TECHNICAL SPECIFICATIONS

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Introduction, General Information and General Requirement

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Section 1

Introduction, General Information and General Requirement

This Document describes the technical specifications for Communication Equipment for Establishment of Fibre Optic Communication System under the contract. This specification describes the functional and performance requirements of the system.

1.1 Scope and General Requirements

The broad scope of the procurement of this part include the survey, planning, design, engineering, supply, transportation, insurance, delivery at site, unloading, handling, storage, installation, termination, testing, training, and demonstration for acceptance, commissioning and documentation for:

(i) SDH Equipment along with suitable optical line interfaces & tributary cards.
(ii) Craft Terminal based Network Management System(NMS)
(iii) All cabling, wiring, Digital Distribution Frame patch facilities and interconnections to the supplied equipment at the defined interfaces.
(iv) System integration of the supplied subsystems and also integration with existing communication equipment such as SDH
(v) Integration of supplied system with the User equipments such as RTUs, SCADA system etc.
(vi) Maintenance of the supplied system

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

1.2 General Requirements

The Contractor is encouraged to offer standard products and designs. However, the Contractor must conform to the requirements and provide any special equipment necessary to meet the requirements stated herein.
It should be noted that preliminary design information and bill of quantity (BoQ) specified in this specifications are indicative only. The Contractor shall verify the design data during the site surveys & detail engineering and finalise the BoQ as required for ultimate design & system performance.

The Bidder's proposal shall address all functional and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for inquiries.

An analysis of the functional and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude that additional items are required that are not specifically mentioned in this specification. The Contractor shall be responsible for providing at no added cost to the Employer, all such additional items and services

such that a viable and fully functional communication equipment system is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials and services shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items and services in their proposal.

All equipment provided shall be designed to interface with existing equipment and shall be capable of supporting all present requirements and spare capacity requirement identified in this specification.

The communication equipment shall be designed and provisioned for expansions and reconfigurations without impairing normal operation, including adding and removing circuits. The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against rodents, contaminants, pollutants, water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

The Bidders are advised to visit sites (at their own expense), prior to the submission of a proposal, and make surveys and assessments as deemed necessary for proposal submission. The successful bidder (Contractor) is required to visit all sites. The site visits after contract award shall include all necessary surveys to allow the contractor to perform the design and implementation functions. The Contractor shall inform their site survey schedule to the Employer well in advance. The site survey schedule shall be finalised in consultation with the Employer. The Employer may be associated with the Contractor during their site survey activities.

After the site survey, the Contractor shall submit to the Employer a survey report on each link and site. This report shall include at least the following items:

(a) Proposed layout of Equipment in the existing rooms and buildings.
(b) Proposed routing of power, earthing, signal cables and patch cords etc.
(c) Confirmation of adequacy of Space and AC/DC Power supply requirements
(d) Proposals for new rooms/buildings if required
(e) Identification of facility modifications if required
(f) Identify all additional items required for integration for each site/location.

1.2.1 Synchronization of the Communication Network

The Contractor shall be responsible for synchronization of new communication equipment with existing network utilizing the existing clock. The Contractor shall make an assessment of additional clock requirement for synchronization of the communication equipment.

1.3 General Responsibilities and Obligations

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

1.3.1 Responsibilities for the Implementation Plan

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

1.3.2 Contractor's Responsibilities and Obligations

The Contractor shall be responsible for all cables and wiring associated with the equipment provided, both inside and outside buildings in accordance with technical specifications. The Contractor shall also be responsible for determining the adequacy of the local power source for the equipment and for wiring to it, with adequate circuit protective breakers. In addition, the Contractor shall be responsible for shielding equipment and cabling to eliminate potential interference to or from the equipment, and for earthing all cabinets and shields.

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

(1) Site visits, and surveys, necessary to identify and provide all equipment needed to implementation the network.

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

(3) Overall integration of communication equipments/subsystem procured in present with existing User equipments such as SDH, RTUs, SCADA system etc.

(4) All cabling, wiring including supply, laying and termination etc of the cables, and distribution frame at wideband nodes required for full interconnectivity and proper operation of the telecommunications network including equipment supplied under this package and the connectivity and interfacing of user equipment.

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

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

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

(8) Implement all minor civil works and identify any major civil works i.e. expansion or construction of rooms, trenches necessary for installation of proposed equipment and provide the details of such work to the Employer.

(9) Factory and site testing of all hardware, software, and firmware provided.

(10) Provide documented evidence of satisfactory Type Test performance to the Employer and if required by The Employer, conduct type test.

(11) Provide a Quality Assurance Plan, ensuring the Employer access to the manufacturing process.

(12) Training of the Employer personnel.

(13) Hardware, software, and firmware maintenance, debugging, and support of the equipment through final acceptance, and maintenance on all new equipment through out the warranty period and for a period of six (6) years after warranty period.

(14) Availability of service, spare and expansion parts for the supplied items for the designed life of the equipment or seven (7) years after the declaration of withdrawal of equipment from production, whichever is earlier. However, the termination of production shall not occur prior to Operational Acceptance of the system by the Employer.

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

1.3.3 The Employer Responsibilities and Obligations

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

(1) Overall project management of the project
(2) Review and approval of the Contractor's designs, drawings, and recommendations.
(3) Communication network configuration data, including:
    (a) Channel assignments for voice and data
    (b) Interconnection drawings for existing equipment
(4) Review and approval of test procedures.
(5) Participation in and approval of "Type", factory and site acceptance tests where testing is required.
(6) Review and approval of training plans.
(7) Providing support and access to facilities at the sites.
(8) Implement the major civil works such as expansions or construction of rooms, trenches etc. as required for the equipment to be provided by the Contractor.
(9) Coordination of the Contractor's activities with the Employer's and constituents' concerned departments.
(10) Provide to the extent possible drawings for existing sites and facilities for which equipment installations are planned.
(11) Approval of the key personnel for the project

1.4 Applicable Standards

The applicable standards are mentioned in the respective technical section. The offered equipment shall conform to the standards mentioned in the specification except to the extent modified by this specification. In case of any discrepancy between the description given in the specification and the standards, the provisions of the technical specification shall be followed. The parameters not specifically mentioned in this specification shall conform to the standard mentioned in this specification.

Specifications and codes shall be the latest version, inclusive of revisions, which are in force at the date of the contract award. Where new specifications, codes, and revisions are issued during the period of the contract, the Contractor shall attempt to comply with such, provided that no additional expenses are charged to the Employer without Employer's written consent.

In the event the Contractor offers to supply material and/or equipment in compliance to any standard other than Standards listed herein, the Contractor shall include with their proposal, full salient characteristics of the new standard for comparison.

In case values indicated for certain parameters in the specifications are more stringent than those specified by the standards, the specification shall override the standards.

---------- **End of this Section** ----------

Section 2
Network Configuration and Equipment Characteristics

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Section 2

Network Configuration and Equipment Characteristics

2.1 Introduction

This section describes the Fibre Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are:

(1) Fibre Optic Transmission System (FOTS)
(2) Craft Terminal based Network Management System (NMS)
(3) DDF and Cabling

The requirements described herein are applicable to and in support of network requirements.

The security related requirements of the equipment shall be as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time to time basis shall be followed/complied by the vendor.

The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing,facility and supply chain and subject all software to a security /threat check any time during the supplies of equipment

The contractor shall ensure that the supplied equipments have been got tested as per relevant contemporary Indian or International Security Standards e.g. IT and IT related elements against ISO/IEC 15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards until 31st March 2013. From 1st April, 2013, the certification shall be got done from authorized and certified agency/lab in India.

The Contractor shall also ensure that the equipment supplied has all the contemporary security related features and features related to communication security as prescribed under relevant security standards. A list of features, equipments, software etc. supplied and implemented in the project shall be given for use by the Employer

The contractor shall get the Employer's equipment audited from security point of view once a year from a network audit and certification agency as identified by DoT. The audit of the equipment shall be carried once in a financial year till the maintenance service contract in the bid.

In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of DoT

and any other Government department.

2.2 General Network Characteristics

2.2.1 Description

The fibre optic network shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-4/STM-16 as indentified in the BoQ. The network shall consist of overhead fibre optic links with a minimum bit rate of Synchronous Transport Module-4/STM-16 (STM-4/16). The Contractor can propose a system based on higher bit rate systems, if required, so as to meet the link budget requirements or any other specification requirement. The detailed BOQ is described in appendices.

2.2.2 Functional Requirement

The primary function of the communication network is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS/RTUs/PMUs. The communications support requirement for SCADA/EMS/RTUs/PMUs system is for low & high speed data, express voice circuits and administrative voice circuits as defined in appendices. A brief summary of the communication system requirements is as follows:

(a) High speed E1 channel support

(b) Data transport supporting Network Management channels

(c) The connectivity envisaged between RTUs and Control Centre over TCP-IP using Ethernet interface.

2.2.3 General Systems Requirements

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

2.2.3.1 System Synchronization

The Contractor shall synchronize the existing equipments and all the new equipments under the contract using existing Master clock. The Contractor shall provide the additional clocks as required under the set of clock indicated in BoQ. In addition to GPS input reference, the synchronization clock must have provision to take INPUT reference coming from other clock. The contractor shall submit the synchronisation plan as per standard ITU-T G.811. All sync equipments proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-T G.812 standard requirements.

The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipments new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of

ITU-T G.803. The synchronization plan shall clearly indicate the requirement of additional clocks with full justification.

The system equipment requiring "clock" shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.

2.2.3.2 System Maintainability

To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed both locally and from remote locations, manually and/or initiated under NMS control. Such testing shall not affect the functional operation of the system.

2.2.3.3 System Upgradeability and Expandability

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

2.2.3.4 Equipment Availability

The calculated availability of each fibre optic link (E1 to E1)shall be at least 99.999%. The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. For this analysis, an MTTR of atleast 4 hours shall be assumed. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided by the Contractor during detailed engineering.

2.2.3.5 Revision Levels and Modifications

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

2.2.3.6 Equipment Capacities

Equipment supplied shall be sized and equipped with sufficient capacity to support BoQ and configuration requirements as identified in the appendices. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion.

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

2.2.3.7 Redundancy Requirements and Protection Schemes

Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 2-1. The failure of one element shall not prevent the use of any other that has not failed.

Table 2-1
Equipment Redundancy Requirements Summary

Fiber Optic transmission Equipment :	
SDH equipment	
Power Supply & Converters ----------	1:1 APS or distributed power supply
Common Control* Cards ----------	1:1 APS
*** = Common control cards which are essentially required for operation of the equipment.**	

The offered equipment shall support at least SNCP **as per standard ITU-T G.841**. In case the equipment offered by the Bidder does not support the above mentioned minimum protection methods, the bidder shall have to provide all additional equipment needed to provide same level of flexibility, redundancy and functionality at no additional cost to Employer. The bidders shall provide details of protection schemes supported in the Bid document.

The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switch over shall be provided by the Contractor.

2.2.3.8 Lost Signal Recovery

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

2.2.3.9 Software Upgrades

The Contractor shall provide antivirus software along with all the computer hardware/software which shall be upgraded periodically till the maintenance services contract in the bid. Further, to meet all the specifications requirements during implementation and maintenance, if upgrade in the hardware/software of supplied item is required, the same shall be done by the contractor without any additional cost to the Employer.

2.2.3.10 General Site Considerations

All fiber optic links up to 250 kms transmission line length shall be implemented by the Contractor without repeaters. In order to meet the link budget requirement, the Contractor shall provide all the necessary equipments only in the end stations. The contractor may provide the optical amplifier, wave length translator, optical cards or high capacity SDH equipment with suitable rack/subrack to meet the maximum distance limit. All the provided equipments shall be monitored by centralized NMS.

2.2.3.11 Proposed Optical Fibre Characteristics

The link budget calculations and equipment design shall be based on the specified fibre parameters. The optical cables shall have Dual Window Single Mode (DWSM) fibres conforming to ITU-T Recommendations G.652D and the major parameters of these optical fibre(s) are defined in Table-2-2:

Table-2-2
Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode (DWSM)
Mode Field Diameter:	8.6 to 9.5 μm (±0.6 μm)
Cladding Diameter:	125.0 μm $\pm$ 1μm
Mode field Concentricity Error:	$\leq$ 0.6μm
Core-Clad concentricity error:	$\leq$ 1.0μm
Cladding non-circularity	$\leq$ 1%
Cable Cut off Wavelength:	$\leq$ 1260 nm
1550 loss performance	As per G.652D
Proof Test Level	≥ 0.69 Gpa
Attenuation coefficient	@1310nm $\leq$ 0.35 dB/Km @1550nm $\leq$ 0.21 dB/Km
Attenuation variation with wavelength **1285 nm - 1330 nm** **1525 nm – 1575 nm**	 Attenuation coefficient @1310 ± 0.05 dB Attenuation coefficient @1550 ± 0.05 dB
Point discontinuities	$\leq$ 0.1dB

Table-2-2 Optical Fibre Characteristics	
Chromatic Dispersion; Max.:	18.0 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) @ 1288-1339nm 5.3 ps/(nm x km) @ 1271-1360nm
Zero Dispersion Wavelength: **Zero Dispersion Slope:**	1300 to 1324nm 0.092 ps/(nm^2xkm) maximum
Polarization mode dispersion coefficient	$\leq$ 0.2 ps/km$^{1/2}$
Temperature Dependence:	Induced attenuation $\leq$ 0.05 dB (-60 deg C - +85 deg C)
Bend performance:	@1310nm (75$\pm$2 mm dia Mandrel), 100 turns; Attenuation rise ≤ 0.05 dB @1550nm (30$\pm$1 mm dia Mandrel), 100 turns; Attenuation rise ≤ 0.10 dB @1550nm (32$\pm$0.5 mm dia Mandrel), 1 turn; Attenuation rise ≤ 0.50 dB

2.2.5 Fibre Optic Link Lengths

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

2.3 Fibre Optic Transmission System

The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4/STM-16 and equipped with 2 nos. of minimum 16 port E1 interface(G.703) card, one no. of minimum 4 port Ethernet interface (IEEE 802.3/IEEE 802.3u) card supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. Protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032.

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

2.3.1 SDH Equipment

2.3.1.1 Functional Requirement

There is a requirement for different types of equipment under this project which are described in this section. The BOQ is provided in the appendices. For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary Cards (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary cards).

If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications. Further, control card shall not be equipped with more than one optical interface/SFP and optical base card shall not be equipped with more than two optical interface/SFPs.

The equipment shall be configurable either as Terminal Multiplexer (TM) as well as ADM with software settings only.

SDH ADM

The aggregate interfaces shall be (at least) STM-4/STM-16 towards at least two protected directions (Protected as specified in this specifications). At present the equipment shall be equipped with a 2 nos., min.16 E-1 port electrical tributary cards & one no., min.4 port Ethernet interface card as tributaries. The equipment shall provide access to full STM-4 payload.

The offered STM-4 SDH equipment shall be upgradeable to STM-16 by changing optical line cards only. Cross connection (VC4) capability of offered SDH equipment shall be provided according to STM-16 equipment. The contractor shall demonstrate the STM-16 upgradeability during FAT.

2.3.1.2 Redundancy and Protection

Two fibre rings shall be implemented wherever the network permits. On linear sections of

the network, protected links using 4 fibres shall be implemented.

2.3.1.3 Service Channel

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

2.3.1.4 Supervision and Alarms

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

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

2.3.1.5 Synchronisation

The equipment shall provide synchronisation as per Table 2-2. One 2MHz synchronisation output from each equipment shall be provided.

2.3.1.6 Electrical and Optical I/O Characteristics and General Parameters

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

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

Optical Wavelength NOTE (1)	1310/1550nm
Optical Source NOTE (2)	Laser
Optical Source Lifespan	Better than 5 $X10^5$ hours
Optical Fibre Type	G.652 D
Optical Connectors	Type FC-PC
Transmission Quality	Per ITU-T G.821, G.823, G.826
Source Primary Power	-48 Vdc
Equipment Specifications	Per ITU-T G.783
Tributary, Electrical Interface	Per ITU-T G.703, 75 Ω
Ethernet Interface	10/100 Mbps
SDH Bit Rates	Per ITU-T G.703

Optical Interfaces	Per ITU-T G.957, G.958
Frame and Multiplexing Structure for SDH	Per ITU-T G.707
Synchronization	Per ITU-T G.813
Management Functions	Per ITU-T G.774, G.784
Protection Architectures	Per ITU-T G.841
Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784

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

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

NOTE (3) In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector are to be provided to connect with FODP.

2.3.2 Optical Link Performance Requirements

The optical fibre link performance requirements are specified as follows:

2.3.2.1 Link Budget Calculations

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

(1) Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.

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

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

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

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

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

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

(8) Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm.Km @1550 nm & 3.5 ps/nm.km @ 1310 nm for DWSM fibres.

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

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each category of fibre optic link during detailed engineering.
For finalising the FOTS system design & BOQ, above methodology shall be adopted taking into account fibre attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

2.3.2.2 Link Performance

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

2.3.2.3 FODP to SDH Equipment

The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall provide FC PC coupled patch cords. The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.

2.4 DDF and Cabling

For the purposes of the specification, the contractor shall provide cabling, wiring, DDF patching facilities to the wideband telecommunications system. Equipment and material components for DDF and cabling are also part of this procurement. It shall be the Contractor's responsibility to provide all cable support required for full supplied equipment interconnection and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.

2.5.1 Digital Distribution Frame Functional Requirements

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

(i) "Normally thru" circuit routing
(ii) Circuit rerouting via patch cord assemblies
(iii) Circuit disconnect and termination

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

2.5 Patch Cords

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

2.6 Telecommunication Management Network / Network Management System

The Contractor shall provide Craft Terminal based Telecommunications Management Network System (NMS) for operational support to the FOTS subsystems. This NMS shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network with the help of a portable personal computer to be known as craft terminal. The Contractor shall submit for Employer's approval the NMS architecture describing in detail the following subsystems/features:

(a) Database used in NMS
(b) Peripherals and hardware
(c) Software and operating system
(d) Craft Terminals

2.7.1 Management Functions

The NMS shall support following Management functions:

2.7.1.1 Configuration Management

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

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

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

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

d. Provide verification testing to support new equipment installation.

2.7.1.2 Fault Management

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

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

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

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

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

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

f. Track network equipment failure history.

2.7.1.3 Performance Management

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

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

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

   1. Select/deselect network equipments, events, and threshold parameters to monitor
   2. Set monitoring start time and duration or end time

3. Set monitoring sampling frequency
4. Set/change threshold values on selected performance parameters
5. Generate alarm events when thresholds are exceeded.

6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.

7. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the equipment Contractors.

8. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.

9. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

2.7.1.4 Security Management

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

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

2.7 Communication Channel Requirement and Integration

Communication requirements for NMS system have not been considered in Appendices and the Contractor shall provide these as a part of NMS system. The Contractor shall provide all required interface cards / devices etc. The NMS data transport shall utilize the wideband communications transmission system service channel in the overhead whenever possible.

2.8 Craft Terminal

Each equipment on the fibre optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the operator shall be able to:

a. Change the configuration of the station & the connected NEs.
b. Perform tests
c. Get detailed fault information

The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with necessary system and application software to support the functions listed above, shall be supplied to the employer as per BOQ given in the appendices.

2.9 Hardware Requirements

2.10.1 Craft Terminal

The craft terminal shall have suitable processor(s) which shall be sufficient to meet all the functional requirement and expansion capabilities stipulated in this specification. Only reputed make like Dell, IBM, HP, Compaq make shall be supplied.

The Craft Terminal shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse/trackball etc., parallel, serial/USB (2.0) ports to accommodate printers, and Internal/external Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.

2.10.2 Power Supplies

The NMS system shall use 220 volts 50 Hz A.C or -48 volt D.C as available at site for its operation as available at site.

2.10 General Software/Firmware Requirements

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

2.11.1 Operating System Software

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

2.11.2 Applications Software

All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The

contractor shall make no modifications to the applications program except as provided as USER development tools.

2.11.3 Software Utilities

A utility shall be provided to convert all reports into standard PC application formats such as excel.

2.11.4 Revisions, Upgrades, Maintainability

All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming.

All software shall be easily user expandable to accommodate the anticipated system growth, as defined in this specification. Reassembly recompilation or revision upgrades of the software or components of the software, shall not be necessary to accommodate full system expansion.

Software provided shall be compliant with national and international industry standards.

2.11.5 Database(s)

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

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

2.11.6 Help

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

----------End of the Section----------

Section – 3
Environment, EMI, Power Supply, Cabling and Earthing

Section - 3

Environment, EMI, Power Supply, Cabling and Earthing

The purpose of this section is to describe the minimum general equipment characteristics and specifications for environmental conditions, source power conditioning and backup, equipment construction, and installation. The section also highlights the stringent Electro Magnetic Compatibility (EMC) guidelines for equipment that will be operated under the severest Electro Magnetic Interference (EMI) and Electro Static Discharge (ESD) conditions expected in an Extra High Voltage (EHV) power system environment.

3.1 Environmental Requirements

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

3.1.1 Temperature and Humidity

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

Table 4-1
Environmental Operating Limits

Temperature Range: **Specification** **Operation without damage** **Shipping/storage**	(Un Controlled Environment) 0 to 45°C -10 to 55°C -40 to 60°C
Relative Humidity, non-condensing	Upto 90%
Elevation: **Operating** **Non-operating**	 to 3,000 m to 10,000 m

For each location, the Contractor is required to assess the environmental conditions for the equipment to be installed under this specification. The Contractor is responsible for all necessary enclosure, rack or equipment upgrades to ensure the proper operation of the installed equipment.

3.1.2 EMI and Electrostatic Interference

At each location, the Contractor shall assess the need for shielding against radiated emissions and shall provide recommended solutions for any EMI problem found at each location. Specifications provides the type of immunity tests for which the equipment shall be required to

pass without failure. For the individual tests to be carried out at the different interfaces, references are made to the relevant IEC and ITU-T recommendations.

3.1.3 Vibration and Shock Resistance

As per testing requirements indicated in this specification.

3.1.4 Tropicalization

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

3.1.5 Contaminants

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

3.2 Primary Source AC/DC Power Requirements

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

3.2.1 Primary Source AC Power

It will be the Employer's responsibility to provide required Primary AC source Power for communications equipment installed under this specification. The Primary AC Power supplied will be 240 VAC ± 10%, 50Hz with a frequency variance between 46 and 55 Hz. Harmonic distortion will not exceed five (5) percent.

All equipment and components provided under this specification requiring Primary AC Power, shall be designed for normal operation under the above stated tolerances for 240 VAC supply.

The Contractor shall provide in their Bid as well as in the survey report to the Employer the projected 240 VAC Primary Power load requirement per equipment and totals, by location, for equipment provided under this specification. The Contractor shall provide suitable UPS for communication equipment/module etc. requiring AC power supply at locations other than control centre.

3.2.2 -48V DC Power

Power supplies/converters for communications equipment (except computer system supplied as part of NMS which shall use 240 VAC) provided under this specification, shall use -48Vdc uninterrupted primary source power. The power supply may vary normally within the voltage range -42 to -58 Vdc and the supplied equipment shall operate satisfactorily within this range.

3.2.3 Power Distribution and Protection

The Employer will furnish only one source primary 240 VAC and/or -48 VDC power. It shall be the Contractor's responsibility for the connection and distribution of all Primary AC and -48V dc source power, in full compliance with all local and national electrical codes.

The Employer shall indicate during the survey by Contractor, on the primary source, the feeders/points that can be used by the Contractor. The Contractor shall supply & install Primary AC and -48Vdc feeder cables to Contractor-furnished distribution panels.

The Contractor shall provide required distribution panels, circuit breakers and appropriate Panel Disconnects. Distribution Panel feeders, Panel Disconnects, distribution panels and circuit breakers shall be sized and equipped to support at least 100% expanded load requirements.

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

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

Partially equipped subsystems shall be installed with provision for expansion. Equipment power supplies provided under this specification, shall be sized to support fully equipped subsystems. Primary power distribution protection shall be sized to support and protect maximum operating load potential whether or not the actual projected load shall meet that maximum load potential.

The Contractor shall provide equipment and rack safety earthing in compliance with this specification.

3.3 Equipment Construction, Assembly and Installation

All equipment supplied under this specification shall be constructed, assembled and installed in accordance with the following requirements:

3.3.1 Identification

All cabling, racks/enclosures, equipment, modules and materials shall be uniquely identifiable as per the following:

3.3.1.1 Equipment

Each equipment component to the level of printed circuit card, shall be clearly marked with the manufacturer's part number, serial number, month/year of manufacture and revision level. Changes to components shall be identified by an unambiguous change to the marked revision level. The Contractor shall be responsible for maintaining the master revision level list until the Contractor has complied with all requirements of this specification.

Where custom components and parts are provided, each component/part shall be marked to specifically identify that component/part. Printed circuit card cages are defined as an equipment component and as such, shall be clearly identified as stated within this specification.

Equipment chassis and printed circuit card cages having wired backplanes, shall be clearly marked with the manufacturer's part number, serial number, month/year of manufacture, revision level and an additional identifier corresponding directly to the applicable backplane wiring diagram/list.

3.3.1.2 Power Distribution

Power distribution panels shall be clearly marked with their unique identifier, source feed information, and remote source feed emergency disconnect location and identity.

Power distribution panel "Main Disconnect" and circuit breakers shall be clearly marked with a unique identifier. Circuit breaker feed lists shall be clear, accurate and the feed list information shall be posted inside each distribution panel door.

Inter-rack and intra-rack (enclosure) power distribution shall be clearly identified with source feed, voltage and power rating information. All power feed cabling shall be clearly identified near the point of termination.

All power distribution identification shall utilize heat-resistant permanent marking techniques such as stamped non-metallic tags, embossed labels, etc. Marking techniques are subject to approval by the Employer. Power distribution identifiers and information shall agree with the Contractor's power cable plant drawings.

3.3.1.3 Signal Cabling

Connectorised signal cabling/wiring requires marking with a unique identifier at each connectorised end. The signal cable/wire identifier shall include a cable identifier and the location of both terminations.

Signal cable/wiring installed on terminal blocks requires marking with the cable identifier and distant end location. The cable tag shall be clearly visible at the cable fanout point.

All signal cable, wiring and terminations shall be clearly labelled/tagged with identifiers consistent with Contractor supplied cable plant records. Marking techniques are subject to approval by the Employer.

3.3.1.4 Equipment Racks and Enclosures

All equipment racks, enclosures and equipment, including distribution frames, shall be clearly labelled with unique identifiers consistent with Contractor supplied floor plans and rack elevations.

3.3.2 Installation Hardware

Equipment racks, enclosures, cable raceways and installation hardware shall, at a minimum, comply with the following requirements:

3.3.2.1 Equipment Sub-Racks and Cabinets (Enclosures)

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

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

(A) Equipment SubRack Construction

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

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

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

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

(B) Equipment Cabinet (Enclosure) Construction

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

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

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

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

3.3.2.2 Cable Raceways

The Contractor is required to provide and install all additional necessary indoor and outdoor cable raceways. The cable raceways shall be in conformance with the following:

(1) Signal cabling and power cabling shall require separate cable raceways. Signal and power cabling shall not share the same raceways and shall be installed as far apart as is practical. Adequate shielding shall be provided as required.

(2) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor.

(3) Outdoor cable raceways shall be of corrugated construction and shall be fitted with solid covers overlapping all sides of the cable raceways.

(4) Outdoor cable raceways shall be fabricated from construction grade aluminum, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anti-corrosion measures shall be taken. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to-paint bond.

(5) Indoor cable raceways fabricated of aluminum or galvanized iron, shall not normally need special finishing or painting, unless otherwise stipulated by the Employer. Steel fabricated raceways shall require a red oxide primer coat at a minimum.

3.3.3 Signaling Distribution

The Contractor shall be responsible for all signal wiring associated with furnished equipment in accordance with the following:

(1) All signal wiring connections to the communications equipment shall be via Krone type or equivalent terminal blocks.

(2) The Contractor shall provide subscriber level wiring and patching wherever required.

3.3.4 Lightning and Transient Voltage Protection

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

(1) At the outside cable plant point-of-entry of all cabling penetrations for all cabling

installed by the Contractor, the Contractor shall provide lightning and transient voltage isolation for the inside plants cabling, wiring, and all terminations and equipment.

(2) All equipment installed under this specification that requires 240VAC primary power, shall be surge protected.

3.3.5 Station Safety Earthing and Signal Grounding

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

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

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

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

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

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

The Contractor shall extend the existing station earth to the equipment room using suitable G.I. earthing strip (50 x 6 mm), wherever required. .

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

The Contractor shall be responsible for determining the suitability of existing station earth for the equipment to be supplied under this contract. In case existing earthing arrangement at the site is not adequate, the Contractor shall either make improvement in the existing earthing arrangement or make new earthing as per requirement.

3.3.6 Interconnections

All power and signal cabling between component units of the communications systems shall be supplied and installed by the Contractor and shall be shown on contractor-supplied as-built drawings.

The Contractor shall supply and install all primary power cords, powerstrips, receptacles, circuit breakers, fuse panels, switches, earth fault detectors, surge protectors, distribution cabling, and power connectors required to support all equipment enclosures and system components furnished and installed under this specification, except as specifically excluded.

Plug-type power connectors with captive fastening (such as "Twist-Lock") shall be used for interconnection of source power to the equipment enclosures or racks.

Plug-type connectors with captive fasteners (ie. DB-25, etc) shall be used for the interconnection of all inter and intra-enclosure signalling cable.

3.3.7 Finish Colors

Unless otherwise specified, finish colors for enclosures shall be gloss white enamel on the inside, and semi-gloss medium grey enamel on the outside. Only brushed aluminum trim shall be used. Employer reserves the right to approve the proposed color scheme.

3.4 Location of Equipment, Cable Routes and Associated Civil Works

During the Site Surveys, the Contractor shall determine and propose locations for all equipment to be supplied under this contract. Further, the Contractor shall locate and identify proposed routing for all cabling between all equipment locations including existing and planned equipment not provided under this contract, but required to be connected under the scope of this contract. This subsection defines the requirements and clarifies the responsibilities of the Employer and the Contractor regarding equipment siting, intra and inter facility interconnectivity and necessary associated civil works.

3.4.1 Locations for Supplied Equipment

All transmission equipment and associated DDFs, shall generally be co-located in the same communications room located in the Control Building whenever possible.

3.4.2 Associated Civil Works

The Contractor shall provide all required minor civil works necessary for full connectivity as required in the Contractor’s scope of work as follows:

(1) All wall and floor penetrations necessary for the installation of all cabling to be performed in accordance with the requirements of this specification.

(2) Installation of racks, cabinets, cable raceways, and cabling supplied as part of this

contract.

3.4.3 Cable Trenches

A network of cable trenches and/or ducts may exist at some sites but shall require expansion and/or new construction at some stations. It shall be a responsibility of the contractor to cooperate fully with the Employer and all other on-going project contractors in the planning and efficient use of existing and new cable trenches. The existing cable trenches/ cable raceways proposed to be used shall be identified in the survey report. The contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be proposed for Employer approval. The Employer shall provide any additional cable trenches required for such approved alternatives.

It may be noted that in order to utilise the existing trenches, the Contractor supplied cables may be required to be co-located with LV cables. Accordingly, the contractor shall ensure that selection and installation of cables is suitable for the purpose. The contractor shall be responsible for new building penetrations required for supplied cabling. Caution shall be taken to ensure existing equipment and site personnel are protected from dust and debris incident to the cable penetration work. Penetration shall be neatly formed and sealed for protection from moisture, dust wind and vermin intrusion.

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

----------End of this Section----------

Section - 04

Inspection, Test and Availability

Table of Content

Section - 04

Inspection, Test and Availability

All materials furnished and all work performed under this Contract shall be inspected and tested. Deliverables shall not be shipped until all required inspections and tests have been completed, and all deficiencies have been corrected to comply with this Specification and approved for shipment by the Employer.

Except where otherwise specified, the Contractor shall provide all manpower and materials for tests, including testing facilities, logistics, power and instrumentation, and replacement of damaged parts. The costs shall be borne by the Contractor and shall be deemed to be included in the contract price.

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/Employer's representative.

Acceptance or waiver of tests shall not relieve the Contractor from the responsibility to furnish material in accordance with the specifications.

All tests shall be witnessed by the Employer and/or its authorized representative (hereinafter referred to as the Employer) unless the Employer authorizes testing to proceed without witness. The Employer representative shall sign the test form indicating approval of successful tests.

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 Contractor as necessary to correct the noted deficiencies at no cost to the Employer. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

The Employer reserves the right to require the Contractor to perform, at the Employer's expense, any other reasonable test(s) at the Contractor's premises, on site, or elsewhere in addition to the specified Type, Acceptance, Routine, or Manufacturing tests to assure the Employer of specification compliance.

All security related features shall be demonstrated during FAT/SAT as required by the Employer.

4.1 Inspection

Access to the Contractor's facilities during system manufacturing and testing and to any facility where systems/ equipment are being produced/ tested/ integrated for the fibre optic

communication network, shall be available to the Employer. At all times the Employer shall have full facilities for unrestricted inspection of such materials or equipment. To facilitate this, the Contractor shall submit for the Employer approval, a comprehensive Quality Assurance Plan using ISO 9000 as a general guideline. In addition, the Quality Assurance Plan shall satisfy the following:

(a) 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 Contractor to the Employer.

(b) Inspections to be performed by the Employer will include visual examination of hardware, cable dressings and labeling. Contractor's documentation will also be examined to verify that it adequately identifies and describes all offered items and spare parts.

(c) Access to inspect the Contractor's standards, procedures, and records that are applicable to the supplied equipment shall be provided to the Employer. Documents will be inspected to verify that the Contractor has performed the required quality assurance activities.

(d) The inspection rights described above shall also apply to sub Contractors who are responsible for supplying major components described in this Specification. These items shall be inspected and tested at the sub Contractor's factory by the Employer's representatives prior to shipping this equipment to the Contractor's facility or directly to the Employer.

(e) The above inspection rights shall also apply to sub Contractors supplying assemblies, subassemblies and components. However, such items will normally be inspected and tested by the Employer's representatives at the Contractor's site before acceptance.

4.2 Test Plans and Procedures

Test plans and test procedures for both factory and site acceptance tests shall be provided by the Contractor. Test plans and test procedures shall ensure that each factory and site test is comprehensive and 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.

The Contractor shall submit a Test Schedule for the Employer's approval within one (1) week after the award of contract for Type Tests and three (3) months after the award of contract for all other tests. 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.

The Contractor shall give the Employer twenty one (21) days written notice of any material being ready for testing. Fifteen days prior to the scheduled testing, the Employer shall provide written notice to the Contractor of any drawings, equipment, material, or workmanship which, in the Employer's opinion, are not compliant to the specification. The Contractor 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.

4.2.1 Factory and Site Test Plans

A test plan for factory and site acceptance tests shall be submitted for approval, at least four (4) weeks before the start of testing. The test plan 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 4-1.

Table 4-1
Factory & field Test Plan Requirements

Item:	Description:
1.	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

4.2.2 Test Procedures

Test procedures for factory and site testing shall be submitted for the Employer approval at least four (4) weeks before each individual test. Fully approved test procedures shall be submitted to the Employer at least four weeks prior to the commencement of testing. Testing shall not commence without approved test procedures. At a minimum, test procedures shall include the items listed in Table 4-2.

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.

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

Table 4-2

Test Procedure Requirements

Item:	Description:
1.	Test Title and Revision Level, if applicable
2.	List of Standard(s) complied with
3.	Function(s) / parameter(s) to be tested
4.	Purpose of each test segment
5.	List of required test equipment
6.	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.
7.	Test setup including test configuration block diagrams and/or illustrations.
8.	Test procedures to be followed.
9.	Required inputs and expected outputs for each test segment
10.	Acceptance criteria for each test segment.
11.	List of test data to be supplied by the Contractor(s) and copies of any certified data to be used
12.	Format of test reports.

4.2.3 Test Records

Complete and indexed records of all factory and site acceptance tests results shall be maintained and provided to the Employer by the Contractor in hardcopy. The records shall be keyed to the steps enumerated in the test procedures. The minimal items required in test records are described in Table 4-3.

Table 4-3

Test Record Requirements

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.	Contractor's test engineer(s) identification, signature and remarks
9.	Employer's test witness identification, signature and remarks
10.	List of all attachments

Table 4-3

Test Record Requirements

Item:	Description:
11.	Attachments (including system logs, printouts, variances, hard copies of visual test result displays, etc.)

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 Employer within the specified duration after the completion of test. 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 Contractor's reference and heading.

4.2.4 Rejection of Elements

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

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 Contractor at his own expense. After adjustment or modification, the Contractor shall submit the items to the Employer for further inspection and/or tests.

4.2.5 Test Periods Defined

The terminology used in Volume I, General Conditions of Contract and their correlation with the tests requirements described within this section is as follows:

Pre-Commissioning & Commissioning Period - The Site Acceptance Test (SAT)
Operational Acceptance - Successful completion of SAT

4.3 Type Testing

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

(a) All equipment being supplied shall conform to type tests as per technical specification.

(b) The test reports submitted shall be of the tests conducted within last five (5) years prior to the date of bid opening. In case the test reports are older than five years (5) ago on the date of bid opening, the Contractor shall repeat these tests at no extra cost to the purchaser.

(c) The Contractor shall submit, within 30 days of Contract Award, copies of test reports for all of the Type Tests that are specified in the specifications and that have previously (before Contract award) been performed. These reports may be accepted by the Employer only if they apply to materials and equipment that are essentially identical to those due to be delivered under the Contract and only if test procedures and parameter values are identical to those specified in this specifications carried out at accredited labs and witnessed by third party / customer's representatives.

In the event of any discrepancy in the test reports or any type tests not carried out, same shall be carried out by Contractor without any additional cost implication to the Employer.

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

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

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

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

4.3.1 Type Test Samples

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

random. At least three samples of each of the proposed equipment shall be offered for selection, out of which one sample for each equipment shall be selected.

4.3.2 List of Type Tests

The type testing shall be conducted on the following equipment

(a) SDH Equipment with all types of cards (optical card, Tributary card or any other equipment as part of repeater less links)

4.3.2.1 List of type test to be conducted on Telecom equipment

The type tests for SDH Equipment with all types of cards, Primary Multiplexer & Drop – Insert Mux with subscriber interface card and DACS are described below:

4.3.2.1.1 Temperature and Humidity Tests

The tests listed below are defined in IEC Publication 60068.

(a) Low Temperature Test: Operation to Specifications

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

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

(2) Degree of Severity: Test shall be done at 0°C

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

(b) Low Temperature Test : Operation without Damage

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

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

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

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

(c) Dry Heat Test: Operation to Specifications

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

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

(2) Degree of Severity: As per table 5-1: operation to specification range.

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

(d) Dry Heat Test: Operation without Damage

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

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

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

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

(e) Damp Heat Test

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

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

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

(f) Temperature Variation Test

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

(1) Number of cycles required is five (5)
(2) The degree of severity: temperature TL:0°C, TH: As per table 5-1 (Operation to specification range)
(3) Cycle duration for each temperature is three (3) hours.
(4) Ramp : 1 ^{o}C/minute.
(5) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

4.3.2.1.2 Power Supply and EMI/EMC tests

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

(a) Immunity Tests

The list of Immunity tests are specified below in Table 4-4:

Table 4-4: Recommended Immunity Tests

S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
1	Voltage Fluctuations	Yes	Yes	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 - **Level : 1**
2	Voltage dips and Interruptions	Yes	Yes	N/A	N/A	
3	100/1300 µs surge	Yes	Yes	N/A	N/A	Table 12 of IEC 60870-2-1: 1995
4	1.2/50 - 8/20 µs surges	Yes	Yes	Yes	N/A	Table 12 of IEC 60870-2-1: 1995 - **Level : 4**
5	Fast transient bursts	Yes	Yes	Yes	Yes	

Table 4-4: Recommended Immunity Tests

S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
6	Damped oscillatory waves	Yes	Yes	Yes	Yes	
7	10/700 µs surges	N/A	N/A	N/A	Yes	
8	Electrostatic discharge	Yes				Table 13 of IEC 60870-2-1: 1995 - **Level : 4**
9	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - **Level : 4**
10	Damped oscillatory magnetic field	Yes				
11	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 - **Level : 4**
12	Power Frequency voltage on control and signal lines	N/A	N/A	Yes	Yes	IEC 61000-4-16 : 2002-07 **Level : 4**
13	DC voltage on control and signal lines	N/A	N/A	Yes	N/A	IEC 61000-4-16 : 2002-07 **Level : 4**
-End of Table-						

(b) Emission Tests

The list of Emission tests are specified below in Table 4-5

Table 4-5:
Recommended Emission Tests

S. NO.	Emission test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres

Table 4-5:
Recommended Emission Tests

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

(c) Insulation Withstand Voltages

As per section 6 of IEC 870-2-1. Recommended class : VW1 of Table 18.

4.3.2.1.3 Mechanical Tests

(a) Mechanical Vibration Test

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

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

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

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

(b) Shock Test

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

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

Or Free Fall Test

This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 60068-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 68-2-32. The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing.

Or Bump Test

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

4.4 Factory Acceptance Tests

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Factory acceptance testing shall be carried out on SDH Equipments, associated line & tributary cards, Termination Equipments (Primary Mux, Drop/Insert, DACS, associated Subscriber Line Interface Cards etc), Network Management System etc. and all other items for which price has been identified separately in the Bid Price Schedules.

Equipment shall not be shipped to the Employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the Employer, and the Employer has issued Material Inspection & Clearance Certificate (MICC). Successful completion of the factory tests and the Employer approval to ship, shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the Employer's authorised representatives unless waiver for witnessing by Employer’s representatives is intimated to the contractor.

Factory acceptance tests shall not proceed without the prior delivery to and approval of all test documentation by the Employer.

The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to this specifications and approved drawings and documents. List of factory acceptance tests for Fibre Optic Transmission system, Termination Equipment Sub-system and NMS are given in specified Tables in this section. This list of factory acceptance tests shall be supplemented by the Contractor's standard FAT testing program. The factory acceptance tests for the other items shall be proposed by the Contractor in accordance with technical specifications and Contractor's (including Sub-Contractor's / supplier's) standard FAT testing program. In general the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces, alarms and diagnostics etc.

For Test equipment & clock, FAT shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/ report.

4.4.1 Sampling for FAT

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

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

4.4.2 Production Testing

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

Table 4-6:
Factory Acceptance Testing for Fibre Optic Transmission System

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

4.5 Site Acceptance Tests

The Contractor shall be responsible for the submission of all equipment & test equipment supplied in this contract for site tests and inspection as required by the Employer. All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for Telecom equipment, NMS etc. is outlined in following section. This testing shall be supplemented by the Contractor's standard installation testing program, which shall be in accordance with his quality plan(s) for Telecom equipment installation.

During the course of installation, the Employer shall have full access for inspection and verification of the progress of the work and for checking workmanship and accuracy, as may be required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the Employer to demonstrate that it is entirely suitable for commercial operation.

4.5.1 Phases for Site Acceptance Testing

The SAT shall be completed in following phases:

4.5.1.1 Installation Testing

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

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

The minimal installation testing requirements for fiber optic transmission subsystem, Termination equipment sub-system and NMS are provided in respective Tables in this section.

4.5.1.2 Link Commissioning Tests

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

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

a) Ping test
b) Throughput test
c) Latency test
d) Packet Loss

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

In case any link does not meet the performance requirements during 12 hour, then the cause of failure shall be investigated and the test shall be repeated after rectifying the defects.

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

4.5.1.3 Integrated Testing

Prior to commencement of integrated testing the overall system shall be configured as required to provide all the channesl required to interconnect the various User's interfaces. The integrated testing for a batch shall include end-to-end testing of back-bone network included in that batch. Integrated testing for last batch shall include testing of the entire back-bone. The intent of integrated testing is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and communications testing have been corrected, and that the communication equipment is compatible with other equipment at all locations. The Integrated System Test shall include all fibre optic transmission equipment, the network management subsystem and other components.

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

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

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

(3) Demonstration of Protection switching and synchronization of equipment as per synchronization plan.

Table 4-7

Fibre Optic Transmission system Installation Testing

Item:	Description:
1.	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Station power supply input and equipment power supply (DC-DC converter) output voltage measurements
3.	Terminal transceiver performance testing (Tx power, Tx spectrum, receive signal strength, connector losses etc.)
4.	Service channel performance
5.	Craftsperson interface, alarm and control functional performance

6.	Rack and local alarms: No alarms shall be present and all alarms shall be demonstrated to be functional
7.	Network management interface and supervision performance
8.	Correct configuration, level setting & adjustments and termination of Input/ output interfaces
9.	Proper establishment of Safety and signalling earthing system and resistance to ground to be checked.
10.	Simulation of failure conditions and failover of protected components.

----------End of this Section----------

Section-5

Training and Support Services

Index

Section-5

Training and Support Services

This section describes the requirements for Contractor-supplied training, support services, and maintenance of the FOTS. The intent of the training and support program is to ensure a smooth transfer of systems and technologies from the Contractor to the Employer, and to ensure that Employer staff is fully trained to operate, maintain and expand the integrated telecommunication network.

5.1 Training

The Contractor shall provide a comprehensive training program that prepares the Employer's personnel for on-site installation support, operation, and maintenance of the telecommunication network.

Training may be conducted by the Contractor, the Contractor's subcontractors, and/or original equipment manufacturers (OEMs). The training requirements of this Specification shall apply to all such courses.

Training courses shall be conducted by personnel who speak understandable English and who are experienced in instruction. All necessary training material shall be provided by the Contractor. The training charges quoted by the Contractor shall include training materials and all associated expenses. However, for all training courses in India or abroad, the travel (e.g., airfare) and per diem expenses of the participants will be borne by the Employer. For courses conducted abroad, however, the Contractor shall extend all necessary assistance for making appropriate lodging arrangement.

Hands-on training shall be provided with equipment identical to that being supplied to the Employer.

The schedule, location and detailed training contents shall be submitted by the Contractor to the Employer for approval.

5.1.1 System Design & Overview Training

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

The training shall be oriented to a user's point of view. The Employer/Owner users will include managers, design & planning personnel, communication support staff and maintenance person-

nel. As part of the proposal, the Contractor shall identify the number of days deemed appropriate for this training.

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

5.1.2 Installation & Maintenance Training

There shall be separate modules of the installation & maintenance training for the FO Transmission System.

The installation & maintenance trainings shall enable the Employer to be self-sufficient in preventive & restorative maintenance of the respective communications subsystems purchased by the Employer.

5.1.3 Network Management Training

The Network Management training shall familiarize the Employer's telecommunication personnel with the concepts and techniques for configuring, programming, maintaining, and troubleshooting the Contractor supplied NMS and its associated database. The Network Management training course shall provide the course participants with hands-on experience using the actual system being supplied.

5.1.4 Training Course Requirements

This section describes general requirements that apply to all training courses.

5.1.4.1 Class Size

The Employer plans to send a number of participants to the training courses for a specified duration as described in Appendices.

5.1.4.2 Training Schedule

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

The training courses shall be offered in one cycle, such that none of the courses within the cycle overlap. The Contractor shall take the above requirements into account in developing the preliminary training schedule. Contractor shall develop a final training schedule in consultation with the Employer after contract award.

5.1.4.3 Manuals and Equipment

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

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

Upon completion of each course, instructor's manuals, training manuals, and training aids shall become the property of the Employer. As part of the delivered system documentation and the final documentation, the Contractor shall supply the Employer with all changes and revisions to the training manuals and other training documentation. The Employer reserves the right to copy all training manuals and aids for use in the Employer-conducted training courses. The Contractor shall furnish for use during training courses all special tools, equipment, training aids, and any other materials required to train course participants.

5.2 Support Services

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

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

After final acceptance of the communications equipment, the Contractor shall offer continuing technical support and spare parts for the designed life of the equipment or 7 years after the declaration of withdrawal of equipment from production whichever is earlier. However the termination of production shall not occur prior to Operational Acceptance of the system by the Employer.

5.2.1 Technical Support

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

5.2.2 Contractor's Future Hardware/Software Changes

The Employer shall be informed of all alterations or improvements to the hardware supplied under this Specification. The Employer shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation, and solution of hardware/software problems as well as other improvements that could be made to supply equipment. The service shall begin at the time of contract award, and shall continue for 10 years. The Contractor shall also include a subscription to the hardware subcontractors' change notification service from the time of contract award through the warranty period, with a Employer renewable option for extended periods.

5.3 Spare Parts and Test Equipment

The spare parts and test equipment shall be provided for each subsystem as described below.

5.3.1 Mandatory Spare Parts

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

5.3.2 Test Equipment

Appendix-B provides mandatory test equipment requirements, to be provided. The parameters / features of the mandatory equipments are enumerated in Table 6.2 below:

Table 6.2

S.No.	Test equipment	Parameter
1	SDH Analyser (upto STM-16) with Jitter and Wander Options	Equivalent to JDSU MTS8000 or better
2	Handheld 2Mbps BER Tester	Equivalent to JDSU EDT-135 or better
3	Digital Multimeter	Equivalent to Fluke287 or better
4	Ethernet Tester (with dual port, 10/100 ports Mbps Ethernet option, layer-1 & layer-2 functionality)	Equivalent to JDSU FST 2802 or better

In case the offered make/model of test equipment has multiple options for the parameters, the option of higher range shall be acceptable. The supplied test equipment shall be suitable for use in the high EMI/EMC environment. The Contractor shall submit performance certificate for offered test equipment from at least one customer. The Contractor shall offer only reputed make test equipment such as Acterna (JDSU)/Anirutsu/ Fluke/Agilent/EXFO etc.

The Contractor shall provide in their bid, additionally recommended test equipment list necessary to support system availability figures specified in technical specifications. These lists shall

include all relevant technical descriptions and recommended minimum quantities based upon the guidelines consistent with the telecommunications resource management hierarchy and continuing maintenance concept. The recommended test equipment shall not be considered for evaluation and may be included in the final scope of supply.

5.4 System Maintenance

As per DoT guidelines, operation and maintenance of the network shall be entirely by Indian engineers and dependence on foreign engineers shall be minimal within a period of two years from the date of LoA. The contractor shall be responsible to maintain the confidentiality of the Employer's System Information that Employer shares with the contractor for maintenance period.

5.4.1 Warranty Period

The one year period commencing immediately after the operational acceptance is called the Warranty Period/Defect liability Period. In addition to the responsibilities covered under Vol-I Condition of Contracts during Defect Liability Period, the Contractor shall also be responsible for maintenance of the Fibre Optic Transmission System supplied under this Package. The specification for the maintenance of the system after Operational Acceptance is enclosed at Annexure-I.

5.4.2 Contractor's Maintenance Responsibility

The Contractor shall be responsible for carrying out "Non-Comprehensive Maintenance" of the Communication System for a period of six years after warranty period for ensuring the successful operation of the system. The Contractor shall be responsible for achieving the system availability and the response time mentioned in technical specifications. The bidder shall quote the Annual Maintenance Charges for six years after Warranty Period which shall be considered in the bid evaluation. Bidder shall submit the detailed procedure for achieving above in the bid. The specification for the maintenance of the system is enclosed at Annexure-I. Upon expiry of the six years AMC period Employer may, at its discretion, extend this Maintenance for additional one year at the same price & terms and conditions.

5.5 Miscellaneous Supplies

The Contractor shall provide all required consumable and non-consumable supplies necessary to support all installation and test activities through final operational acceptance. However, if there are any problems in the SAT and additional consumables are required, the same shall also be supplied by the Contractor at no additional cost.

5.6 Documentation

The Contractor shall submit following documents during detailed engineering:

(a) Data Requirement sheets
(b) Link Budget calculations
(c) MQP, FQP
(d) Bill of Quantity including mandatory spares

(e) Previous Type test reports
(f) Factory Test report
(g) Manuals for each equipment
(h) Schematic drawing
(i) Numbering, Marking, labelling document
(j) Synchronization plan
(k) Test schedule
(l) Training manual
(m) Configuration diagram
(n) Transportation & handling Procedure
(o) Installation Manuals
(p) Maintenance Manuals

Annexure-I

Technical Specifications for Maintenance after operational acceptance during maintenance period (i.e. Warranty/defect liability period & AMC Period)

A -1.0 GENERAL

The Contractor shall be responsible for the maintenance of all the communication equipment installed under this Contract as follows:

(i) Non-comprehensive Maintenance: Non-comprehensive maintenance shall be on call basis and shall not require deployment of manpower on Employer's location but the maintenance Engineer shall reach the site and restore the system within 24 hours (excluding travel time) after the complaint is registered. However, in case of non-comprehensive maintenance also, semi-annual planned site visit will be required as detailed here.

The maintenance contract shall commence after completion of the project i.e. after Operational Acceptance. Contractor shall meet system availability of 99.9% for fibre optic system.

Contractor's maintenance engineer/service engineer shall have minimum qualification of graduate in Computer or IT or Electronics & Telecommunication with minimum one year experience or Diploma with three years maintenance/testing & commissioning experience on the equipment proposed to be supplied & installed. The Degree/Diploma must be recognised Indian professional qualification. This staff shall be supported by head office technical staff for restorative problem or other assistance as may be required.

Contractor will arrange for adequate transportation for their staff as per the work demand.

All the spares required during maintenance period shall be provided by the Contractor at no additional cost to the Employer.

A - 1.1 RESOURCE DEPLOYMENT

The contract shall identify maintenance coordinator who will interact with the Employer for maintenance requirement.

The contractor shall deploy the maintenance/service engineer at the required locations of the link on call basis for rectification of fault as well as carry out preventive maintenance (Half Yearly) of the system.

A 1.2 MONITORING

Network will be monitored by the Employer Network Monitoring Team (NMT), whenever, notices any fault/abnormality in the system shall notify to the Contractor's maintenance Co-ordinator, over phone with an event no. An event report shall be generated by the Employer as per the formats finalized during detailed engineering. On

issuance of Event report (may be recorded over phone) by NMT, corrective action/s shall be carried out by Contractor's maintenance personnel for rectification. Contractor's representative must report within twenty four (24) hours at required location (including travel time). Time mentioned here is irrespective of normal working hours or holidays. The NMT shall co-ordinate and control any site visits to ensure that communication network is operating with a minimum of disruption during these visits. The NMT will inform the relevant Employer representative to facilitate the access to the site/equipment where fault is suspected.

The main responsibilities of the Employer's Network Monitoring Team are:

a) Communication Network monitoring by NMT
b) Detect faults, prioritizing them and notifying to the Contractor for immediate corrective actions.
c) Follow up on corrective actions to verify that the agreed time frames are met.
d) Record all faults in the fault record sheet and summary of action taken for fault rectifications.
e) Co-ordinate all planned / breakdown site visits to minimize disturbance of service.
f) Update status information of operated network to user's communication network.

A 1.3 MAINTENANCE

Maintenance activities are either Event Based (Fault/breakdown maintenance,) or planned site visits (Semi annual site visit, testing of channel/s, augmentation and modification in the network if end equipment does not communicate with corresponding equipment as and when required. Planned visits shall mainly carried out during working days.

Event based work is to be carried out on call basis. A start status shall be jointly filled by Employer & Contractors representative at 10.00 Hrs of commencement date of maintenance contract.

Planned site visits shall be carried out twice in a year (semi-annually) at all the sites in the network or time to time if speech/data is affected at a particular site. Thus, in a year, not less than two planned site visits to all locations will be undertaken.

Contractor will maintain record of events during the maintenance services ; simultaneously Employer shall also record the events in the LOG BOOK.

The tasks during the planned site visits for the system include but are not limited to following:

- Visual inspection of equipment
- Alarm measurement verification
- Status report of site
- Updating of log records

- Cleaning the equipment
- Tightening of connectors
- Sealing of cabinets to arrest entry of rodents etc.
- Measurement of earth resistance

Formats for the works to be taken up during semi-annual site visits shall be finalized during detailed engineering.

Fault/Breakdown maintenance is a process of fault correction / trouble shooting/interfacing with other contractor as per the fault reported by NMT. Contractor will maintain a log of activities carried out at all locations and necessary History will include site name, visit date, actions taken and site condition. Detailed report in this respect shall be submitted by the contractor in the monthly meeting.

The Employer representatives will associate in trouble shooting, change of unit as per programme notified/intimated by the contractor however, due to any reason if Employer cannot depute their representative, contractor will proceed for the work so as to attend the breakdown/testing as per their programme.

The scope of corrective maintenance is as follows:

- Troubleshooting on a network element and its interfaces as and when required and directed by NMT, engineer/coordinator of Employer.
- Diagnostics on interfaces to locate problems in network elements. If required, the contractor shall depute maintenance engineer for joint inspection with other vendors for pin-pointing the fault.
- Identification of the faulty hardware unit, replacing it.
- Performance of function verification in co-ordination with the NMT operators
- Handing over of faulty unit to Employer at site or Control Centre.

A 1.4 HARDWARE SERVICES

In case any failure or malfunction is discovered, the maintenance team shall identify the problem, organise to promptly attend the fault, replace the faulty equipment/card/module or any other hardware component with a spare unit and ship the faulty unit to specified location. Each faulty unit shall be accompanied with correctly filled-out Event Report. Contractor shall ensure maximum utilisation of the channel capacity, hence healthy channel/s will be put in use and hardwired to respective DDF point, in coordination with Employer, without disturbing end user connection so that outright replacement of card is avoided. Card shall be replaced when all the healthy channels are faulty. Necessary modification (temporary) in drawing/s in site copy will have to be done without changing original document.

The Contractor shall be responsible for providing all the spares (cards/modules/accessories etc.) for supplied & installed equipment. The spares shall be provided/arranged by the contractor at no extra cost to Employer**.** For early restoration during the emergency condition, if spares are made available by Employer, the same shall have to be replenished by the

Contractor within thirty (30) days.

Contractor will carry out the following tasks for hardware services:

a) Handover the faulty unit/s to Employer
b) Replace faulty units from their own spares stock.
c) Send faulty units to Original equipment supplier's representative in India on Employer behalf with the correctly completed Failure Report with site information and symptoms of failure.
d) Test the repaired unit for their healthiness after the same is rectified by the original manufacturer.

A 1.5 MAINTENANCE SERVICES SUMMARY

The Maintenance Services are summarised below:

MAINTENANCE FAULT/BREAKDOWN	
Equipment Scope	As per BoQ enclosed in Appendices
Scope	Rectification /Corrective maintenance
Availability	On call basis as mentioned above in TS
PLANNED SITE VISIT	
Equipment Scope	As per BoQ enclosed in Appendices
Scope	Visual inspection of equipment, alarms measurement verifications, status report of site, updating of log record, cleaning the equipment, modification & augmentation
Availability	Semi-annual / planned visits

A 1.6 OUTAGE TIME DEFINITION:

An outage time refers to period in which loss of communication is detected on any part of the telecommunication network / equipment and continues until the fault is cleared by taking into account conditions listed below.

a) Time of unavailability excludes running with faulty equipment on specific instruction from POWERGRID/Constituent (not affecting communication or monitoring of other units other than faulty unit).

b) The time of unavailability excludes the transportation time to a faulty site average of twelve (12) hours and time to get authorization for access to the telecommunication room and to the equipment.

c) An event would not be considered as failure when the system features allow to continue the data transmission utilizing redundancies available in the subsystem/equipment.

d) In case of failure of any E1, no consequential lower level channel failure shall be accounted for.

e) In case a loss of communication is detected in system of third party (RTU/SCADA, existing SDH equipment procured under separate contract) and no corresponding alarm is detected in NMS the event will be jointly studied with the parties and plan/schedule of fault finding will be made. However, under such conditions of fault attribution to the third party, it would be contractor's responsibility to logically establish such attribution.

f) If it is needed to identify the fault, it is allowed to disconnect/loop circuits for trouble shootings. This testing time shall not be counted in the outage time calculations. However, interruption time for healthy channel should not exceed 10 minutes. Proper planning and coordination with all concerned may be required while carrying out this activity so as to minimize outage time.

g) Outage due to force majeure conditions (Not attending fault due to war, curfew, earthquake at the location of fault, serious accident during traveling for attending fault) or outage due to failure in power system equipment other than supplied by the Contractor (or AC/DC).

h) Outages which are not attributable to equipment faults such as fault in fibre optic cable will not be considered for calculation in system availability.

A 1.7 DOCUMENTATION DURING MAINTENANCE PERIOD

Events shall be recorded by using of event form. The forms shall be filled in duly dated, timed and signed by representatives of both the parties. Absence of one or the other party's representative shall not render the record invalid but assumes only that such representative signs the record at his earliest convenience.

The initial condition of the system shall be recorded on the start status form to constitute or reference for later events. All the events recorded in the start status form shall have to be rectified within 15 days. Faults not attended within 15 days will be considered as outage. Any and all events such as incoming and existing alarms, fault occurrence, action taken for remedies etc. shall be recorded in the event report forms. If a unit is replaced or repaired both the new and the replaced or repaired unit is to be recorded in the event report form. Contractor shall submit the detailed report for fault occurrence after the cards/equipment is rectified at the works of supplier.

A 1.8 AVAILABILITY REQUIREMENT

The availability of wideband communication equipment shall be measured in categories as below:

a) management data channels
b) E-1 /Ethernet channels

The availability requirement for type of channels for wideband communication equipment shall be 99.9%.

However not withstanding the commutation of availability of the communication system as specified above, the prompt restortion of the faulty equipment/part of the network is also of equal importance and any delay in restoration of the faulty system shall be

goverened as per terms & condition of the contract.

A 1.9 SCOPE OF WORK DURING MAINTENANCE PERIOD

Sl.no.	Description	Detailed Scope
1	***Overall Infrastructure***	Infrastructure includes the building, air conditioners, AC/DC system, UPS, cable trenches, Earthing etc provided by Employer. They will be maintained by Employer.
1.1	***Equipment site***	
1.1.1	General conditions	General checking during semi annual / troubleshooting site visits and advise
1.1.2	Cleanliness of the room	General checking during semi annual / troubleshooting site visits and advise.
1.1.3	Earthing interconnections	Checking, connector cleaning, redoing the connection during semi annual / troubleshooting site visits (limited to the earthing of equipment under scope of maintenance)and as required specifically. Earthing interconnection will be checked upto earthing star point). Earthing interconnection shall also be checked and corrected during troubleshooting site visits if it is considered the probable cause of fault. Measurement of earth resistance during semi-annual site visit
1.1.4	Air conditioning	General checking during semi annual / troubleshooting site visits and advise
1.1.5	Cable route	General checking during semi annual / troubleshooting site visits and advise
1.1.6	EMI issues	Contractor shall study in special case of repeated faults if the probable cause is earthing interconnection at the station or possibility of spurious signals through various cable connections to the wideband equipment and advise.
1.2	Indoor cabling	Checking terminations, re-kroning, if necessary, during semi-annual/troubleshooting site visits. It shall also be checked during troubleshooting site visits if it is the probable cause of faults.
1.3	Out-door cabling	Checking terminations, re-kroning, if necessary, during semi-annual/troubleshooting site visits. It shall also be checked during troubleshooting site visits if it is the probable cause of faults.
1.4	Fibre Optic Cable	Checking with OTDR and advice. Rectification if fault is found to be in the approach cable/ patch cord etc. up to

		DDF.
2	***Main Equipment***	
2.1	Fibre Optic terminal SDH	Faulty equipment to be replaced at site as per conditions of Maintenance Plan.
2.2	GPS Clock	Faulty equipment to be replaced at site as per conditions of Maintenance Plan. Contractor shall be responsible for providing hardware , if required, during maintenance without any additional cost implication to Employer.
2.4	***Craft Terminal based NMS of SDH***	
2.4.1	Computer hardware	Contractor shall be responsible for providing all hardware & software required during maintenance without any additional cost implication to Employer.
2.4.2	Alarm handling, Backups etc. - software part	Alarm deletions, Backups as per maintenance plan. Consumables to be provided by Employer. Software corruption to be corrected as per actual requirement.
3	***Contractor's set-up***	Generally in consonance with the set-up mentioned in the maintenance plan.

A 2.0 PENALTY FOR DEFAULT IN SERVICES

(a) Contractor will maintain an adequate level of qualified staff for carrying out this maintenance contract, failing which Rs 50,000/- per month will be deducted by Employer from the amount due to contractor under this contract. In addition 5% of the total payable amount shall be deducted for every fall of 1% or part thereof in the specified availability.

(b) Employer shall have the right to terminate the contract after giving notice of two month if the availability of the system is not attained as per specification consecutively for two months.

A 3.0 CO-ORDINATION REQUIREMENTS

A 3.1 MEETING PRACTICE

Regular meeting between Employer and the Contractor is vital for communication and information flow between these two organisations. The purpose of the meeting is to tackle the essential issues concerning the services and network performance. The suggested schedule for meeting is once in every month. The meeting agenda shall be decided between Employer and Contractor and could for example consist of the following issues:

- Services and network performance according to the report during last month
- Review of emergency situation
- Status of spare
- Action plan

- Next Meeting
- Alarms/events unattended till the date of meeting

The following participants should be present in this meeting:

- Co-ordinator (Contractor)
- Members of the Contractor team as needed
- Co-ordinator Employer representative
- Operation and maintenance staff as designated to attend (Employer)

A 3.2 EMERGENCY MEETING

Whenever a major outage occurs in any part of the network, an emergency meeting may be called if desired by Employer. In the meeting, the outage will be discussed in the context of cause, correction and prevention**.**

A 3.3 REPORTING PROCEDURE

The purpose of report is to summarize the activities performed during the reporting period. The report provides the information on the performance of the services and describes the current status of the network. The report is a monthly report from Contractor to Employer which shows the trends in the network and services provided by the Contractor. By analysing the report data, management and expert of Employer and contractor are able to focus attention on the areas where further improvement is needed.

Emergency Reports: Contractor reports to Employer every time the emergencies call up and call out service is invoked. In these cases, on termination of the emergency all details of the fault and clearance information are submitted within five working days.

----------End of this Section----------

Appendix-A

Bill of Quantities
(BOQ)

Table - 1
BOQ for Telecom Equipment

S.NO.	Item Description	Unit	TOTAL QTY.
1.0	**Transmission Equipment**		
A	**SDH Equipment - STM- 4 (upto two protected directions)**		
(I)	Base Equipment (Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories including sub-racks, patch cords, DDF etc. fully equipped excluding (II) and (III) below)	No.	
(II)	**Optical Interface/SFP# for:**		
(a)	S4.1	No.	
(b)	L4.1	No.	
(c)	L4.2	No.	
(d)	Optical Interface/SFP (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card.)	No.	
B	**SDH Equipment - STM- 16 (upto two protected directions)**		
(I)	Base Equipment (Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories including sub-racks, patch cords, DDF etc. fully equipped excluding (II) and (III) below)	No.	
(II)	**Optical Interface/SFP# for:**		
(a)	S16.1	No.	
(b)	L16.1	No.	
(c)	L16.2	No.	
(d)	Optical Interface/SFP (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	

S.NO.	Item Description	Unit	TOTAL QTY.
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card.)	No.	
C	**SDH Equipment - STM- 4 (for more than two protected directions)**		
(I)	Base Equipment (Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories including sub-racks, patch cords, DDF etc. fully equipped excluding (II) and (III) below)	No.	
(II)	**Optical Interface/SFP# for:**		
(a)	S4.1	No.	
(b)	L4.1	No.	
(c)	L4.2	No.	
(d)	Optical Interface/SFP card (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card)	No.	
D	**SDH Equipment - STM- 16 (for more than two protected directions)**		
(I)	Base Equipment (Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories including sub-racks, patch cords, DDF etc. fully equipped excluding (II) and (III) below)	No.	
(II)	**Optical Interface/SFP# for:**		
(a)	S16.1	No.	
(b)	L16.1	No.	
(c)	L16.2	No.	
(d)	Optical Interface/SFP card (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		

S.NO.	Item Description	Unit	TOTAL QTY.
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card)	No.	
2.0	**Equipment Cabinets**		
a)	**For SDH Equipment**	No.	
3.0	**NMS#**		
(i)	**Craft Terminal**		
(a)	Hardware	Set*	
(b)	Software	Set*	
4.0	**Synchronization Equipment**		
	GPS clock including all hardware & accessories	Set	

Note*: Set shall include all required hardware/software for complete TMN system as specified in technical specifications. NMS facilities for SDH equipment shall include monitoring of Ethernet ports also.

Note** : Suitable Optical Interface Card(s) or any other solution such as SDH equipment with optical amplifier, wavelength translator or higher aggregate bit rate SDH equipment may be offer for the lengths to meet the link budget requirements without repeater.

Note# :Optical interface/SFP can be provided with Optical base card or Control card with the condition that control card shall not be equipped with more than one Optical interface/SFP and optical card with not more than two Optical interface/SFP. However main and protection channel shall be terminated on separate cards.

Note## : Requirement of NMS as per capacity of Network. For small networks, Craft terminal based NMS would suffice.

Table 2
BOQ of Mandatory spares for Telecom Equipment

S.NO.	Item Description	Unit	TOTAL QTY.
1.0	**Transmission Equipment**		
A	**SDH Equipment -STM- 4 (ADM, upto two protected directions)**		
(I)	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each)	Set[$$]	
(II)	**Optical Interface/SFP[@] for:**		
(a)	S4.1	No.	
(b)	L4.1	No.	
(c)	L4.2	No.	
(d)	Optical Interface/SFP (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 km)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card.)	No.	
B	**SDH Equipment -STM- 16 (ADM, upto two protected directions)**		
(I)	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each)	Set[$$]	
(II)	**Optical Interface/SFP[@] for:**		
(a)	S16.1	No.	
(b)	L16.1	No.	
(c)	L16.2	No.	
(d)	Optical Interface/SFP[@] (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP[@] (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2	No.	

S.NO.	Item Description	Unit	TOTAL QTY.
	switching (Minimum 4 interfaces per card.)		
C	**SDH Equipment -STM- 4(ADM for more than two protected directions)**		
(I)	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each)	Set[$$]	
(II)	**Optical Interface/SFP[@] for:**		
(a)	S4.1	No.	
(b)	L4.1	No.	
(c)	L4.2	No.	
(d)	Optical Interface/SFP (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP (to support upto 250 km)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card.)	No.	
D	**SDH Equipment - STM- 16 (ADM for more than two protected directions)**		
(I)	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each)	Set[$$]	
(II)	**Optical Interface/SFP[@] for:**		
(a)	S16.1	No.	
(b)	L16.1	No.	
(c)	L16.2	No.	
(d)	Optical Interface/SFP[@] card (to support minimum 150 kms)**	No.	
(e)	Optical Interface/SFP[@] (to support upto 250 kms)**	No.	
	(1) To support minimum 175 km	No.	
	(2) To support minimum 200 km	No.	
	(3) To support minimum 225 km	No.	
	(4) To support minimum 250 km	No.	
(III)	**Tributary Cards**		
(a)	E1 Interface card (Minimum 16 interfaces per card)	No.	
(b)	Ethernet interfaces 10/100 Mbps with Layer-2 switching (Minimum 4 interfaces per card)	No.	
2.0	**Pre Connectorized Optical Fiber Patch Cords (10 Mtrs) – Pack of six Patch cords**	Set	

Note** : Suitable Optical Interface Card(s) or any other solution such as SDH equipment with optical amplifier, wavelength translator or higher aggregate bit rate SDH equipment may be offered for the length to meet the link budget requirements without repeater.

Note$$: One Set means one of each type of module/unit card etc

Note@: Include each type of optical base card which has been supplied under main quantity meeting the criteria of 10% spare

Table -3
BOQ for Test equipment

S.No.	Test equipment for Telecom Equipment	Unit	TOTAL QTY
1	SDH Analyser with Jitter and Wander Options	No.	
2	Handheld 2Mbps BER Tester	No.	
3	Digital Multimeter	No.	
4	Ethernet Tester (with dual port, 10/100 ports Mbps Ethernet option, layer-1 & layer-2 functionality)	No.	

Note: The testing capacity of SDH analyser shall be provided according to offered bit rate of SDH equipment (e.g upto STM-16 for STM-16 SDH equipment)

Table -4 Maintenance Charges			
S. No.	**Items Description**	**Unit**	**Qty**
1	Maintenance Charges for Communication System for 6 year after Warranty period	Year	

Table: - 5
Proposed Training Requirements

S.NO.	Item Description	Location	No. of Trainees	Duration in working days
1	Training on SDH equipment and Craft Terminal based NMS	Manufacturer works/Training centre		

Appendix-B

Data Requirement Sheets

Appendix-C

Data Requirement Sheets

The following sets of Data Requirement Sheets are required to be filled up by the bidders to aid in the evaluation process. The response shall be brief and to the point and shall be supported by the printed product description and other literature. The DRS duly filled and the relevant drawings shall also be submitted during the detailed engineering along with the relevant technical brochures.

DRS Form 01

DATA REQUIREMENTS SHEETS for
OPTICAL LINE TERMINATION EQUIPMENT (OLTE)

Manufacturer:_____

Model #: _____

GENERAL OLTE FEATURES

Seq	Parameter:	As per Technical Specification		As per Bidder Offering	
		STM-16 Equipment	STM-4 Equipment	STM-16 Equipment	STM-4 Equipment
1.	SDH hierarchy level: Capacity Aggregate Bit-rate: CEPT E-1 Ports:	STM-16 2.5Gbps 1008 x E1	STM-4 620 Mbps 252 x E1		
2.	Minimum No. of protected (MSP) directions	Five/Three (as applicable)	Three		
3.	No. of E1 ports in E1 tributary cards	minimum 16	minimum 16		
4.	No. of ethernet ports in Ethernet interface tributary cards	minimum 4	minimum 4		
5.	Service Channel provision a) Voice Channel b) Data Channel	Yes Minimum 1 Minimum 1	Yes Minimum 1 Minimum 1		
6.	Power Supply cards of SDH equipment Common Control* Card of SDH equipment	1:1 APS or distributed power supply 1:1 APS	1:1 APS or distributed power supply 1:1 APS		

* = Common Control Cards which are essentially required for the operation of the equipment

----------End of the Appendix----------