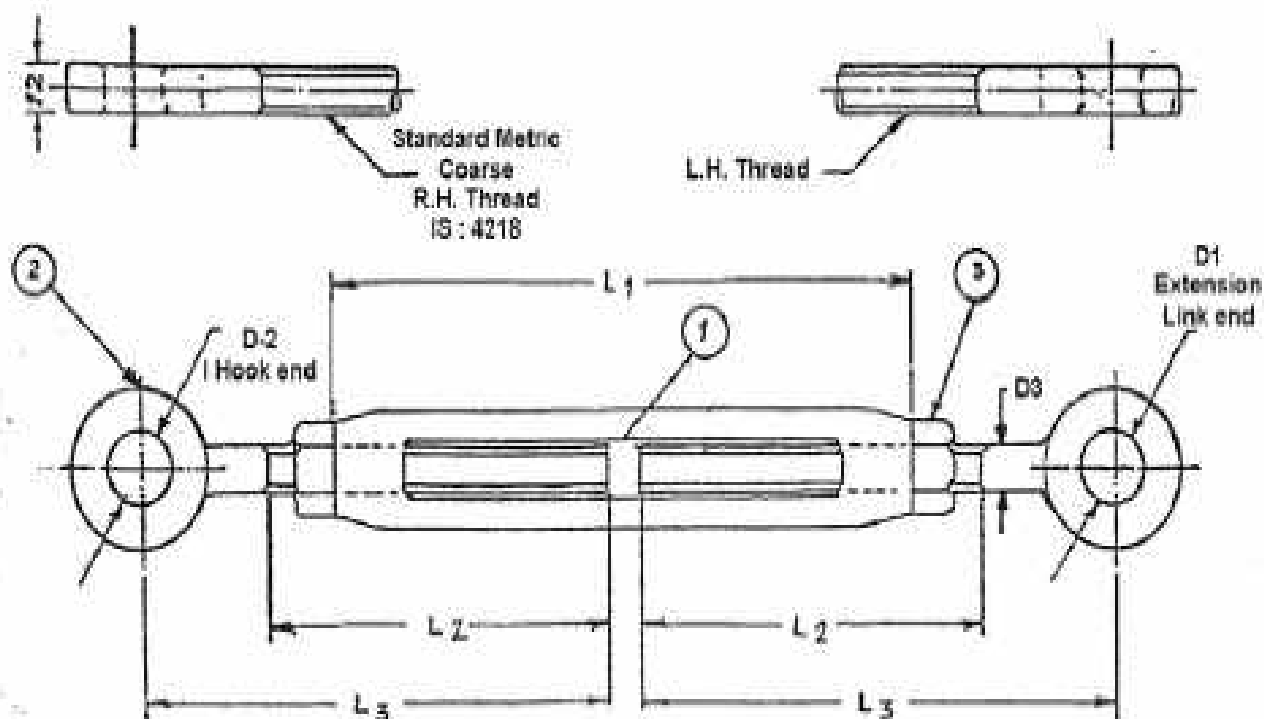
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

TO BE USED HERE C-BRACKET IS AVAILABLE ON POLE FOR FITMENT OF TENSION HOOK
HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1 BODY	ALLOY STEEL GALVANISED	IS : 2004	1
2 NUT	MILD STEEL GALVANISED	IS : 1363	1
3 PLAIN WASHER	MILD STEEL GALVANISED	IS : 2016	1
4 SPRING WASHER	SPRING STEEL GALVANISED	IS : 3063	1
5 SPLIT PIN	STAINLESS STEEL	IS : 549	1

TENSION HOOK	
NOT TO SCALE	UNIT - MM

FIG - 6



DIMENSIONS IN MM :

L1	L2	L3	D1	D2	D3
170	100	140	18	18	12

NOTE : TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

MIN. LENGTH : 290 MM

MAX. LENGTH : 400 MM

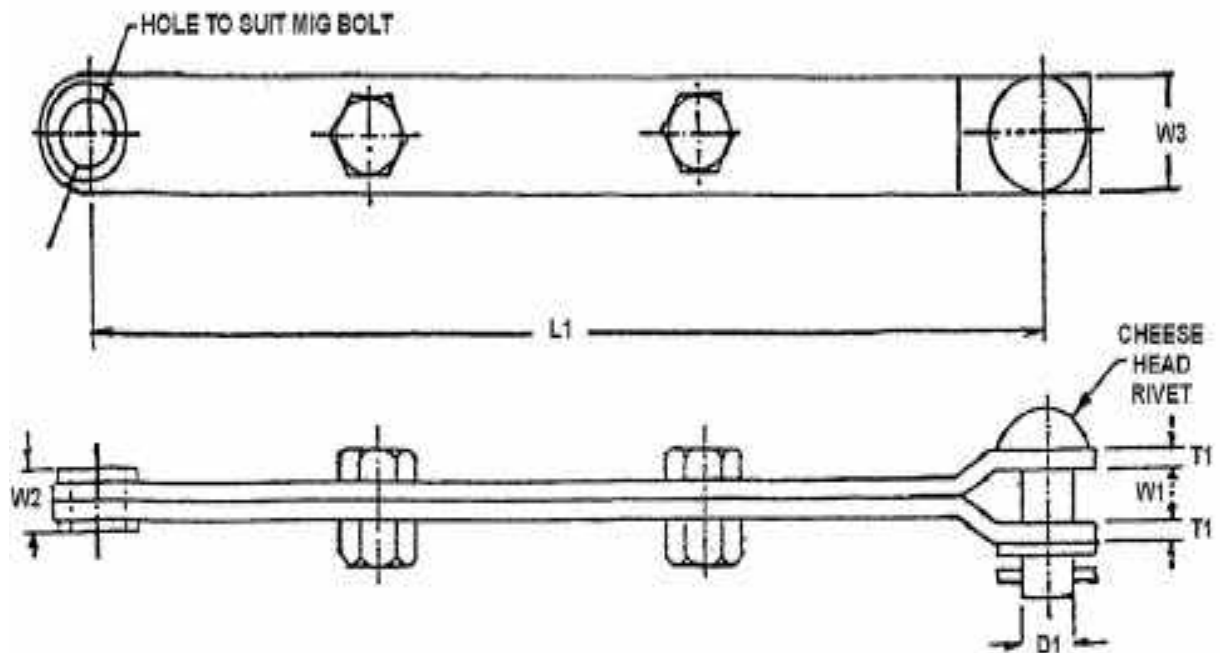
RANGE OF ADJ : 110 MM

HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	MATERIAL	REF. Spec	Qty.
1 BODY	MILD STEEL FORGED GLAV.	IS : 2004	1
2 NUT BOLT	MILD STEEL FORGED GLAV.	IS : 2062	2
3 NUT	MILD STEEL	IS : 1363	2

TURN BUCKLE	
NOT TO SCALE	UNIT - MM

FIG - 7



DIMENSIONS IN MM :

L1	T1	W1	W2	W3	D1
465	5	14	16	30	16

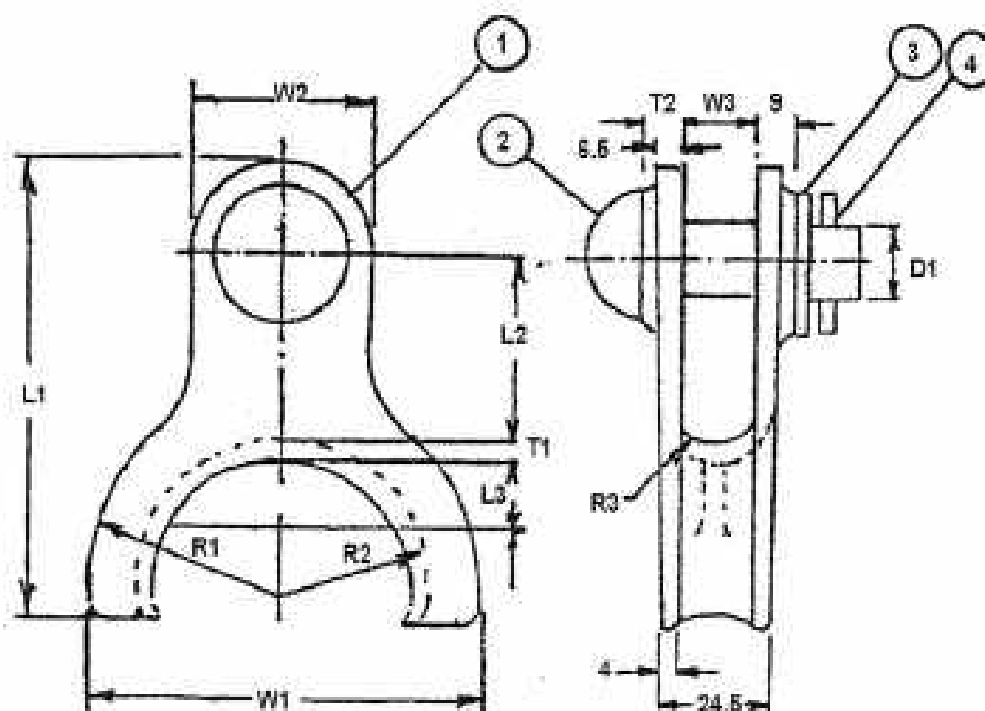
NOTE :- TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	METERIAL	REF. Spec	Qty.
1 STRAP	MILD STEEL GALVANISED	IS : 2067	1
2 RIVET & WASHER	MILD STEEL GALVANISED	IS : 2016	1
3 SPLIT PIN	STAINLESS STEEL	IS : 549	1
4 BOLT & NUT M 16	MILD STEEL GALVANISED	IS : 1363	1

EXTENSION LINK	
NOT TO SCALE	UNIT - MM

FIG - 8



DIMENSIONS IN MM :

L1	L2	L3	T1	T2	R1	R2	R3	W1	W2	W3	D1
102	42	15	4	9	23	15	8	92	40	18	18

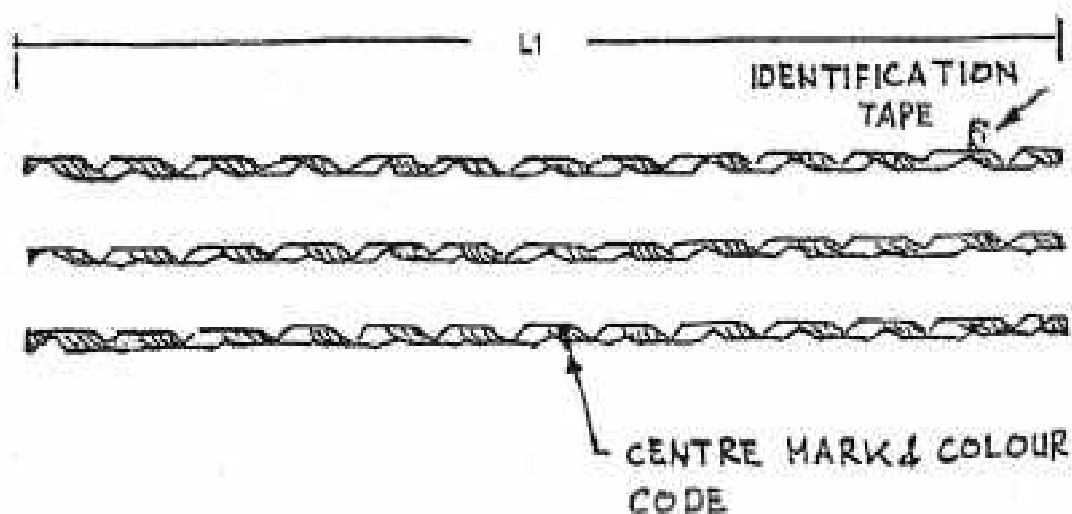
NOTE :- TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

FEROUS PARTS ARE HOR DIP GALVANISED
AS PER IS : 2029

DESCRIPTION	METERIAL	REF. Spec	Qty
1 CLAMP	ALUMINIUM ALLOY GDC	IS : 817	1
2 RIVET M16 x 45	GALV. STEEL	IS : 2016	1
3 WASHER	GALV. STEEL	IS : 2016	1
4 SPLIT PIN	STAINLESS STEEL	IS : 549	1

CLEVIS THIMBLE	
NOT TO SCALE	UNIT - MM

FIG - 9



FOR EXAMPLE

DIMENSIONS (FOR CABLE SIZE, D = 14.4 MM)

- I. DIA OF EACH WIRE - 3.2 ± 0.1
- II. NO. OF SETS - 3
- III. NO. OF WIRE PER SET - 5
- IV. LENGTH OF HELIX - 1400

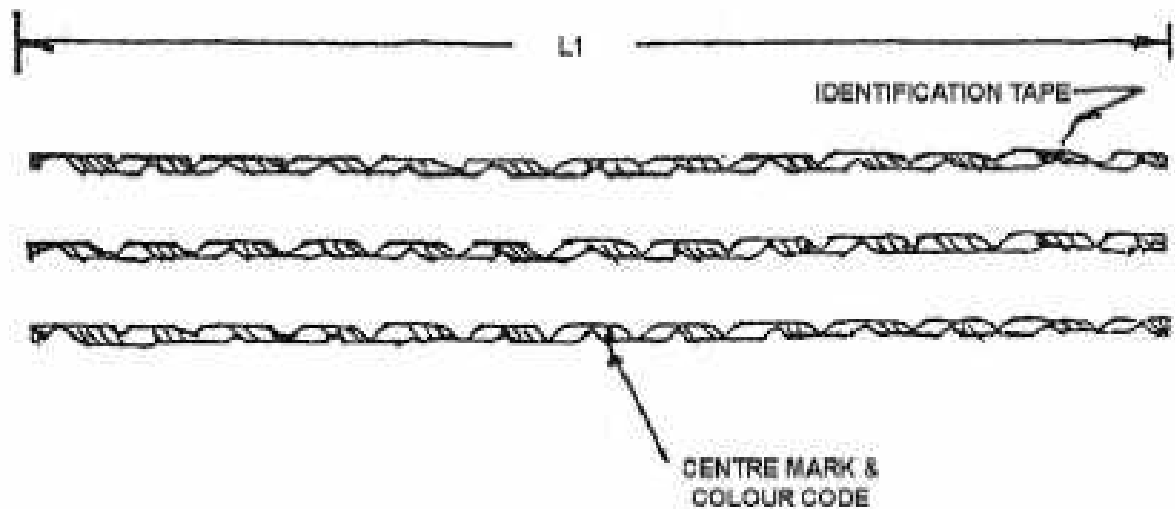
DIMENSION DETAILS FOR OTHER CABLE SIZE SHALL BE INDICATED BY THE MANUFACTURER INCLUDING THE PITCH OF HELIX

NOTE : ENDS OF RODS SHALL BE DEBURRED TOLERANCE SHALL BE AS PER IS : 2102 (DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1. PROTECTIVE HELIX	ALUMINIUM ALLOY 6061		

PROTECTIVE HELIX (S)	
NOT TO SCALE	UNIT - MM

FIG - 10



FOR EXAMLE
DIMENSIONS (FOR CABLE SIZE, D - 14.4 MM)

- I. DIA. OF EACH WIRE - 3.2 ± 0.1
- II. NO. OF SETS - 3
- III. NO. OF WIRE PER SET - 5
- IV. LENGTH OF HELIX - 1000

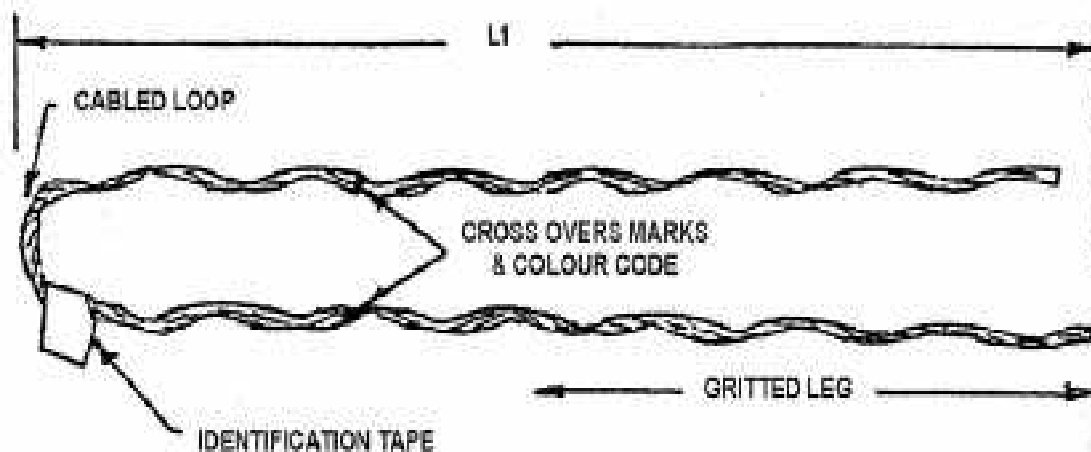
DIMENTION DETAILS FOR OTHER CABLE SIZE SHALL BE INDICATED BY THE
MANUFACTURER INCLUDING THE PITCH OF HELIX

NOTE : ENDS OF RODS SHALL BE DEBURRED TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

DESCRIPTION	METERIAL	REF. Spec	Qty.
1 PROTECTIVE HELIX	ALUMINIUM ALLOY 6061		

PROTECTIVE HELIX (T)	
NOT TO SCALE	UNIT - MM

FIG - 11



DIMENSIONS
FOR EXAMPLE

L1	T1
1000	2.2±0.1

D IS DIA OF EACH WIRE ROD
NO. OF WIRES USED 5

NOTE : TOLERANCE SHALL BE PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

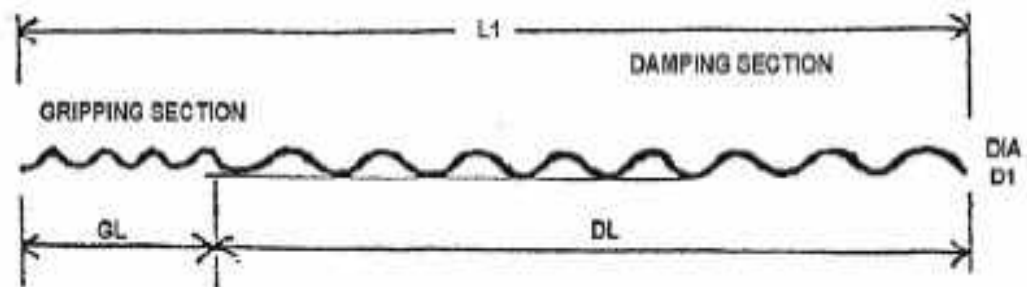
DIMENSION DETAIL FOR DIFFERE CABLE SIZES TO BE DECIDED AP TYPE TEST APPROVAL
FOR EXAMPLE CABLE SIZE

ENDS OF RODS SHALL BE DEBUR LENGTH OF TERMINATING HELIX 1000 MM,
TER MINATING HELIX TO BE USED WITH THIMBLE C DIA - 14.4 MM

DESCRIPTION	METERIAL	REF. Spec	Qty.
1 DEADEHD GRIP	ALUMINISED STEEL		

TERMINATING HELIX	
NOT TO SCALE	UNIT - MM

FIG - 12



DIMENSIONS IN MM

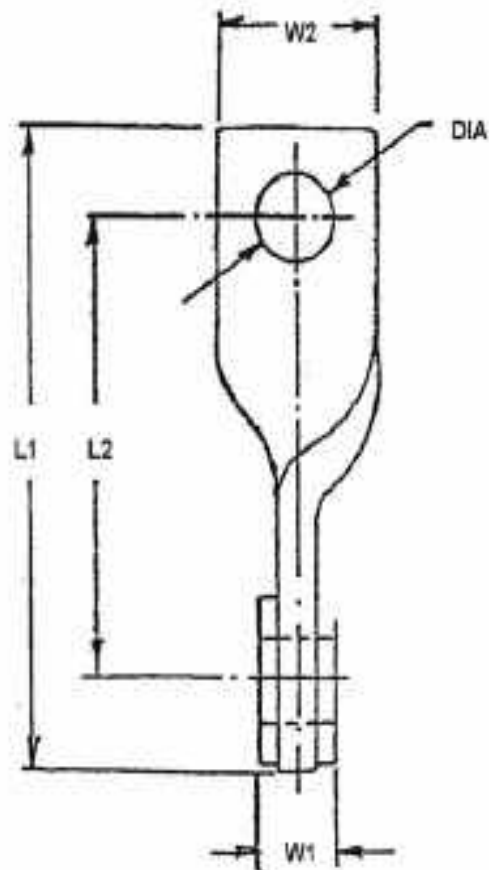
L1	GL	DL	D1
1346	446	900	12 $\pm$ 1

NOTE : TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1 SPIRAL VIBRATION DAMPER	POLYVINYL COMPOUNDED		

SPIRAL VIBRATION DAMPER	
NOT TO SCALE	UNIT - MM

FIG - 13



DIMENSIONS IN MM

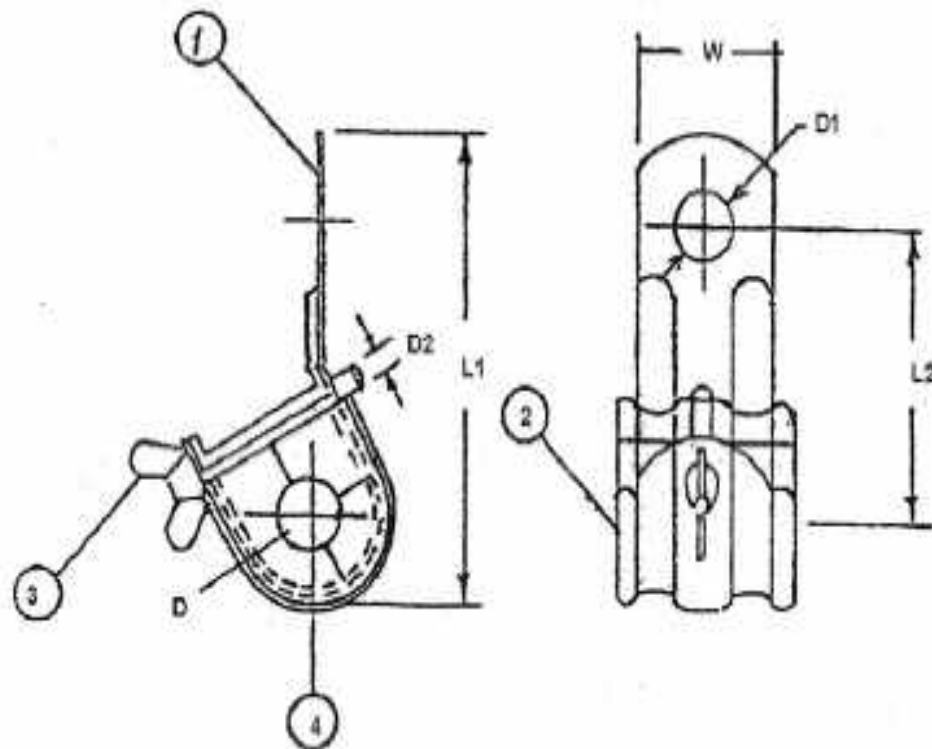
L1	L2	W1	W2	DIA
138	100	27	38	18

NOTE : TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)
HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	MATERIAL	REF. Spec.	Qty.
1 LINK	MILD STEEL	IS : 2062	1

TWISTED EYE LINK	
NOT TO SCALE	UNIT - MM

FIG - 14



DIMENSIONS IN MM

L1	L2	D1	D2	W
105	65	17.5	5-6	35

DIMENSIONS IN MM OF INSERT PAD

L	INNER DIA	OUTER DIA
40	15	30

NOTE : TOLERANCE SHALL BE AS PER IS : 2102

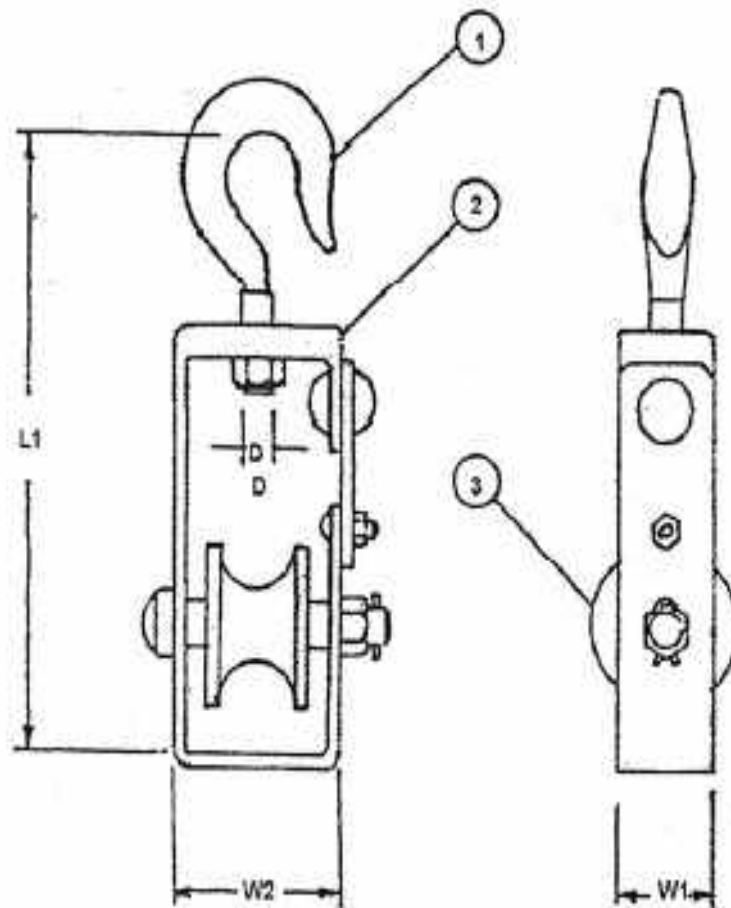
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)

INSERT IN TOW HALVES D TO SUIT CABLE DIA FERROUS PARTS ARE HOT DIP GALVASIED AS PER IS : 2029

DESCRIPTION	METERIAL	REF. Spec	Qty.
1 STRAP	MILD STEEL GALV	IS : 2062	1
2 INSERT	POLYCHLORADPRENE COMPOUNDED		1
3 WING BOLT	MILD STEEL GALV	IS 2062	1

JUMPER CABLE CLAMP	
NOT TO SCALE	UNIT - MM

FIG - 15



DIMENSIONS IN MM

L1	W1	W2	D
280	50	92	12

NOTE : TOLERANCE SHALL BE AS PER IS : 2102
(DETAIL AS PER GR, UNLESS UNTILL SPECIFIED)
FERROUS PARTS ARE HOT DIP GALVANISED AS PER IS : 2629

DESCRIPTION	MATERIAL	REF. Spec	Qty.
1 HOOK	GALVANISED STEEL		
2 BODY	GALVANISED STEEL		1 SET
3 SPOOL	ALUMINIUM COATED NEOPRENE		

DEMOUNTABLE PULLEY	
NOT TO SCALE	UNIT - MM

FIG - 16

यांत्रिक अनुदेश ENGINEERING INSTRUCTION

LAYING PRACTICES OF OPTICAL FIBRE CABLE BY HDD (HORIZONTAL DIRECTIONAL DRILLING) METHOD

(No.: TR/OFC/A-001)

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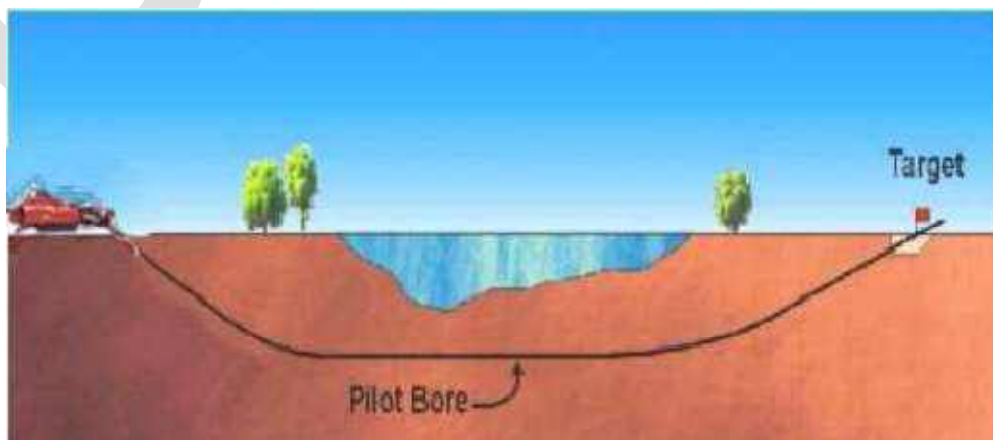


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LAYING PRACTICES OF OPTICAL FIBRE CABLE BY HORIZONTAL DIRECTIONAL DRILLING (HDD) METHOD

1. **Scope.** This Engineering Instruction deals with the methods to be adopted in laying of PLB HDPE pipes for Optical Fibre Cable using Horizontal Directional Drilling (HDD - also called as the trench less technology or mirco tunnelling) and laying of Optical Fibre Cable using the cable blowing method. The following laying practices may be adopted by the field units. This EI exclusively deals with the HDD only and only a few references are given with respect to conventional open trench method. However for regular open trench OF cable laying work involved in between HDD works, the EI issued by T&D circle vide 'Local Area Network OF cable D-001 dated 11-07-2005' along with the latest amendments may please be referred.
2. **General**
 - 2.1 BSNL has already introduced Optical Fibre Transmission system for local junctions and for long distance routes. Various types of cables such as 24 & 12 fibre non-metallic, 8 fibre non-metallic, 8 fibre with metallic strength member and 6 fibre non metallic have been already introduced. Wherever, O.F. Cable with metallic conductors are to be used, they will fall, within the purview of PTCC code and should be referred to PTCC.
 - 2.2 Now BSNL corporate office has been deploying high count fibres with fibre count starting from 48F to 576F (48F/96F/144F/288F/576F). Large scale deployment is planned in the current year and in future as fibre is going to be the ultimate medium for most of the access technologies. Normally all these high count cables are ribbon fibre cables with 12Fibers in one ribbon.
 - 2.3 These cables are being laid in the important cities under the Overlay Access Network Project, which is the fibre infrastructure project of BSNL. This shall support the Gigabit Passive Optical Network (GPON)/Gigabit Ethernet Passive Optical Network (GE-PON), the Fibre to the Home (FTTH) equipment being introduced in 2006-07. These cables are laid in multiple ducts using Horizontal Directional Drilling (HDD) or the conventional Open trenching method.



- 2.4 HDD may be deployed mainly within the corporation / municipality limits of the District Head Quarters. Further, deployment may be as per the local requirement as mentioned in para 2.6 also. The HDD deployment

may be justified financially with reference to the right of charges to be paid to the local authorities for the open trenching and other associated expenditure.

- 2.5 Multiple ducts used in HDD should essentially have different colours. More than twelve different colours are prescribed for laying in the Overlay Access Network.
- 2.6 The HDD may also be used for the water canal crossings, highway crossings and railway crossings also. These crossings may be made as part of the open trench work itself after exactly assessing the crossing requirement.
- 2.7 The areas of the deployment of HDD and the Conventional open trenching should be indicated clearly in the preliminary survey report of the OF cable route proposed. Financial justification is to be incorporated in the survey reports. The SSA heads/ GM (Projects) may approve the areas of the deployment as per the above guidelines.
- 2.8 PLB pipe coils of one Km length shall be economical and result in less wastage in HDD deployment.
- 2.9 HDD Operation: The operation of HDD is explained in the **Annexure –II**.

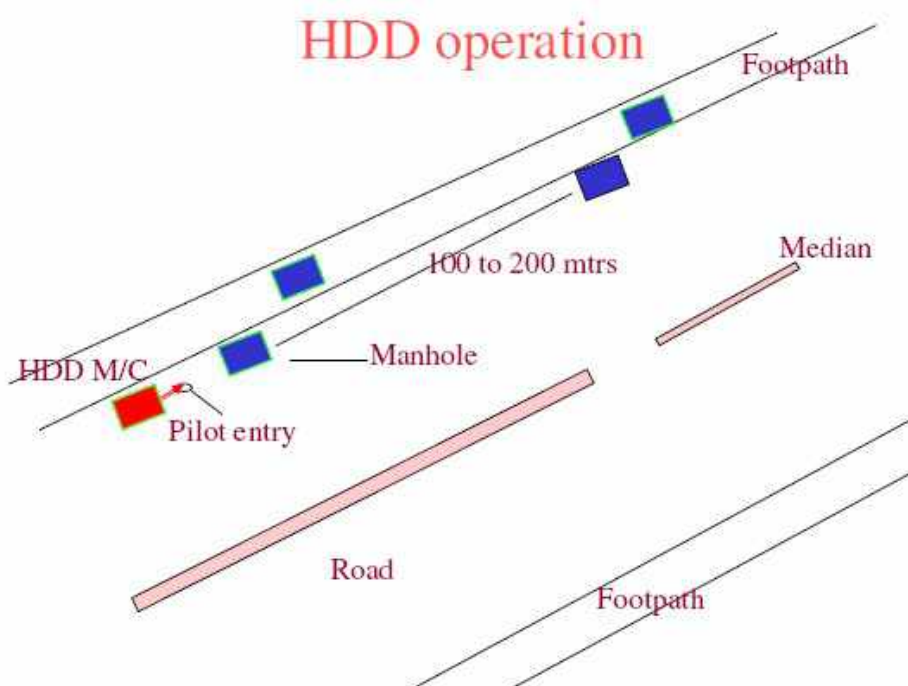


Fig-2

3. Detailed Survey

- 3.1 Following alternatives should be considered after techno-economic evaluation to meet the planned objectives of the scheme.
 - 3.1.1 The HDD is normally deployed in the soft soils only. HDD deployment in rocky areas and laterite soils may be very expensive and hence may not be financially viable. In addition, HDD operation in rocky areas shall be extremely slow. Thus only in soft soil areas this technology may be deployed.

- 3.1.2 Deployment of HDD may be the choice in congested roads where open trenching is not possible (mainly in District Head Quarters). In addition, in some states/cities Black Top roads, Pre-stressed Cement Concrete roads are made from end to end leaving no margin for PLB pipe laying by opentrenching.
- 3.1.3 Ease of obtaining the right of way by deployment of HDD for laying the OF cables may be another reason for deploying this method. Very low charges may need to be paid where this technology is deployed. The charges for the Manholes, which are being installed as part Overlay Access Network (OAN), may needs to be paid additionally. The OAN plan is as given below in Fig.3.

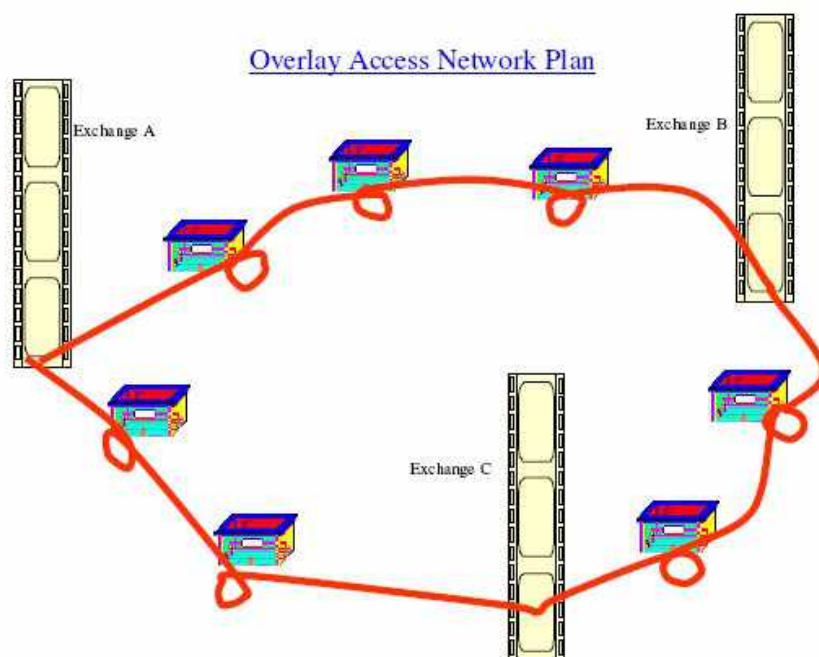


Fig - 3

- 3.1.4 Survey may be done on the roads having maximum number of business buildings, commercially important customers and with a good number of potential customers.
- 3.1.5 The routes proposed can include various main exchanges/RSUs/RLUs/DLCs/GSM BTS sites/WLL sites/LAN Switches /DSLAMs/Broadband DLCs/STM-1 CPEs/Ethernet Media Converters etc.
- 3.1.6 The en-route Commercially Important Customers and the buildings of interest which are though little away from proposed main route may also be covered in the survey and dropping of OF cable may be planned through outdoor FDMS and Customer Premises FDMS.
- 3.1.7 Multiple ducts may be planned depending on the potential customers and bandwidth demand. Uniform number of ducts

per city may be planned, instead of planning varying number of ducts in different routes in the same city.

- 3.1.8 High count fibres may be planned so that the ultimate capacity of the ducts and the cables to be laid shall meet the demands of the future access technologies.
- 3.1.9 Fibre to the home (FTTH) technologies such as GE-PON and GPON are being introduced in the network. Hence the planning of the fibres needs to be done as per the ultimate customer demand.

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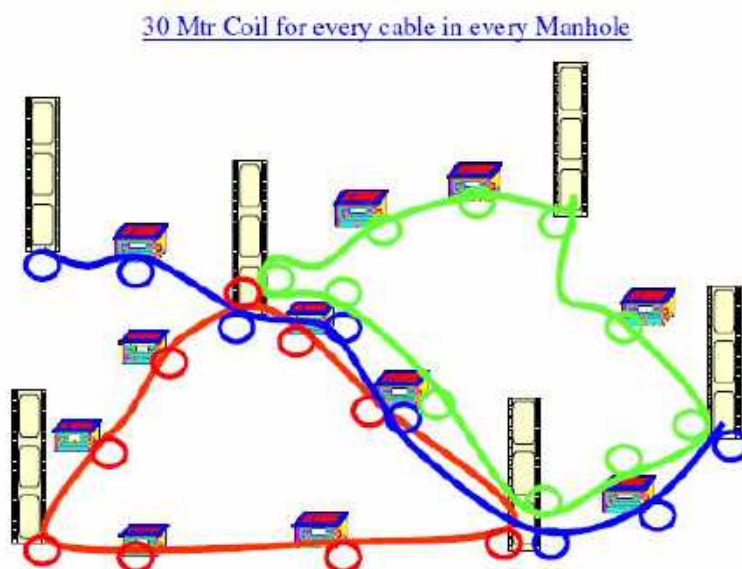
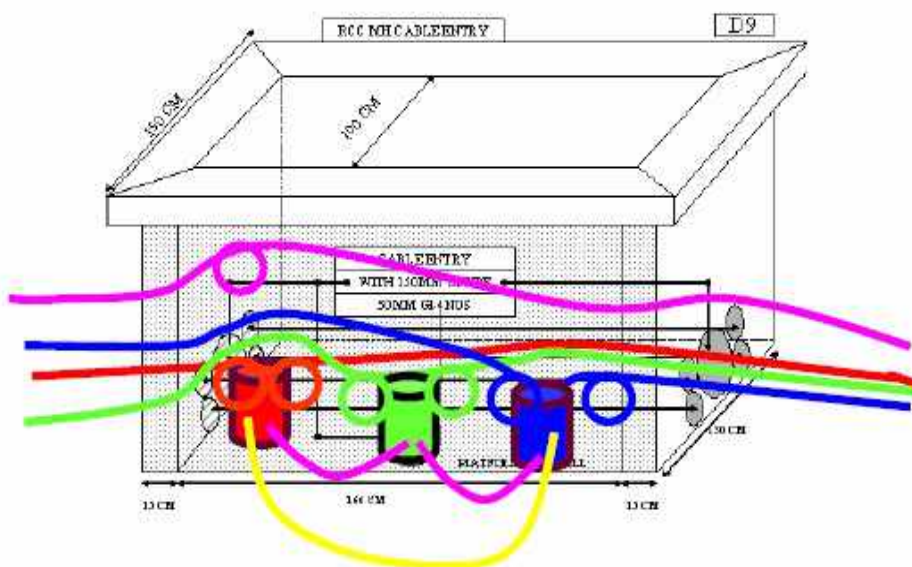


Fig-4

- 3.1.10 The route survey may be done by planning the manholes / new buildings for OF cable terminations on main route or housing the terminations in the existing exchange buildings on the routes.
- 3.1.11 Ground Probing Radar (GPR) may be used, to identify the Cable duct path and the proposed manhole locations, in the roads where the underground assets are densely located.

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- 3.1.12 The approximate location of the manhole and the length of the route should be clearly recorded in the report.
- 3.1.13 The number of coloured PLB pipes proposed to be laid should be recorded along with the approximate quantity required. 5 % additional pipe length may be taken as the requirement for executing the work. Please refer the Annexure- IV for the details of the additional pipe requirement.
- 3.1.14 For maintenance purpose 5% more additional pipe provision may be made in the report.
- 3.2 **Cable Laying.** After deciding above mentioned issues a detailed measurement of lengths of cable route along with the details of rail / road crossings, culverts, causeways etc. may be recorded in the detailed survey register. The probable location of joints, terminations and leading-in may also be decided and marked on the road map.
- 3.3 On the basis of surveys, general permission from road and rail/local authorities for laying the Optical Fibre Cable along the suitable roads and at particular rail/road crossings will have to be obtained. Generally OF Cable may preferably be laid straight as far as possible along the road near the boundaries, away from the burrow pits/when the OF Cable is laid along the National Highways, Cable should run along the road land boundary or at a minimum distance of 15 to 30 meters from the centre line of the road where the road land is wider.
- 3.4 In special cases where it may be necessary to avoid burrow pits or low lying areas, the cable may be run underneath the shoulders at a distance of 0.6 meter from the outer edge of the road embankment provided the same is located at least 4.5 meters away from the centre line of road and with standard depth below the road surface.
- 3.5 In the cities where the Overlay Access Network (OAN) is being planned, the OF cable alignment may be planned on the footpath or along the edge of the road. Manholes may also be located along the alignments.
- 4. **Associated Points**
 - 4.1 **Soil Categorisation.** Soil is categorized only under two broad categories i.e. "Rocky" and "non Rocky" and "Non Rocky", for purpose of deciding the depth at which the cable is to be laid. The soil is categorized as rocky if the cable trench cannot be dug without blasting and / or chiselling. All other types of soils shall be categorised as "Non rocky" including Murrum & soil mixed with stone or soft rock. However for the purpose of execution of trenching contracts, project authorities may classify the soil in the more than one group and decide contractual obligations suitably. HDD may be deployed in the soft soils only. Only in the exceptional cases the HDD technology may be used in other soils. This may be done with the consent of the head of the circle. Contractual obligations suitably. HDD may be deployed in the soft soils only. Only in

the exceptional cases the HDD technology may be used in other soils. This may be done with the consent of the head of the circle.

- 4.2 **Types of pipe to be used for Optical Fibre Cable.** Optical Fibre Cables should be pulled or blown through 50mm/40 mm/32 mm (outer dia) PLB HDPE pipes having strength of 10 kg/cm². The HDPE PLB pipe meets the specification as given in GR No. G/CDS-05/01 DEC 94, shall only be used for laying the OF Cable. Wherever GI pipes or R.C.C. pipes are used for protection, the two ends of the pipe should be properly sealed to protect HDPE PLB pipe from sharp edge of GI pipe and to bar the entry of rodents. For providing additional protection Split RCC/GI pipes should be used from top instead of full RCC / GI Pipes.

- 4.3 All depths should be measured from the top of pipe. However the depth is considered acceptable if its is not less by more than 8 cm from the specified depth of 1.5 m in non rocky soil and 0.9 m in case of rocky soil. This margin of 8 cm is not applicable for the minimum depth prescribed for providing protection i.e. 1.2 m in non-rocky / rocky soil and 0.5 m in case of rocky soil.

5. **Trenching and Drilling.** Major specifications for trenching are:-

- 5.1 Normally depth of the drilled portion should be more than 250 cm. This depth may be achieved at a distance of 10 meters from the leading edge of the proposed Manhole.
- 5.2 Manhole to be opened for the entry pit and the exit pit shall be minimum of 1.5 x 1.5 x 1.7 mtrs. (Fig 5). The general manhole design guidelines are available in Annexure-III. Both entry and exit pits are opened before drilling is commenced.

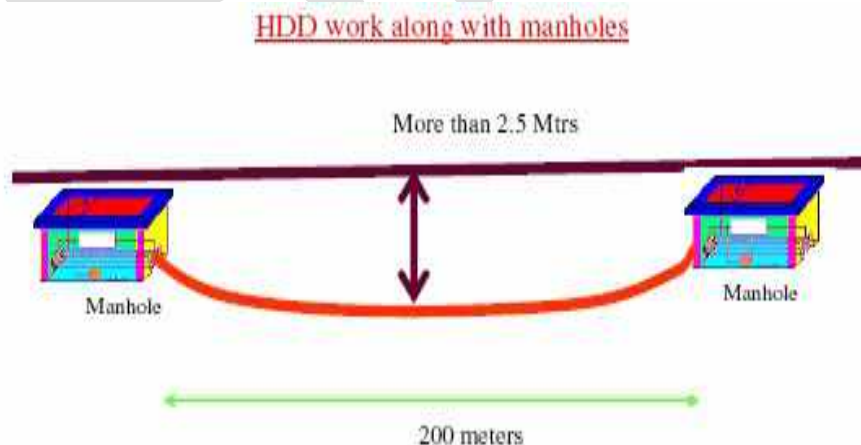
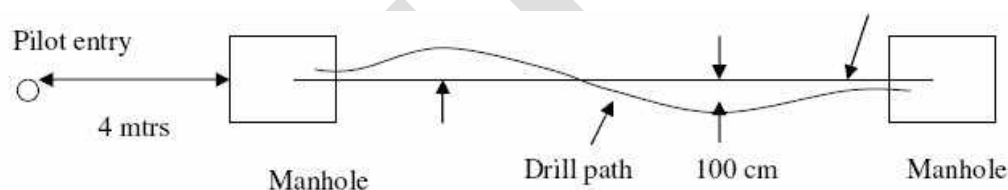


Fig-6

- 5.3 Drilling wherever possible, should be at the road boundary and as far as possible, straight.
- 5.4 Where 4 PLB pipes are less are to be laid, 100mm dia bore may be done by the HDD machine. Where 5 to 8 PLB pipes are to be laid, 200 mm dia bore may be done by the HDD machine.

- 5.5 The machines should be capable of drilling for minimum 150 mtrs at a time without fail in the soft soil. The drill lengths of 200 to 250 mtrs are also desirable. In general, the machines with 10 tonnes or more thrust capacity are having the capability for this purpose.
- 5.6 The depth at the entry pit shall be 165 cms. For achieving this depth in the manhole a pilot entry pit shall be opened with min 20 cm depth for enabling the drill pilot to enter. (Figure-2 & 7). The pilot entry pit shall be at least 4 meters away from the manhole.
- 5.7 Whenever curves or deviations are encountered it should be a very smooth curve, the deviations should not be more than 100 cm from the mean line joining the centre of entry pit and the centre of the exit pit. A nylon wire shall be fixed between these two pits before the drilling operation



- 5.8 After the drilling operation commences, the depth and offset of the pilot is to be recorded at every 3 mtrs using the hand held tracker. The tracker should have been properly calibrated. The offset of the drill shall be recorded with reference to the edge of the road and also the deviation with reference to the mean line represented by the Nylon rope on the ground.
- 5.9 The depth, deviations and offset readings may be provided by the machine automatically, apart from the manual records made.
- 5.10 Bottom of the trenches should be at uniform level without any abrupt ups and downs. After the trenching is done for sufficient length, the bottom levelling should be inspected for uniformity to ensure that pipe could be laid without sharp bends.
- 5.11 In exceptional case, the depth of the trench could be less than 2.50 m due to undulating terrain. However, in no case it should be less than 1.20m.
- 5.12 In certain cases, in a uniform terrain a sudden burrow pit/old culvert of short length might be encountered. In such case, the HDPE pipe can be further protected by GI/RCC pipes of suitable size.
- 5.13 In water logged area drilling should be done in the dry areas and dewatering should be got done before pipe laying.
- 5.14 When trenching is done close to power cables precautions detailed in EI lines & cables underground should be observed.
- 5.15 When trenching is undertaken along streets and railway lines safety precautions given in EI lines and cables underground should be observed.

- 5.16 Caution boards should be provided at each entry, exit and pilot pit of the trench to caution the traffic. Caution tapes/red flags may also be planted around the working area throughout the drilling path. This is essential to track the drill pilot with the tracker and to record the accurate depth and offset.
- 5.17 If the manholes are to remain open at night red lamps or luminous caution boards on either ends should be provided.
- 5.18 After the pipe laying is completed, bed of manhole may be prepared for constructing the RCC manhole (please refer the OAN guidelines issued in December 2003 also available on the intranet). After the manhole is constructed the PLB duct is ready for laying the OF cable.
- 5.19 It is very much necessary to use the ground penetrating radar to localizing other utilities in the absence of accurate documents depicting the position of other utilities. Hence, the ground penetrating radar is a must during survey and as well as while carrying out the job to follow the path of the horizontal drilling.
- 5.20 All the trenching drilling operations are to be continuously monitored by the SDE (Project). SDE(Mtce) should also visit the site during the execution.

6. Laying/Construction Practices

6.1 In Cross-Country Routes: Open Trenching

- 6.1.1 Optical Fibre Cables shall be laid in the trench through PLB HDPE pipes at a depth of 1.5M as measured from top of HDPE pipe. Taking into account the diameter of the HDPE pipe and provisions of soft soil below HDPE pipe, it will be desirable to have the trench dug to depth better than, 1.60 meters. In case of obstructions etc, the cables can be laid at a lesser depth provided.
- 6.1.2 HDD may not be deployed in the cross country areas. It may be deployed only for the water canal crossings, Highway crossings and Railway crossings. Exceptional cases where the HDD needs to be deployed may be decided by the DGM(Project) after recording the same suitably.
- 6.1.3 A minimum depth of 0.90 is achieved in case of rocky soil. In case of non-rocky soil. In case of non-rocky soil where due to any obstructions in built up areas it is not possible to dig deeper, a minimum of 1.00 meter from top of pipe shall be maintained. Wherever the minimum depth of 0.9 M in rocky soil cannot be adhered to, depth can further be reduced up to 0.5 M but for such cases CGM projects should grant relaxation on specific recommendation of GM(Proj) concerned who have visited the site. In all such cases where the depth is less than 0.9m, mechanical protection by reinforced concrete casing should be provided. The size of concreting may vary as per the number of PLB ducts are being laid simultaneously.
- 6.1.4 Suitable mechanical protection by using RCC/GI pipes to be provided for all cables laid at a depth less 1.2M. No protection, however, need be given if the cable depth is more than 1.2m.

- 6.1.5 The reasons for not laying the cable at stipulated depth of 1.5m are recorded and certified by the D.E. i/C of cable laying.
- 6.1.6 Where rocky soil is encountered for a distance of 50 meters or less, the cable depth will be maintained at 1.5m in case of adjoining non-rocky soil.

6.2 In Built Up Areas

6.2.1 City/Town, urban areas falling within municipal /Corporation limits normally fall under this category where the following laying /Construction practices shall be adopted. For other inhabited villages / towns etc. not falling under any municipal /corporation limits suitable cable depth / protection is to be decided jointly by DGM (Project) and DGM (Mtce Region). In case the works are being executed by the territorial circle, DGM(Planning) and DGM (Circle Transmission Mtce) shall decide the protection.

6.2.2 **On Ducted Routes.** Optical fibre cables may be laid through the existing ducts wherever the concrete ducts are available. As far as possible the cable may be diverted to the new ducts laid subsequently. When the cables are laid in ducts, no particular depth is prescribed. End of the ducts should be properly sealed and necessary protection by way of W.I. pipe / RCC pipe should be provided at the entry and exit of the duct till the cable is buried to a depth of 1.5 m. The above is applicable in town or any other ducts laid cross country.

6.2.3 On Non-Ducts Routes

6.2.3.1 PLB pipe laying may be done as per the approved detailed survey report.

6.2.3.2 **Open Trenching.** As the non-ducts routes in built up areas are more vulnerable to faults due to cables/pipes of other services laid close to BSNL cables, it is essential to take special care while laying optical fibre cables on these routes. The OF cable shall be laid through PLB HDPE pipes at a depth of 1.5m, and additional protection by using RCC/GI pipes shall be provided. If need be the OF cable can be laid below the cables and pipes of other agencies including local telephone cables and if required cable may be laid via alternate longer route. Only in exceptional cases the depth of cable laying may be relaxed to 1.00 in non rocky soil and 0.9 in rocky soil as in case of cross country routes, provided the reasons for not laying the cables at a stipulated depth of 1.5m are recorded and certified by DGM in-charge of cable laying. The minimum depth of 0.9m in rocky soil may further relaxed to 0.5m for location where permission for blasting is not granted by local authorities even after taking up for the same at G.M. (Project) level. In all such cases mechanical protection by reinforced

concrete casing of suitable size shall be provided.

- 6.2.3.3 **HDD.** The pipe laying shall be done as described in 5.0. Due to intangible underground hindrances / old buried structures, HDD work may be converted as the open trenching work. DET (Project) or the DET who is the in-charge of the work should inspect the site and record the reasons for the same. Where the PLB pipe is to be laid at deeper depths (more than 350 cm), DET in chargeshould inspect the site and record the reasons.

6.3 On Culverts / Bridges over Nullahs

- 6.3.1 **Nullahs Dry for Nine Months in a Year.** The cable shall be laid at 1.5 m depth below the bed of nullah through HDPE pipe and protection provided by using RCC pipe of minimum internal dia of 100 mm. The RCC pipe shall extend 2 M minimum beyond the end Nullah on either side. Depth of 1.5 m can further be reduced depending on nature of soil and other conditions in accordance with para 6.1 & 6.2 with a view to minimize the damage to the OF cable during flood season the cable should be laid on upstream side of causeway at an approximate distance of about 4 times than depth of the flow during high floods.
- 6.3.2 **On Culverts/Bridges over Other Nullahs.** Various options are available as depicted in figures 3a, 3b, 3c, 3d & 3e for laying the O.F. cable along the parapet wall of the culverts/bridges. One of these options may be adapted depending upon side conditions. On approach roads to these bridges/culverts also, protection by using RCC pipes shall beprovided for 2 M on both sides.
- 6.3.3 **On Rail Bridges /Crossings.** On rail bridges / crossings the optical fibre cables shall be laid through HDPE pipe which shall be encased in split able cast iron / RCC pipe as prescribed by Railway authorities.
- 6.3.4 **On Road Crossings.** The Optical fibre cable shall be laid at a depth of 1.5 m through HDPE pipe encased in RCC pipes which shall extend three meters on either side of the end road to take care of any future expansion. Depth of 1.5 M can further be reduced depending on nature of soil & other conditions in accordance with para 6.1 & 6.2.

7. Pipe Laying

- 7.1 PLB pipes are uncoiled from the PLB coils using the roller jack mechanism. Removing the pipes from the coil in this manner will avoid the coil effect, which makes the pipes to wind in curls even though the pipes are laid straight.
- 7.2 Pipes may be cut from the original coil using the duct cutter only.

- 7.3 The pipe may be laid in the most economical manner. The total length of the PLB pipes left unused may not be more than 5% of the length measured between the centre of the two manholes(entry pit and exit pit).
- 7.4 The start reading and the end reading for each PLB pipe shall be recorded by the Engineer-In-Charge.
- 7.5 The pipes may be laid in the manholes so that the bunch of pipes shall overlap on the pipes laid from the other side.
- 7.6 Push-fit couplers may be used for joining the PLB pipes.
- 7.7 Open Trenching or pulling the cable manually through the pipes, it is necessary to have suitable manhole made at every 200 M length and at suitable bends and corners. The construction of manhole hole and jointing man hole is shown below. Please refer annexure-III for the design guidelines of manhole for OAN works. The pipes are laid for 200 M or less, at a time, depending upon the distance between two manholes. For a 200 M trench 200 M length of 40 mm PLB pipes of continuous length and two end plugs are required for laying one duct. The PLB HDPE pipe shall be sign written with indelible red paint as 'ITD' with mark of telephone. In addition for closing the ends of the two extreme end pipes 2 special types of caps are also needed. A 4 mm polypropylene rope could be drawn through the pipes and safely tied to the caps at either end with hooks. These 4 mm ropes are to be provided throughout the route which could serve to pull the 12 mm rope which is ultimately required to pull the cable. Indicators are not required as the manhole provide the identity for the PLB ducts. Cuddapah slabs/ Stone Slabs/RCC slabs may be used as a protection measure for these multiple pipes. Necessary offset diagrams are also required indicating the distance from the centre of the road. The depth of the trench is also to be recorded.
- 7.8 **HDD.** The multiple PLB pipes are bunched together at the exit pit. At every one meter length, the pipes are bundled using the flexible iron wire tightly. The end plugs shall be tightly fixed on both ends. Chinese fingers are to be used as the pulling grips for all these bundled pipes. All the Chinese fingers shall be combined and tightened together to connect to the back reamer of the HDD machine. The machine pulls the pipes towards it. After the pipes are pulled out for about one and half meter from the drill entry point in the Entry pit which is near the HDD machine, the pipes may be de linked from the back reamer. The Chinese fingers may be detached from the PLB pipes. Leaving one and half meter length of the bunch of pipes in the exit pit, the additional pipes may be cut and necessary.
- 7.8.1 During execution, in many cities where soil is sandy or otherwise not compact, the maximum length of drilling and subsequent pipes pulling is less than even 100 meters. So, while execution all the lengths of pipes are brought to road surface, keeping them peep about 1 ft. when subsequently they are lowered down at the depth of the trench, they are cut and thus there is wastage of pipe.

Leading out Arrangement in Manhole

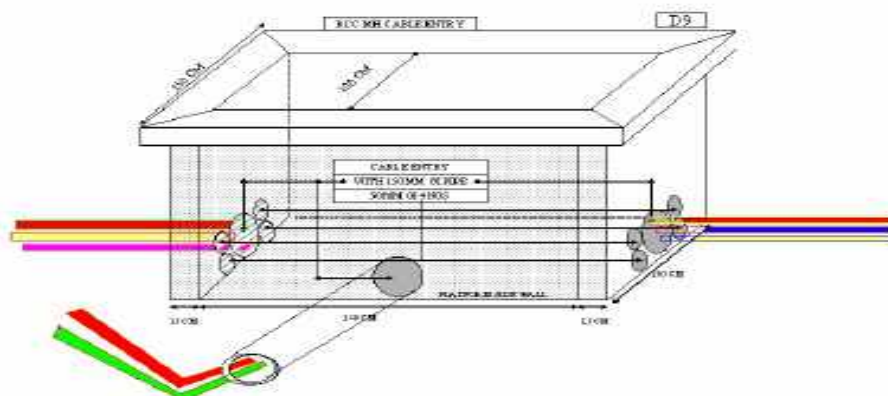


Fig - 8

Leading out Arrangement

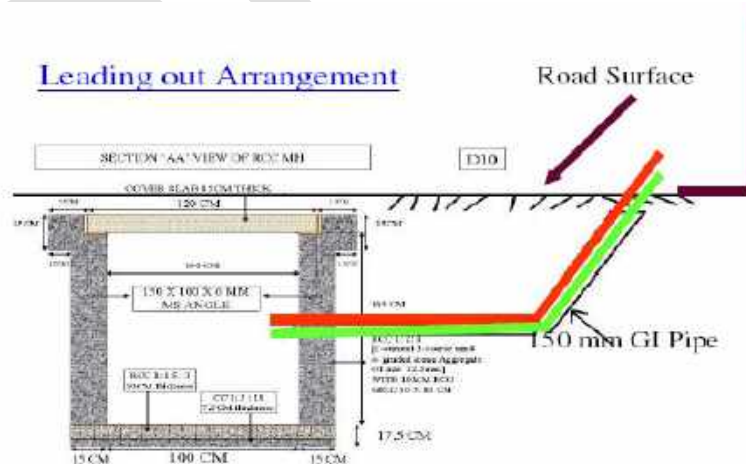


Fig - 9

- 7.9 **Duct Integrity Test.** Continuity of the pipe is to be tested and ensured. It is quite possible that the pipe may get elongated and its bore may get reduced in the process of pulling up the pipe which may ultimately result into difficulty in pulling cables. The DIT should be conducted after the pipes are laid either in open trench method or in the HDD method for verifying this problem. The DIT involves two tests. In one test one side of the PLB pipe laid is sealed using the end plug. On the other side air compressor/blower is used to hold the 5 Kg/cm-cm pressure in side the pipe under test. The pressure should be held for 1

hour without any leakage. In the second test a wooden bullet having 80% of the diameter of inner diameter of PLB pipe and having a length of 2 inches may be blown from one side of the PLB pipe. The other side of the pipe shall be left open. The bullet should fly out without any blockage. Then the PLB pipe laying is successful. Care should be taken by covering the end of the PLB pipe with a nylon/wire mesh so that the flying bullet shall not hit any one. 7.10

- 7.10 **Protection of ducts.** No protection is required for pulling pipes in HDD method.

8.

8.1 Laying of pipes on bridges, culverts, etc.

- 8.1.1 In small bridges and culverts across canals, different methods as given below could be followed.
- 8.1.2 If the bridge or culvert is broad and is having sufficient cushioning, the pipes can be buried inside the cushioning.
- 8.1.3 If the bridges / culvert is provided with raised and hollow foot-path or wheel guard, the pipe encased in GI can be buried inside the hollow foot-path or can be laid over the wheel guard and chambered.
- 8.1.4 If the supporting pillars are having projects and between pillars the distance is less, then the pipes (HDPE with GI encasing could be laid over the pillar projections.
- 8.1.5 If then one of the solutions is possible, then outside the parapet wall, GI troughs can be fitted with suitable clamps. For smaller bridges, the HDPE pipes can be laid inside the trough. However, for long bridges, HDPE pipes need not be laid inside the trough. While laying the cable, glass wool or other cushioning items may be used. In either case, the gaps between two troughs after putting the lids should be thoroughly covered to prevent entry of rodents.
- 8.1.6 Special type of bridges such as cantilever type requires special type of troughs to be locally manufactured to withstand the vertical and horizontal movement of the joints of cantilever bridges.

8.2 Route Indicators

- 8.2.1 In the Overlay Access Network, since manholes are placed at every 200 mtrs, no route indicators and joint indicators are required. Indicators may be used where the manholes are below the road surface and cannot be identified. Usage of a small brass/steel plate (15 X 15 cm) with all the offset/route details embedded on it may be used to fix/clamp to the nearest road margin wall. Where manholes are not placed at every 200 mtrs are less, route indicators may be used. The manhole indicators as suggested in clause 7.7 above may be used.
- 8.2.2 The G.I. indicators in square plate shape with base of 10"x10" of suitable thickness may be provided at every manhole and as may be required. These plates may be fixed on the wall against the manhole. The route details, RID details of Manhole

may be painted or embedded on the plate. Its bottom portion should be kept 30 cms mm above the ground level. In future electronic markers shall be used fore route ndicators.

8.3 Joint Indicators

- 8.3.1 The G.I. joint indicators embedded in concrete similar to that of RI may be provided at joint locations and may be buried is ground with at least 30 cm of it above the ground level. The joint indicator may be kept along the road side clearly visible from road and may be painted red. In future electronic markers shall be used for joint indicators.

9. **Depth A/T.** Two types of Depth AT are proposed. Traditionally Depth AT is done after PLB pipes are buried. While deploying HDD, it may be required to carry out the Depth AT simultaneously. In case the machine deployed is capable of providing the automatic depth, deviation and offset details depth AT can be conducted at a later date also. The DET A/T of the respective area shall decide on the method of A/T to be followed in consultation with the DGM A/T of the respective area.

9.1 Traditional Depth AT

- 9.1.1 Before the cable is actually pulled through the pipe, the project circle should offer the route for A/T of the depth and position for the cable and correctness of the route diagram. The best way should be to offer it in streches of 10-20, kms soon after the HDPE pipe is buried.
- 9.1.2 The route diagram should be prepared and made over to the A/T unit in advance. The HDD machine recording of the depth deviations authenticated by the division head is to be provided to the A/T unit. The A/T unit will specify the sports roughly two per km for checking of depth and position of the cable, sound laying practices and prescribed protection. Wherever depths are prescribed the tolerance upto minus 8 cm is permissible. For checking accuracy of the route diagram and position of the cable, the permissible tolerance will be +/- 0.5 metre. For checking position of the cable, standard survey tapes will be used.
- 9.1.3 If the pipe is found to be at a depth less than prescribed, OF cable should not be drawn through HDPE pipe and pipe should be lowered to the proper depth at the locations where necessary relaxation of competent authority as mentioned in earlier paras is not available.
- 9.1.4 Duct Integrity test should be carried out as specified at 7.9.
- 9.1.5 Duct sealing is also to be tested. One end of each of the duct should be closed at the air pressure should be maintained at constant rate of 5Kg/mt2 for 5 mins. The pressure leakage should not be more than 1% in these 5 mins. All the laid pipes must be sealed used the end plugs.
- 9.1.6 Cable sealing plugs must be used for sealing the PLB pipes in which OF cables are laid. Cable sealing test is also conducted for the ducts where the cable is laid.

- 9.1.7 The duct integrity test and duct sealing test shall be carried out for all the ducts laid.
- 9.2 **Concurrent Depth AT.** At present there is no specification for conducting depth A/T for HDD. However acceptance testing is offered by considering the Depth graph given by the site incharge at entry / exit points of bore. Taking the test pits will be difficult as the Bore line is passing through tarred / concreted and congested areas. Test pits may be taken where ever feasible and earthen surface is available. For acceptance test pits may not be permitted in city areas since it involves digging to a depth of 2 mts. To 3 mts. Hence depth AT may also be done while the work is in progress. During the execution, on intimation, the AT-incharge may inspect the site and measure the depths of the duct at four places which are at least 20 mtrs away from each other. This shall be in addition to the depth of the drill at the entry pit or the depth of the duct at the exit pit.
- 9.2.1 Duct Integrity test should be carried out as specified at 7.9.
- 9.2.2 Duct sealing is also to be tested. One end of each of the duct should be closed at the air pressure should be maintained at constant rate of 5Kg/mt² for 5 mins. The pressure leakage should not be more than 1% in these 5 mins. All the laid pipes must be sealed using the end plugs.
- 9.2.3 Cable sealing plugs must be used for sealing the PLB pipes in which OF cables are laid. Cable sealing test is also conducted for the duct where the cable is laid.
- 9.2.4 The duct integrity test and duct sealing test shall be carried out for all the ducts laid.
10. General Instructions on AT of the OF cable laying by HDD are available at **Annexure-I.**
11. **General Precautions**
- 11.1 The optical fibre cable drums should be handled with utmost care. The drums should not be subjected to shocks by dropping etc. The drum should not rolled along the road for long distance and when rolled, should be in the direction indicated by the arrow. The covering planks should be removed only at the time of actual laying.
- 11.2 The previously laid pipes, manholes and portion of bends etc. on the cable route as per records maintained at the time of laying pipes, should be got cleaner of earth and the pipes may be cleaned thoroughly before pulling of cable is started.
- 11.3 Depending upon the length of the drum (1 km / 2 km) and cooling required for jointing purposes, chain measurement is taken from the starting end of section and exact joint location is marked. If it does not fall at the existing manhole location, a separate manhole of 2M x 2M is to be made to accommodate the joint box as well as coil. All the joint locations are fixed in a similar manner. The intermediate manholes of 2 M x 2M are also to be kept ready for pulling purposes.
- 11.4 As the cable drums are standardized for 2 km, it is preferable to lay the cable by placing the cable drum at the manhole point nearest to 1 km from the joint locations.

- 11.5 The standard practice is to keep the clock wise end of the cable to the 'A' side of the route and the anti clock wise end to 'B' side. Also, it is the practice to have the clock wise end on top and anti-clock wise at the bottom of the drum. With the above in view, cable drum is to be mounted on the jack and wheel with drum shaft (Axle) in horizontal position.
- 11.6 The rope end is to be fixed at one end of a swivel (Antitwist device) permanently or by means of a shackle. The other end of the swivel is tied to the pulling eye of the cable. If a pulling eye is not available, then a cable grip is to be used.
- 11.7 As the cable length is 2 km, during cable laying work, proper communication is to be established. This can be done with walkie talkies or magneto telephones with drop wire.
12. **Precaution against Damage by Termites & Rodents.** In the rodent prone areas Optical Fibre cable joint closures should be applied with BHC 10% dust (Benzene Hydro chloride 10%) to prevent rodent & termite damage. The method suggested is "BHC" 10% dust of 1 kg is to be mixed in an approximate 2 kg of sand and applied around the optical fibre cable joint enclosures.
13. **Cable Laying**
- 13.1 Cable laying is proposed either by traditional Cable pulling method or by Cable blowing method.
- 13.2 **Cable pulling**
- 13.2.1 List of tools & other items required for cable laying is given below. This can be taken as a check list.
- 13.2.1.1 Jack- One pair.
- 13.2.1.2 Rope for unloading / loading/unloading.
- 13.2.1.3 Cable winch.
- 13.2.1.4 Cable winch.
- 13.2.1.5 Nylon rope drum of 1250 M (For machine pulling).
- 13.2.1.6 4 mm rope.
- 13.2.1.7 Swivel and shackle.
- 13.2.1.8 Pulling socks or cable grip.
- 13.2.1.9 Lubricant.
- 13.2.1.10 Plastic bowls for lubricant.
- 13.2.1.11 Sponge.
- 13.2.1.12 Walkie-Talkie 6 Nos. or
- 13.2.1.13 Magneto
- 13.2.1.14 Drop wire 2 kms. (for magneto).
- 13.2.1.15 Rubber 2 / manhole.
- 13.2.1.16 Half round (split) pipes 2 /manhole.
- 13.2.1.17 Polythene tape 5 m/manhole.
- 13.2.1.18 Clamps 4 /prs, //manhole.
- 13.2.1.19 Cleaning brush for cleaning pipes.

- 13.2.1.20 Mandrill.
- 13.2.1.21 Sometimes there is considerable lapse of time between the pipe laying and cable laying. This intervening period could have heavy rains too. Therefore there is possibility of entering dissolved muddy water into the HDPE pipes. This dissolved muddy water may transform into a thick paste or solid mud. Cleaning of the pipes before the cable laying is absolutely necessary to remove any such obstructions. A 4 mm nylon rope is already laid in HDPE pipe. One end of this rope is connected to Mandrill. The other end of mandrill is connected to another rope of 4 mm size and suitable length to cover the distance between two manholes. The existing 4 mm rope is pulled from other manhole and thus the mandrill will clear the pipes. Similar operation is then done by replacing mandrill with nylon brush and rugs.
- 13.2.2 The pulling of the cable can be done in three ways:
- 13.2.2.1 By cable winch.
- 13.2.2.2 By cable winch assisted by manual pulling at inter mediate manholes.
- 13.2.2.3 By manual pulling at all the manholes.
- 13.2.3 For manual pulling, the rope may be attached to a diameter and then to the pulling eye which is fixed to the cable end by supplier. The pulling may be done either manually under close supervision watching all the time the pulling tension or by means of winch with automatic cut off at set tension monitored through dynamometer fitted in the pulling winch.
- 13.2.4 To reduce the friction between the cable and HDPE, a suitable lubricant may be continuously applied with a sponge to the cable surface during pulling at every intermediate man-hole. The standard lubricants with low frictional coefficient may be used.
- 13.2.5 As soon as 1 km cable or so is pulled towards one side of the route, sufficient overlap of cable may be kept at splicing location so that the ends may be taken into the Air conditioned splicing van placed at a convenient and nearby place. 15 metre cable may be the maximum requirement.
- 13.2.6 Laying the remaining half of the cable:
- 13.2.6.1 Take out the winch to the other end if machine pulling is done.
- 13.2.6.2 Uncoil the cable and make the formation of 8. This should be done manually with sufficient care and minimum bending radius.
- 13.2.6.3 Repeat the process of connecting the end of the cable with eye or pulling grip to the swivel to which the pulling rope is attached.

- 13.2.6.4 Repeat the process of pulling the cable by winch or manual with special attention to lubricant super vision and coiling the overlapping length in the pit.
- 13.2.6.5 The mouth of the HDPE pipes at every man hole is closed by rubber bushing. This is mainly required for prevention of rodent entry.
- 13.2.6.6 The cable at the intermediate manholes are to be covered by split 65 mm OD 10 kg/cm² HDPE pipes, covered with polythene tapes and clamped at 4 places. Thereafter re-instatement of the man holes is to be done.

13.3 Cable Blowing

- 13.3.1 **Laying of Permanently Lubricated HDPE Telecom Duct by Blowing Technique Scope.** This EI describes the procedure for lying of PLB HDPE TELECOM DUCT. Telecom Duct is an advanced pre-lubricated duct system. Lubricants are built in to a durable polymer base. Duct has a low coefficient of friction and the built in lubricants do not diminish with age.
- 13.3.2 **Advantages of Duct Systems.** Duct systems may provide several significant advantages:
 - 13.3.2.1 HDPE Telecom Duct provides the mechanical protection to the Optic Fibre Cable and eliminates the need for armoured cable, which is more expensive. The combination of the un-armoured cable and the HDPE duct offers a better cable protection system as compared to the armoured configuration.
 - 13.3.2.2 Empty ducts can be placed during initials construction for future use when more fibre optic capacity is needed, this eliminates the entire re-digging / construction process against and again. This reducing future upgrade costs.
 - 13.3.2.3 With HDPE duct it is possible to access the cable from manhole at any time. It is therefore not necessary to re-dig and block off streets and pathways, which is both time consuming and expensive. It is possible to install longer cable lengths into HDPE Telecom Duct with fewer splicing points in the network. This saves money and time on installation. Fewer splicing points along the cable route also offers better transmission parameters. Fewer splices mean less down time during the network's lifetime. Most faults requiring maintenance appear at splice points. Significant savings, both immediate and long term, are achieved by limiting the number of splice points. Limiting the

no. of splice points increase the transmission quality of the fibre optic network.

- 13.3.2.4 When encountering defective cable or if the cable does not meet the capacity of one's bandwidth needs, it is possible to withdraw existing cables and replace them with different cable. Removed cables can be reused in other parts of the network with lower bandwidth needs. With HDPE Telecom ducts this process can successfully be executed without digging the earth. This can be achieved simply by opening two manholes. HDPE Telecom Ducts ensures the same technical conditions related to the ease with which cable can be inserted or withdrawn from the system regardless of whether this action is taken after 10 days or 10 years of the proper installation of the duct system.

13.3.3 **Duct Unloading and Loading.** Different ways of unloading the HDPE Duct:

- 13.3.3.1 Using ways of unloading the HDPE Duct:

13.3.3.2 When using a boom truck to unload the Duct Coil, place a bar through the reel / coil arbour, then attach a chain to the bar. DO NOT wrap the chain around the duct to lift the coil.

13.3.3.3 Open the tail board of truck, carrying coil and put wooden or metallic planks at appropriate places, slopping from the floor of the truck to ground. Roll down over these planks to rest on ground.

13.3.3.4 Duct coil can also be dropped from the floor of truck on sand or soft soil bed of about 12" height or more.

13.3.4 **Duct Mounting**

13.3.4.1 Place "Flange No. 1" of Collapsible Steel Reel on ground.

13.3.4.2 Put Duct Coil on "Flange No. 1" evenly in such a way that all holes of Flange No. 1 are accessible for fixing the traverse Bars from inner space of Duct Coil.

13.3.4.3 Place "Flange No. 2" on top of the coil and fix it in a place by tightening them with Traverse Bars by means of bolts and nuts.

13.3.4.4 Lift the Reel with the Coil and mount it on proper Jack Stand with the help of a strong iron shaft passing through the centre of the Collapsible Reel.

- 13.4 **Duct Installation.** For installation ducts in an open trench, use of the methods described below:-

- 13.4.1 **Manual Laying.** This method is efficiently used when installing single duct in an open trench or when there are many obstructions like trees etc along the route. Steps in manual laying: Place the Jack Stand along the sides of the trench.
- 13.4.1.1 Observe correct drum position i.e. duct should be uncoiled from the bottom of the drum by anticlockwise rotation of the drum. NOT from the top of the drum.
 - 13.4.1.2 Drive the reel slowly to avoid spinning of reel while pulling HDPE Duct for installation.
 - 13.4.1.3 Unroll the duct to the required length spacing the workers after every 15-20 mtrs.
 - 13.4.1.4 When encountering an obstruction, utility crossing or bore, pull the HDPE Duct beyond the obstruction until enough duct to manoeuvre it through or under the obstruction and then repull the duct.
 - 13.4.1.5 Duct can be placed into open trench either directly from a drum or temporally laid along the side of trench and placed later on.
- 13.4.2 **Multi Duct Laying.** Foreseen Duct Laying Whenever it is foreseen that in future more no. of cables will required, a 110 mm PVC Duct can be laid and 4 nos. of sub duct can be pulled, which can be tighten by Anchor block at the end of PVC pipe.
- 13.4.2.1 In long distance network this 110 mm pipe can be buried directly in the Sand, and in the Built up areas it can be encased in the 200x200x200 MM Cement Concrete.
 - 13.4.2.2 3 to 4 Kms length of OF cable reel is recommended to reduce the no. of splices.
 - 13.4.2.3 Coordination can set-up with Central / State government authorities, that while construction of Bridges / Culverts, provision of 8 to 10 Ducts of 110 mm.
 - 13.4.2.4 The cost of the same can be born by BSNL.
- 13.4.3 **Moving Trailer Method.** This method is most efficiently used when path of duct does not contain any road bores, utility crossings and other obstructions that require the duct to be placed under or pulled through without unloading it.
- 13.4.3.1 Mount the duct on the reel.
 - 13.4.3.2 Fix the Jack Stand properly on the trailer.
 - 13.4.3.3 Mount the duct along with the reel on the Jack Stand.
 - 13.4.3.4 Secure the cut end at the desired start location.

- 13.4.3.5 Move the trailer slowly along the trench route pay out the duct and avoid over spinning of the reel.

13.4.4 **Attaching Mechanical Pulling Machines to HDPE Telecom Ducts.** This method is suitable for laying multiple ducts simultaneously. In this method duct is pulled by mechanical pulling machine with the help of Pulling device that is fitted in-between duct and mechanical pulling machine. Two types of pulling devices commonly used are:

13.4.4.1 **Pulling Grip.** These offer excellent means of pulling ducts. Grips are made of high quality galvanized steel stand to assure long life.

13.4.4.1.1 Apply compressible bands of tape to HDPE ducts before installing the grip. Make the bands more than 1/16" thick using friction, vinyl or duct tape. Make these bands one tape width wide.

13.4.4.1.2 Start first band of tapes about 6-8 inches behind the cap on the duct end. Remember to keep the duct capped.

13.4.4.1.3 Start the second band of tape 6-8 inches behind the first band the grip will shorten when you stretch it to fit over the duct. Add bands until you have covered the length of duct, the grip will cover.

13.4.4.1.4 Pass the grip over the capped duct end and bands of tape. Apply tape on the grip.

13.4.4.2 **Thread-In-Pulling Eye.** These are used to pull HDPE duct, when properly sized and installed, these eyes will not pull out from duct.

13.5 **Procedure for Duct Laying Using Pulling Devices and Mechanical Pulling Machines.**

- 13.5.1 Mount duct coil on Collapsible Steel Reel (Refer to Procedure For Duct Mounting).
- 13.5.2 Put the duct, wound on collapsible still reel, on a rigid Jack Stand with the help of a strong iron shaft passing through the centre of collapsible steel reel.
- 13.5.3 Connect one end each of multiple ducts (already mounted on collapsible steel reel) to the pulling devices (pulling grip / pulling eye).
- 13.5.4 Attach ducts (connected to pulling devices) to Multiple Pulling Harness.

- 13.5.5 Connect the multiple pulling harness to suitable Mechanical Handling Machine (Excavator, Jeep etc.).
- 13.5.6 Move the Mechanical Handling Machine along the side of trench, while unwinding duct from collapsible steel reel. Feed the ducts directly in to the trench without entanglement so that duct are laid without crisscrossing.
- 13.6 **Duct Laying In Culverts, Bridges, Railway Crossing And Rivers:-**
 - 13.6.1 **Duct Laying in Culverts / Bridges.** In culverts without earth cushioning or less cushioning, the wheel guard (kerb) may be broken and G.I. pipe is fixed and kerb is rebuilt enclosing the G.I. pipe. HDPE DUCT can be pushed or pulled through the G.I. pipe. At slopes, G.I. shall be enclosed in brick masonry chamber for better protection. At curves flexible G.I. shall be used.
 - 13.6.1.1 NOTE: Do not use plastic couplings inside the G.I. pipe.
 - 13.6.1.2 If the kerb is of RCC and where breaking is not permitted, 150 mm x 150 mm concrete chamber shall be constructed on kerb to enclose the G.I. pipe. If neither of above method is possible, a G.I. pipe should be clamped to the outside of parapet wall.
 - 13.6.2 At railway crossings, mole or Directional Boring system is used for boring hole under railway track and G.I./C.I. pipe is introduced through the hole. Always use a bigger diameter G.I./C.I. pipe at railway crossing so that one can use it in future when traffic increases.
- 14. **Placement of Duct Into an Open Trench**
 - 14.1 When placing the duct into an open trench, the bottom of the trench must be reasonably flat, free of horizontal and vertical bends, and free of stones and debris. If surrounding soil contains sharp stone or other materials, the duct should be insulated with a protective layer of fine sand (approximately 5 to 10 cm under and above the duct).
 - 14.2 Place the duct as straight as possible. In case of any directional changes, keep the bending radius as big as possible. A min. bending radius, which is 10 times the outer diameter of the duct, is to be maintained.
 - 14.3 Vertical and horizontal winding in the trench directly lowers the distances. The cable can be pulled or blown.
 - 14.4 When duct takes a vertical position, it is important to support the duct to prevent damage or kinking during restoration. To accomplish this, compact the soil under and behind the bend.
 - 14.5 Use backfill to make rapid changes more gradual. During transportation and storing at the site duct, it is necessary to seal the ends of the duct with the proper End caps against water penetration or other impurities. Sand, soil or water and other impurities significantly increase the friction between the duct and the cable out sheet.

- 14.6 When installing duct into an open trench from a drum, correct drum position should be observed. Duct should be uncoiled the bottom not from the top of the drum.
 - 14.7 When placing multiple ducts in a single trench simultaneously, it is important not to cross or twist the ducts inside the trench. When installing large quantities of ducts it is possible to stack them one on top of the other in addition to side by side. However, positioning of the ducts must be designed in the planning stage to ensure clarity between duct placement.
 - 14.8 When placement of the duct is over and connections of duct ends are deferred to a later stage, it is advised to overlap duct ends by one meter from each side. Both ends of the duct must be properly sealed with End Plug to prevent water, dust or any other foreign articles from entering into the duct.
 - 14.9 Duct can be placed into an open trench either directly from a drum or temporarily laid along side the trench and placed later on. It is not recommended to hang ducts on fences, barriers, etc.
 - 14.10 When crossing the rivers and streams, duct is typically buried 120 cm below the riverbed. Vertical bends required to descend to this depth below the river floor must be executed as gradually as possible to ensure optimal cable installation lengths.
 - 14.11 When crossing bridges, HDPE Telecom Duct can either be bound directly to the bridge frame or it can be pulled within a Metal/PVC/ Concrete pipe fixed to the bridge frame. As always, sharp bends should be avoided. An ideal installation should have only gradual bends.
 - 14.12 Pump out water, if any, from the trench before placement of duct.
 - 14.13 Whenever tree roots are found in the trench, make sure to lay the duct under tree roots and not above.
 - 14.14 Place the duct along the trench as straight as possible. Tightly close the ends of the ducts with self tightening End Plug to that no dirt, dust or moisture enters into the duct.
15. **Duct Spacer.** When multiple ducts are placed in a single trench, it is better to use Duct Spacers so that ducts do not cross each other inside the trench. Duct end connections: There are two main choices for connecting duct ends: 1. metal non-reusable connectors or 2 plastic-reusable Couplers. Metal connectors made of Aluminium are recommended when installing sub duct into a main duct system. This type of metal connector is not typically water or airtight. It is recommended to use heat shrink sleeve over metal cover to ensure water tightness and to protect against corrosion. The Plastic Couplers are re-usable and versatile, however, they double the outer diameter of a duct, which can cause problems in a main duct system. They may still be used in a broad spectrum of installation situations. They are pressure tight and water tight, can withstand a minimum pressure of 10bar.
16. **The Installation of Metal Connectors.**
- 16.1 Metal connectors have clockwise threads in one half and counter clockwise threads in the other half of one continuous piece of metal. This design enables the engineer to tighten both duct ends to the connector simply by twisting the connector in one direction.

- 16.1.1 Cut the duct at the same place where they overlap. The cutting of two duct ends should match up perfectly. Each end must be chamfered with a deburring toll in both the outer and the inner diameter ends. This is to prevent any sharp duct ends from catching the cable as it shoots through the HDPETelecom Duct.
- 16.1.2 Mark duct on the duct ends before attaching the connectors to see how much of the duct will enter to the centre of the connector.
- 16.1.3 Push on the heat shrink sleeve and put both ends of the duct into the connector.
- 16.1.4 Tighten metal connectors with an installation tool in the direction of the arrow until the marked point is reached.
- 16.1.5 Centre the heat shrink sleeve over the connector. Heat the sleeve with a heat source such as a blowtorch until it shrinks tightly over the metal connector. Heat should be applied from the centre of the sleeve towards the ends. When using the heat shrink, follow the instructions from the manufacturer. Let the finished heat shrink cool for approximately ten minutes.
- 16.1.6 The installation of plastic coupler.
 - 16.1.6.1 Cut the duct at the same place where they overlap, in such a way that the duct end matches with each other perfectly because it is very important for the Coupling joints to be airtight. Proper pipe shears or cutters must be used for smooth cutting. Do not use a hacksaw to cut the duct.
- 16.1.7 Debar both the inside and the outside edges of the duct with a debarring tool.
- 16.1.8 Apply a small amount of proper lubricant (liquid detergent) for better installation of plastic Couplers.
- 16.1.9 Tighten the plastic coupler with C-Spanner.
- 16.2 **End Plug**
 - 16.2.1 Close the ends of duct with End Plugs so that moisture, dirt and dust do not enter the duct.
 - 16.2.2 It seals the duct ends completely and prevents air, moisture from entering the duct, even when it is laid underground.
 - 16.2.3 Further, interior surface of empty ducts also remains clean even after several years.
 - 16.2.4 Inspect the Neoprene Rubber for various defects such as pinholes, cuts, etc. In case of any such defect, replace the rubber gasket with a new one.
- 16.3 **Simple Plug**
 - 16.3.1 When the cable is already installed inside the duct, seal the duct with "SIMPLE PLUG".

- 16.3.2 It also saves the cable from dust, dirt, moisture etc. and increases the life of cable, since the contact with moisture is eliminated.

16.4 Duct Cutters and C – Spanner

17. **Methods for Fibre Optic Cable Installation Into HDPE Ducts.** The two most common methods are generally used for installation of O.F. Cable into HDPE Telecom duct, which are:

17.1 Cable Pulling.

17.2 Cable Blowing.

17.3 **Cable Blowing.** This advanced method is based on the concept of a consistent high-pressure airflow, equally distributed along the entire cable throughout the duct. The cable is mechanically fed into the pressurized space to overcome the pressure drop at the entry point. The additional pushing force at the entry point is important to increase the total blowable length. A cable jet-blowing machine is combination with an appropriate Compressor is essential for optimal blowing. For an effective Cable Blowing at an average speed of 50-60 meter /min. the Compressor should have the following parameters:

17.3.1 Factors Influencing the Blowable Length:

17.3.1.1 Inside diameter of the duct.

17.3.1.2 Outside cable diameter.

17.3.1.3 Cable weight.

17.3.1.4 Coefficient of friction between cable sheath and duct inner surface.

17.3.1.5 Number of slopes.

17.3.1.6 Cable stiffness

17.3.1.7 Compressor parameters.

17.3.1.8 Straightness of route.

17.3.1.9 Degree of winding of the duct in the trench.

17.3.1.10 Ambient temperature.

17.3.2 **Blowing Chamber & Manholes**

17.3.2.1 These Chambers at a distance of 1 Km, are required. The size of the Blowing Chamber is 3m x 1m x 1.5m (length x width x depth). These Blowing Chambers are temporary Chambers and are refilled after accomplishing the blowing operation.

17.3.2.2 **Joint Pit.** These are required at the termination locations. The distance of the Splice Chambers depends upon the length of the Optic Fibre Cable being used. Generally 2 Kms. length of Optical Fibre Cable is used. However, in developed countries, 4/6 Kms. of Optic Fibre Cable lengths are used. Pit size must be chosen carefully, taking into account length of Splice Closure and cable loop required for splicing and

future repair. Joint Pit is always greater than Splice Closure length plus twice the minimum bending radius of the cable. A pit length of 1 metre is sufficient for most of the splice Closures Generally size of the manhole is 1.5 m x 1m x 1.65 (length x width x depth).

- 17.3.2.3 The basic Rules and Recommendations for Blowing Cable into HDPE Telecom Duct: Use a proper compressor, never underestimate the compressor parameters. Ideally, internal diameter (I.D.) of the duct should be 2 times the outerdiameter (O.D) of the cable, For appropriate duct size please refer the following table:

Ser No	Outer Dia of OF Cable (mm)	Recommended Duct Size (OD/LD) mm
1.	9.0 – 12.5	32/26
2.	13.0 – 16.0	40/33
3.	16.5 – 20.0	50/42

- 17.3.2.4 Before starting the Cable blowing, be sure that duct is free of any obstacles or damage. Use a proper mandrel equipped with a transmitting device. This method will quickly locate the damaged areas if any, which must be replaced immediately.

- 17.3.2.5 When cable blowing is carried in high temperatures, protect cable from direct sunlight where possible. High temperature drastically reduces blow able lengths.

- 17.3.2.6 The blowing method is far less sensitive to bends and curves along the route compared to the pulling technique. When using state-of-the art HDPE Telecom Duct and Cable jetblowing machines, it is possible to safely install fibre optic cable around 30° to 90° bends without any additional lubricant.

- 17.3.2.7 Before beginning the cable blowing survey the route to determine the best locations, for access points for blowing machines and compressors. This can save considerable materials and labour. Always blow downhill wherever possible. Up-hill slopes located at the beginning of the route reduce the blow able length.

- 17.3.2.8 The blowing technique can be used in almost any situation and reduces costs relative to the pulling method in many cases, blowing exerts less stress on the cable.
- 17.3.2.9 This lowered stress combined with fewer splices to the fibre optic cable increases overall network quality.
- 17.3.2.10 The average blow able distance with one machine ranges between 700 and 2000 metres depending on the above-mentioned parameters. Longer utilizing several blowing machines in tandem can accommodate blowing lengths, positioned in a series of access points along the route. Another technique for achieving extra long cable installation, distances is to access, the cable at manholes like 8 then pull out the cable and continue installation from this point along the route.

18. **How to Repair Damaged HDPE Telecom Duct.** The HDPE Telecom duct system can be damaged during the construction activities of other utilities or agricultural activities, if the duct route is not traced properly, or when executing agencies do not respect the importance of tracing the duct route. Often people who dig the trenches or construct the main duct, route damage existing communications networks, because they have not properly identified the location of the underground network, before digging. Duct can be damaged either when empty or whitehousing optic fibre cable. The methods to repair these two possible situations are quite different.

18.1 How to Repair Empty Duct: The location of the damage should be excavated for three meters along the troubled area. The manhole must be big enough, including width, for labourers to work comfortably.

- 18.1.1 Cut off the damaged part of the duct.
- 18.1.2 Prepare the same length, same size, and same colour of spare length.
- 18.1.3 Debar the ends of both ducts entering the manhole and the two ends of the new piece. Connect the joints with plastic Couplers.
- 18.1.4 Place locator or markers on the newly placed Couplers and enter this data into any relevant documentation.
- 18.1.5 Place the Coupler into the ground and cover with fine sand or soil. Place warning tape and cover with earth when finished.

Annexure-I**GENERAL INSTRUCTIONS ON THE ACCEPTANCE PROCEDURE
FOR OF CABLES LAID BY HDD**

1. Following are the major observations/tests to be conducted during Acceptance testing of OFC by HDD method.
 - 1.1 Check at entry/exist pits:-
 - 1.1.1 As far as feasible, the A/T representative should be called during start of HDD operation. At the entry pit proper protection should be provided if the depth of duct is less than prescribed depth.
 - 1.1.2 It may be ensured that proper caution boards and other barricades are provided to prevent any accidents during HDD operation.
 - 1.1.3 It may be ensured that at entry and exist pit duct is brought to proper level manually and joint with coupler.
 - 1.1.4 The Route Index Diagram (RID) of HDD duct route made with the help of tracker should be verified with reference to various landmarks on the duct route.
 - 1.1.5 The cable route indicator to be provided suitably on the pavement or walls depending on the feasibility. In case of normal trunk route the route indicators to be provided on each manhole.
 - 1.1.6 The reference of other operators existing in the near vicinity should also be indicated in the RID.
 - 1.1.7 The duct at the lowest depth and the maximum depth of the duct should also be recorded. If A/T is done concurrently then tracking of ducts can also be verified with the help of tracker & preparation of RID.
 - 1.2 Check of manholes:-Verifying the following major points with reference to manholes:
 - 1.2.1 Check that the construction of manholes is as per the drawing & design approved by the competent authority (verify size/depth etc).
 - 1.2.2 Please ensure that duct is having proper hangers for keeping the coil of slack OFC.
 - 1.2.3 Ensure that unused ducts are provided with end caps.
 - 1.2.4 Check that proper holes are provided at suitable depth for taking the fibre to different buildings as per the requirements.
 - 1.2.5 Ensure the proper placement of FDMS and proper workmanship to ensure the fault free operation.
 - 1.2.6 Suitable arrangements are made to avoid entering water and mud in the manhole.

- 1.2.7 Check of provision of manhole numbering plate properly fixed at the manhole or imbedded on nearby wall or pavements with suitable direction and distance for easy location of manhole on sides of manhole.
- 1.2.8 Ensure that spare OFC cable is coiled with one meter Dia roll and hanged properly.
- 1.2.9 Record the depth of PLB duct at the manhole (it should be more than 1.65 meters).
- 1.3 Duct Integrity Test (DIT).
 - 1.3.1 Conduct the Duct Integrity Test from manhole to manhole or for specified duct length as per instructions already given in paras above.
 - 1.3.2 Please ensure that the ducts are laid with proper colour code as specified for OAN (Over lay Access Network).
- 1.4 Check of proper documentation
 - 1.4.1 Please ensure that proper RID is made and the duct route is drawn on the geographical map to the extent feasible. In larger projects GIS based route map may also be floated.
 - 1.4.2 Please ensure that in less depth case if any are covered by relaxation by competent authority and proper mechanical board is provided as per the standards laid by BSNL.
 - 1.4.3 Please also record the routes of other operators if any and details of distance from out duct route for future reference.
- 1.5 Check of HDD laid duct on bridges and culverts:-
- 1.6 Provision of site register.

HDD OPERATION

Contents

- Horizontal Directional Drilling (HDD)
- Applications of HDD
- Project Planning
- HDD Tooling
- Locating
- HDD Fluids

HORIZONTAL DIRECTIONAL DRILLING (HDD)

1. **HDD Overview.** Horizontal directional drilling is an excellent alternative to traditional utility installation methods. Unlike manual labor, trenching or excavation, the HDD process is highly suitable in urban areas or places where aboveground obstructions exist that are expensive, inconvenient or impossible to disturb for product installation. HDD machines install utilities under obstacles such as roads, rivers, creeks, buildings and highways — with little or no impact to the aboveground surface.
2. **Drill Rig.** Horizontal directional drilling machines are available in many sizes. Regardless of a machine's size, it has three main functions — rotation, forward thrust/pullback and fluid flow.



3. **HDD Process.** Horizontal directional drilling machines will bore under or around obstacles. Once the drill path is planned, an underground pilot bore is performed utilizing a series of drill rods connected to a drill head. After the pilot bore is completed, a back reamer is attached to the drill string that enlarges the drill path to accommodate the product that will subsequently be pulled into place. Vermeer NAVIGATOR horizontal directional drilling machines can install product under roads, buildings, railroad tracks, streets, rivers, creeks and in congested underground areas.
4. **Steering.** Steering refers to control of the direction of a drill path. The shape of a drill bit on the drill head allows an operator to change the drill path direction during a bore. When an operator points the drill bit downward to the 6 o'clock position and pushes the drill head forward, the drill head goes deeper. When the drill faces the 12 o'clock position, the drill head will rise. Pushed to the 9 o'clock position, the head goes left. Pushed to the 3 o'clock position, the head goes right. If no change in drill path is needed, the drill head and rod are rotated while thrusting.
5. **Locating.** Prior to starting a bore, the drill head is equipped with a transmitter that sends signals to an aboveground receiver during the bore. The drill head's location must be tracked during a bore in order to provide steering position information to the HDD operator.



6. **Backreamers.** When a pilot bore is complete, the drill head exits the drill path and a backreamer is attached. Utilizing drilling fluid and the drill string, the backreamer is pulled back through the path to enlarge it to accommodate the product that will be pulled into place. Sometimes prereaming is performed to incrementally enlarge the drill-path wall. The installation product is then attached to the drill string and pulled into place. Many backreamer styles and sizes are available for different ground conditions and product sizes.
7. **Mud Flow.** Mud flow is an important component of the HDD process. Mud flow is created by pumping a combination of water and specialized drilling fluid additives through the drill rod and head (or backreamer). The drilling fluid then mixes with soil in the drill path and creates a flowing slurry back out of the path as the product pipe is pulled into place. Mud flow cools the transmitter housing in the

drill head, suspends cuttings to help prevent product pipe from getting stuck during the bore and seals the bore to help prevent fluid loss and bore wall collapse.

Applications of HDD

8. **Applications Overview.** The horizontal directional drilling process has several distinct advantages over other methods of utility product installation. The HDD process offers precise installation, minimizes traffic interruption and excavation, and eliminates the need to dig up roads and disturb commercial interests.

Project Planning

9. **Project Planning Overview.** Prior to starting an HDD project, certain steps should be taken to ensure that you are performing the bore as efficiently as possible.
10. **Safety.** A thorough understanding of all safety and operating procedures is necessary to successfully operate an HDD. Each HDD unit is equipped with an operator's manual in a protected storage location. It is essential to study this manual before using the HDD unit.
11. **Exposing Utilities.** Location and exposure of utilities must be completed prior to starting an HDD project. Locating underground utilities and obstacles before beginning a project will help to ensure the final success of a bore. Ground-penetrating radar systems (GPR) can be used in conjunction with traditional locating techniques to help provide more accurate production of underground information.
12. **Machine Setup.** Proper placement of the machine prior to starting the project can greatly affect the efficiency of your bore. The HDD unit must be placed at the job site with care to ensure that the maximum depth of the bore can be obtained without overstressing the drill rods or the product being installed. The Vermeer Terrain Mapping System is available to help map geographical conditions at the job site. Information from the Terrain Mapping System can also be uploaded directly to software to help ensure proper machine placement.

HDD Tooling

13. **Tooling Overview.** Tooling is an essential component of the HDD process. Because tooling is subject to wear, choosing high-quality tooling for your HDD unit will help keep your projects more productive in the long run. Specialty tooling is also available for applications like rock and sewer. Customized tooling created to fit your work environment is available by special order.
14. **Drill Rod.** Drill rod is designed for pushing drill heads and pulling backreamers and new product through the drill path. They are made with a hollow center to allow drilling fluid to flow through the rod, into the drill head or backreamer and out into the bore path. Drill rod has an allowable bend radius which determines how

much it can be steered to produce the desired drill path. The bend radius is specific to each rod length and diameter.

15. **Drill Heads.** A drill head connects to the end of the drill rod and houses the locating transmitter and cutting bit. Drill heads also transfer drilling fluid from the drill rod to the drill bit. Drill heads can be connected to the drill rod using a connection system or hex collar connection system. A variety of drill heads is available for use in different ground conditions and applications.
 - 15.1 For use in standard dirt-based soil conditions.
 - 15.2 For use ranging from standard soil conditions to softer rock formations.
 - 15.3 For short- to mid-range use in solid rock formations.
 - 15.4 For use with bores involving wire line, gravity sewer or extended-battery operation.
16. **Drill Bits.** A drill bit attaches to the drill head and accomplishes the cutting action during a bore. There are many drill bits available for various underground conditions. Vendors offers a large variety of drill bits, several of which include standard bits for use in normal soil conditions and carbide-tipped and carbide-fragmented bits for tougher, more abrasive soil conditions.
17. **Backreamers.** There is a large variety of backreamers available for various soil conditions. The primary function of all backreamers is to prepare the bore path by cutting, shearing and mixing soil and drilling fluid into a flowing substance called slurry. When pulling product into place, the size of the backreamer used is larger than the outside diameter of the product(s), creating a flowing slurry between the bore path wall and product(s).
18. **Pipe-Pulling Accessories.** Pipe-pulling accessories are used to enhance the performance of a product pullback and project efficiency. Several commonly used pipe accessories include:
 - 18.1 Swivels — Prevent product from twisting while being pulled into the bore path.
 - 18.2 Pipe pullers (including pull grips, expanding taper pullers and carrot-type pullers) —Allow product to be pulled into the bore path.

Locating

19. **Locating Overview.** The type of locator most commonly used in HDD is a walkover system. The walkover system consists of a transmitter and a receiver. This type of system allows the user to walk over the top of the drill head with a receiver that interprets signals from the transmitter in the drill head. Information from these transmissions allows the user to determine the position of the drill head and displays several important pieces of information including pitch, roll, depth and location. This information is then relayed to a remote screen at the machine for the operator to see.
20. **Depth/Position.** To determine location of the drill head, the receiver uses signal strength from the transmitter in the drill head to indicate its depth and position. The depth and position information is displayed on the locator screen.

21. **Roll.** Roll is the rotary position of the drill head. It is indicated by a clock-face reading. Roll is very important when making a steering correction. When the operator of the drill rack faces the direction that the drill is advancing, 12 o'clock means the drill head will steer upward, 6 o'clock indicates a downward thrust, 9 o'clock is left and 3 o'clock is right. A bit can be positioned to move two directions at the same time by choosing a clock position in between any of the main clock positions. Example: 2 o'clock would cause the drill head to move mainly to the right, but a little upward as well.
22. **Pitch.** Pitch is the inclination of the drill head and can be expressed either in degrees or as a percentage of slope. If the pitch is zero, the drill head is level. If the pitch is minus, then the drill head is pointed down. A positive pitch indicates the drill head is pointed up. By knowing the pitch, you can calculate how much depth change there will be.

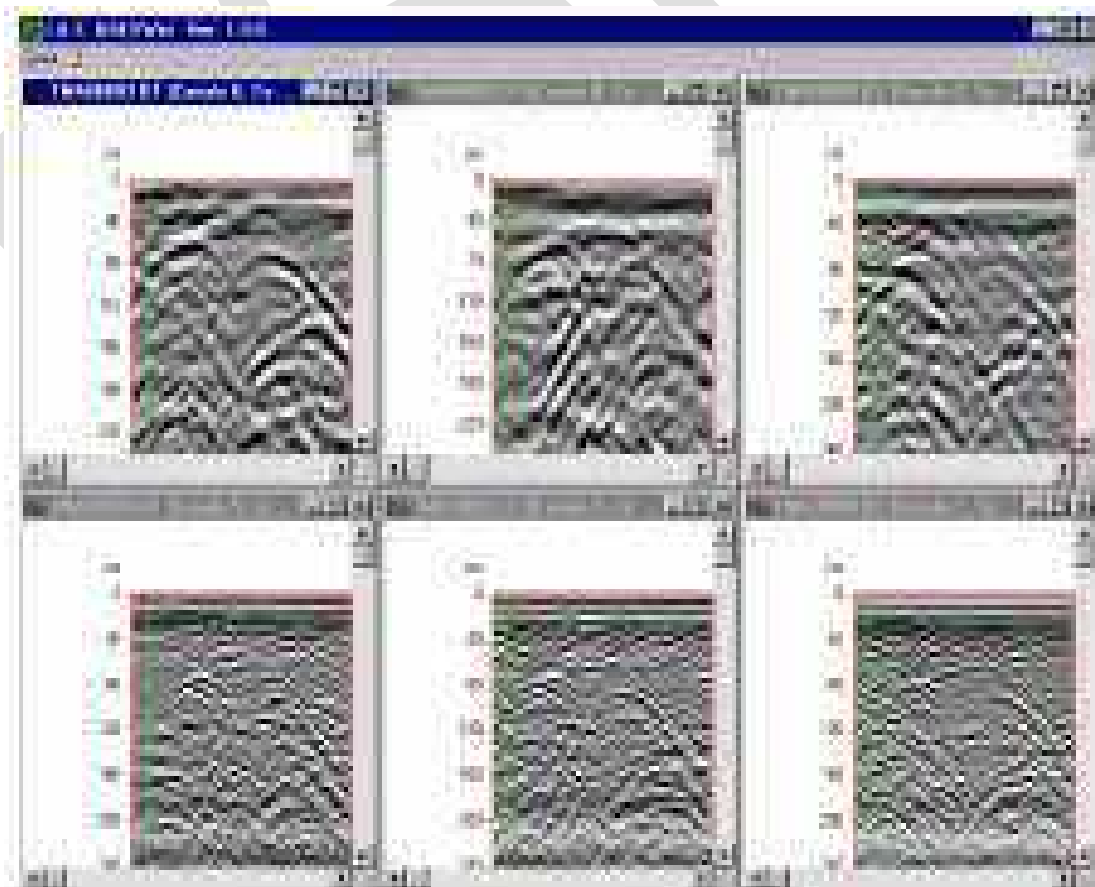
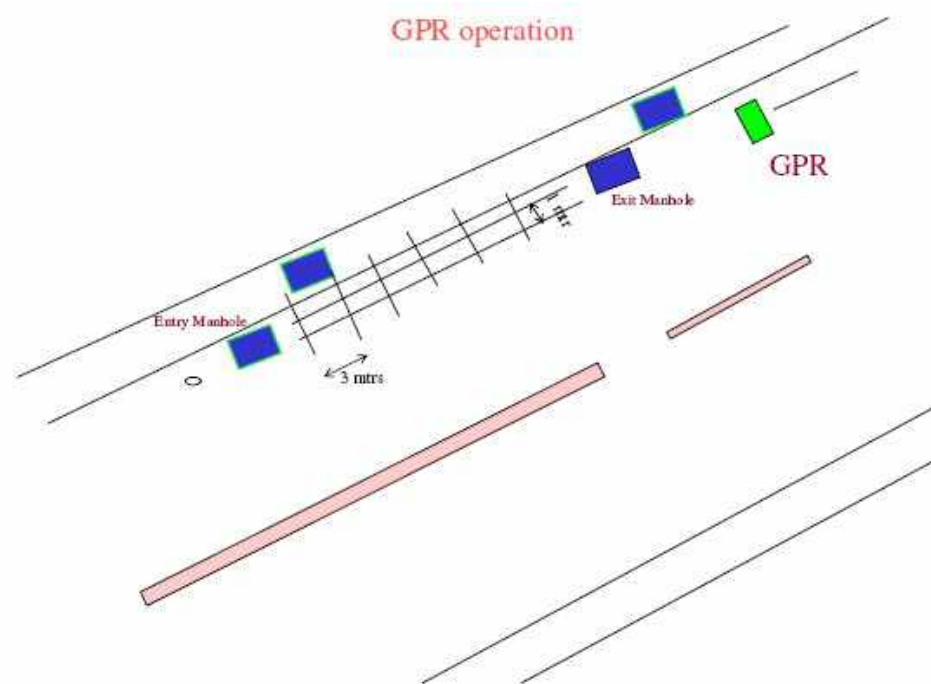
HDD Fluids

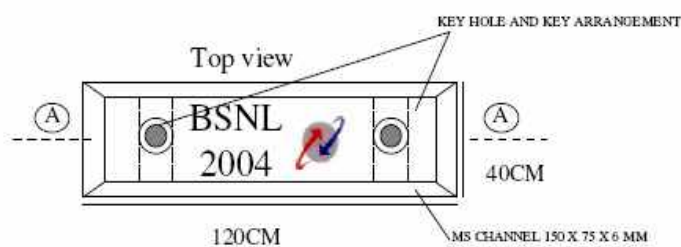
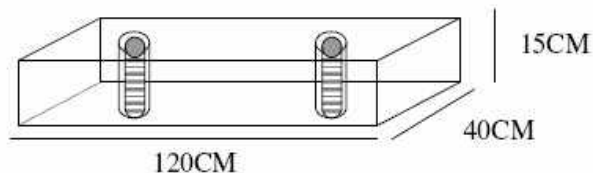
23. **Fluids Overview.** Drilling fluid is a mixture of water and specialized additives used in the drilling process. Drilling fluid cools the drill head and transmitter, lubricates the drill string and product being pulled back and suspends drill path cuttings into a slurry which flows out of the drill path as the product pipe is pulled into the bore path. A key requirement of drilling fluid is the ability to stay in the drill path without dissipating into the surrounding soil. The type of drilling fluid used depends upon the type of soil at the HDD project site.
24. **Soil Types.** Soils can be placed into two general categories — coarse and fine. Coarse soils consist of sands and gravels. Fine soils are comprised of clay. Coarse soils are non compactable and allow water to flow freely into the formation. Fine soils will usually prevent water from flowing into the formation, but have a strong tendency to become sticky and swell when mixed with water. It is possible to have a soil type that is a mixture of these two general types.
25. **Fluid Additives.** Depending upon work-site soil conditions, certain additives are mixed with the drilling fluid.
- 25.1 Bentonite is added to drilling fluid that will be used in coarse soil types. Bentonite forms a filter cake around the bore wall to prevent drilling fluid from dissipating into the surrounding soil.
- 25.2 Polymers and surfactants are used for fine soil types. Polymers reduce swelling of the soil and lubricate the drill path to reduce friction on the drill stem and product.
26. **Pullback Volume.** The amount of drilling fluid used on an HDD project is equally important to the type of drilling fluid used. Your objective is to have enough fluid to allow cuttings (slurry) to flow out of the drill path as it is displaced by the product being installed. The size of the drill path and soil conditions should be considered when determining pullback fluid volume. To determine the amount of soil in a bore path, the following formula should be used:
- 26.1 **Metric**
- 26.1.1 Reamer in inches squared then divided by 2 = liters per meter.
- 26.1.2 Liters per meter multiplied by meters of drill path = liters of soil in bore path.

26.2 English

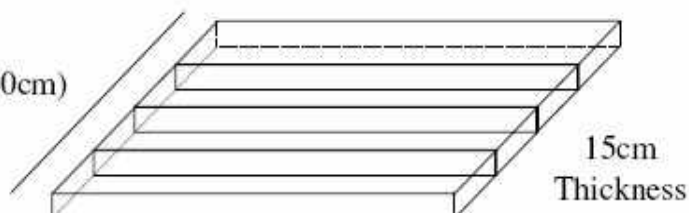
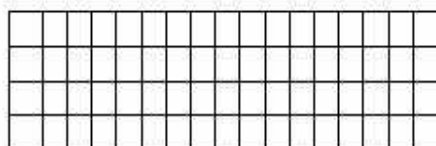
- 26.2.1 Diameter of backreamer squared then divided by 24.5 = gallons per foot.
- 26.2.2 Gallons per foot multiplied by feet of drill path = gallons of soil in bore path.
- 26.2.3 Enough drilling fluid needs to be added to the drill path to create a flowable slurry. As a general rule, the minimum amount of fluid required will produce a 1:1 ratio of drilling fluid to soil in the bore path. In some ground conditions like dry, reactive clay, a higher ratio of drilling fluid to soil is required. A leading cause of failed or stuck bores is not using enough drilling fluid. The pullback volume formula will assist in planning how much drilling fluid will be required at the job site.
27. **Pullback Speed.** Patiently pulling in product and using enough drilling fluid will contribute greatly to ensuring a successful pullback. After determining how much drilling fluid will be used per meter (foot), it is helpful to multiply this measurement by the length of drill rod being used to determine the volume of fluid that will be needed per rod. Dividing total volume per rod by the volume of fluid pumped per minute will provide a minimum pullback time for that rod. In some cases, the pumping capability of a unit could theoretically reduce pullback time to a minimum. It is extremely important that the pullback is slow enough to allow proper mixing of drilling fluids and soil in the bore path.

Ground Probing Radar

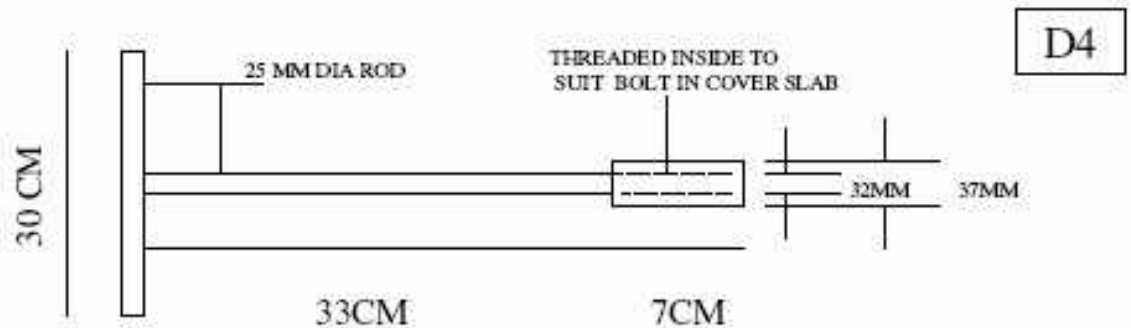
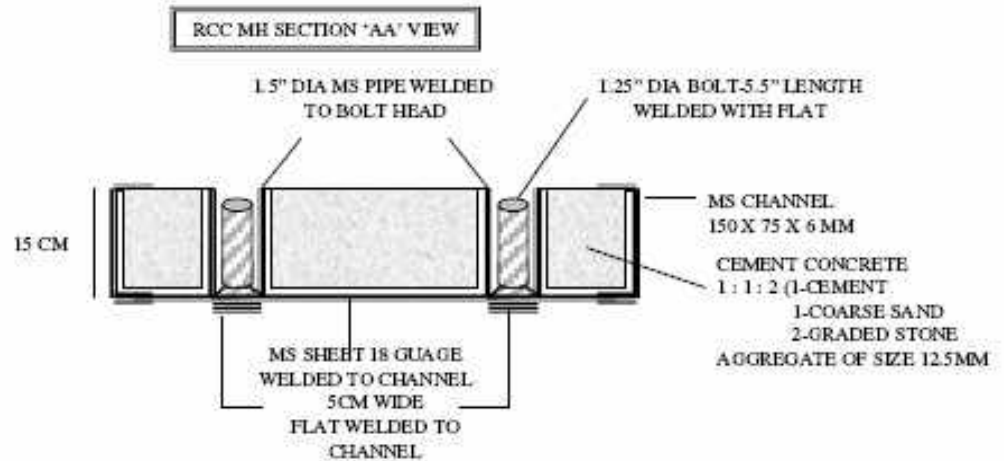
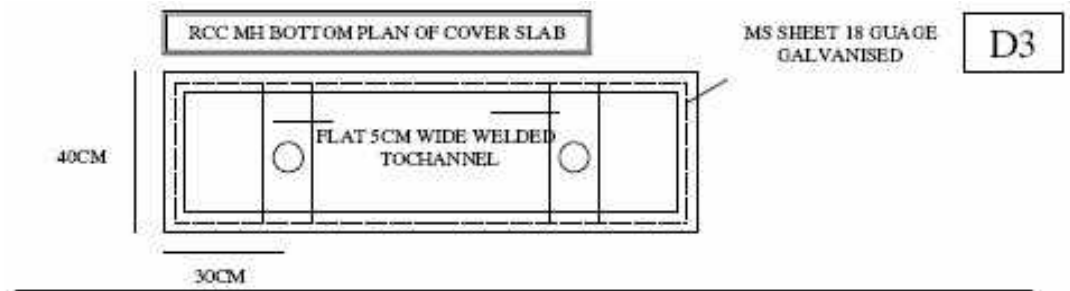


Annexure-III**Manhole Design Aspects****RCC MH COVER SLAB- FRONT VIEW****D1****RCCMH COVER SLAB APPEARANCE**

120cm

D2160cm
(4no x 40cm)**Reinforcement & Cement Concrete Mix Details for MH Cover Slabs**

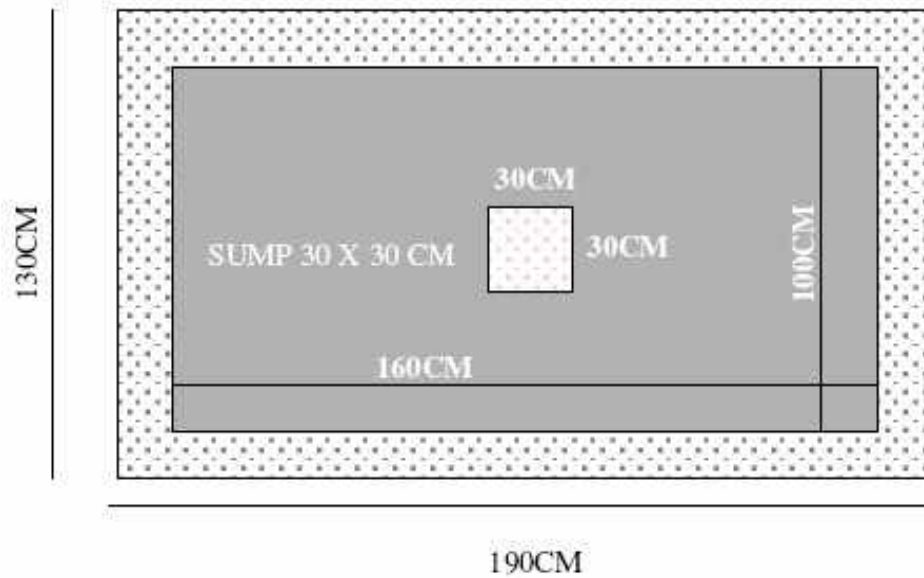
CEMENT CONCRETE 1: 1: 2
 (1 Cement: 1 Coarse Sand : 2 Grade stone
 Aggregate of 12.5MM nominal size)
 WITH 12 MM REINFORCEMENT AND 10 X 10 CM GRID



MILD STEEL COVER SLAB LIFTING KEY

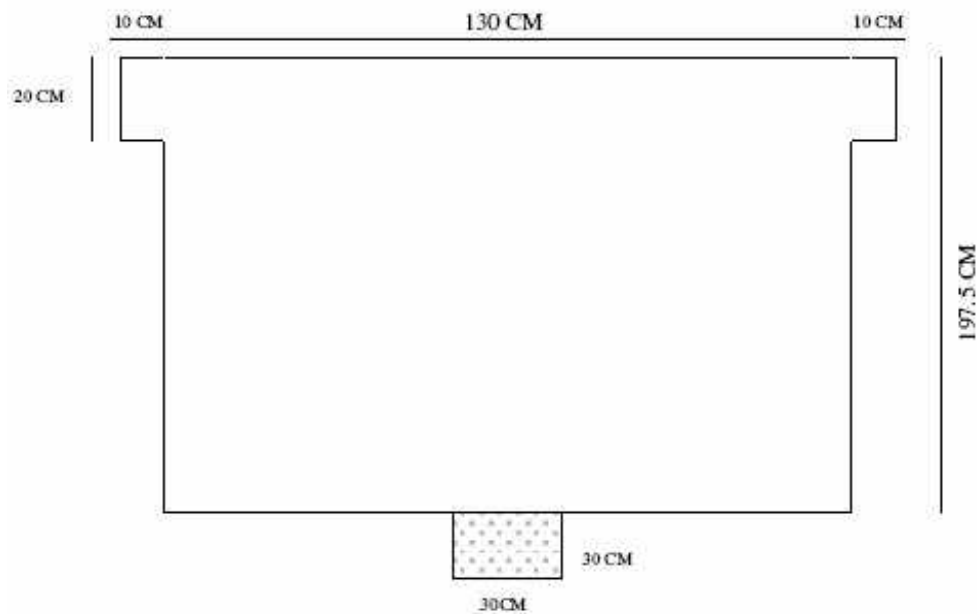
D5

HORIZONTAL SECTIONAL VIEW OF RCC MAN HOLE



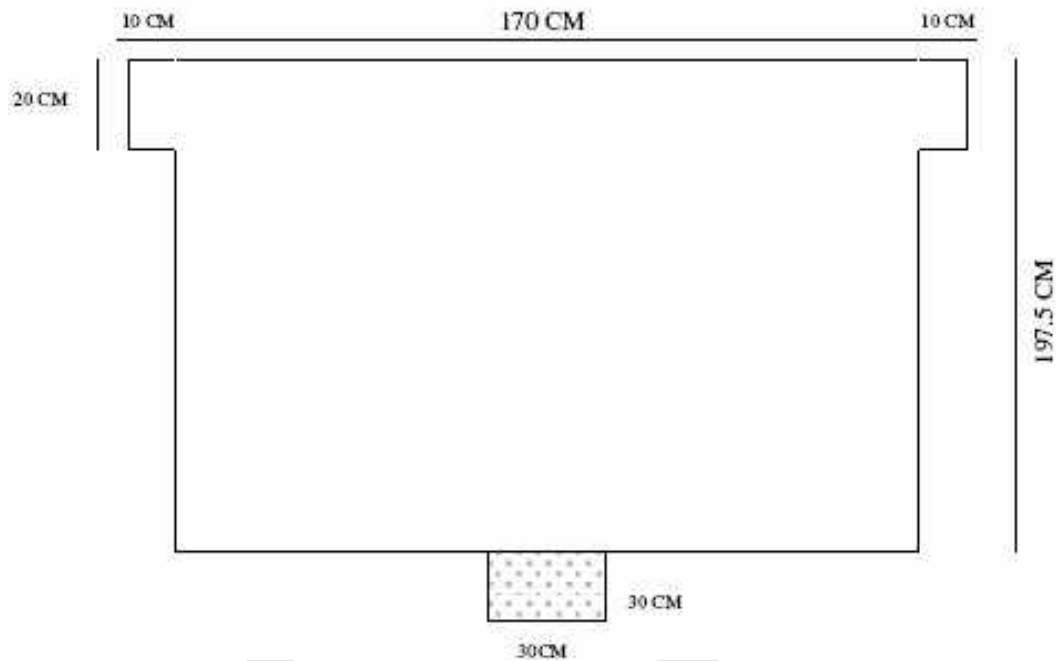
D6

FRONT ELEVATION OF RCC-MH



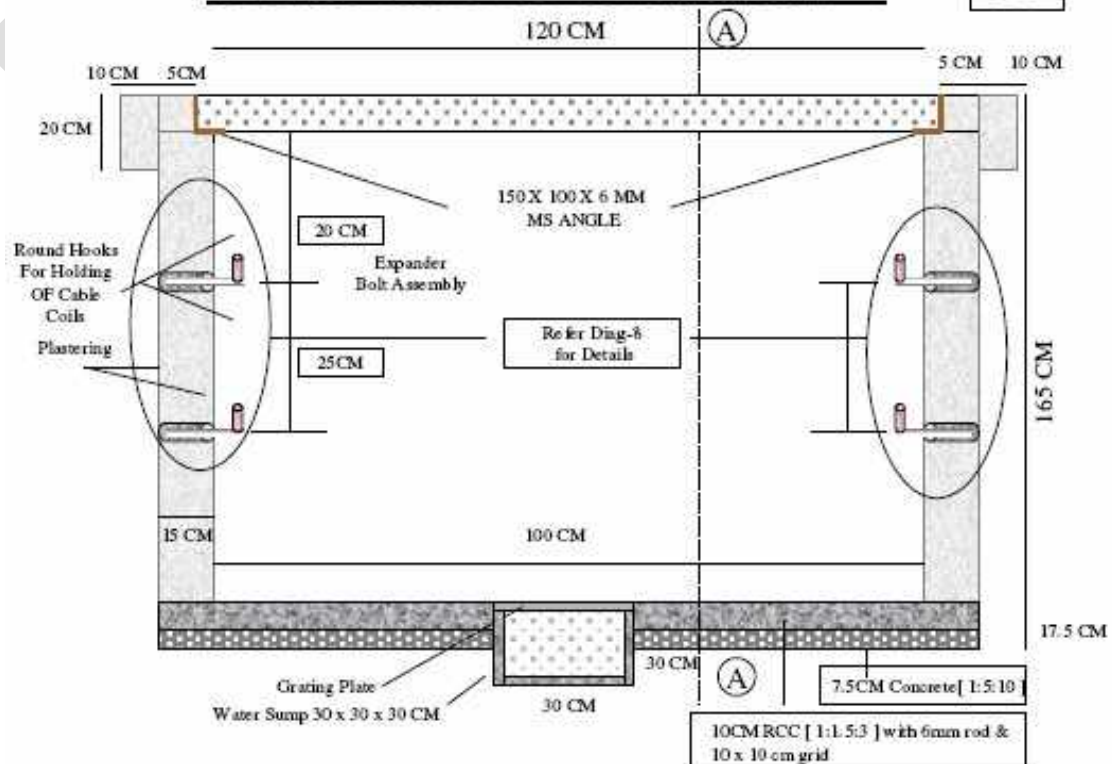
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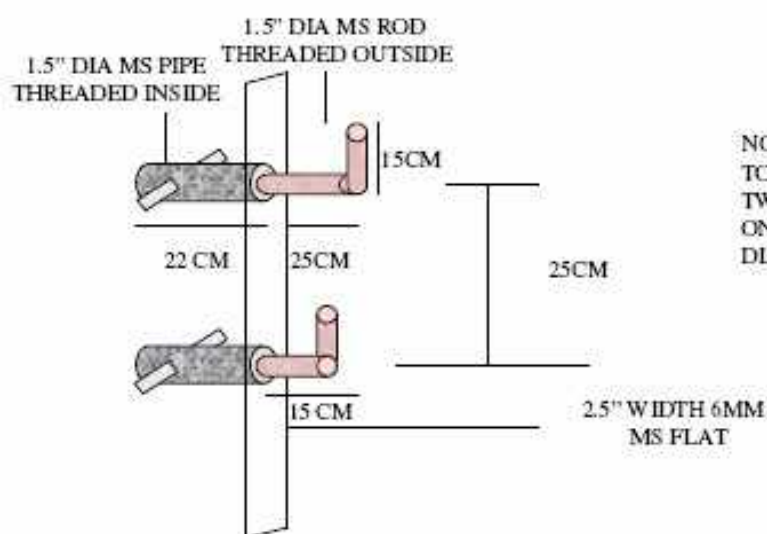
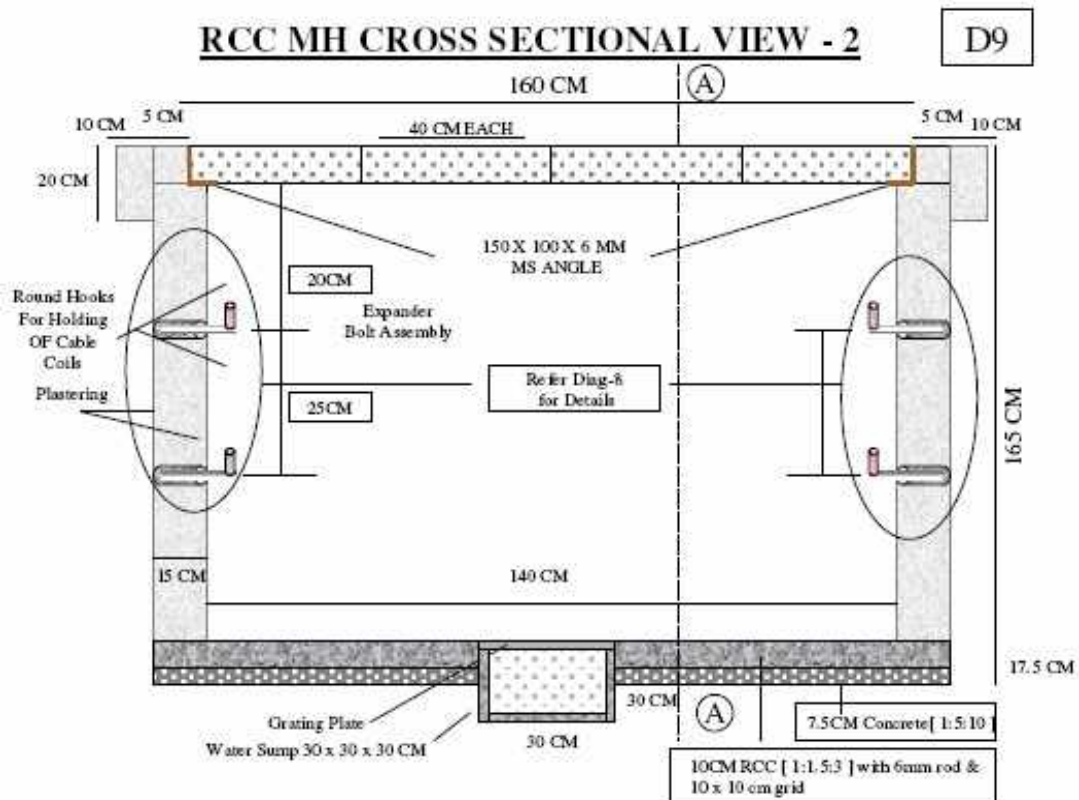
FRONT ELEVATION OF RCC-MH



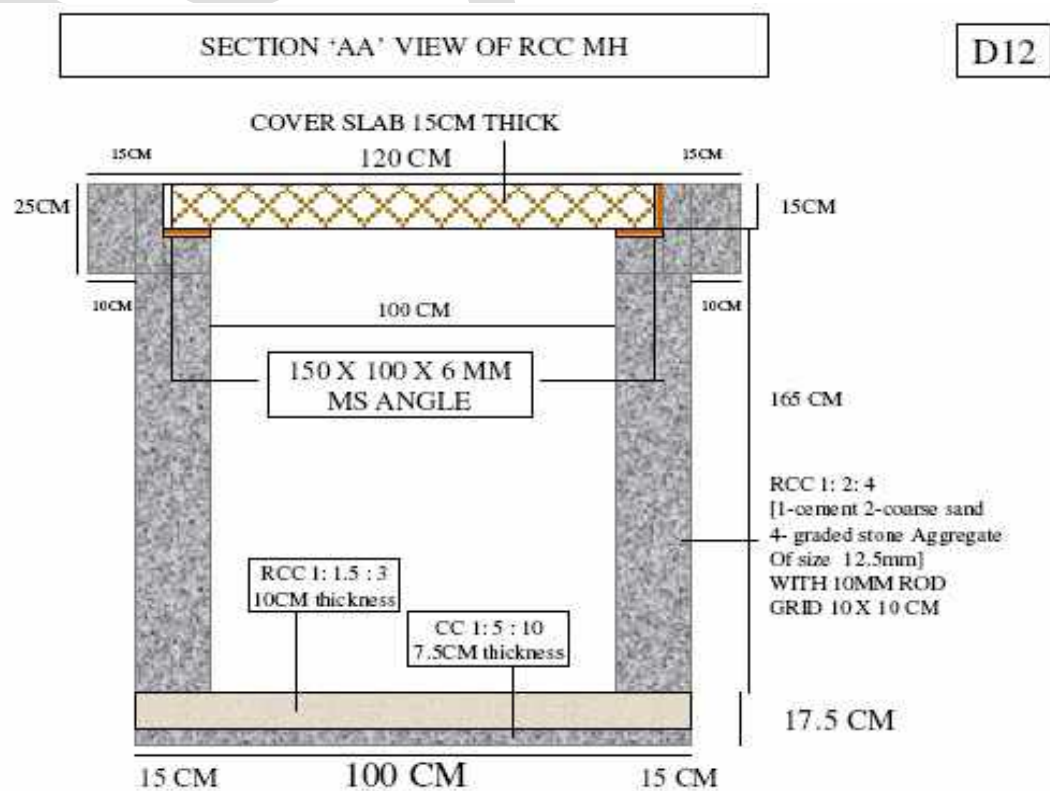
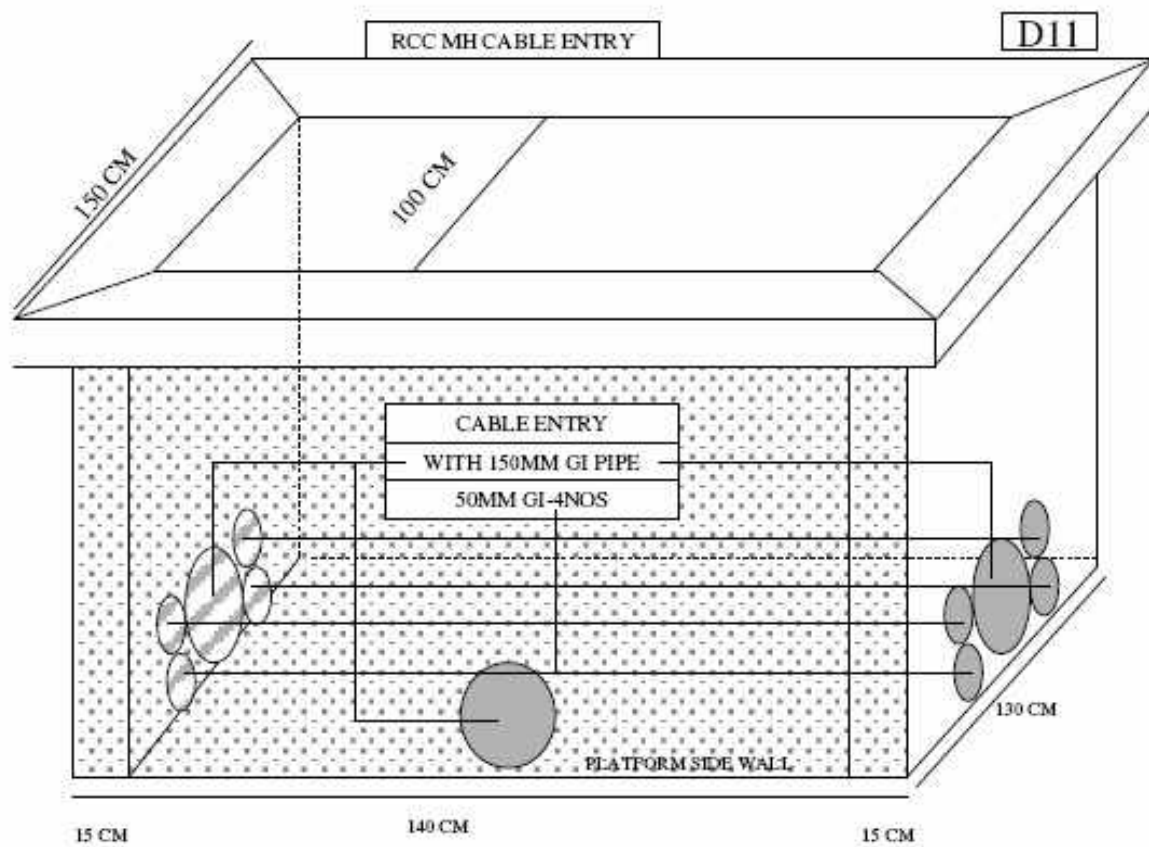
RCC MH CROSS SECTIONAL VIEW - 1

D8





NOTE: ONE HOLDER ASSEMBLY
TO BE PROVIDED ON THE OTHER
TWO WALLS OF THE MH EACH
ONE MT AWAY FROM THE WALL
DIAGONALLY OPP SIDE



Manhole under construction in Chennai



Open Trench: Protection – Stone slabs, RCC Half cuts to be incorporated.

ABBREVIATION:

1. FTTH : Fibre to the Home
2. GE-PON : Gigabit Ethernet Passive Optical Network
3. GPON : Gigabit Passive Optical Network
4. GPR : Ground Probing Radar
5. HDD : Horizontal Directional Drilling Method.
6. OAN : Overlay Access Network
7. RCC : Reinforced Cement Concrete

GLOSSARY

Backreamer: a cutting/mixing tool attached to the end of the drill string that is pulled and rotated through the pilot bore to enlarge the drill path.

Backreaming: the process of pulling and rotating a cutting/mixing tool through the pilot bore to enlarge the drill path.

Bentonite: a form of powdered clay used to contain fluid in the drill path.

Bore path/drill path: a path made in the ground by drilling or pushing the drill rod and drill head.

Boring/drilling: The process of creating an underground path for the purpose of product installation.

Drill bit: the cutting tool that attaches to the front of the drill head. It mounts to the head at an angle. This angle is what provides steering capability when pushing the drill string.

Drill head: tooling that is connected between the drill rod and drill bit. The drill headhouses the locator transmitter.

HDD: the abbreviation for the process of horizontal directional drilling; the abbreviation for a horizontal directional drilling unit — horizontal directional drill.

Horizontal Directional Drilling :The process of using a steerable cutting head attached to the end of a rotating drill rod string to bore through the earth in a horizontal direction.

Lineman's boots: insulated boots worn by HDD crews to help protect against electrocution hazards.

Locator: unit that reads the signal from the transmitter. The unit provides location, pitch, roll and depth information.

Locating: the process of collecting underground information from a transmitter to determine the position, pitch and depth of the drill head.

Pilot bore: the initial path created in the ground during the process of directional drilling.

Pitch: a measurement identifying the drill head's angle of ascent or descent.

Planning/setup: the process of preparing equipment and information for a drilling project.

Polymer: a compound that enhances gel strength, lowers filtration rate and increases lubricity.

Pullback: the process of installing product in the drill path.

Steering/roll: control of the direction of a drill path; the rotary position of the drillbit. It is indicated by a clock-face reading.

Slurry/mud: a flowing substance comprised of soil and drilling fluid. **Probe/transmitter:** an electronic device that fits inside the drill head and sends out a signal used to locate and determine the depth, pitch and position of the head. **Thrust:** occurs when the drill stem is pushed into the ground without rotating. **Utilities/product:** The service, pipe or material that is installed underground to carry water, gas, fiber, cable, electric, sewer, etc.

REFERENCE:

Recommendation of the committee of BSNL Corporate Office, vide Letter No. 35-9/04 -TPL (OF) (Pt.) Dated 16/10/06.

यांत्रिक अनुदेश

ENGINEERING INSTRUCTION

ओ.एफ.सी. केबिल की एच.ओ.डी. द्वारा संस्थापन प्रक्रिया में हैंड होल व्यवस्था
PROVISION OF HAND HOLE IN CASE OF HDD ON OFC LAYING

क्रमांक : टी.आर./ सी.ओ.एफ.सी./आई-004

(NO.: TR/COFC/I-004)

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All efforts have been made to incorporate all relevant up to date information available, any discrepancies or need for addition or deletion is felt necessarily may please be intimated to this office for further improvement, on E-Mail Id agmcfa@gmail.com.



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MP-482001

PROVISION OF HAND HOLE IN CASE OF HDD ON OFC LAYING

1. **Scope.** This Engineering Instruction provides instructions about hand hole in case of Horizontal Directional Drilling (HDD) on OFC laying. The purpose of the hand hole is to have more pulling points which can be easily located and opened so as to locate the fault. Beside this the spare OFC cable in the hand hole can be used for jointing.
2. **Introduction.** HDD Overview: Horizontal directional drilling is an excellent alternative to traditional utility installation methods. Unlike manual labor, trenching or excavation, the HDD process is highly suitable in urban areas or places where aboveground obstructions exist that are expensive, inconvenient or impossible to disturb for product installation. HDD machines install utilities under obstacles such as roads, rivers, creeks, buildings and highways — with little or no impact to the aboveground surface. The hand hole can be similar to joint chamber. The joint chambers being used in projects are mainly of two types
 - 2.1 Brick chambers
 - 2.2 Pre casted RCC chambers
3. **General Constructional Requirements**
 - 3.1 Bonding and Grounding attachments
 - 3.2 The Pulling Eyes shall be located at opposite ends of each conduit entrance point and shall have diameter as per requisite specifications (7/8 inches minimum)
 - 3.3 All Hand Hole covers shall be marked for easy identification and have a permanently attached label indicating the assigned Hand Hole number.
 - 3.4 All Hand Holes shall be equipped with slip resistant covers with height adjustment brackets, torsion assisted openings, guard bars and hexagonal head type bolts.
 - 3.5 All covers shall be rated for heavy and constant vehicular traffic regardless of placement location.
 - 3.6 Care should be taken to avoid placing the Hand Hole in a main conduit route between two Maintenance Holes.
 - 3.7 Splices may be permitted in Hand Holes depending upon cable type and size with all Hand Hole splice locations approved prior to their installation.
 - 3.8 Hand Holes shall be placed at strategic locations in a conduit system to allow installers to pull the cable through the conduit with minimum difficulty and to protect the cable from excess tension.
 - 3.9 Care should be taken to avoid lateral conduits entry/exit of Hand holes.
 - 3.10 Hand Holes conduits shall be plugged with duct seal material to prevent the entrance of water and gases.

- 3.11 No more than two 90-degree sweeps/bends shall be allowed between buildings & Hand Holes and between Hand Holes to Hand Holes. Regardless of depth, all bends and sweeps shall be concrete encased to prevent movement and “burning through” by the pull rope during cable installations.
- 3.12 Types of pipe to be used for Optical Fibre Cable: Optical Fibre Cables should be pulled or blown through 50mm/40 mm/32 mm (outer dia) PLB HDPE pipes having strength of 10 kg/cm². The HDPE PLB pipe meets the specification as given in GR No. G/CDS-05/01 DEC 94, shall only be used for laying the OF Cable. Wherever GI pipes or R.C.C. pipes are used for protection, the two ends of the pipe should be properly sealed to protect HDPE PLB pipe from sharp edge of GI pipe and to bar the entry of rodents. For providing additional protection Split RCC/GI pipes should be used from top instead of full RCC / GI Pipes.

4. Brick Chamber Type Hand Hole

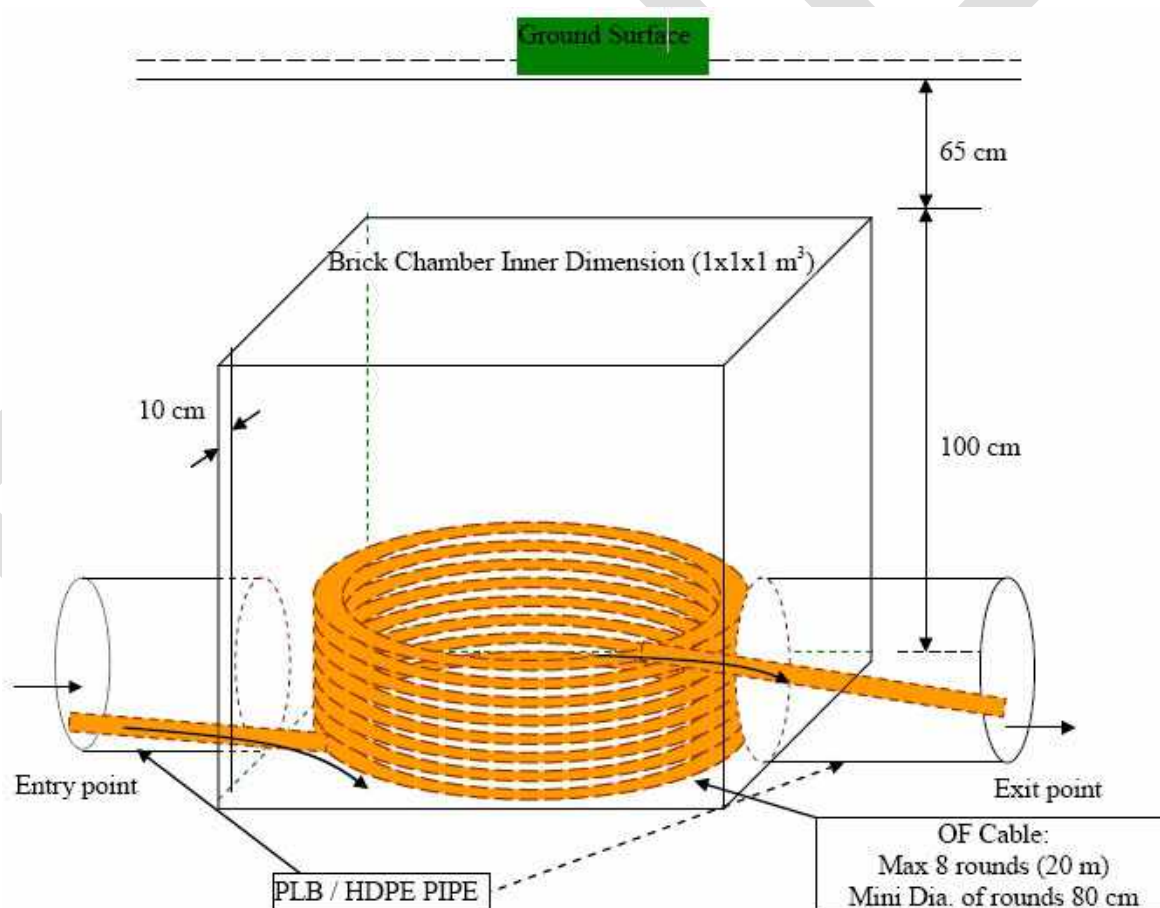


Figure: Block diagram of a brick chamber type Hand hole

- 4.1 For constructing brick chamber, first, base of the chamber is made using concrete mix of 1:5:10 (1: cement, 5: coarse sand, 10: graded stone aggregate 40mm nominal size) of size of 1.5m x 1.5 m x 0.15 m (thickness). Wall of brick chamber having internal dimensions of 1 m x 1 m x 1 m (H) should be constructed on this base having wall thickness of 9" using cement mortar mix of 1:5 (1: cement, 5: fine sand). The bricks to be used for this purpose should be of size 9" x 4.5" x 3", best quality available and should have smooth rectangular shape with sharp corners and shall be uniform in color and emit clear ringing sound when struck. The joint chamber should be so constructed that HDPE/PLB pipe ends remain protruding minimum 5cms inside the chamber on completion of plastering. The HDPE/PLB pipes should be embedded in wall in such a way so that, the bottom brick should support the pipe and upper brick should be provided in a manner that HDPE/PLB pipe remains free from the weight of the construction.
- 4.2 The joint chamber should be plastered on all internal surfaces and top edges with cement mortar of 1:3 (1: cement, 3: coarse sand), 12 mm thick finished with a floating coat of complete cement as per standard. Pre-cast RCC slab with two handles to facilitate easy lifting, of size 0.6 m x 1.2 m and of thickness of 5 cm having one handle for each half in centre and word "OFC BSNL" engraved on it are to be used to cover the joint chamber. Two numbers of such slabs are required for one joint chamber. This pre-cast slab should be made of cement concrete mix of 1:2:4 (1: cement, 2: coarse sand, 4: stone aggregate 6 mm nominal size) reinforced with steel wire fabric 75 x 25 mm mesh of weight not less than 7.75 Kg per sq. meter. The joint chamber is filled with clean sand before closing. Lastly, back filling of joint chamber pit with excavated soil is carried out.
- 4.3 The depth should be sufficient (165cm, plz. refer EI on laying practices of Optical Fiber Cable by HDD, NO.TR/COFC/A-001 dated 31-01-2007) so that the hand hole is safe i.e. not damaged by normal city activities. The top of the hand hole should be about 60 cm +/- 10 cm. This depth will be neither too much for maintenance work nor too less.

5. Pre Cast RCC Chamber (Ring) Type Hand Hole

- 5.1 RCC ring should conform to NP2 class pipe as given in table above as per dimensions given in drawing. RCC TOP and BOTTOM plate shall have reinforcement as:
- 5.1.1 Single round ring of 6mm dia.
- 5.1.2 Horizontal and vertical rods of 6mm dia.
- 5.2 Cement concrete of 1:2:4 where 1Cement, 2 Sand and 4 Stone aggregate of 6 mm size should be used. It should be finished in dimensions as per drawing. Surface should be smooth and finished. It should be of sufficient strength, so that it may not get damage while

heading i.e. loading, unloading and fixing at site. The two entry points as mentioned in the drawing for facilitating entry of OF cable.

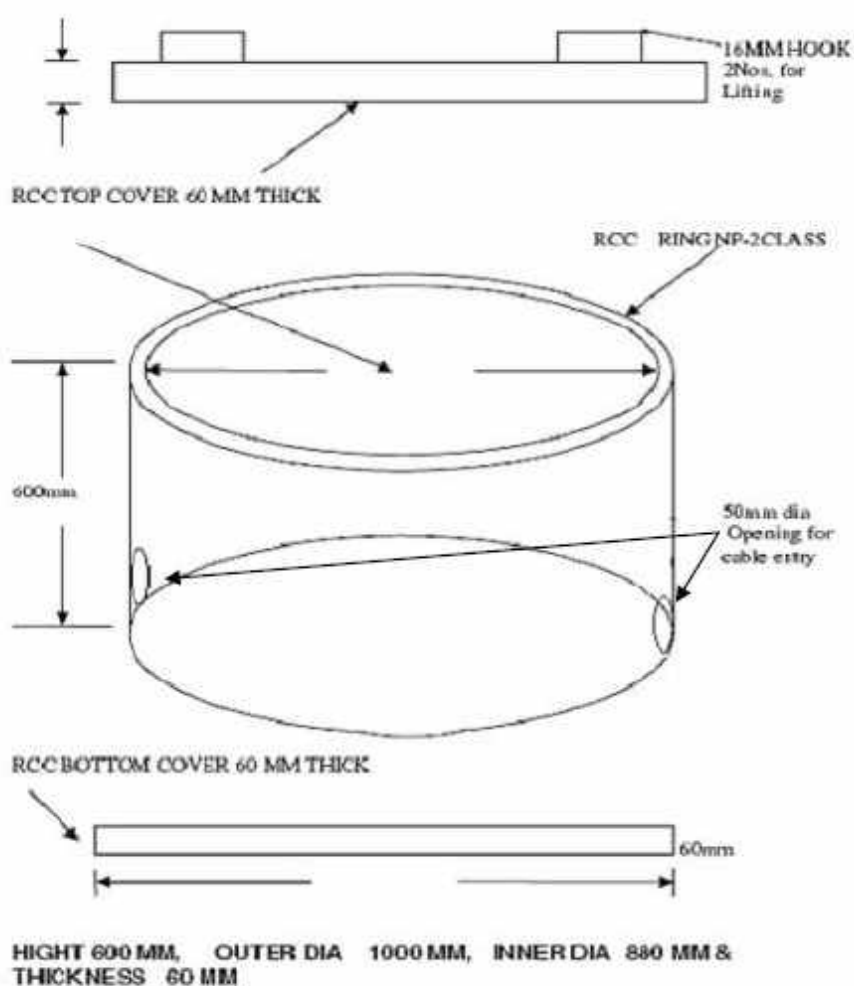


Figure: Drawing for Pre cast RCC Chamber with Base Plate and Cover

6. General Technical Requirements

- 6.1 The minimum diameter of the roll in hand hole should be 80 cm. (safe limit of bending radius is about 15 times the diameter of cable)
- 6.2 Approximate length of cable to be kept in hand hole should be 20 m or 8 rolls.
- 6.3 The OF cable rolls will be kept horizontally as being done in joint pits.(to keep cable vertically fixers are to be provided which will increase the cost of hand hole)
- 6.4 There will be no clamp and fixers at entry point. The entry and exit will be same as in joint pit.
- 6.5 The depth should be sufficient so that the hand hole is safe i.e. not damaged by normal city activities. The top of the hand hole should about 60 cm +/- 10 cm. This depth will be neither too much for maintenance work nor too less.

- 6.6 The distance between hand holes should be 400m. The deviation from the 7th RTPC meeting (at Solan, H.P.) decision is due to cost involved in hand hole construction, cost of fiber used as roll in hand hole and resultant increase in optical length. The approximate cable in 200m hand hole will be 9 x 20 m i.e. 180 m i.e. about 9% of fiber length. The approximate cable in hand hole at distance of 400 m will be 4 x 20 m i.e. 80 m i.e. about 4 % of fiber length (i.e. 5% saving of OFC cable, constructional cost saving is extra). The 400 m span is tradeoff between the expenditure and need. Since the roles will be made similar to practice in joint pit so there will be no significant detrimental effect on technical performance of the fibre i.e. attenuation/absorption and other losses.
- 6.7 One PVC/HDPE or any suitable pipe should be kept vertically over the top of hand hole up to a height 5cms below surface. This will further help in locating hand hole in future.
7. Numbering scheme. The numbering scheme for these hand holes will be hand hole No followed by the joint no. For example 2/2 hand hole means 2nd hand hole after 2nd joint. Hand hole no 3/14 means this is third hand hole after the 14th joint. Hand hole no 4/0 means that it is 4th hand hole after the termination (0 joint). **The numbering existing hand holes should not be disturbed on account of additional joints.** The location of hand hole should be properly marked on route index diagram (RID) and the location of its indicator should be properly indicated in RID so that its location is easy and correct in future during maintenance.
8. **Customization Requirements**
- 8.1 In case of situation demand / very dense population / highly revenue or market area the hand hole may be constructed at 200m distance, instead of 400m.
- 8.2 In case of difficulties being faced for digging bigger pit due to soil or municipal restrictions, chamber of smaller size can be constructed of specific dimensions at the description of competent authority on case by case basis.
9. **Conclusion**
- 9.1 The Brick chamber (in the northern region) and the Pre cast RCC (in the western region) Hand holes are continuously in practice since about 30 year in the Telecom Sector of India.
- 9.2 The revised process and necessary instructions to change the construction practices are changed time to time as per instructions from BSNL Corporate office. The amendments in this EI shall be incorporated as and when the instruction received from BSNL Corporate office.

GLOSSARY

1. **Bonding.** The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.
2. **Conduit** A raceway of circular cross-section.
3. **Cross-connection.** A connection scheme between cabling runs subsystems, and equipment using patch cords or jumpers to attach to connecting hardware on each end.
4. **Entrance point.** The point of emergence of telecommunications conductors through an exterior wall, a concrete floor slab, or from a rigid metal conduit or intermediate metal conduit.
5. **Grounding conductor.** A conductor used to connect the grounding electrode to the building's main grounding bus bar.
6. **Grounding electrode.** A conductor, usually a rod, pipe or plate (or group of conductors) in direct contact with the earth for the purpose of providing a low-impedance connection to the earth.
7. **Hand hole.** A structure similar to a small maintenance hole in which it is expected that a person cannot enter to perform work.
8. **Inner Duct.** Typically, a nonmetallic pathway within a pathway. Also known as sub duct.
9. **Manhole (Manhole).** A vault located in the ground or earth as part of an underground duct system and is used to facilitate placing, connectorization, and maintenance of cables as well as the placing of associated equipment, in which it is expected that a person will enter to perform work.
10. **Pathway.** A facility for the placement of telecommunications cable.
11. **Pull cord or pull wire.** A cord or wire placed within a raceway and used to pull wire and cable through the raceway.
12. **Raceway.** Any enclosed channel designed for holding wires or cables.
13. **Splice.** A joining of conductors generally meant to be permanent, generally from separate sheaths.
14. **Splice box.** A box, located in a pathway run, intended to house a cable splice.

Abbreviations

EI	Engineering Instruction
HDD	Horizontal Directional Drilling
NTR	Northern Telecom Region Circle
OFC	Optical Fibre Cable
PVC/HDPE	Polyvinyl chloride/ High Density Polyethylene (type of pipes)
RID	Route Index Diagram
RTPC meeting	Regional Trunk Planning Committee Meeting of BSNL.

Reference:

1. EI on laying practices of Optical Fiber Cable by HDD,NO.TR/COFC/A-001 dated 31-01-2007.
2. 7th RTPC meeting minutes vide letter No. 4-23/2010-TP/RTPC dated 29th June 2010.
3. Telecom Standards from the Net.

यांत्रिक अनुदेश

ENGINEERING INSTRUCTION

ओ.एफ.सी.केविल लेयिंग में माइक्रो टनलिंग का परिचय

INTRODUCTION OF MICRO-TUNNELLING IN LAYING OF O.F. CABLE

क्रमांक : टी.आर./सी.ओ.एफ.सी./ए.002

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MICRO-TUNNELLING FOR LAYING OF OPTICAL FIBER CABLE

1. **Scope.** This Engineering Instruction deals with the methods to be adopted in laying of PLB HDPE pipes for Optical Fiber Cable using micro-tunneling or Horizontal Directional Drilling (HDD) -also called as the trench less technology.
2. **General**
 - 2.1 Micro-Tunnelling boring, commonly known as horizontal directional drilling or HDD, is a steerable trenchless method for installing underground pipes and cables in a shallow arc along a prescribed bore path by using a surface launched drilling rig, with minimum impact on the surrounding area. Directional boring is used when trenching or excavating is not practical. Directional boring minimizes environmental disruption. It is suitable for a variety of soil conditions and jobs including road, landscape and river crossings. In BSNL directional boring is used for installing PLB-HDPE pipe for laying of Optical Fiber Cable and U/G telephone cable. It is used for crossing waterways, roadways, congested areas, environmentally sensitive areas, and areas where other methods are costlier. It is used instead of other techniques to provide less traffic disruption, lower cost, deeper and longer installation, no access pit, shorter completion times, and environmental safety. The technique has extensive use in urban areas for developing utility services as it helps to avoid huge disruption and hazards created during open cut trenches. The use however necessitates that the operator must have the complete information about the existing utility services so that he can plan his whole alignment to avoid damaging those utility services. Since uncontrolled drilling can lead to such damages, different agencies/government authorities owning the urban utility services have formed their rules for safe work execution. To standardize the techniques, different trenchless technology promoting organizations have developed guidelines for this technique.
 - 2.2 BSNL has already introduced Optical Fiber Transmission systems for local junctions and for long distance routes. For local junction and long distance routes different types of Optical Fiber Cables like 24Fibres, 12Fibres & 6Fibres (metallic & non-metallic) have already been introduced in BSNL for installation of Optical Fiber Cable Transmission systems. As Optical Fiber is going to be the ultimate medium for most of the access technologies in future, high count fibers like 48Fibres, 96Fibres & 144Fibres O.F Cables are deployed in large scale in the recent years. All these high count cables are ribbon fiber cables with 12Fibers in one ribbon. Under the Overlay Access Network Project, these cables are laid in ducts using Micro-tunneling trench. The Micro tunnel duct or Horizontal Directional Drilling (HDD) usually deployed mainly for the O.F.C routes within the corporation & municipality limit. The Micro tunnel duct may also be used at the water canal crossings, highway crossings and railway crossings. HDPE pipe coil of 1Km. length shall be economical resulting less wastage in micro-tunneling process.
3. **Detailed Survey**
 - 3.1 The HDD is normally deployed in the soft soils only. In rocky areas and laterite soils deployment of this technology shall be very expensive and hence may not be financially viable. In addition, HDD operation in rocky

areas shall be extremely slow. Thus only in soft soil areas this technology is preferable.

- 3.2 Deployment of HDD may be the first choice in congested road, Cement Concrete roads made from end to end leaving no margin, where PLB pipe laying by open Trenching is not possible.
 - 3.3 A detail survey is to be done on the roads having maximum number of business buildings, with a good number of important commercial and potential customers. The routes proposed should include various Main Telephone Exchanges / RSU&RLU/ GSM &WLL BTS sites / DSLAMs.
 - 3.4 The commercially important customers and the buildings of interest, if little away from the proposed main route may also be covered in the survey and dropping of O.F. Cable may be planned through outdoor FDMS and Customer Premises FDMS.
 - 3.5 High count fibers may be planned so that the ultimate capacity of the ducts and the cables to be laid shall meet the demands of the future access.
 - 3.6 In the cities where the Overlay Access Network (OAN) is being planned, the O.F. Cable alignment may be planned on the footpath or along the edge of the road. Manholes may also be located along the alignments. Fiber to the home (FTTH) technologies are being introduced in the network, hence the planning of the fibers needs to be done as per the ultimate customer demand. In every manhole 30 meter Coil should be kept for every cable.
 - 3.7 The route survey should include the planning of manholes / new buildings for OF cable terminations on main route or housing the terminations in the existing Exchange buildings on the routes.
 - 3.8 On the basis of surveys, general permission from road and rail/local authorities for laying the Optical Fiber Cable along the suitable roads and at particular rail/road crossings will have to be obtained. The OF Cable preferably be laid straight as far as possible along the road. When the OF Cable is laid along the National Highways, Cable should run along the road land boundary or at a distance of 15 to 30 meters from the centre line of the road where the road land is wider.
4. **Soil Categorisation.** Soil is categorized only under two broad categories i.e. “Rocky” and “non Rocky”, for purpose of deciding the depth at which the cable is to be laid. The soil is categorized as rocky if the cable trench cannot be dug without blasting or chiseling. All other types of soils shall be categorized as “Non rocky” including soil mixed with stone or soft rock. Micro-tunneling usually deployed in the soft soils only, but in some exceptional cases this technology may be used in other soils.
5. **Laying Details**
- 5.1 Horizontal directional drilling is an excellent alternative to conventional installation methods. Unlike manual labor, trenching or excavation, the HDD process is highly suitable in urban areas or places where aboveground obstructions exist that are expensive, inconvenient or impossible to disturb. Deployment of HDD machines overcome the obstacles such as roads, rivers, buildings and highways — with little or no impact to the aboveground surface.

- 5.2 The Micro-Tunneling machine should be capable of drilling for minimum 150 meters to 250 meters at a time without fail in the soft soil. In general, the machines with 10 Tones or more thrust capacity are having the capability for this purpose. Normally depth of the drilled portion should be more than 2.5 meters. This depth may be achieved at a distance of 10 meters from the leading edge of the Manhole. Manhole to be opened for the entry pit and the exit pit with minimum measurement of 1.5m x1.5m x 1.7m. Both entry and exit pits are opened before drilling is commenced. The depth at the entry pit should be 1.65 metres and for achieving this depth in the manhole a pilot entry pit shall be opened with minimum 2 meters depth for enabling the drill pilot to enter. The pilot entry pit shall be at least 4 meters away from the manhole.
- 5.3 Whenever curves or deviations are encountered it should be a very smooth curve, the deviations should not be more than 100 cm from the mean line joining the centre of entry pit and the centre of the exit pit. A nylon wire shall be fixed between these two pits before the drilling operation commences, for identifying the deviations.
- 5.4 After the drilling operation commences, the depth and offset of the pilot is to be recorded at every 3 meters using the properly calibrated machine tracker. The offset of the drill shall be recorded with reference to the edge of the road and also the deviation with reference to the mean line represented by the Nylon rope on the ground. The depth, deviations and offset readings may be provided by the machine automatically, apart from the manual records made.
- 5.5 Bottom of the trenches should be at uniform level without any abrupt ups and downs. After the trenching is done for sufficient length, the bottom leveling should be inspected for uniformity to ensure that pipe could be laid without sharp bends.
- 5.6 In exceptional case, the depth of the trench could be less than 2.50 meters due to difficult terrain. However, in no case it should be less than 1.20 meters. In certain cases, in a uniform terrain a sudden burrow pit or old culvert of short length might be encountered. In such case, the HDPE pipe can be further protected by GI/RCC pipes of suitable size.
- 5.7 When trenching is done close to underground power cables proper precautions to be taken to avoid hazards. When trenching is undertaken along streets and railway lines, caution board or red flags are to be provided at each entry, exit and pilot pit of the trench to alert the traffic. If the manholes are to remain open at night, red lamps or luminous caution boards on either ends should be provided. Cables should be pulled or blown through 50 mm (outer dia.) PLB HDPE pipes. Wherever GI pipes or R.C.C. pipes are used for protection, the two ends of the pipe should be properly sealed to protect HDPE PLB pipe from sharp edge of GI pipe. For providing additional protection Split RCC/GI pipes should be used from top instead of full RCC / GI Pipes.
- 5.8 In the Overlay Access Network, since manholes are placed on road surface at every 200 metres, no route indicators and joint indicators are required. Indicators may be used where the manholes are below the road surface and cannot be visible. Where manholes are not placed at every 200 metres or less, route indicators may be used. The G.I. indicators in square plate shape with base of 10"x10" of suitable thickness to be provided at every manhole. These plates may be fixed on the wall

against the manhole. The G.I. Joint Indicators embedded in concrete similar to that of Route Indicator may be provided at joint locations and may be buried in ground with at least 30 cm of it above the ground level. The joint indicator may be kept along the road side clearly visible from road and may be painted red.

- 5.9 It is quite possible that the pipe may get elongated and its bore may get reduced in the process of pulling up the pipe which may ultimately result into difficulty in pulling cables. To overcome this Duct Integrity Test (DIT) should be conducted after the pipes are laid either in open trench method or in the HDD method for verifying the continuity of the pipe. The DIT involves two tests. In one test one side of the PLB pipe laid is sealed using the end plug and on the other side air compressor or blower is used to hold the 5 Kg/cm-cm pressure in side the pipe under test. The pressure should be held for 1 hour without any leakage. In the second test a wooden bullet having 80% of the diameter of inner diameter of PLB pipe and having a length of 5 cm. may be blown from one side of the PLB pipe. The other side of the pipe shall be left open. The bullet should fly out without any blockage then the PLB pipe laying is successful. Care should be taken by covering the end of the PLB pipe with a nylon wire so that the flying bullet shall not hit anyone. While laying for inter district or inter state routes, normally open trenching process is adopted, but Micro-tunneling may be deployed at the water canal crossings, highway crossings and Railway crossings.
- 5.10 The O.F. Cable had to be laid in the trench through HDPE pipes at a depth of 1.5M measured from top of HDPE pipe. Taking into account the diameter of the HDPE pipe and provisions of soft soil below HDPE pipe, it will be desirable to dug the trench at a depth better than, 1.60 meters. In case of rocky soil a minimum depth of 0.90mtr. is to be achieved. In case of non-rocky soil where due to any obstructions in built up areas it is not possible to dig deeper, a minimum of 1.00 meter from top of pipe shall be maintained. Wherever the minimum depth of 0.9 meter in rocky soil cannot be adhered to, depth can further be reduced up to 0.5 meter with prior relaxation from competent authority. In all such cases where the depth is less than 0.9m, mechanical protection by reinforced concrete casing should be given. Suitable mechanical protection by using RCC/GI pipes to be provided for all cables laid at a depth less 1.2M. No protection, however, need to be given if the depth is more than 1.2m.
- 5.11 When the cables are laid in ducts, no particular depth is prescribed. End of the ducts should be properly sealed and necessary protection by G.I. pipe / RCC pipe should be provided at the entry and exit of the duct till the cable is buried to a depth of 1.5 m.
- 5.12 HDPE pipe laying in built up areas become vulnerable to faults due to cables/pipes of other essential services laid close to BSNL cables. Special care is essential while laying optical fiber cables on these routes. If necessary the OF cable may be laid below the cables and pipes of other agencies including local telephone cables and in particular case cable may be laid via alternate longer route.
- 5.13 On Culvert & bridge over nullah HDPE pipe is to be laid at 1.5 M depth and protection provided by using RCC pipe. The RCC pipe shall extend 2 M minimum beyond the end Nullah on either side.

- 5.14 On rail bridges / crossings the HDPE pipe must be encased in split able cast iron / RCC pipe as prescribed by the Railway authorities.

6. Micro-Tunnelling Process

- 6.1 The method comprises a three stage process. In the first stage, the machine drills a pilot hole on the designed path and the second stage enlarges the hole by passing a larger cutting tool known as the back reamer. The third stage places the casing pipe (in BSNL it is PLB-HDPE pipe) in the enlarged hole. The directional control capabilities assist the rig operator in making necessary changes in the directions of the drilling head.
- 6.2 Horizontal directional drilling is done with the help of a viscous fluid known as drilling fluid. It is a mixture of water and, usually, bentonite or polymer continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilize the bore hole, cool the cutting head, and lubricate the passage of the product pipe.
- 6.3 Location and guidance of the drilling is a very important part of the drilling operation, as the drilling head is under the ground while drilling and, in most cases, not visible from the ground surface. Uncontrolled or unguided drilling can lead to substantial destruction, which can be eliminated by properly locating and guiding the drill head. There are two types of locating equipment for locating the bore head, the 'walk-over' locating system or a 'wire-line' locating system. In both of the systems a device comprising of a transmitter behind the bore head registers angle, rotation, direction and temperature data. This information is encoded into an electro-magnetic signal and transmitted through the ground to the surface in a walk-over system. At the surface a receiver (handheld 'locator') decoded the signal and steering directions are relayed to the bore machine operator. In a wireline system, this information is transmitted through the cable fitted within the drill string. Both systems have their own merits and depending upon the site requirements a particular system is chosen. Directional drilling machines will bore under or around obstacles. Once the drill path is planned, an underground pilot bore is performed utilizing a series of drill rods connected to a drill head. After the pilot bore is completed, the back reamer enlarges the drill path to accommodate the product that will subsequently be pulled into place.
- 6.4 Steering refers to control of the direction of a drill path. The shape of a drill bit on the drill head allows an operator to change the drill path direction during a bore. When an operator points the drill bit downward to the 6 o'clock position and pushes the drill head forward, the drill head goes deeper. When the drill faces the 12 o'clock position, the drill head will rise. Pushed to the 9 o'clock position, the head goes left. Pushed to the 3 o'clock position, the head goes right. If no change in drill path is needed, the drill head and rod are rotated while thrusting.
- 6.5 After completion of pilot bore, the drill head exits the drill path and the back reamer is attached. Utilizing drilling fluid and the drill string the back reamer is pulled back through the path to enlarge it to accommodate the product that will be pulled into place. Sometimes prereaming is performed to incrementally enlarge the drill-path wall. The installation product is then attached to the drill string and pulled into place.
- 6.6 Many back reamer styles and sizes are available for different ground conditions and product sizes.

- 6.7 Mud flow is an important component of the HDD process. Mud flow is created by pumping a combination of water and specialized drilling fluid additives (Bentonite / Polymer) through the drill rod and head (back reamer). The drilling fluid then mixes with soil in the drill path and creates flowing slurry back out of the path as the product pipe is pulled into place. Mud flow cools the transmitter housing in the drill head, suspends cuttings to help prevent product pipe from getting stuck during the bore and seals the bore to help prevent fluid loss and bore wall collapse.

7. **Concerened Points**

- 7.1 The horizontal directional drilling process has several distinct advantages over other methods of utility product installation. The HDD process offers precise installation, minimizes traffic interruption and excavation, and eliminates the need to dig up roads and disturb commercial interests. Prior to starting an HDD project, certain steps should be taken to ensure efficient boring.
- 7.2 A clear conception regarding all safety and operating procedures is necessary to operate a HDD machine successfully. Each Machine should be equipped with an operator's manual and it is essential to study this manual before using the HDD unit.
- 7.3 Locating underground utility services and obstacles before beginning a project will help to ensure the final success of a bore. Ground-penetrating radar systems (GPR) can be used in conjunction with traditional locating techniques to help provide more accurate production of underground information.
- 7.4 Proper placement of the machine before starting the project, increases the efficiency of the bore. The HDD unit must be placed at the job site with care to ensure that the maximum depth of the bore can be obtained without overstressing the drill rods or the product being installed.
- 7.5 The tooling of HDD is an essential component of the process. As tooling is subject to wear, selection of high-quality tooling for the HDD unit will help to keep more productive in the long run.
- 7.6 Drill rod is designed for pushing drill heads and pulling backreamers and new product through the drill path. They are made with a hollow center to allow drilling fluid to flow through the rod, into the drill head or backreamer and out into the bore path. Drill rod has an allowable bend radius which determines how much it can be steered to produce the desired drill path. The bend radius is specific to each rod length and diameter.
- 7.7 A drill head connects to the end of the drill rod and houses the locating transmitter Drill heads also transfer drilling fluid from the drill rod to the drill bit. Drill heads can be connected to the drill rod using a connection system. A variety of drill heads is available for use in different ground conditions and applications.
- 7.8 There is a large variety of Backreamers available for various soil conditions. The primary function of all backreamers is to prepare the bore path by cutting, shearing and mixing soil and drilling fluid into a flowing substance called slurry. When pulling product into place, the size of the backreamer used is larger than the outside diameter of the product, creating flowing slurry between the bore path wall and product.

- 7.9 The type of locator most commonly used in HDD is a walkover system. The walkover system consists of a transmitter and a receiver. This type of system allows the user to walk over the top of the drill head with a receiver that interprets signals from the transmitter in the drill head. Information from these transmissions allows the user to determine the position of the drill head and displays several important pieces of information including pitch, roll, depth and location. This information is then relayed to a remote screen at the machine for the operator to see.
- 7.10 To determine location of the drill head, the receiver uses signal strength from the transmitter in the drill head to indicate its depth and position. The depth and position information is displayed on the locator screen.
- 7.11 Roll is the rotary position of the drill head. It is indicated by a clock-face reading. Roll is very important when making a steering correction. When the operator of the drill rack faces the direction that the drill is advancing, 12 o'clock means the drill head will steer upward, 6 o'clock indicates a downward thrust, 9 o'clock is left and 3 o'clock is right. A bit can be positioned to move two directions at the same time by choosing a clock position in between any of the main clock positions. Example: 2 o'clock would cause the drill head to move mainly to the right, but a little upward as well.
- 7.12 HDD Fluids is a mixture of water and specialized additives used in the drilling process. Drilling fluid cools the drill head and transmitter, lubricates the drill string and product being pulled back and suspends drill path cuttings into slurry which flows out of the drill path as the product pipe is pulled into the bore path. A key requirement of drilling fluid is the ability to stay in the drill path without dissipating into the surrounding soil. The type of drilling fluid used depends upon the type of soil at the HDD project site.
- 7.13 **Soil Types.** Soils can be placed into two general categories — coarse and fine. Coarse soils consist of sands and gravels. Fine soils are comprised of clay. Coarse soils are non compactable and allow water to flow freely into the formation. Fine soils will usually prevent water from flowing into the formation, but have a strong tendency to become sticky and swell when mixed with water. It is possible to have a soil type that is a mixture of these two general types.
- 7.14 **Fluid Additives.** Depending upon work-site soil conditions, certain additives are mixed with the drilling fluid. Bentonite is added to drilling fluid that will be used in coarse soil types. Bentonite forms a filter cake around the bore wall to prevent drilling fluid from dissipating into the surrounding soil. Polymers are used for fine soil types. Polymers reduce swelling of the soil and lubricate the drill path to reduce friction on the drill stem and product.
8. **Depth A/T.** Two types of depth A/T are followed normally. Traditional depth A/T is done after completion of PLB pipes laying. While deploying HDD, it may be required to carry out the depth A/T simultaneously i.e. concurrent A/T. In case the machine deployed is capable of providing the automatic depth, deviation and offset details, depth A/T can be conducted at a later date also. The A/T Authority of the respective area shall decide on the method of A/T to be followed.
- 8.1 **Traditional Depth A/T.** Before the cable is actually pulled through the pipe, the project circle should offer the route for A/T of the depth and position for the cable and correctness of the route diagram.

The best way should be to offer it in stretches of **10-20 kms** soon after the HDPE pipe is buried. The route diagram should be prepared and made over to the A/T unit in advance. The HDD machine recording of the depth deviations authenticated by the division head is to be provided to the A/T unit. The A/T unit will specify the test pit roughly two per km for checking of depth. Wherever depths are prescribed, the tolerance up to minus 5 cm is permissible. If the pipe is found to be at a depth less than specified value O.F cable should not be drawn through HDPE pipe and pipe should be lowered to the proper depth at the locations where necessary relaxation of competent authority is not available.

- 8.2 **Concurrent Depth A/T.** At present there is no specification available for conducting depth A/T for HDD. However acceptance testing is offered by considering the Depth graph given by the site In-charge at entry / exit points of bore. When the Bore line is passing through concreted and congested areas, test pits may be taken where ever feasible and earthen surface is available. Test pits may not be permitted in city areas since it involves digging to a depth of 2 meters to 3 meters. Hence depth A/T is preferable to perform while the work is in progress. During the execution, on intimation, the AT-In-charge may inspect the site and measure the depths of the duct at four places which are at least 20 meters away from each other. This shall be in addition to the depth of the drill at the entry pit or the depth of the duct at the exit pit.

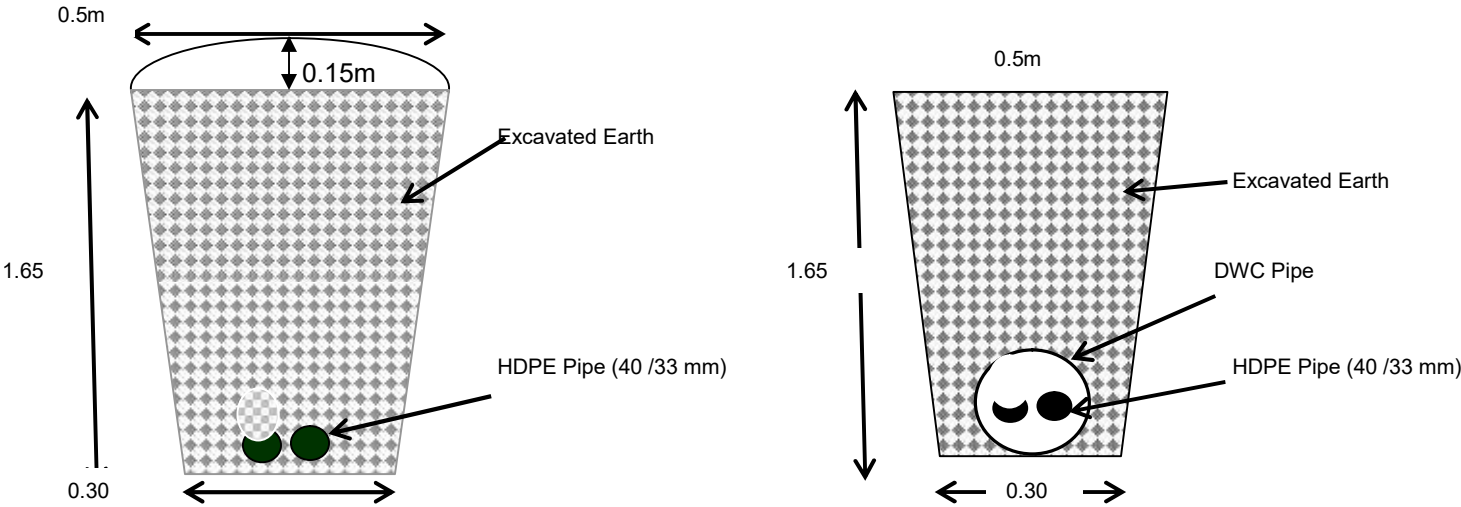
9. **Conclusion.** Micro-Tunneling boring or horizontal directional drilling (HDD) is a trenchless method for installing underground pipes and cables in developed locations along a prescribed bore path by using a surface launched drilling rig, with minimum impact on the surrounding area. Directional boring is used when trenching or excavating is not practical. Directional boring minimizes environmental disruption. It is suitable for a variety of soil conditions and jobs including road, landscape and river crossings. In BSNL directional boring is used for installing PLB-HDPE pipe for laying of Optical Fiber Cable and U/G telephone cable.

Appendix ‘K’

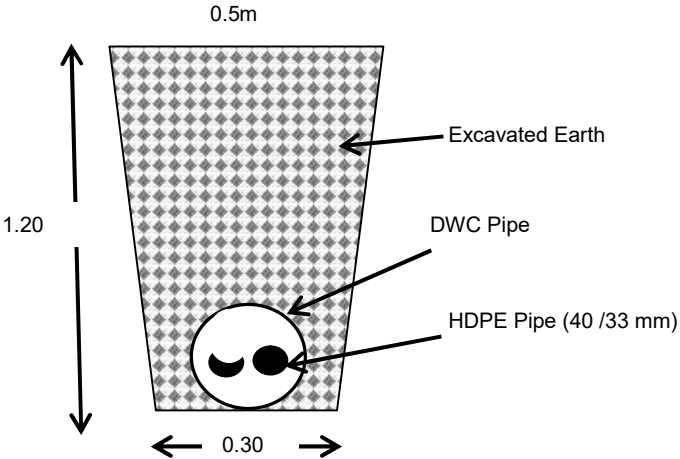
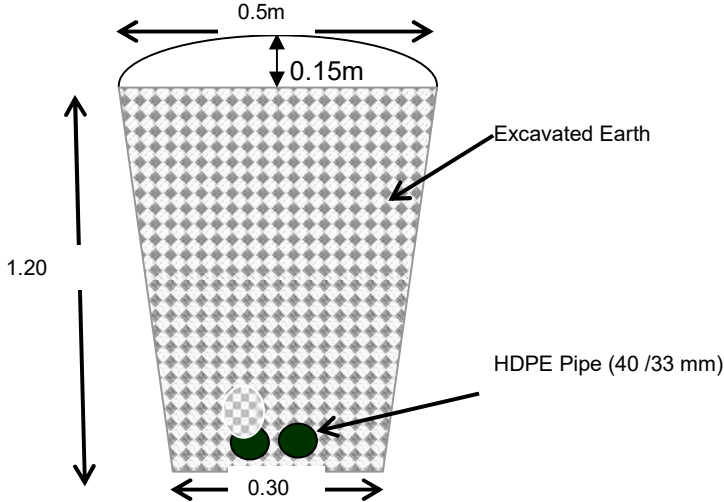
(Refer Para77.1
of Section IV)

TECHNICAL SPECIFICATIONS FOR LAYING OF DUCT

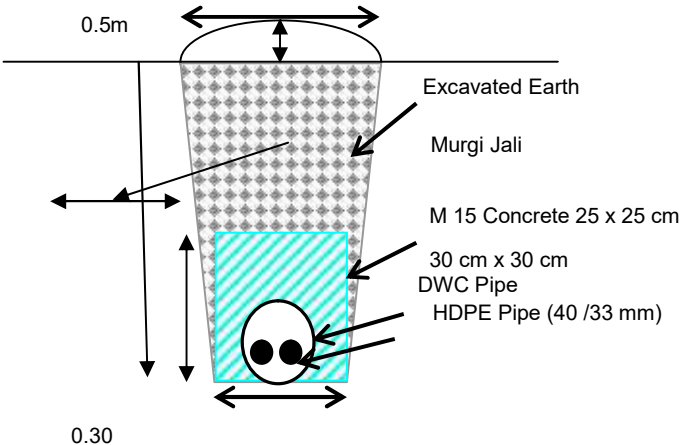
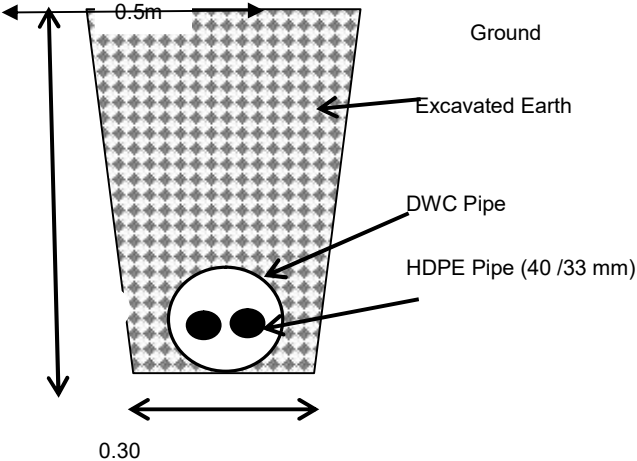
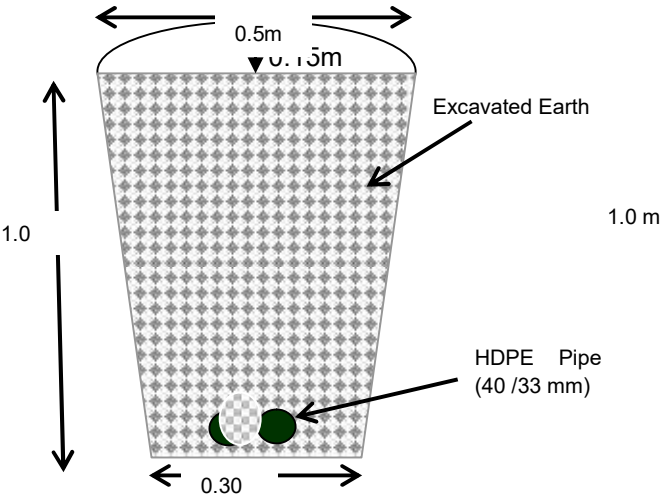
OPEN CUT METHOD	
SPECIFICATION DRAWINGS	
SPECIFICATION DRAWINGS	
Excavation and Backfilling [Depth 1.65 m]	Road / Culvert Crossing [Depth 1.65m]



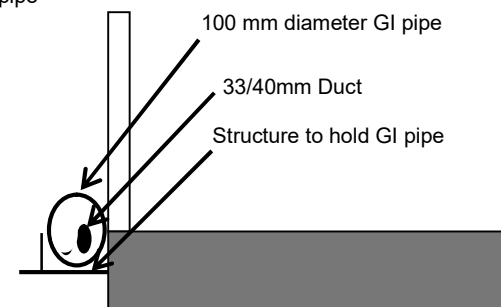
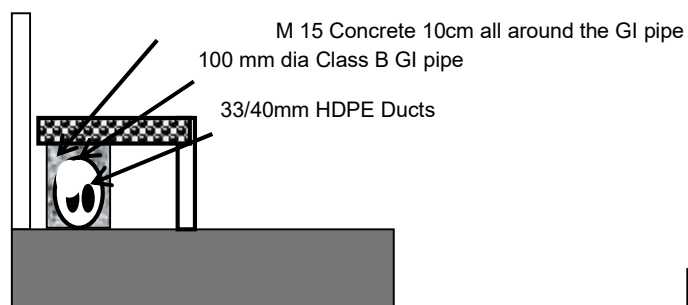
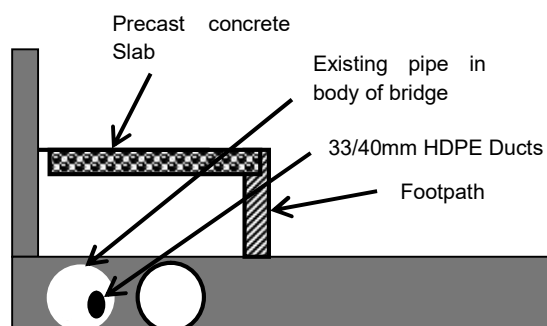
SOFT ROCK	
Excavation and Backfilling [Depth 1.20 m]	Road / Culvert Crossing [Depth 1.20m]



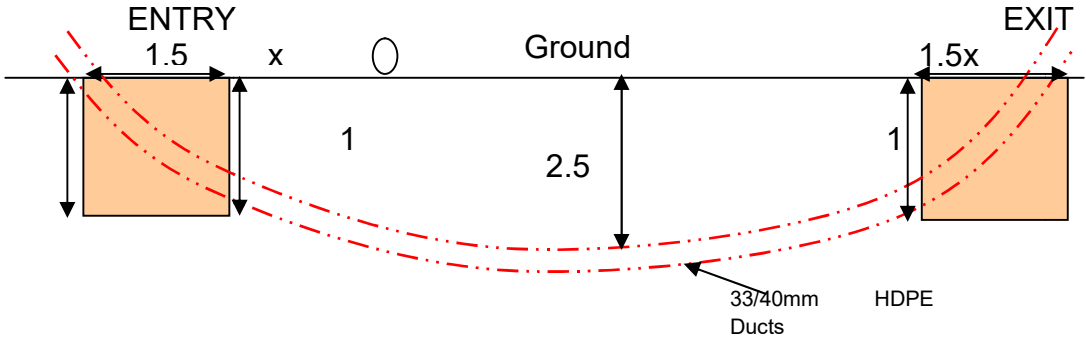
HARD ROCK		
Excavation and Backfilling [Depth 1.0 m]	Road / Culvert Crossing [Depth 1.0m]	Excavation and Backfilling [Depth 0.65 m]



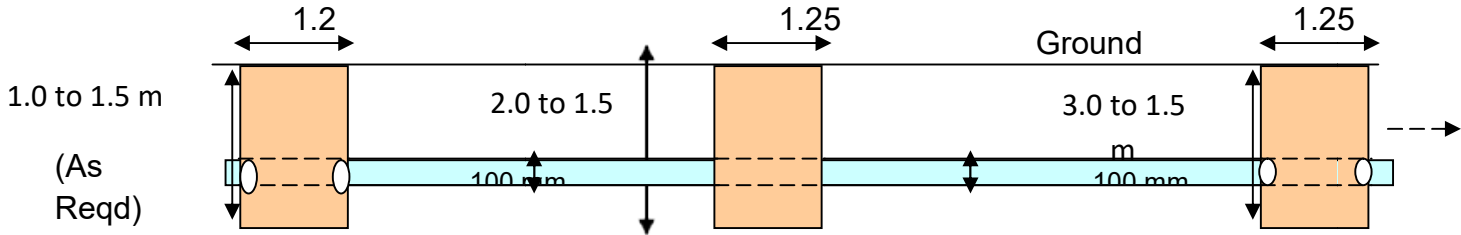
BRIDGE CROSSING METHOD		
Crossing through existing pipe in bridge body	Crossing through Foot path (GI pipe with concrete encasement)	Crossing through GI Pipe Clamped at Side



TRENCHLESS METHOD



MAULING METHOD



Appendix 'L'
(Refer Para 187
of Section IV Part D)

DETAILS OF ZONE WISE DEPLOYMENT OF MAINTENANCE TEAMS

Ser No	Description	No of Teams
1.	Package A	159
2.	Package B	93
3.	Package C	117
4.	Package D	118
5.	Package E	88
6.	Package F	73
7.	Package G	124

Appendix 'M'
(Refer SoR Note
of Section V)

INFORMATION OF SOURCE AND MAKE/MODEL OF LINE ITEMS

FOR ALL PACKAGES

Ser No	Item Description	Make	Model
1.	Type A : Intrusion Proof Fiber Optic Cable [(24F Ribbon G.655 + 24F Ribbon G.652D) + 8F G.652D Sensory Fibers] for NLD Routes		
2.	Type B: Non Intrusion Proof Fiber Optic Cable [24F Ribbon G.655 + 24F Ribbon G.652D] for NLD Routes		
3.	Type C: Intrusion Proof Fiber Optic Cable [48F Ribbon G.652D + 8F G.652D Sensory Fibers] for Access Network		
4.	Permanently Lubricated HDPE duct along with associated accessories		
5.	Fiber Distribution Management System (FDMS) consisting of		
5.1	Standard 42U Rack		
5.2	Splicing Cum Patching Shelf		
6.	Electronic Route Locator		
7.	Electronic Route Marker		
8.	Joint Closure		
9.	Warning Tape		

Note

1. Sample of OFC, HDPE Ducts and other associated accessories may be evaluated during the techno-commercial evaluation for this project.
2. Assessment of Manufacturing Capacity and infrastructure capability may be ascertained by CET, during evaluation stage.

Appendix 'N'

(Refer Para **Error!**
Reference source not
found.of Section I)

BHARAT SANCHAR NIGAM LTD
(A Government of India Enterprise)

MM Cell
 Corporate Office
 New Delhi – 110001

NON-DISCLOSURE AGREEMENT

This Agreement is made on _____ day of _____ 2013 between BHARAT SANCHAR NIGAM LIMITED (BSNL) a Government of India enterprises, having its registered and corporate office at 10th floor Statesman House, 148-B, Barakhamba Road, Connaught Place, New Delhi hereinafter called BSNL which expression shall unless repugnant to the subject or the context mean and included its successor, nominees or assigns and M/s _____ a company incorporated under the Indian Companies act, 1956, and having its registered office at _____ herein after called "bidder" which expression shall unless repugnant to the subject or the context mean and include its successors, nominees or assigns.

Whereas an RFP was floated by BSNL for '**Procurement, Supply, Trenching, Laying, Installations, Testing and Maintenance of Optical fiber Cable, PLB and Accessories for Underground NLD backbone and Access Routes on Turnkey Basis**' and M/s _____ is one of the shortlisted bidders. The shortlisted bidder will be issued tender document, which contains highly classified and confidential information. The information is to be protected from unauthorized use and disclosure:

In consideration of this, the bidder agrees as follows:-

1. This Agreement will apply to any information including information listed in Exhibit A attached hereto pertaining to project disclosed by BSNL to the bidder in writing or otherwise information consists of tender document, specifications, designs, plans drawing, software, prototypes and / or technical information, and all copies and derivatives containing such Information, that may be disclosed to bidder for and during the Purpose. Information may be in any form or medium, tangible or intangible, and may be communicated/disclosed in writing, orally, or through visual observation or by any other means by BSNL to the bidder.

2. The bidder shall use the information pertaining to this project only for the purpose and shall hold information in confidence using the same degree of care as it normally exercises to protect its own proprietary information, but not less than reasonable care, taking into account the nature of the information, and shall grant access to information only to its employees who have need to know, but only to the extent necessary to carry out the business purposes of this project as defined in. The bidder shall cause its employees to comply with the provisions of this Agreement applicable to his and shall not reproduce information without prior permission of BSNL. The permission to reproduce shall only be given if considered necessary and to the extent essential for fulfilling the purpose. The bidder may, however, disclose the information to its consultants and contractors with a need to know; provided that by doing so, the bidder agrees to bind those consultants and contractors to terms at least as restrictive as those stated herein, advise them of their obligations and indemnify BSNL for any breach of those obligations.
3. The bidder shall not disclose any information pertaining to this project to any third party.
4. Upon the request of BSNL, he shall return all information to BSNL immediately, provided, however, that an archival copy of the information may be retained in the files of the bidder's counsel, solely for the purpose of providing the contents of the information.
5. In case the bidder is not selected for awarding the work of this project, he shall return to BSNL all the original documents that have been made over by BSNL to him pertaining to this project Within 15 days of outcome of the tender and shall destroy all hard / soft copy/(ies) of the information pertaining to this project. Intimation in this regard is to be given by bidder to BSNL.
6. The bidder recognizes and agrees that all the information pertaining to this project is highly confidential and is owned solely by BSNL Govt of India and that the unauthorized disclosure or use of such Confidential information would cause irreparable harm and significant injury, the degree of which may be difficult to ascertain. Accordingly, the bidder agrees that BSNL will have the right to obtain an immediate injunction enjoining any breach of this Agreement, as well as the right to pursue any and all other rights and remedies available at law or in equity for such a breach.
7. The bidder's failure to enforce any provision, right or remedy under this agreement shall not constitute waiver of such provision, right or remedy.
8. This Agreement will be construed in, interpreted and applied in accordance with the laws of India.

9. This Agreement and Exhibit Aattached hereto constitutes the entire agreement with respect to the bidders obligations in connection with information disclosed hereunder.
10. The bidder shall not assign this Agreement without first securing BSNL's written consent.
11. This agreement will remain in effect for ten years from the date of the last disclosure of confidential information, at which time it will terminate, unless extended by BSNL in writing.

IN WITNESS WHEREOF, the parties hereto have executed this agreement by their duly authorized officer or representatives.

M/s _____

BHARAT SHANCHAR NIGAM LIMITED

Signature _____

Signature _____

Printed Name _____

Printed Name _____

Title _____

Title _____

Exhibit 'A'
(Refer Para 1 above of NDA)

1. **Business Purpose.** Procurement, Supply, Trenching, Laying, Installation, Testing and Maintenance of Optical fiber Cable, PLB and Accessories for Underground NLD Backbone and access Routes on Turnkey Basis'.
2. **Confidential Information of Bharat Sanchar Nigam Limited (BSNL)**
 - 2.1. Tender document for NLD and Access routes.
 - 2.2. The technical specifications / bill of material for NLD and Access Routes.
 - 2.3. Details of network locations, Link lists and Network Roll out Plan.
 - 2.4. All network details of NLD and Access routes.
 - 2.5. All information shared in oral or in written by BSNL with M/s _____.

BSNL : _____

M/s _____

Signed

Signed

Appendix 'O'

(Refer Para 19.1.12
of Section II)

UNDERTAKING & DECLARATION**For understanding the terms & condition of Tender & Spec. of work**

A) Certified that:

1. I/ We have read, understood and agree with all the instructions, terms and conditions, specifications included in the tender documents & offer to execute the work at the rates quoted by us in the tender form.
2. If I/ We fail to enter into the agreement & commence the work in time the EMD/ SD deposited by us will stand forfeited to the BSNL.

B) The tenderer hereby covenants and declares that:

1. All the information, Documents, Photo copies of the Documents/ Certificates enclosed along with the Tender offer are correct.
2. If anything is found false and/or incorrect and/or reveals any suppression of fact at any time, BSNL reserves the right to debar our tender offer/ cancel the LOA/ Purchase/ work order if issued and forfeit the EMD/ SD/ Bill amount pending with BSNL. In addition, BSNL may debar the contractor from participation in its future tenders.

Date:

Signature of Tenderer

Place:

Name of Tenderer

Along with date & Seal

Appendix 'P'

(Refer Para 48.5 of
Section II)

NO NEAR RELATION CERTIFICATE

(Certificate to be given by the contractor in respect of status of employment of his/ her near relative (s) in BSNL)

"I.....s/o.....r/o

.....hereby certify that none of my relative(s) as defined in the tender document is/are employed in BSNL unit as per details given in tender document. In case at any stage, it is found that the information given by me is false / incorrect, BSNL shall have the absolute right to take any action as deemed fit/without any prior intimation to me."

Signature of the tenderer
with date and seal