582967/2021/TBG-TB_HVDC

# BHARAT HEAVY ELECTRICALS LIMITED
## TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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| | | | | DATE | | | |
| | | | | GROUP | TBEM | W.O. No | |
| CUSTOMER | Telangana State Power Generation Corporation Limited (TSGENCO) | | | | | | |
| PROJECTS | 400kV Switchyard at 5 x 800 MW Bhadradri TPS | | | | | | |



CONTENTS



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# SECTION 1

# SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

## 1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, supervision of erection, site testing and commissioning of SDH equipment, termination equipment & Telecommunication Management Network (TMN) complete with accessories as listed under this specification.

This section covers the specific technical requirements of SDH equipment, termination equipment & Telecommunication Management Network (TMN). This constitutes minimum technical parameters for the above item as specified by the customer (TSGENCO). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:
Section-1: Scope, Specific Technical Requirements & Bill of Quantities
Section-2: Equipment Specification
Section-3: Project Details and General Technical Requirements
Section-4: Guaranteed Technical Particulars
Section-5: Enclosures

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

## 1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer : Telangana State Power Generation Corporation Limited (TSGENCO)
Name of The Project : 400kV Switchyard At 5 x 800 MW Yadadri TPS

Refer Section - 3 for Project Details and General Specifications.

## 1.2 BILL OF QUANTITIES

**The BOQ for this package is enclosed in Annexure-A.**

**The bidder(s) is required to submit their offer for supply and services as per BOQ.**

## 1.3 TYPE TEST REQUIRMENTS

The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in TSGENCO shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by TSGENCO or representative authorized by TSGENCO or Utility or

representative of accredited test lab or reputed consultant.
The test reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.
Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser. In case type tests are required to be conducted / repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the contractor.

## 1.4 INSPECTION, TESTING AND ACCEPTANCE

Bidder has to follow specification and TSGENCO approved Manufacturing Quality Plan and FAT/SAT procedures.

## 1.5 DEVIATION

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

## 1.6 DOCUMENTATION

Final Documentation (after approval) shall be separate for each Substation.

## 1.7 DOCUMENTS REQUIRED DURING TENDER STAGE

Following documents are required during tender stage:

a) Clause wise compliance to the specification
b) Available catalogs of offered items
c) Filled checklist
d) Un-priced Bill of Quantity

**Note**: It may be noted that word “contractor “wherever is referred in section-2 & 4 shall be read as bidder and word “employer “wherever is referred in section – 2 & 4 shall be read as “TSGENCO”.

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## ANNEXURE-A: Bill of Quantities of OPTICAL LINE TERMINAL EQUIPMENTS (OLTE)

**Project: TSGENCO 5X800MW YADADRI TPS- SWITCHYARD SCOPE**

**Contractor: Bharat Heavy Electricals Limited (Transmission Business Grou**

| Sl No. | Supply | UOM | Total Qty |
|---|---|---|---|
| 1 | Two directional Managed Synchronous Digital Hierarchy (SDH) type, long Haul which can drive upto 120KM, STM-4 upgradable to STM-16 OLTE with Primary Multiplexer - ***ECI MAKE: NPT1200*** | Nos | **4** |
| 2 | Two directional Managed Synchronous Digital Hierarchy (SDH) type, Short Haul that can drive upto 30KM in both direction, STM-4 upgradable to STM-16 OLTE with Primary Multiplexer ***ECI MAKE: NPT1200*** | Nos | **2** |
| 3 | Two directional Managed Synchronous Digital Hierarchy (SDH) type, Long Haul that can drive upto 180KM in both direction, STM-4 upgradable to STM-16 OLTE with Primary Multiplexer ***ECI MAKE: NPT1200*** | Nos | **2** |
| 4 | FODP Rack | Nos | **4** |
| 5 | C37.94 Optical Inteface Card with 4 Nos SFP ports suitable for OLTEs | Nos | **16** |
| 6 | Digital Protection signaling Equipment along with Racks (only 2 Nos DTPCs shall be Mounted in one rack)- ***SIEMENS MAKE SWT3000*** | Nos | **32** |
| 7 | EPAX (16/16) with 4E1 cards Wired for 128 Ports fully wired. | Nos | **2** |
| 8 | EPB Telephones | Nos | **20** |
| 9 | 6 Pair PVC Copper Telephone cable | km | **2** |
| 10 | CAT 6UTP CABLE(1 Box=305 MTRS) | Bundles | **3** |
| 11 | 20 pair armoured jelly filled copper telephone cable | km | **2** |
| 12 | 4 1/2 digit true rms Digital multimetre CAT IV | Nos | **2** |
| 13 | Medsize tool kit (1)Screw driver set with detachable bits(2)Spanner set(3,4)Cutting-Nose Plier(5)Wire stripper(6,7)25W-50W Soldering Iron(8)Crimping Tool 4/6/8 pin(9)3-1/2Digital Multimeter with case | Set | **2** |
| 14 | Optical Time domain Reflector(OTDR) | Nos | **2** |
| 15 | Fusion Splicing Machine (FSM) along with Standard accessories | Nos | **2** |
| 16 | Optical Power Meter | Nos | **2** |
| 17 | OFC tool kit consisting of Fibre stripping tool and tools for cutting and stripping of sheathing, jacket armouring of OFAC/ADSS/OPGW cables including two binoculars | Set | **2** |
| 18 | Laptop PC for configuration of remote OLTE,MUX, Digital Teleprotection equipment with necessary software | Nos | **1** |
| 19 | Fibre Distribution panels for termination of fibres with connectors of 24F capacity (FODP 24F: indoor type, rack mounted of any standard make) (For arranging line Differential Relay Protection)) | Nos | **8** |
| 20 | Fibre Approach cable (OFAC) 24fibres of DWSM type with 40133 mm HDPE pipe | km | **4** |
| 21 | Patch cards suitable to Relay Panel Fibre port and 24F FODP panel | Nos | **20** |

| | | | |
|---|---|---|---|
| **Spares (Telecom Material)** | | | |
| 22 | Mandatory spare set for OLTE equipment and MUX equipment (One module for each type) | Set | **3** |
| 23 | Mandatory spare set of Digital tele protection equipment (one module for each type) | Set | **4** |
| 24 | Mandatory spare set for EPAX (One module for each type) | Set | **1** |
| **Services** | | | |
| 25 | SAT & COMMISSIONING OF COMMUNICATION EQUIPMENT INCLUDING SUPERVISION OF INSTALLATION (STATION-WISE) | LOT | **1** |
| | | | |

Note:

1) Any other items like rack mounted DCDB, hardware, communication cable, jumper cable, krone tool, pre-connectorized optics fibre patch cord, signal cables, E1 cables etc. which are required for completion of the system are deemed to be included in the offer. BHEL will provide only 1.1kV Cu control and Al auxiliary power supply cables for external system cable connections and 48V DC system (Battery/Charger/Main DCDB). Power Supply Cable Terminal Blocks provided in the OLTE equipments shall be suitable for termination of 2C x 16 sq mm Al power cable.

2) Any other commissioning/ technical support required for system commissioning to the satisfaction of TSGENCO/ BHEL and Link budget calculation is deemed to be included in the offered price. No price implication shall be entertained during execution and handingover of the system.

3) Offered OLTE equipments shall be suitable for use in a short line of length 4.7km approx. in one direction and shall be suitable for interfacing with Line Current Differential cum Distance Protection Relays supplied under a separate contract (2 Relays at each end).

4) Individual Item Qty may vary upto +/-50% at contract stage.

5) The above quantities are subject to change by ±30% at contract stage.

However, Overall quantities are subject to change by ±30% at contract stage

## Technical specifications for SDH Type Optical Line Terminal Equipment (OLTE) with integrated Access Multiplexer equipment

1.0 Design, manufacture, factory testing before dispatch, packing, supply, installation, testing and commissioning of SDH type optical line terminal equipment (OLTE) with a capacity of STM4 with 1+1 path protection at optical level in each direction for signal transmission on 1310 nm & 1550 nm with Primary Multiplexer, DACS, Tele-protection equipment and combined NMS for voice, data and protection signaling etc. on the following 400 KV EHT line sections.

1.1 The digital multiplex equipment shall be designed to operate in electrical high-voltage networks and shall be suitable for installations in substations with harsh environment and high electromagnetic interference. it shall be highly reliable and provide secure communications for real time signals such as VOICE, SCADA, TELEPROTECTION, DATA including IP/ETHERNET and status/control signals. the equipment offered shall already be working successfully in telecommunication networks operated by power utilities. it shall comply with the latest ITU-T recommendations and ETSI standards and be able to be interconnected with legacy multiplex and other telecommunication equipment.

1.2 It is not the intent of this specification to specify completely herein all details of the design and construction of the equipment or materials to be supplied or services to be rendered. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous operation as per latest international standards, in hostile electrical environments prevailing near extra high voltage grid substations, in absence of any air-conditioning environment. The purchaser will interpret the meanings of drawing, documents and specification and shall have the power to reject any work or material, which in his judgment is not in accordance therewith.

1.3 All fiber optic links as specified above 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/sub rack to meet the maximum distance limit. All the provided equipments shall be monitored by centralized NMS.

The lengths specified above are the transmission line route lengths; however, the actual fiber cable length may 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.

1.4 The equipment shall be in line with current practice as followed by Dept. Of Telecommunication (Govt. Of India) or by internationally accepted practices for communication system.

1.5 All the tools and testing equipment etc required for installation, testing and commissioning of the system shall be provided by the successful bidder and the same shall be treated to have been provided in the bid prices. no additional claim shall be entertained by the purchaser at any stage of the contract.

1.6 **Integration:** It is the total responsibility of the bidder to integrate the entire supplied equipment with the existing communiaction system (PLCC, OLTE, OFC, MUX, EPAX and RTU etc.) For transmission of speech, real time data the necessary information for integration will be furnished during engineering stage. However the bidder should supply any necessary cables, connectors etc required for integration without any additional cost.

**1.7 TRAINING OF PURCHASER STAFF:** The supplier shall be required to provide facilities for imparting training at no extra cost to 5 Engineers to be nominated by the purchaser (TSGENCO/TSTRANSCO) for OLTE and associated equipment at the manufacture's works place for one week. An important objective of

training is to increase the ability to control, supervise and carry out maintenance work on plant and equipment supplied and installed by the contractor. The supplier shall provide boarding, lodging and transportation to the training place as a part of the contract without any additional financial commitment to TSGENCO/TSTRANSCO.)

**1.8 Cabling:**

All signalling cables within the telecommunication system, and the power supply cables are part of contractor's delivery and installation. Signal cables and power supply cables shall be placed apart from each other (minimum distance 150 mm). Redundant cables and cables to redundant equipment shall be placed in separate cable routes. All Contractor supplied inside plant cables and cable assemblies shall be constructed from non-PVC, fire/smoke resistant materials.

Whether called for specifically or not, all accessories (attenuators, patch cards, test probes etc) required for normal and satisfactory operation (as deemed fit by the purchaser) shall be considered to be a part of the tenderers basic scope of supply and no claim for extra payment will be accepted on these grounds.

**1.9 Equipment Shelf:**

An equipment shelf be provided to hold all equipment modules and shall provide a backplane for system power and inter module communications. The shelf shall be capable of being mounted on a standard EIA 19-inch rack. If more than one shelf is required at any site, multiple shelves shall be combined and shall function as one integrated node.

**2.0 General technical requirements of OLTE & hardware**

2.1 The equipment shall be modular in design, compact and composite construction including power supply, switching and control units.

2.2 The equipment shall be fully solid state, field proven and adopt state-of-art technology.

2.3 The mechanical design and construction of each unit sub-assembly shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport.

2.4 The equipment shall have self cooling arrangement. No forced cooling using fans etc. Is envisaged.

2.5 The equipment shall operate from a nominal 48VDC battery, positive grounded. The equipment shall work satisfactorily over battery voltage variations of +20% / –15% (40.8VDC – 57.6VDC). Redundant Power-supply (1+1 protection) shall be supported. The equipment shall support dual power feed i.e. that two power sources can be connected directly to the equipment (two connection points).

2.6 The plug in units, whose removal or insertion, when in operation might endanger the reliability or performance of the units, shall have suitable protection.

2.7 All important switches/controls on front panel shall be provided with suitable safeguards such as interlock system to avoid accidental operation by the maintenance personnel.

2.8 The equipment shall be made vermin proof, protected against dust and insects. The indoor equipment shall conform to IP52 and outdoor equipment to IS-2147.

2.9 The equipment shall be able to work in saline atmosphere in coastal areas and should be protected against corrosion.

2.10 All components shall be easily accessible for testing. Similarly, all bays and bay panel wiring shall be easily accessible.

2.11 Special tools required for wiring are included within the scope of the specifications and shall be provided along with the equipment.

**3.0 Operational requirement**:

3.1 Each sub-assembly shall be clearly marked to show its function, schematic reference so that they are identifiable from the component layout diagram in the handbook.

3.2 Maintenance philosophy is to replace faulty units after quick analysis of monitoring and alarm indications and built-in test equipment. The actual repair will be undertaken at suitable centralized repair centre. The installation at site shall involve simply plug - in connection only.

3.3 Each station shall be provided with alarm interface card to take up to 8 external alarms (say air conditioned failure etc.)

3.4 The healthy, unhealthy and change of status condition of the units shall be displayed by LEDs and also should be seen from the Network Management System (NMS).

**4.0 GENERAL**

The fibre optic equipment supplied under this project shall be based on the Synchronous Digital Hierarchy (SDH) technology. The SDH system shall be designed for digital transmission using single mode fibre optics and shall comply with ITU-T G.707. The telecommunication network shall mainly use fibre optic system including optical SDH equipment and associated accessories.

The SDH equipment shall be an ultra-compact, carrier class, and cost effective bandwidth provisioning equipment designed to manage and deliver services from the optical core to the access.

The SDH equipment shall be configured as a Terminal Multiplexer (TMUX), Add-Drop Multiplexer (ADM), and In-Line Amplifier or as stand-alone Cross-Connect.

SDH equipment shall be a STM-4/16 platform, has been envisaged to address the growing demand of an ultra-compact STM-4/16 Add-drop Multiplexer (ADM) and provide Ethernet-over-SDH/SONET mapping functions, including Link Capacity Adjustment Scheme (LCAS) with Virtual Concatenation (VCAT).

The SDH equipment shall support the following interfaces—STM-1o/e, STM-4o, E1/DS1, E3/D3 and 10/100BaseT/x and GE Interfaces.

SDH equipment shall be configured in various topologies such as linear, ring and bus. The multiplexing structure of the proposed SDH equipment shall permit the extraction of individual circuits from high capacity systems having the whole STM-4 frame. 1+1 Cross Connect facility shall be provided to enable interconnection between different channels and network components. The SDH equipment shall consists of redundant cross connect card with STM-4 optical interfaces and interface slots for equipping E1 and Ethernet interface modules.

The SDH optical multiplexer equipment shall perform both multiplexing and optical line terminal functions. All features and functions of the SDH multiplexer equipment shall be readily software configurable to suit operational requirements of the fibre optic communication system.

All optical SDH ports shall support SFPS (small form factor pluggable Transceiver unit) for short, medium, long and extra-long optical communication. ALS (automatic laser shut-down) shall be fully supported.

**4.1 SDH EQUIPMENT:**

The rack mountable STM-4 system shall be capable of offering both data and TDM and Ethernet services on a single platform.

STM-4 equipment (upgradeable to STM-16) shall be provided with STM-4 optical interfaces, n x 63 E1s, n x 8 port 10/100 Mbit/s, L2 Ethernet interfaces and Gigabit Ethernet interface.

SDH STM-4/16 equipment should be equipped with 1+1 protection for cross connect & timing module. System should provide STM-4 interfaces on each of the cross connect cards configurable as 1+1 MSP and SNCP.

The SDH transmission equipment shall be a next generation optical system capable of transporting both circuit based TDM traffic as well as packet based data traffic and shall be capable of being configurable in linear, 1+1 linear and ring configuration.

The SDH equipment shelf should provide spare slots for equipping STM-16 (electrical /optical) interfaces in future.

SDH STM-4 equipment shall be up-gradable to STM-16 by changing the optical interface (SFP) without replacing the common control cards

The SDH equipment should be multi-service provisioning platform with add/drop, terminal and cross-connect functionality for universal installation at all network levels and shall be capable of supporting regeneration in the same platform.

The SDH equipment shall support GFP –F encapsulation for Ethernet data. It shall support Status Message Scheme (SSM) for SDH timing. Network protection timing shall be as per ETSI/ITU

**4.2. Cross Connection Capability of the SDH Equipment**

SDH equipment switching matrix shall be provided in 1+1 redundant configuration and shall support for fully non-blocking cross connections: -

a) Cross-connect capability with a granularity of VC-4, VC-3 and VC-12-bit rate

b) The cross-connects are non-blocking and can be created dynamically between STM rings terminating on the SDH network elements.

It should allow direct mapping of any 2 Mbps into any STM-4 aggregate. The equipment shall be equipped with redundant, decentralized cross-connection functions. The cross-connect capacity shall be at least 40x 2Mbit/s (i.e. 1200x 64kbit/s) and non-blocking. For high-density applications the cross-connect capacity shall be upgradeable up to 128x 2Mbit/s with a granularity of 64kbit/s. Cross-connection shall be possible at line to line, line to tributary, tributary to line, tributary to tributary.

**4.3 Optical Aggregate Interfaces**

The multi-service SDH transport system shall support multiple optical interfaces in the same platform. The interface should be compliant with ITU-T G.957 SDH specifications.

It should support for 1+ 1 MSP on STM 4 level and SNCP on VC-12/VC-3/VC-4 level.

**Access Interfaces**

The offered SDH STM-4/16 equipment shall support following service interface modules: -

A) Cross-connect and timing and control system redundancy cards.
b) STM-4 Optical Interface card
c) 32x E1electrical interface card
d) 8 port FE Layer 2 Ethernet interface card

**4.4 E1 Interface Card (32xE1/DS1)**

The E1 interface card shall provide line interfaces to 32 E1 channels respectively in both add and drop directions.

The E1 interface card shall have two Euro connectors at the front providing an interface for 32 and 31 E1/DS1 channels respectively. Status and Active LEDs are provided to indicate the power on and working status of the E1 interface card.
E1s shall be drawn from SDH eqpt. only and PDH eqpt. should not be used between SDH eqpt. and Primary MUX.

**4.5 8xFE Switching Card (STM4 backhaul)**

Ethernet interface module shall provide 8 LAN ports 10/100 Base-T (RJ-45) and two (2) SFP slots for GE interfaces.

Ethernet interface card shall be a tributary interface card, which provides line interface to 8x10/100 Mbps (FE) Ethernet ports. In addition to supporting EOS applications with an uplink bandwidth of STM-4, The Ethernet card shall capable of switching at L2 level and doing traffic classification from L2 to L7 level.

Status and Active LEDs shall indicate the power on and working status of the Ethernet interface card.
Ethernet L2 services EPL, EVPL, ELAN services with the following features shall be supported:

a) It shall support auto-negotiation feature.
b) At least eight 10/100 Mbps Tx/Fx Ethernet ports
c) IEEE 802.3 Flow Control
d) Support for dynamic provisioning using LCAS as per ITU-T G.7042.
e) VLAN tagging and priority as per 802.1 p/q
f) Advanced layer 2 protection
g) Spanning tree protocol as per 802.1d
h) Rapid spanning tree protocol as per 802.1 w
i) Multiple spanning tree as per 802.1s
j) VLAN, MAC learning and forwarding

**4.6 SDH Capabilities**

**SDH equipment shall support 1+1 MSP function on STM-4 interface. SDH equipment shall provide to support minimum 4 directions.**

SDH equipment shall support GFP-F（ITU-T G.7041/Y.1303）encapsulation for Ethernet data.

SDH equipment shall support VC-12/3/4 - xv virtual concatenation (ITU-T G.707/Y.1322)

SDH equipment shall support LCAS (ITU-T G.7042) at VC12/3/4 -xv level, which shall provide dynamic bandwidth adjustment.

It should support the synchronous status message scheme (SSM) for SDH timing

SDH equipment shall support DCC transparency function. By using D1-D3 or D4-D12 channels, SDH equipment shall transparently pass through the management information of third party NEs.

The SDH equipment shall support EOW interface using E1, E2 channels.

To prevent personal injury form emerging laser light in the case of the fiber break, SDH equipment shall support Automatic Laser Shutdown (ALS) function according to ITU-T G.958 and ITU-T G.644.

**4.7 1+1 Path protection**

The equipment shall provide means to protect 64kbit/s channels. The protection shall be end to end from one interface (telephone, data, protection signaling) to the other. It shall switch automatically from the main channel to the standby channel. It shall be configurable whether the system switches back to the main channel (reversible switching) or not (non-reversible).

If a path has switched to its standby route because the main route is disturbed this shall be indicated with an alarm. the switching shall be done within the multiplexer without using the network management system.

**4.8 1+1 section protection**

The equipment shall provide means to protect STM-4 (MSP). It shall be possible to use two independent links: one as the main and the other as the standby. The system shall automatically switch to the standby connection and generate an alarm if the main connection is disturbed.
The switching shall be done within the multiplexer without using the network management system.

**4.9 Synchronization and Timing**

SDH equipment shall derive its clock from the following source:

Line-timed mode: In this mode, SDH equipment shall derive its clock from any one of the E1/DS1 tributaries or STM- 4 (OC-3/12) signals.

Externally timed mode: In this mode, an external 2048 KHz or 2.048 Mbps signal shall be used as the clock source.

Holdover mode: In this mode, SDH equipment shall use the stored timing data to control the output frequency for a short duration (of around 24 hrs). Beyond this it shall use its own internal oscillator in a free-running mode.

**4.10 Protection**

**4.11 Equipment Protection Switching**

Equipment protection switching shall accommodate various hardware failures while the transport facility is still functional. In an event of hardware failure, the hardware shall be substituted without affecting the traffic.

**4.12 Cross-connect Card Redundancy**

The SDH equipment shall facilitate the cross-connect redundancy by having main and standby cross-connect cards. Software on each cross-connect card decides which cross-connect card is the active controller. The active cross-connect card takes control of all the processor bus signals on the backplane. The processor bus is shared across all the tributary cards.

All the traffic related devices on each cross-connect card is always under the control of the active cross-connect card.

**4.13 Power Supply Redundancy**

The SDH equipment shall have two power supplies to facilitate power supply redundancy. The output of both the power supplies are shorted together on the backplane and then in turn given to all the cards.

SDH equipment shall be powered from DC power sources. The power supply card shall support -48 V (range –40.8 V to -57.6 V) DC power.

There shall be two power supply slots located on the chassis for equipping the power supply modules.

**4.14 Protection and Redundancy**

SDH equipment shall support multiple layer network protection functions and multiple layer protection escalation. The network protection functions supported shall be as follows:

a) MSP 1+1 protection at STM-4/16, Unidirectional or bi-directional, revertive or non-revertive modes, in compliance with ITU-T G.783/841
b) SNCP at VC-12, VC-3 and VC-4 levels, single ended, non-revertive and revertive in compliance with ITU-T G.783/841.
c) The switching time for above protections in case of failure shall be less than 50 milliseconds
d) LCAS protection
e) Rapid Spanning Tree Protocol (on cards incorporating layer 2 switching capabilities), in compliance with IEEE 802.1w, Spanning tree protocol shall prevent against loops at the Ethernet level of the network while providing L2 protection.

The optical line terminal equipment (OLTE) shall convert 'at the send end' STM-4 digital signals based on the 2048 kbps hierarchy, into optical signal for transmission over an optical fiber media and perform the reciprocal function on the receive side. Separate fibers shall be used for transmit and receive. Transmit/receive on single fiber is not acceptable.

**4.15 OLTE shall comprise following modular units.**

Transmit unit
- Code converter (transmit),
- Optical transmitter,

Receive unit
- Optical receiver,
- Code converter (receive),

Miscellaneous units
- Alarm control unit,
- Protection switching,
- Order wire unit/ service data interface unit
- Power supply unit.

**4.16 Optical transmitter and receiver**

The type of opto-electronic devices proposed shall be stated by the tenderer and shall be to the approval of the TSGENCO/TSTRANSCO. Data concerning the reliability of the opto-electronic devices, accelerated tests of device life time and mean time between failure (MTBF) calculations etc shall be submitted for approval.

Full automatic gain control (AGC) shall be provided for the optical receiver to cover a wide range of input levels, due to various cable lengths, and to provide temperature compensation of the detecting device.

The output power of the transmitter optical device and optical power at the receiver shall be designed such as to provide the same mean BER in each section as specified in this tender.

**Bidder shall submit power budget calculation along with the offer.**

**4.17 Code converter (transmitter)**

The code converter (transmitter) shall regenerate and equalise the ITU-T standard coded signal received from the digital multiplexer equipment and convert this to binary bit stream. Overhead bits for the service data channel shall be inserted into the aggregate data stream before conversion to the chosen optical signal code.

**4.18 Code converter (receiver)**

The code converter (receiver) shall convert the received optical signal to binary form and extract the overhead bits for the service data channel before further conversion to the ITU-T standard code used at the remote transmitter. The standard coded signal shall then be passed to the digital multiplexer equipment.

**4.19 Alarm control unit**

The operating conditions at each terminal and at each repeater shall be monitored by an alarm control unit associated with that equipment. This information shall be transmitted to each terminal equipment for processing via the service data channel. It shall ascertain alarm conditions to be detected and a command shall be given to the protection switching to changeover to the stand-by system. The following system faults shall cause line switching to occur:

- Loss of optical input signal,
- Loss of optical output signal,
- Loss of synchronisation,
- Excessive bit error rate.

**4.20 Protection switching**

The OLTE shall be equipped with two optical transmitter/receiver pairs (one used as normal system, the other as stand-by system) connected to two different fibres on the transmission side, and to another two on the reception side.

On receipt of a command from the alarm control unit, the protection switching shall automatically transfer all traffic from the normal to the stand-by system. Traffic shall resume on the normal transmission system when the fault detected by the alarm control unit has been cleared. Provision shall however be made to permit traffic to stay on the stand-by system until a fault occurs on the stand-by system, even if the normal system is restored to a healthy condition.

Provision shall also be made for traffic to be forced switched by bypassing the control circuit with a manually operated switch. Switch over shall also be possible by a remote command issued from a centralised fault supervision system.

Equipment entering the redundant state shall initiate alarm indications and shall also initiate the changeover signal. The switching criteria in the automatic mode shall be based on the following fault conditions being detected within the system:

- An alarm initiation signal (AIS),
- Loss of incoming signal (LIS),
- Bit error rate (BER) > 5 $x10^{-4.}$

Both AIS and LIS shall be considered as major fault conditions. The status of all signal path switches shall be indicated on the equipment. Switching shall be completed within 50 ms from time of detection of fault condition that initiates the protection switch to time of changeover of signal path.

**4.21 Engineer order wire telephone**

In order to facilitate maintenance of the fibre optic communication system, an order wire telephone channel shall be provided. Selective calling, using dual tone multi-frequency (DTMF) signalling, shall be provided.

The engineer order wire telephone signal shall be PCM to produce digital signals at 64 Kbits/s. These signals shall be presented to the service data interface for inclusion in a composite signal to be processed by the code converters for transmission in the service data channel.

This 64 kbps channel shall be over and above 8MBPS transmission capacity of the equipment.

**4.22 Clock signal:**

The system shall have its own internal clock for synchronisation purpose. Also it shall have the capability to regenerate clock signal from the 2 Mb stream received from nearby station. The system shall also accept external clock signal to be given from any reference station.
The priority of working of the clock signals is as below:
1. External clock from reference station.
2. Clock regenerated from 2 Mb stream
3. Internal clock

**5.0 DIGITAL DISTRIBUTION FRAME.**

Digital distribution Frame with a capacity of 63 E1s shall be provided. Initially, DDF is terminated with 32 E1s (E1 Tributary capacity) with all necessary cables and connectors both for transmitter and receiver. Interfacing cables for 32 E1s shall be provided with connectors for SDH equipment side to interface with the Multiplexes or existing fibre optic equipment in TSTRANSCO.
**All suitable Connectors for both ends along with 100 metres cable and 2 Nos. Crimping tool shall be supplied as mandatory spare to terminate spare E1s in future.**

**6.0 SNMP COMPATIBILITY:**

**The offered equipment under the present project (OLTE, MUX and Digital Tele-protection eqpt.) shall be compatible to SNMP (Simple Network Management Protocol). It shall be able to integrate to the third party Network Management system. The supplier shall handover the MIB (Management Information Base) file of the offered equipment to TSTRANSCO and shall extend his cooperation for integration of the equipment to the 3rd party Network Management system during the execution of the project or after. The supplier shall show demonstration on how he is going to integrate his equipment to the one of the existing NMS available with TSTRANSCO. The bidder can view the existing NMS at TSTRANSCO with a prior intimation and approval before bidding.**

## 7.0 Technical specifications for multiplexer (MUX) equipment

The telecommunication system to be offered shall comprise of optical fibre system which is intended to be used for:
- Voice communication.
- Tele-protection signalling.
- Data transmission.
- Facsimile communication.
- Video conferences

## 7.1 Multiplex equipment (MUX) PCM:

The equipment shall be designed and tested in accordance with ITU-T G.742 and G.823 recommendations. Shall be provided with optical interfaces for distance and differential protection (IEEEC37.94)

The 2 MBPS multiplexer shall be standard PCM multiplexer, providing 30 digital and/or analogue channels with associated signalling, in accordance with ITU-T G.711, G.712, and G.732 recommendations. The equipment shall be provided with redundant power supply module. At each station the PCM MUX shall be provided suitable for 120 channels so that in future the channel capacity can be increased by just inserting the interface modules.

PCM multiplexer should take one clock input of 2 MHz for synchronization and shall able to give at least one-clock outputs for synchronization of other equipment in a station.

The equipment shall serve as the basic system for the higher digital hierarchy levels in accordance with ITU-T G.702 recommendation. Digital interfaces at 64 Kbits/s and 2,048 Kbits/s shall be provided in accordance with ITU-T G.703 recommendation.

PCM transmission shall be based on a sampling rate of 8,000 samples/s of each incoming VF element. The encoding law used shall be a-law using 8 binary digits per sample, thus generating a 64 Kbits/s signal in accordance with ITU-T g.711 recommendation.

32 channels of 64 Kbits/s each, transmitted in 32 time slots of 8 bits per frame, shall build up to a digital bit stream of 2,048 Kbits/s. 30 channels, corresponding to 30 time slots, shall be for speech/ data channels. Time slot # 0 shall be used for frame alignment and remote supervision whilst the remaining timeslot (timeslot #16) shall be used for channel associated telephone signalling.

Signalling units shall be provided at both subscriber and exchange ends of the system for PCM line working. The type of signalling unit shall be as stated in the technical specifications.

The rated supply voltage shall be 48 to 60V DC, however the equipment shall be able to work in the range of 48 V (-15%. To +20%)

The multiplex and signalling equipment shall be equipped with circuits to detect at least the following:

- Loss of incoming signal (2,048 Kbit/s),
- Loss of frame alignment,
- Bit error rate (BER) greater than $10^{-3}$,
- Alarm indication signal (AIS) detection,
- Failure of 64 Kbits/s interface (signalling only),
- Failure of power supply.

The speech companding law employed in encoding and decoding shall follow the logarithmic A-law with the value of A=87.6 and approximated by 13 segments. Single channel code structure is preferred. The MTBF shall be $\leq 10^5$ hours at operating temperature conditions. The tenderer shall indicate the MTBF at standard temperature conditions.

The PCM multiplexers shall be installed in same distribution rack as that for OLTE.

Digital interfaces at 2,048 Kbits/s shall be provided in accordance with ITU-T G.703 recommendation.

Signal bit rates shall be 2,048 Kbits/s +/ - 50ppm and signal code format shall be HDB3. The impedance shall be 75 ohm unbalanced.

Loss of frame alignment shall be considered to have occurred when 4 consecutive frame alignment signals are incorrectly received in their predicted positions. When 3 successive frame alignment signals are correctly detected, the system may be deemed to have regained frame alignment.

In a given frame, the status of the cyclic bit contained in the justifiable digit time slot associated with a particular tributary shall be indicated by means of 3 relevant justification control bits, in accordance with table 1 of ITU-T G.742 recommendation. Positive justification shall be indicated by the signal 111; and no justification by the signal 000.

The maximum permissible limits of jitters at the 2,048 Kbits/s interfaces shall be in accordance with table 1 of ITU-T G.823 recommendation.

With the following input signals encoded in hdb3 format, at a bit rate of 2,048 Kbits/s ± 50ppm, connected to any 2,048 Kbits/s input port, the error rate introduced at the corresponding 2,048k bits/s output port, shall be less $5.10^{-11}$ :

- a rated aggregate signal
- a repetitive signal having a block length of 8 bits,
- an all binary zeros signal,
- an all binary one's signal.

This requirement shall be met for all signal conditions on the remaining 2,048 Kbits/s input ports. The output tributary bit rates of all tributary outputs shall remain within 2,048 Kbits/s ± 50 ppm when any 2,048 Kbits/s input tributary signal is lost.

With the following conditions at one or more input ports, the remaining tributaries shall continue to function within their specified limits:

- no input signal,
- input signal outside the limits of this specification,
- removal or insertion of any of the tributary cards other than those cards appropriate to the tributary under test.

The following fault conditions shall be detected and alarm indications provided, in accordance with clause 10 of ITU-T G.742 recommendation:

- failure of power supply,
- loss of incoming, 2,048 Kbits/s tributary system at input port,
- loss of frame alignment, alarm indication signal (AIS) from remote multiplex equipment.
- bit error rate (BER) greater than $10^{-3}$,
- failure of multiplex- de multiplex timing,
- failure of 2,048 Kbits/s AIS clock,

All the E1s shall be derived from the SDH frame only and no PDH shall be used. E1 Tributary card shall be an integral part of the SDH equipment.
All equipment shall be of modular construction and installed in the same distribution rack as of the OLTE. They shall be wired for their maximum capacity at 64 kbps & 2 Mbps level; future extension shall be possible by simple field installation of the appropriate modules.
For testing purpose remote/local loop back at 64 kbps as well as at 2 Mbps shall be possible by using software. Bidder shall explain how the testing will be carried out by using these loops.

The rated supply voltage shall be 48 to 60 V DC; however, the equipment shall be able to work in the range of (-48 -15% to +20%) V DC. Redundant power supply shall be provided.

The equipment shall be compatible to the existing one in order to cater for any upgrading without limitation. at present 2 mbps system is envisaged. Synchronisation at 2 Mbps level with external signalling received from the existing OLTEs shall be possible.

Equipment at each end station shall be capable of providing 60 channels so that number of drop/insert channels can be increased in future by just inserting the interfacing modules.

Bidder shall provide the full capacity termination for unused 2 Mbps signals at each station which shall provide transparent 2 MBPS interfaces for transmission of 2 Mbps signal from these stations to other directions.

**Configuration of MUX equipment shall include the following interface cards at each station**:

**1. Voice frequency modules suitable for 2 hot lines and remote subscriber facility i.e. FXO & FXS. (8 ports) shall be provided.**
**2. Voice frequency 4W E&M modules suitable for min 16 ports**
**3.G.703 data interface modules suitable for min 4 ports**
**4. V.35 data interface modules suitable for min 4 ports of n x 64 kbps**
**5. V.24 / V.28 data interface module suitable for min 4 ports.**
**6. V.11 data interface module suitable for min 4 ports**
**7.External Alarm interfacing for 8nos.**

### 7.2 MAIN DISTRIBUTION FRAME

Main Distribution Frame with a capacity of 100 krones for termination of voice and data circuits shall be provided. Subscriber lines and Trunk lines are to be terminated on the MDF on one side of the terminal-block with the legend of the terminal connections clearly indicated in alphanumeric. The MDF shall be provided with individual surge protection.

Krone tag blocks are preferred to be used for the MDF. The supply of relevant wire terminating tool (Krone tool) shall be supplied.

All the subscriber lines and the trunk lines shall be provided with surge protection. Invariably suitable surge protectors in the form of Gas discharge tubes and fuses are to be provided to protect electronic circuitry of the MUX equipment from the damages due to external surges /spikes. Minimum maintenance and free workability on the equipment is to be ensured.

### 8.0 DIGITAL ACCESS CROSS CONNECT SYSTEM

The contractor shall be required to provide digital access cross connect systems (DACS) capable of switching 16 or more E-1 lines in compliance with the electrical input-output characteristics provided in Table 8.0. DACS shall be fully compatible with CEPT E-1 tributary standards.
DACSS shall be provided at locations specified in the appendices and shall be used to establish and reconfigure cross-connections at the tributary level of up to 480 x 64Kb/s channels. DACS E-1-line interface shall be fully capable of accessing each e-1 line.

Within the context of this specification, sizing of DACS system is defined as 4 x n where n is the maximum size of the port switching matrix. Thus a DACS sized as 8 x 16 means that 8 E1 ports are interfaced over a 16 port (E1) matrix.

A DACS system shall consist of the switch matrix, all routing logic and timing circuitry for internally sourced, line derived or externally supplied network timing and full software support.

The DACSS to be provided under this contract shall consist of at least a 16 port-switching matrix, with 16 ports equipped, I.E. 16 X 16 size. The DACS shall also be able to switch the signaling of the voice channels along with the voice channels. The DACS shall not use, decrease or block the specified capacity of the switching matrix while switching the signaling. The DACS shall support the channel associated signaling (CAS) and common channel signaling (CCS) both as per ITU-T G. 704.

The DACS shall provide user-friendly control and management software. the user shall be able to operate the DACS locally through craft terminal, via an RS-232 interface or remotely under TMN supervisory control.

Table 8.0
CEPT E-1 DIGITAL ACCESS CROSS CONNECT SYSTEM
REQUIRED OPERATING CHARACTERISTICS

| | |
|---|---|
| E-1 Trunk Capacity: | Minimum 16-port switch matrix<br>Minimum 4-port I/O per card |
| Tributary Capacity: | 30 X 64 KBPS |
| Compatibility: | CEPT E-1, CEPT E-1 tributary channel |
| Frame delay: | Minimum < 1 frame<br>Minimum < 2 frames |
| E-1 PORT INTERFACE:<br>Interface code:<br>Impedance:<br>Peak level @ 75 OHM:<br>Maximum Insertion loss: | 2.048 MB/S ± 50 PPM<br>HDB3<br>75 OHM unbalanced (120 balanced)<br>2.37 VOLTS ± 10%<br>6 DB |
| Signal Waveform:<br>Frame Structure:<br>Jitter Performance: | PER CCITT G.703<br>PER CCITT G.742<br>PER CCITT G.823 |
| Synchronization: | Internal, external source and synchronized on incoming e-1 |
| Routing:<br>Routing table capacity: | Fully non- blocking tributary to/from e-1 channel<br>Minimum of 9 routing tables for reconfiguration |
| Supervisory ports:<br>Supervisory port interface:<br>Interface: | Serial com ports<br>Rs-232<br>Standard ASCII ANSI compatible terminal |
| Supervisory channel | Yank data rates, software selectable:<br>Speed of 110-9600 bps, odd or even parity 7 or 8 bits |
| Power supply voltage: | -48 VDC |

**8.1 REQUIRED DACS APPLICATIONS**

The DACS provided shall be fully capable of implementing standard applications such as “Groom and Fill”, drop & insert/Bypass, Broad cost and Alternative Routing.

Menus and Reports

DACSs throughout the network shall be required to function as fully integrated subsystems of the Telecommunications Management Network (TMN).

The DACS software shall provide menu driven management of DACS and shall provide at least the following:

I. Active Configuration: The user shall be able to modify the current active configuration.

II. Configuration: The configurations other than the active one shall be listed, edited, viewed, renamed, deleted and activated. Actions shall be allowed manually, upon a carrier failure or specified alarm condition, remotely or on a scheduled basis.

III. Reports: The user shall have selection of pre formatted specific reports and “Report Options” to be used to select where the next reports will be sent.

IV. Administration: This shall provide the user, options to control, view and maintain

various logs and the DACS Software.

V. Alarms: This shall display Alarm Status on all active ports and shall have an alert mechanism that readily identifies an alarm event to the user through TMN (locally as well as remotely). The alarms shall have different colors based on the importance of the alarm.

**9.0 Network Management System**

The Network Management System shall be common for primary OLTE, multiplexer and Digital Tele-protection equipment. The hardware platform shall be PC based. The man machine interface shall use mouse and window technique. The software of MIB file of OLTEs, MUX and Digital Tele-protection equipment should be provided to interface with existing NMS of TSTRANSCO.

The network manager shall be able to address any of the primary multiplexer and second order multiplexer. The network manager shall have four levels of interaction with password protection limiting the access to the users. From the software it shall be possible to program the multiplexers, do the level settings etc without any necessity of hardware settings. It shall be possible to do the monitoring and configuration of remote network element from NMS station. The necessary embedded operation channel for the NMS shall be provided by the bidder. This embedded operation channel shall be in addition to the engineer order wire mentioned elsewhere in the specification. It shall be possible to remotely configure the system from the master station up to 64 kbps level thus obviating the need for any handheld terminals at other stations.

The NMS program shall be based on windows with its well known mouse operated “pull down menu and interactive communication box technology. By using embedded data channel, it shall be possible to configure all network elements remotely from NMS.

The main objectives of the NMS software are:

- Checking the user authorization and allow/deny access to the user
- Display of the SW version
- To be used as a tool to write and store the configuration files
- Control the interactions between pc and communication equipment
- Identification of particular communication equipment
- Loading the configuration data to the database of the communication equipment
- Copying the database of the equipment and convert/store it as a configuration file
- Allow temporary changes of the configuration for test purposes
- Setting individual parameters
- Printing reports
- It must support to integrate with existing NMS.

**9.1 General:**

Network Management System (NMS) shall be provided as a part of this procurement. This NMS shall provide the capability to monitor, reconfigure, and control elements of the equipments supplied under this procurement. The above capability shall be provided at centralized locations indicated in BOQ. The NMS shall be capable of managing minimum of Fifty Nos. (50 Nos.) Network Elements and shall be upgradable to manage 100 Nos. Network elements minimum in future.

NMS shall provide display of faults for complete equipments under this contract at central locations as indicated in BOQ. Following types of faults management shall be provided by NMS:

1) Real Time alarm monitoring
2) Alarm acknowledgement
3) History of alarms storage & retrieval

The NMS supplied by Contractor shall be capable of upgrading to support an Integrated TNMS.

**Technical Characteristics – General:**

The management system should follow the ITU-T Recommendations. Management Framework (IS 7498-4), which defines the following management facilities needed by the Employer as follows:

a) Configuration management.
b) Fault management
c) Performance management
d) Security management

**CONFIGURATION MANAGEMENT**

**General Requirements:**

Configuration management is concerned with management, display, and control of the network configuration. 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 report.
c. Provide tools for planning, establishing, and changing the static equipment configuration. Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.
d. Provide verification testing to support new equipment installation.
e. Provide a database capability to maintain various types of information, such as:

1. Network equipment assets, including manufacturer, model number, maintenance record, and maintenance telephone contact.
2. Future data to be defined by Employer after commissioning.

**Fault Management**:

**General Requirements**:

Fault management is concerned with detecting, diagnosing, bypassing, directing service restoral, and reporting on all the equipments supplied under this tender. 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.
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. Bypass failures through the use of automatic failover to redundant equipment where possible and through operator-initiated actions where automatic failover is not possible. The criteria for failover shall be configurable. As an example, the NMS shall support the transfer of switching orders to hot-standby fibre terminal equipment configurations and drop insert equipment.

f. Track network equipment failure history.

**Power Failure:**
After a power failure, all equipment shall return without any manual reset to the same mode as before the failure.

**Performance Management:**
**General Requirements:**

Performance management is concerned with evaluation of the use of network equipments and their capability to meet performance objective. Specific requirements that shall be satisfied include the following:
a. Monitor point to point and end to end signal quality & history.
b. 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. Provide graphical displays of current point to point and end to end performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
8. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

**Security Management:**
**General requirements:**
The NMS shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel. Authentication techniques shall be provided to verify the identify of anyone trying to access the NMS or any operator interface where network parameters may be viewed or changed. Command security shall be ensured, if possible through use of redundant data communication channels providing command results annunciation and alarms if

- command is not executed. Access methods shall be provided to limit access to only authorized users of the EMS. At least three levels of access shall be provided – none, read only, and write.
- 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 & warnings. Repetitive violation of security measures shall generate an intrusion alarm, which shall be logged and displayed at all authorized operator management stations. Physical intrusion detected should be reported as an alarm condition.

**Operator Authorization Levels**:
Two levels of operator authorization, as a minimum, shall be provided.

a. Monitoring Level: Monitoring Level operators are authorized to supervise the network, but should not be able to change the configuration of the network.
b. Master Level: Master Level operators can supervise the network and carry out protected functions such as change network configuration & other functions such as database maintenance functions Authorization at the master level may encompass the whole network or only a part of it.

Monitoring Level A monitoring level operator shall have access to at least the following items or features:
a. Diagram of the network.
b. Name of network elements (NE).
c. Connections between NEs.
d. Faults in NEs.
e. Faults in lines.

After the selection of a link or a network element, the operator shall have access to the following information:
a. All signals with status between two NEs.
b. All input signals with status to NEs.
c. All output signals with status from NEs.
d. Faults in plug-in unit level.
e. Equipped units in sub rack.
f. Unequipped units in sub rack.
g. Priority levels (class)

Master Level:
The master level operator shall be able to make the following configuration changes:
a. Increase the number of NEs.
b. Create new or revised connections between two network elements.
c. Decrease the number of NEs.
d. Remove the connections between two network elements.

**Alarm Indications:**

The following types of alarms shall be provided as a minimum in addition to other alarms generated as described above.
a. Transit frame alarms (e.g. input data failed)
b. Receiver frame alarms (e.g., BER>10-3 or > 10-6)
c. Receiver alarms (e.g., AGC at max)
d. Switch over requested.
e. Power supply alarms.
f. Quality parameter indications according to ITU-T Recommendation G.821(erroneous seconds, highly erroneous seconds, degraded minutes).

**Equipment Requirements:**
In general, the minimum monitoring and control requirements for the communications equipment are summarized in above Tables.

**Table-2 -Fibre Optic Transmission Equipment Alarms and Indicators**
1 Device Status
2 LED/Laser drive current
3 Transmit Output Power Failure
4 Transmit Frame Alarms
5 Receiver Frame Alarms
6 Receiver Alarms
7 Quality Parameter Indicators
8 Loopback Actuated Indicator
9 Configuration Status
10 Power Supply/Converter Alarms

**Table –3 Higher Order Multiplex Equipment Alarms and Indicators**

1 Device Status

2 Clock Supply Failure
3 Loss of Frame Alignment
4 Frame Parity Check Failure
5 Quality Parameter Indicators
6 Configuration Status
7 Tributary Alarms
8 Loopback Actuated Indicator
9 Power Supply Alarms

**Table 4- Station Alarms, Indicators and Controls**

1 **Intrusion Detection alarms**
2 Power Failure
3 Fire and Smoke Detection
4 Environmental Control (temperature, humidity, etc.)

**NMS Configuration:**

Each node on the backbone network shall include provision for connecting a laptop PC to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the local operator shall be able to:
a) Change the configuration of the station.
b) Perform tests.
c) Get detailed fault information.

**Interfaces:**

The NMS shall be equipped with graphic workstations in the stations which are defined in the scope of supply.
A Q1 – interface (ITU-T Rec. G.771) is required for network elements as defined in ITU-T Recommendations.
The Bidder shall include the detailed information of the interfaces, especially concerning the lower layer protocols and bit rates supported.

**NMS Architecture:**

The NMS architecture shall be described in detail in the proposal. The following subsystems or features shall be described:
a. Database used in EMS.
b. Desktop PC, hardware, software and operating system.
c. Graphic display terminals.
d. Laptop PCs.
e. Data communication between nodes and EMS computer.
f. Maximum number of Network elements that could be handled and number of systems.
g. License details.

**Configuration of NMS PC**:

The network management for the ordered system shall cover the following SW and HW.
a) P-IV, dual core with 2.8 GHz and HT technology.
b) 4 GB RAM
c) DVD R/W
d) Multimedia keyboard
e) Optical mouse
f) 500 GB HDD
g) 19'' TFT color monitor
h) 10/100MBPS Ethernet card
i) 4nos. of USB ports in front side
j) one serial port
k) Computer table
l) Computer chair

m) Laser printer
n) All necessary SW (MS, OS, drivers, anti -virus etc.) shall be supplied in the form of CDs also.

**CONFIGURATION FOR LAPTOP PC**

Laptop PCs to be supplied under this specification shall meet the following requirements:
Make: IBM / HP / DELL or equivalent
Processor: Intel core-II Duo E8400 (3.00 GHz 6 M cache)
RAM : 4 GB DDR SDRAM
HDD :500GB
Graphics :512MB
DVCD/RW combo, Built in webcam
Serial ports : 2 Nos.
USB ports : 2nos.
Built-in modem,
Intel 10/100 MBPS Ethernet
Ultra NAV (touch pad + track point)
Intel pro/ wireless network connection 802.11b/g
Monitor: wide Screen (15")
Power adaptor: suitable to operate on 230 V AC and with battery backup for four hours.
Carrying case: Good leather carrying case with safety belts.
Thumb memory: : 32 GB

Software: Windows XP professional, driver software, anti virus s/w.

Laptop PCs shall be loaded with OLTE / MUX equipment software and tested for monitoring of the equipment. Necessary interfacing cables and connectors shall also be supplied along with the equipment. However, the bidder shall choose the relevant operating system software suitable for running the equipment software for monitoring the OLTE / MUX equipment.

**10.1 Installation of OFAC:**

Installation in cable trenches and on cable trays.

Each OFAC shall be pulled in HDPE pipe of 40 mm diameter and required thickness (mm) placed in cable trench (separate trays for OFAC's). There shall be spare HDPE pipes for the OFAC's to be decided by the Purchaser. The pulling instructions and minimum-bending radius shall be indicated by the bidder. The route for laying the OFAC shall be decided by the contractor in consultation with the Purchaser. Contractor shall terminate the fibers in Fiber Distribution Panel and OFAC shall be spliced with OPGW at the gantry.

**10.2 Burial.**

In the case of direct burial, the OFAC shall be installed in HDPE pipe of 75 mm diameter and required thickness (mm) to a depth of 1.0 m. The pipe shall be embedded in M 15 concrete with cover of 37.5 mm (150 mm overall) and the trench filled with excavated material and hand compacted. The route for laying the OFAC shall be decided by the contractor in consultation with the Purchaser. The supply and burial of the pipe is the responsibility of the contractor.

**11. PIGTAIL CORDS.**

The pigtail cords will be used for the interconnections of the approach cables with the respective optical terminal equipment. The optical fibers of the pigtail cords and approach cable shall be fusion spliced and protected in an approved type terminal box.

On the optical equipment side, FC-PC type optical connectors shall be used. Insertion loss shall not exceed 0.5 d B and return loss shall not be less than 35 dB. **The pigtail cords with optical connectors, terminal boxes and flexible corrugated tubes are an integral part of the scope of supply of the UG OFC/OFAC manufacturer.** The technical specifications of the pigtail cord with a connector, terminal box and of the tubing offered shall be provided with the bid.

## TECHNICAL SPECIFICATION

## DIGITAL TELEPROTECTION EQUIPMENT

11.0 Protection signalling equipment (compatible to fibre optic equipment)

The protection signalling equipment is intended for providing (i) intertripping (ii) direct tripping (iii) blocking commands OF HV lines.

Digital protection signalling equipment shall be provided which shall be suitable for communicating through fibre optic equipment.

Digital Tele-protection coupler equipment shall be independent unit to integrate with offered OLTE & MUX equipment for the links as specified in item no.1 of schedule of requirement. Digital Tele-protection equipment shall be provided with visual trip counters event registers to register events which can be down loaded in to pc or laptop.

The protection signaling equipment shall have digital electrical output preferably V.11 or V.35 interface. Bidder shall quote for protection signaling equipment suitable for 8 commands with trip counters event registers in each equipment and suitable for transmission on V.11 or V.35 electrical interface.

High security and dependability shall be ensured by the contractor. probability of false tripping and failure to trip shall be minimum. curves / figures indicating above-mentioned measures shall be submitted with the tender proposal.

if not otherwise stated routine and type tests of the protection signalling equipment shall consider the IEC recommendations and suggestions of the latest revision.

11.1 Principle of operation during normal operation protection signaling equipment shall transmit a secured guard code. in case protection signaling equipment receives one or more command it should interrupts the guard code and shall transmit the command code in sequence. the receiver recognizes the command code and absence of the guard code and generates the command.

All signal processing i.e. the generation of tripping signal and the evaluation of the signals being received shall be performed completely digitally by using dsp. the digital techniques thus employed obviate any need for calibration.

11.2 Loop testing an automatic loop testing routine shall cyclically check the Tele-protection channel. the test signal shall be transmitted in the same way as the genuine tripping signal shall be recognized by the receiver and shall be reflected back to the transmitter. in case test signal does not reach the transmitter the test should be repeated automatically for at least 5 trials and alarm should be given in case the test still fails.

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

Internal test routine shall continuously monitor the availability of the protection signaling equipment. Proper tripping signal shall always take the priority over the test procedure.

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

- shall employ latest digital signal processing technology.
- shall be able to monitor through same NMS of OLTE & MUX equipment. i.e. Digital Tele-protection equipment shall be an integral part of OLTE & MUX eqpt. for the offered OLTE & MUX

equipment if required digital protection coupler shall also be interface with optical interface to the MUX equipment.

- shall be provided with redundant power supply unit
- Shall be provided with optical interfaces for distance and differential protection (IEEEC37.94)
- shall work in conjunction with PCM multiplexer
- it shall communicate on 64kbps channel preferably on C.37.94
- all I/Os electrically isolated
- full duplex operation
- permissive tripping
- direct tripping
- blocking, unblocking
- auto loop test facility shall be provided
- should meet IEC 834-1 standard
- shall provide an interface facility to connect handheld terminal or pc for indicating status, alarm messages, and transmission time etc.
- shall have the addressing facility
- shall able to transmit up to 8 commands in one 64 kbps channel
- transmission time shall be < 7ms.
- the tele protection eqpt. shall be able to programmed through handheld terminal / pc.
- the Tele protection equipment shall have a visual contains.
- Visible counters for each command (Input/Output should be provided.

**12.0 Protection signalling equipment design**

The Tele-protection equipment shall be of modular construction and shall be an integral part of the optical terminal multiplexer eqpt and shall be completely solid state using semiconductors, micro-processors and self-supervision, providing alarms in the case of equipment failure (TX / RX), absence of the guard frequency signal, power supply failure, etc.

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

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

**12.1** each tele-protection equipment shall be supplied with redundant power supply unit.
all command channels are operationally independent from each other and they meet the following performance characteristics:

- ❖ equipment operating time < 6 ms (8 channels)
- ❖ probability of missing command $p_{mc}$ (at ber < $10^{-3}$) <$10^{-9}$
- ❖ mean time between unwanted commands

(at $t_{ses}$ < 0.005 % and $t_{es}$ < 0.1 %) 100000 a

The error control procedure in the 64 kbit/s channel is based on the use of a block code specifically developed to be used for tele-protection signaling via telecommunication networks based on the ITU-T recommendations. the error control procedure includes a means to identify the origin of the incoming 64 Kbits / s.

command-type Tele-protection applications are normally placed in three categories according to the nature of the information conveyed by the Tele-protection commands: permissive, blocking and inter-tripping schemes.

The Tele-protection signaling equipment shall be managed from network management system of primary multiplexer.

The Tele-protection equipment shall be provided with visible trip counters for both TX and Rx Commands in the form of event register.

Main characteristics:

64 kbit/s interface:

The 64 kbit/s interface meets the requirements of the ITU-T Recommendation G.703. both timing modes, co-directional and contra-directional, are provided.

Command interfaces:

**Command inputs:**
The command inputs should be galvanically isolated inputs, which generate internally the operating voltage for the input circuit.

a) potential free contacts (via internal dc-dc converter with nominal operating voltage 24 VDC)
b) operating current 10 ma
c) wetting current 15 ma

**Command outputs:**

The command outputs should be galvanically isolated outputs. each output has one MOS-FET changeover contact.

a) nominal operating voltage 250V DC or AC
b) maximum switching power 100 VA
c) maximum switching current 1 A

**Command interface-related requirements:**

All interfaces with the protection relay logic comply with the following requirements of IEC 255 / IEC 834-1.

**Command inputs**:
Insulation resistance >100 mohm (measured at the voltage of 500 VDC)
A) isolation voltage test voltage 1 kv AC / 1 minute
B) impulse test voltage 1.2/50 ms 2 kv (differential and common mode)
C) high frequency disturbance test 1.0 kv (differential mode)
D) high frequency disturbance test 2.5 kv (common mode)

**Command outputs:**
a) insulation resistance >100 mohm (measured at the voltage of 500 VDC)
b) isolation voltage test voltage 2 kv AC / 1 minute
c) impulse test voltage 1.2/50 ms 2 kv (common mode)
D) high frequency disturbance test 2.5 kv (common mode)
**Operating voltages:** -20 to –70 VDC (-48/110/220 V DC depending on requirement)

**13.0 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 cable & 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 for telecom equipment prior to the date of bid opening. In case the test reports are older than five years (5) for telecom equipment on the date of bid opening, the contractor shall repeat these tests at no extra 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 if required.
F) The contractor shall ensure that all type tests can be completed within the time schedule offered in his technical proposal.
G) In case of failure during any type test, the supplier is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type 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.

**13.1 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 / item / cable drum except fo cable installation hardware & fittings shall be offered for selection. For FO cable installation hardware & fittings at least ten (10) samples shall be offered for selection.

**13.2 List of type tests**

The type testing shall be conducted on the following equipment/items

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

(B) Drop – insert multiplexer with subscriber interface card

(C) DACS

(D) Approach cable

**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:

### 13.2.1 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 0ºc**

3) **Acceptance criteria**: no degradation of performance during and after the test.

(b) L**ow 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 - 10ºC**

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 13.3.1: operation to specification range.

3) **Acceptance criteria**: no degradation of performance during and after the test.

Table 13.3.1

Environmental Operating Limits

| | |
|---|---|
| Temperature Range<br><br>Specification<br>Operation without damage<br>Shipping/storage | (Un controlled environment)<br><br>0 to 45ºC<br>–10 to 55ºC<br>–40 to 60ºC |
| Relative Humidity, non-condensing | Upto 90% |
| Elevation:<br>Operating<br>Non-operating | to 3,000 m<br>to 10,000 m |

(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) D**amp 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 specification.

(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: 0ºc, TH: as per table 5-1 (operation to specification range)

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

4) Ramp: 1ºc/minute

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

**14.0 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 14.0:

TABLE 14.0: RECOMMENDED IMMUNITY TESTS

| SL. NO. | Immunity Test | AC Power Supply | DC Power Supply | Control & Signal | Telecom line | Parameters |
|---|---|---|---|---|---|---|
| 1 | Voltage Fluctuations | YES | YES | N/A | N/A | Table 11 of IEC 60870-2-1: 1995-LEVEL-I |
| 2 | Voltage Dips and Interruptions | YES | YES | N/A | N/A | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | 100/1300 µS Surges | YES | YES | N/A | N/A | Table 12 of IEC 60870-2-1: 1995-LEVEL-1 |
| 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 | |
| 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 |

(B) **EMISSION TESTS**

The list of Emission tests are specified below in Table 14.1

TABLE 14.1:

RECOMMENDED EMISSION TESTS

| SL.NO. | Emission Test | AC Power Supply | DC Power Supply | Control & Signal | Telecom line | Para Metres |
|---|---|---|---|---|---|---|
| 1. | LF disturbance voltage 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.

**14.2 MECHANICAL TESTS**

(A) **Mechanical Vibration Test**

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

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

The endurance tests 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/s2, 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 contract 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.

**14.3 TYPE TESTS FOR FIBRE OPTIC APPROACH CABLE**

The type tests to be conducted on the fiber optic approach cable are listed in table 6-8: type tests for fiber optic approach cable. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05db/km.

TABLE 14.3

TYPE TESTS FIBRE OPTIC APPROACH CABLE

| S.NO. | TEST NAME | TEST PROCEDURE |
|---|---|---|
| 1 | Water ingress test | (IEC 60794-1-F5/EIA 455-82B)<br><br>Test duration:24 HOURS |
| 2 | Seepage of filling compound | (EIA 455-81A) Preconditioning: 72 Hours, Test duration: 24 Hours |
| 3 | Crush test | (IEC 60794-1-E3/EIA 455-41) |
| 4 | Impact test | (IEC 60794-1-E4/EIA 455-25A) |
| 5 | Stress strain test | (EIA 455-33A) |

| | | |
|---|---|---|
| 6 | Cable cut-off wavelength test | (EIA 455-170) |
| 7 | Temperature cycling test | (IEC 60794-1-F1/EIA-455-3A)-2 CYCLES |
| - END OF TABLE - | | |

**14.4 IMPACT TEST**

The impact test shall be carried out in accordance with IEC: 60794-1-e4. Five separate impacts of 2.0 kg shall be applied at different locations. The radius of the intermediate piece shall be the reel drum radius ± 10%. A permanent or temporary increase in optical attenuation value greater than o.o5 db/km shall constitute failure.

**14.5 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 approach cable and associated hardware fitting, FODP, SDH equipments, associated line & tributary cards, termination equipments (drop/insert multiplexer, DACS, associated subscriber line interface cards etc), network management system. And all other items for which price has been identified separately in the bid price schedules.

Material shall not be shipped to the employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the employer, and the employer has issued material inspection & clearance certificate (MICC). Successful completion of the factory tests and the employer approval to ship shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the employer's authorized representatives unless 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 fiber optic transmission system. Termination equipment sub-system, 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.

**14.6 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.

The sampling rate for the factory acceptance tests shall be 10% of the batch size (minimum2) for FO cable drums, FODPS joint box and other similar items.

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.

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), along with information such as sampling frequency, applicable standards, acceptance criteria etc.

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

## 14.7 FAT OF COMMUNICATION EQUIPMENTS

TABLE 14.7

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 test 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 |
| 10 | Simulation of failure conditions and failover of each redundant unit |
| 11 | VLAN (layer-2 switching) feature testing with atleast three equipments configuration |
| 12 | Protection scheme for ethernet traffic (erps) |
| 13 | Test of spare card slots |
| 14 | Checks of power supply/converter voltage margins |
| 15 | Random inspections to verify the accuracy of documentation |
| 16 | Test of spare parts/modules/cards as per applicable tests |

TABLE 14.8

FACTORY ACCEPTANCE TESTING REQUIREMENTS FOR TERMINATION EQUIPMENT (MUX & DACS)

| ITEM | DESCRIPTION |
|---|---|
| 1 | Physical inspection for conformance to DRS, BOQ, drawings and appearance of equipment |
| 2 | Performance of supervision, alarm, control and switching systems, diagnostics, loopbacks, craftsperson interface etc. |
| 3 | Electrical interface tests which include: output and input jitter, bit error rate, pulse shape, cable compensation, and line rate tolerance for the channel banks/low – level multiplexers |
| 4 | Framing, signaling, and operational and maintenance test consistent with applicable itu-t requirements |
| 5 | Simulation of failure conditions and failover of each redundant unit |
| 6 | Test of spare card slots and test of spare parts/modules/cards as per applicable |
| 7 | Checks of power supply/converter voltage margins and short circuit and overvoltage protection |
| 8 | Random inspections to verify the accuracy of documentation |

TABLE 14.9

FAT ON NMS

| | |
|---|---|
| 1 | Physical inspection of NMS hardware for conformance to approved BOQ, DRS & drawing |
| 2 | Test to demonstrate the expansion capability of the nms system |
| 3 | Test to demonstrate the functionality of north bound interface |
| 4 | Testing of NMS to demonstrate proper operation of all functions: configuration management, performance management, fault management and security management. All standard features and required customization of the NMS shall be demonstrated for proper functioning. |

## 15.0 FACTORY ACCEPTANCE TEST ON APPROACH CABLE

The factory acceptance tests for approach cable specified below in table 15.0

TABLE 15.0

FACTORY ACCEPTANCE TESTS ON APPROACH CABLE

| S.NO. | FACTORY ACCEPTANCE TEST |
|---|---|
| 1 | Attenuation co-efficient at 1310 nm and 1550 nm |
| 2 | Point discontinuities of attenuation |
| 3 | Visual material verification and dimensional checks as per approved drs/drawings |

## 15.1 FACTORY ACCEPTANCE TEST ON SPLICE ENCLOSURE (JOINT BOX)/FODP

The factory acceptance tests for Splice Enclosures/FODP as specified below in Table:

TABLE 15.1

FACTORY ACCEPTANCE TESTS ON SPLICE ENCLOSURES (JOINT BOX)/FODP

| SL.NO. | FACTORY ACCEPTANCE TESTS |
|---|---|

| | |
|---|---|
| 1. | Visual check of quantities and specific component number for each component of splice enclosure/FODP and dimensional checks against the approved drawings |

**15.2 FACTORY ACCEPTANCE TESTS ON TEST EQUIPMENT, PIGTAIL & OTHER ITEMS**

As per technical specification and approved DRS/documents.

**15.3 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 FO cable, 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 FO & 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 maybe 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.

**15.4 MINIMUM SITE ACCEPTANCE TESTING REQUIREMENT FOR FO CABLING**

Prior to installation, every spooled fiber optic cable segment shall be tested for compliance with the pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment.

**15.5 PHASE OF SITE ACCEPTANCE TESTING**

Sat shall be carried out link from FODP to FODP. Sat may be performed in parts in case of long links.

The tests, checks, adjustments etc conducted by the contractor prior to offering the equipment for sat shall be called pre-sat activities. The pre-sat activities shall be described in the installation manuals and field quality plan documents.

**15.6 PHASES FOR SITE ACCEPTANCE TESTING FOR COMMUNICATION EQUIPMENTS**

The sat shall be completed in following phases:

**15.7 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 providing in respective tables in this section.

**16.0 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 fiber 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 requirement 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 hours, 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.

**16.1 INTEGRATED TESTING**

Prior to commencement of integrated testing the overall system shall be configured as required to provide all the data and voice channel required to interconnect the various control centres and RTU. The integrated testing for a batch shall include end-to-end testing of back-bone network included in that batch. Integrated testing for last batch shall include testing of the entire back-bone. The intent of integrated testing is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and communications testing have been corrected, and that the communication equipment is compatible with other equipment at all locations. The integrated system test shall include all fiber optic transmission equipment, termination equipment, the network management subsystem and other components.

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

1) Installation testing for NMS as per tables below

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

3) End to end testing of all individual voice circuits originating from PLCC, PABX or phones and to establish proper interfacing with PLCC/PABX/Phones and to demonstrate proper operation of channels over wideband systems. Operation shall be checked in terms of quality of voice, call initiation and call termination processes. The requirements for integrated testing for PLCC/PABX system is described

4) End-to-end testing of all individual data circuits originating from PLCC, RTU and SCADA front ends and to establish proper interfacing with PLCC/RTU/FRONT end and to demonstrate proper operation of channels over wideband systems. Operation shall be checked in terms of monitoring of BER/packet loss.

5) Testing of NMS to demonstrate proper operation of all functions: configuration management, performance management, fault, management and security management. All the standard features of the NMS shall be demonstrated for proper functioning.

6) Demonstration of protection switching and synchronization of equipment as per synchronization plan.

TABLE 16.1

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 signaling earthing system and resistance to ground to be checked. |
| 10 | Simulation of failure conditions and failover of protected components |

TABLE 16.2

TERMINATION EQUIPMENT SUB-SYSTEM INSTALLATION TESTING

| ITEM | DESCRIPTION |
|---|---|
| 1 | Physical inspection for conformance to drawings, rack elevations and appearance of equipment and cabling |
| 2 | Power supply/converter voltage measurements |
| 3 | Muldem performance testing |
| 4 | Craftsperson interface, alarm and control functional performance |
| 5 | Rack and local alarms |
| 6 | Network management interface and supervision performance |
| 7 | Channel performance |

| | |
|---|---|
| 8 | Safety and signaling earthing system |
| 9 | Simulation of failure conditions and failover of protected components |

TABLE 16.3

NMS INSTALLATION TESTING

| ITEM | DESCRIPTION |
|---|---|
| 1 | Physical inspection for conformance to drawings, rack elevations and appearance of equipment and cabling |
| 2 | Work station hardware inventory, configuration and characteristics |
| 3 | Demonstration of proper operation of all hardware, including workstations peripherals |

**TECHNICAL SPECIFICATION**

**FOR**

# 6 Pair &1 Pair Telephone Cables

# TECHNICAL SPECIFICATION FOR 6 Pair &1 Pair Telephone Cables

1.0 SCOPE:

1.1 THE SCOPE OF THE SPECIFICATION COVERS DESIGN, MANUFACTURE, TESTING, PACKING, FORWARDING AND DELIVERY ON FADS BASIS OF CABLES AS DETAILED BELOW:-

I. 0.63MM 6 PAIR UN-ARMORED TELEPHONE CABLE
II 0.63MM SINGLE PAIR UN-ARMORED TELEPHONE CABLE.

1.2 SIX PAIR AND SINGLE PAIR TELEPHONE CABLES ARE INTENDED TO INTERCONNECT THE SWITCHING EQUIPMENT TO POWER LINE CARRIER COMMUNICATION TERMINAL AND INTERCONNECTING THE SWITCHING EQUIPMENT TO TELEPHONE INSTRUMENTS. THE TELEPHONE CABLES WILL CARRY VOICE AND DATA SIGNALS WITH FREQUENCIES BELOW 4 KHZ. THE CABLES ARE INTENDED FOR INDOOR USE ONLY.

2.0 **STANDARDS:**

THE CABLES PROPOSED FOR PURCHASE SHALL CONFORM TO THE FOLLOWING I.S. STANDARDS WHICH SHALL MEAN LATEST REVISIONS, AMENDMENTS/CHANGES ADOPTED AND PUBLISHED UNLESS OTHERWISE SPECIFIED HEREIN AFTER.

| STANDARDS | TITLE |
|---|---|
| **TELEPHONE CABLES** | |
| IS10579/ | POLYTHENE INSULATION AND SHEATH OF |
| IS5831/84 | PVC INSULATION AND SHEATH OF ELECTRICAL CABLES |

EQUIPMENT MEETING WITH THE REQUIREMENT OF OTHER AUTHORITATIVE STANDARDS, INCLUDING IS WHICH ENSURE EQUAL OR BETTER PERFORMANCE THAN THE STANDARDS MENTIONED ABOVE, SHALL ALSO BE CONSIDERED. WHEN THE EQUIPMENT OFFERED BY THE BIDDER CONFORMS TO OTHER STANDARDS, SALIENT POINTS OF DIFFERENCE BETWEEN STANDARDS ADOPTED AND THE STANDARDS SPECIFIED IN THIS SPECIFICATION SHALL BE CLEARLY BROUGHT OUT IN THE RELEVANT SCHEDULE. FOUR COPIES OF SUCH STANDARDS WITH AUTHENTIC TRANSLATION IN ENGLISH SHALL BE FURNISHED ALONG WITH THE OFFER.

3.0 **CLIMATIC CONDITION:**

3.1. The Cables called in this specification are required to operate satisfactorily as per the service conditions setout in the clause No.23 of Section-III of this specification.

4.0. **PRINCIPAL PARAMETERS:**

**4.2. SIX PAIR/SINGLE PAIR CABLE**

| | | |
|---|---|---|
| 4.2.1. TYPE OF CABLE | : | TELEPHONE CABLE |
| 4.2.2. VOLTAGE GRADE | : | 300V |
| 4.2.3 CONDUCTOR MATERIAL | : | ANNEALED TIN COPPER |
| 4.2.4. CONDUCTOR SIZE | : | 0.63MM +/- 0.1MM |
| 4.2.5. CONDUCTOR RESISTANCE | : | 57 OHMS/KM |

4.2.6. CONDUCTOR ELONGATION (%) : 20.0 (MIN)
4.2.7. INSULATION MATERIAL : SOLID MEDIUM DENSITY POLYTHENE
4.2.8. INSULATION THICKNESS : 0.25 MM NOMINAL
4.2.9. MAX. DIA OF INSULATION CORE : 1.2 MM
4.2.10. OVERALL SHEATH MATERIAL : EXTRUDED PVC ST-1 IS:5831/84
4.2.11. HIGH VOLTAGE : 2 KV RMS FOR 1 MINUTE
4.2.12. CAPACITANCE UNBALANCED : 250 PF (MAX)
4.2.13. PACKING LENGTH / COIL : 100 M +/- 5% COIL
4.2.14. OVERALL SHEATH THICKNESS :
6 PAIR : 1.4MM NOMINAL
SINGLE PAIR : 1.0 MM NOMINAL

4.2.15. OVERALL DIA. OF CABLE
6 PAIR : 8.0 MM
SINGLE PAIR : 5.5 MM

4.2.16 INSULATION MATERIAL : PVC TYPE A OF IS:5831/84
4.2.17 THICKNESS OF INSULATION : 1.2MM NOMINAL
4.2.18 APPROX. CABLE OUTER DIA : 9.5 MM NOMINAL
4.2.19 MAX. CR AT 20 DEG.C. : 0.95 OHMS/KM
4.2.20 VOLUME RESISTIVITY : 1 X $10^{12}$ OHMS/CMS AT 20 DEG.C
4.2.21 HIGH VOLTAGE TEST :3.0 KV FOR 5 MINUTES BETWEEN CONDUCTOR AND GROUND
4.2.22 RLS TYPE : CATEGORY C1
4.2.23 OXYGEN INDEX : AS PER ASTMD 2963
4.2.24 TEMPERATURE INDEX : NOT LESS THAN $25^0$C

5.2. **6 PAIR & SINGLE PAIR TELEPHONE CABLES**

5.2.1 THE TELEPHONE CABLES SHALL BE MADE UP OF 0.63 MM DIAMETER ANNEALED, HIGH CONDUCTIVITY COPPER CONDUCTOR, POLYTHENE INSULATED, 2 CORES TWISTED TO FORM PAIRS ALL PAIRS BUNDLED AND WRAPPED TOGETHER WITH TEFLON PAPER. OVERALL PVC SHEATHED UNARMORED TELEPHONE CABLE GENERALLY CONFORMING TO IS:1554-PART-I.

5.2.2 CABLE SHALL BE DESIGNED AND MANUFACTURED SO THAT DAMAGE WILL NOT RESULT FROM TRANSPORTATION, INSTALLATION AND OPERATION UNDER ANY/OR ALL THE CLIMATIC AND OPERATING CONDITIONS TO WHICH THEY MAY BE SUBJECTED. THE CONDUCTOR IN EVERY SINGLE CORE OF THE CABLE SHALL WITHSTAND AN EXTERNAL VOLTAGE OF 300V.

6.0. **TESTS**

6.1. THE TYPE TESTS CARRIED OUT ON THE OFFERED CABLES SHOULD BE IN ACCORDANCE WITH IS:5026-1969, IS:11967(PART.2/SEC.2)/89,

6.1.1. THE BIDDER ALONG WITH HIS BID SHALL FURNISH TYPE TEST CERTIFICATES FOR THE TESTS SPECIFIED IN CLAUSE NO.10.6.2.0 BELOW FOR THE EQUIPMENT OFFERED BY HIM. THE TYPE TESTS SHOULD HAVE BEEN CONDUCTED ON PARTICULAR TYPE & MODEL OF THE EQUIPMENT I.E., OFFERED BY THE BIDDER AGAINST THIS SPECIFICATION BY A REPUTED INDEPENDENT LABORATORY AND THE SATISFACTORY PERFORMANCE OF THE SAID EQUIPMENT SHOULD HAVE BEEN CERTIFIED BY THE LABORATORY.

THE BIDS OF BIDDERS NOT ACCOMPANIED BY THE TYPE TEST CERTIFICATES AS STATED ABOVE WILL BE TREATED AS INCOMPLETE AND TERMED AS NON-RESPONSIVE AND LIABLE TO BE REJECTED.

TYPE TESTS SHALL MEAN THOSE TESTS, WHICH ARE TO BE CARRIED OUT TO PROVE THE PROCESS OF MANUFACTURE AND GENERAL CONFORMITY OF THE MATERIAL TO THIS SPECIFICATION.

6.2.0. TYPE TESTS

6.2.2. 6 PAIR AND 1 PAIR CABLES

I) RESISTIVITY OF CONDUCTOR
II) DIELECTRIC STRENGTH OF INSULATOR
III) INSULATION RESISTANCE
IV) SPARK TEST
V) HIGH VOLTAGE TEST
VI) HOT DEFORMATION
VII) ELONGATION TEST
VIII) TENSILE STRENGTH TEST

6.3.2. TELEPHONE CABLES

I) DIMENSIONS
II) INSULATION RESISTANCE
III) ELONGATION TEST
IV) TENSILE TEST
V) HIGH VOLTAGE TEST
VI) CONDUCTIVITY TEST / SHRINKAGE
VII) THERMAL STABILITY TEST

6.4. **ROUTINE TESTS**

6.4.2. TELEPHONE CABLES

I) DIMENSIONS
II) INSULATION RESISTANCE
III) ELONGATION TEST
IV) TENSILE TEST
V) HIGH VOLTAGE TEST
VI) CONDUCTIVITY TEST/ SHRINKAGE

6.5. TESTING EXPENSES

THE ENTIRE COST OF TESTING FOR THE ACCEPTANCE AND ROUTINE TESTS AND TESTS DURING MANUFACTURE SPECIFIED HEREIN SHALL BE TREATED AS INCLUDED IN THE QUOTED UNIT PRICE OF CABLES.

6.6. ADDITIONAL TESTS:

THE PURCHASER RESERVES THE RIGHT OF HAVING AT HIS OWN EXPENSES ANY OTHER TEST(S) OF REASONABLE NATURE CARRIED OUT AT BIDDER'S PREMISES, AT SITE, OR IN ANY OTHER PLACE IN ADDITION TO THE AFORESAID TYPE, ACCEPTANCE AND ROUTINE TESTS, TO SATISFY HIMSELF THAT THE MATERIAL COMPLY WITH THE SPECIFICATIONS.

**6.7. TEST REPORTS:**

6.7.1. COPIES OF TEST REPORTS SHALL BE FURNISHED IN AT LEAST SIX (6) COPIES ALONG WITH ONE ORIGINAL. ONE COPY SHALL BE RETURNED DULY CERTIFIED BY THE PURCHASER ONLY AFTER WHICH THE MATERIAL WILL BE DISPATCHED.

6.7.2. RECORD OF ROUTINE TEST REPORTS SHALL BE MAINTAINED BY THE BIDDER AT HIS WORKS FOR PERIODIC INSPECTION OR AS AND WHEN DESIRED BY THE PURCHASER'S REPRESENTATIVE.

6.7.3. TEST CERTIFICATES OF TESTS CONDUCTED DURING MANUFACTURE SHALL BE MAINTAINED BY THE BIDDER. THEY SHALL BE PRODUCED FOR VERIFICATION AS AND WHEN DESIRED BY THE PURCHASER.

6.8. **TEST FACILITIES**

6.8.1. THE FOLLOWING ADDITIONAL TEST FACILITIES SHALL BE AVAILABLE AT BIDDER'S WORKS:

A) VARIOUS TESTING AND MEASURING EQUIPMENT SHALL BE PROVIDED.
B) STANDARD RESISTANCE FOR CALIBRATION OF RESISTANCE BRIDGES.

## Technical Specification for 4-1/2 DIGIT HANDHELD Digital MULTIMETER

1. TYPE : 4 1/2 DIGIT, TRUE RMS TYPE, CAT IV
2. COUNT DISPLAY : 80000 COUNTS LCD DISPLAY
3. DC VOLTAGE ACCURACY : ± (0.05% +10) TO ± (0.05% +40)
4. AC VOLTAGE ACCURACY : ± (0.8% +20) TO ± (1.5% +60)
5. OHM ACCURACY : ± (0.3% +60) TO ± (0.5% +20)
6. FREQUENCY RESPONSE : 100 KHZ
7. RANGES
   - I. DC VOLTAGE : 80 MV TO 1000V
   - II. AC VOLTAGE : 800 MV TO 1000V TRUE (RMS)
   - III. AC & DC CURRENT : 80 MA TO 10A
   - IV. RESISTANCE : 800 OHMS TO 80M OHMS
   - V. CAPACITANCE : 1NF TO 100 μF
   - VI. FREQUENCY : 50 HZ TO 10 KHZ

8. OPERATING VOLTAGE : ON A BUILT-IN 9V RECHARGEABLE BATTERY

9. 4 1/2 DIGITAL HANDHELD DIGITAL MULTIMETER
10. THE 4 1/2 DIGIT HANDHELD DIGITAL MULTIMETER TO BE SUPPLIED UNDER THIS SPECIFICATION MUST HAVE OVERLOAD PROTECTION.
11. THE 4 1/2 DIGIT HANDHELD MULTIMETER SHOULD BE COMPACT IN CONSTRUCTION AND LIGHT WEIGHT AND RUGGED SHOCK ABSORBENT CASE AND WITH CAT IV RATED.
12. THE 4 1/2 DIGIT HANDHELD MULTIMETER SHOULD HAVE THE FOLLOWING INDICATIONS.
13. AUTOMATIC POLARITY
14. LOW BATTERY INDICATION.
15. THE 4 1/2 DIGIT MULTIMETER SHOULD BE SUITABLE FOR CARRIER SIGNAL MEASUREMENT IN DBS ON PLC, VHF AND UHF COMMUNICATION SYSTEM AND SHOULD BE CAPABLE OF DIODE TESTING.
16. ACCESSORIES ALONG WITH EACH METER.

| | |
|---|---|
| FUSES | 2 OF EACH TYPE |
| TESTING PROBES | 2 PAIRS |
| USER MANUAL | 1 |
| BATTERIES INSTALLED | 1SET |

**TECHNICAL SPECIFICATION FOR EPAX, ELECTRONIC PUSH BUTTON TELEPHONES**

7.1.0. **SCOPE:**
THIS SPECIFICATION COVERS DESIGN, MANUFACTURE, TESTING, PACKING, FORWARDING AND DELIVERY FOR DESTINATION OF ELECTRONIC PRIVATE AUTOMATIC EXCHANGES AND ELECTRONIC PUSH BUTTON TELEPHONES.

**7.1.1.1 The EPAX shall support a capacity of 128 universal ports, which can be programmed to either 4W &2W E&M trunks (both conventional & ~~PLCC version~~), 2W Loop Interrupt trunks and 2W subscribers. The EPAXs shall be supplied fully wired and Equipped for all 128 universal ports as follows:**

| | | **For (16/16)** |
|---|---|---|
| **E&M trunks (~~PLCC~~ version)** | **:** | **16** |
| **SUBSCRIBER LINES** | **:** | **16** |

7.1.1.2. THE E&M TRUNK REQUIRES 2 WIRES FOR SIGNALING E & M AND 4 WIRES FOR TX/RX SPEECH. THE SUBSCRIBER LINE SUPPORTS 2-WIRE LOOP SIGNALING.

7.1.1.3. THE EPAX SHOULD SUPPORT BOTH PULSE AND DTMF SIGNALING AND COMPATIBLE WITH THE EXISTING SWITCHING EQUIPMENT IN THE SYSTEM.

**7.1.1.4. THE CPU CARD AND PSU CARDS SHALL BE DUPLICATED FOR REDUNDANCY WITH HOT SWITCHOVER**. IN THE EVENT OF THE FAILURE OF ONE OR BOTH OF THE CARDS, THE STAND-BY CARD SHALL TAKE OVER THE FUNCTIONING OF THE EPAX WITH OUT ANY INTERRUPTION.

7.1.2.0. THE ELECTRONIC PUSH BUTTON TELEPHONES ARE INTENDED TO BE CONNECTED TO THE EPAX FOR PROVIDING SPEECH ON DIALING NETWORK IN THE ~~PLCC SYSTEM~~ PROVIDED ON THE 400 KV~~, 220 KV AND 132 KV~~ TRANSMISSION LINES.

7.1.2.1. THE TELEPHONES SHALL SUPPORT DIALING ON 2-WIRE LOOP MODE.

7.2.0 **STANDARDS:**

7.2.1. AS THERE ARE NO KNOWN IS STANDARDS, THE EPAX AND TELEPHONES PROPOSED FOR PURCHASE AS PER CLAUSE 7.1.0 SHALL CONFORM TO THE RELEVANT CCITT RECOMMENDATION AND ITDS TEC SPECIFICATION INCLUDING LATEST REVISIONS, AMENDMENTS / CHANGES ADOPTED AND PUBLISHED AS DETAILED BELOW:

THE EPAX AND TELEPHONES SHALL HOWEVER BE TESTED THOROUGHLY FOR THE EMC/EMI COMPATIBILITY AS PER THE IS STANDARDS MENTIONED BELOW:

| STANDARDS | TITLE |
|---|---|
| **EPAX** | |
| TEC SPECN.G/PBX | TEC SPECIFICATION APPROVED BY DOT -01/01/MAY'90. |
| | **ELECTRONIC PUSH BUTTON TELEPHONES** |
| TEC SPECN.G/TEL- | TEC SPECIFICATION APPROVED BY DOT 01-02/JUNE'96 |
| IS 6873 SERIES | METHODS OF MEASUREMENT OF ELECTROMAGNETIC INTERFERENCE FROM VARIOUS ELECTRICAL DISTURBANCE |
| IEC 60255-21-1-1988 | VIBRATION TESTS (SINUSOIDAL) |
| IEC 255-21-2-1988 | SHOCK AND BUMP TESTS. |
| IEC 60255-22-1-1988 | 1 MHZ BURST DISTURBANCE TEST. |
| IEC 60255-22-2-1996 | ELECTROSTATIC DISCHARGE TESTS |

IEC 60255-22-3-2000 RADIATED ELECTROMAGENTIC FIELD DISTURBANCE TESTS.

IEC 255-22-4-1992 FAST TRANSIENT DISTURBANCE TEST
IEC 60870-(P1-P6). 1984-2000 TELECONTROL EQUIPMENT AND SYSTEM
EN 55022 RADIATED EMISSION & CONDUCTED EMISSION

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7.2.2. EQUIPMENT MEETING WITH THE REQUIREMENT OF OTHER AUTHORITATIVE STANDARDS, INCLUDING IS, WHICH ENSURE EQUAL OR BETTER PERFORMANCE THAN THE STANDARDS MENTIONED ABOVE, SHALL ALSO BE CONSIDERED. WHEN THE EQUIPMENT OFFERED BY THE BIDDER CONFORMS TO OTHER STANDARDS, SALIENT POINTS OF DIFFERENCE BETWEEN STANDARDS ADOPTED AND THE STANDARDS SPECIFIED IN THIS SPECIFICATION SHALL BE CLEARLY BROUGHT OUT IN THE RELEVANT SCHEDULE. FOUR COPIES OF SUCH STANDARDS WITH AUTHENTIC TRANSLATION IN ENGLISH SHALL BE FURNISHED ALONG WITH THE OFFER.

7.3.0 **CLIMATIC CONDITIONS:**

7.3.1. The EPAX & Push Button Telephones called in this specification are required to operate satisfactorily under climatic conditions given in the Specifications.

7.4.0. **PRINCIPAL PARAMETERS**
7.4.1. **DIGITAL EPAX SYSTEM:**

| S. NO. | PARAMETER | DESCRIPTION |
|---|---|---|
| 1 | TECHNOLOGY (TYPE) | PCM / TDM with 32 bit microprocessor based digital technology Electronic Private Automatic Telephone Exchange (EPAX) on E & M signaling and DC loop signaling to work with ~~PLC Communication System~~. |
| 2 | CONTROL | STORED PROGRAMME CONTROL (SPC) |
| 3 | BACK-UP MEMORY | FLASH ROM BASED (TO STORE UP TO 500 STATION IDS IN THE INTERNAL MEMORY) |
| 4 | SYSTEM CAPACITY<br><br>REQUIRED CAPACITY OF E & M TRUNKS / SUBSCRIBERS | 128 UNIVERSAL PORTS PROGRAMMABLE TO E & M, LOOP INTERRUPT TRUNKS AND SUBSCRIBERS.<br>E & M TRUNKS : 16<br>SUBSCRIBER LINES : 16 |
| 5 | CONFIGURATION | UNIVERSAL SLOTS FOR EXTENSION / TRUNK INTERFACE |
| 6 | PRIORITY FACILITY | SHALL BE PROVIDED AS PER CLAUSE 7.5.1.9 |
| 7 | COMMUNICATION LINKS | 100 % NON-BLOCKING |
| 8 | ARCHITECTURAL DESIGN | DISTRIBUTED DESIGN |
| 9 | SYSTEM MODULARITY | EASY EXPANSION BY ADDING MODULES |
| 10 | APPROVALS REQUIRED | TEC WITH ISDN, BRI AND PRI |
| 11 | TRUNK INTERFACE | **4W / 2W E & M Interface with LED indication with DP / DTMF**<br>E1 / R2 (2MBPS DIGITAL LINK) WITH BNC CONNECTOR<br>VOIP INTERFACE<br>CO TRUNK LINES<br>ISDN BRI & PRI TRUNK LINES |
| 12 | ALARM ON INDICATION | SELF-DIAGNOSTICS WITH ALARM ON FAULT CONDITION SHALL BE PROVIDED. |
| 13 | PROTECTION | ALL THE TRUNK LINES AND SUBSCRIBER LINES SHALL BE PROVIDED WITH SURGE ARRESTERS ON THE MDF |

| | | |
|---|---|---|
| 14 | EXTENSION INTERFACE | STATION INTERFACE FOR NORMAL ANALOG PBT<br>DIGITAL EXTENSION INTERFACE FOR KEY PHONES<br>HYBRID STATION INTERFACE FOR PBT / KEY PHONES |
| 15 | REDUNDANCY | SYSTEM SHOULD HAVE REDUNDANCY FOR PSU & CPU. |
| 16 | SYSTEM VOLTAGE | -48V DC (POSITIVE GROUND) + 15%, -10% WITH MCB PROTECTION |
| 17 | POWER CONSUMPTION | LESS THAN 300W |
| 18 | EMI / EMC | AS PER IEC 17025: 2000 STANDARD |
| 19 | PROGRAMMING | PROGRAMMING OF THE EPAX SHOULD BE DONE USING **CONSOLE/LAPTOP** THAT SHOULD BE PART OF THE EXCHANGE AT NO EXTRA COST . |

7.4.2. **ELECTRONIC PUSH BUTTON TELEPHONES**

7.4.2.1.

A) TYPE : ELECTRONIC PUSH BUTTON TELEPHONES (DECADIC) SUPPORTING BOTH PULSE AND DTMF SIGNALING AND RING LED.

B) DIAL SPEED : 10 PPS ± 5%

C) BREAK MAKE RATIO : 2:1

D) INTER DIGIT PAUSE : 800 MS.

F) RELIABILITY : THE PERFORMANCE OF THE INSTRUMENT SHOULD BE VERY RELIABLE AND ACCURATE WITH LARGE MTBF AS PER TEC REQUIREMENTS.

7.5.1.1. The microprocessor based EPAX should directly interface with communication transmission systems like ~~Power Line Carrier Communication~~, Optical fiber, Satellite and Microwave radio communication links. The subscribers must be able to communicate with local subscribers and far end subscribers through trunk lines. The EPAX should form a part of Communication system and should be capable of switching speech paths on trunk routes.

7.5.1.2. The exchange should be compatible with the existing switching systems for its operation in conjunction with electronic four wire group selectors and EPAXs of any other make at far end stations. It would be the sole responsibility of the successful bidder to guarantee the compatibility of the EPAX with the existing switching systems.

7.5.1.3. THE EXCHANGES SHALL BE MANUFACTURED TO THE STATE OF ART TECHNOLOGY AND EMPLOY THE STORED PROGRAM TECHNIQUE BY UTILIZING THE PRINCIPLES OF TDM/PCM. THE SYSTEM SOFTWARE SHALL BE POSTED IN FLASH MEMORY AS PER THE INTERNATIONAL STANDARDS. THE EQUIPMENT SHOULD BE RELIABLE AND CAPABLE OF GIVING SERVICE IN ADVERSE TROPICAL TEMPERATURE CLIMATIC CONDITION. THE EQUIPMENT SHOULD WORK IN NON AIR-CONDITIONED ENVIRONMENT AT EHT SUB-STATIONS.

7.5.1.4. EXCHANGES ARE TO BE SELF CONTAINED AND PROVIDED WITH CONVENTIONAL FACILITIES LIKE DIAL TONE, BUSY TONE, RINGING TONE, RING BACK TONE ETC. THE DIALING PULSE RATE OF SUBSCRIBER FOR MAKE AND BREAK RATIO 1:2 (33.3MSEC. / 66.66MSEC.) AND FOR TRUNK DIALING 1:1 (50 M SEC./ 50 M SEC). THE EPAX SHOULD BE CAPABLE OF WORKING TO SINGLE, TWO DIGIT AND THREE DIGIT NUMBERING SCHEMES. THE EXISTING TWO DIGIT NUMBERING SCHEME AS ADOPTED IN TSTRANSCO NETWORK IS HOWEVER TO BE PROGRAMMED IN THE EPAX INITIALLY.

7.5.1.5. Main Distribution Frame shall be provided. Subscriber lines and junction lines are to be terminated on the MDF on one side of the terminal-block with the legend of the terminal connections clearly indicated in alphanumeric. The MDF shall be provided with individual surge protection.

7.5.1.6. KRONE TAG BLOCKS ARE PREFERRED TO BE USED FOR THE MDF. THE SUPPLY OF RELEVANT WIRE TERMINATING TOOL FOR THE TYPE OF TAG BLOCK QUOTED TOWARDS MDF IS COVERED IN THE SCOPE OF THIS SPECIFICATION.

7.5.1.7. ALL THE SUBSCRIBER LINES AND THE ~~PLCC~~ JUNCTION LINES SHALL BE PROVIDED WITH SURGE PROTECTION. INVARIABLY SUITABLE SURGE PROTECTORS IN THE FORM OF GAS DISCHARGE TUBES AND FUSES ARE TO BE PROVIDED TO PROTECT ELECTRONIC CIRCUITRY OF THE EXCHANGE FROM THE DAMAGES DUE TO EXTERNAL SURGES /SPIKES. MINIMUM MAINTENANCE AND FREE WORKABILITY ON THE EQUIPMENT IS TO BE ENSURED.

7.5.1.8. The EPAX should be provided with self-checking diagnostic facility to monitor the exchange continuously through software controlled program. The status of the call being established is to be visually displayed suitably as the call is progressing and faults by audible and visual indications. Reliability, security and quality of service must be the main features of the EPAX. The EPAX shall have the priority feature for a particular subscriber.

THE FOLLOWING STATE OF ART FACILITIES ARE ALSO TO BE PROVIDED.

I. PRIORITY CUT-IN INTO AN ENGAGED EXTENSION/TIE LINE.
II. AUTOMATIC CUT OFF ON FORCED RELEASE CONDITION.
III. BARRED ACCESS TO TIE LINES
IV. CALL TRANSFER
V. CALL CONSULT
VI. CALL FORWARD ETC.

7.5.1.9. THE PRIORITY CUT IN FACILITY SHALL BE PROVIDED IN THREE HIERARCHIES AS STATED BELOW.

I. PRIORITY CUT IN INTO TWO BUSY LOCAL EXTENSIONS.
II. PRIORITY CUT IN INTO ONE BUSY LOCAL EXTENSION AND ONE LOCAL E&M TIE TRUNK.
III. PRIORITY CUT IN INTO TWO BUSY E&M TRUNKS IN THE SAME EPAX ON TRANSIT CALL.

SUBSCRIBER ACCESS TO THE E&M TRUNKS SHALL BE CONTROLLED THROUGH BARRED ACCESS FACILITY.

7.5.1.10. **SPECIFIC TRUNK ACCESS**: IF MORE THAN ONE ROUTE IS AVAILABLE FROM THE SAME EPAX TO AN OUT STATION EPAX AND IN CASE THE MAIN ROUTE IS BUSY, THE SELECTION OF ALTERNATE ROUTE SHALL BE MADE AVAILABLE ON AUTOMATIC SELECTION OF AT LEAST TWO ALTERNATIVE ROUTES APART FROM THE MAIN TRUNK ROUTE. SPECIFIC TRUNK ACCESS SHALL ALSO HAVE TO BE PROVIDED. THE SUBSCRIBER SHALL BE ABLE TO ACCESS A SPECIFIC TRUNK ROUTE BY DIALING A SPECIAL ACCESS CODE FOLLOWED BY THE TRUNK ROUTE NUMBER.

The EPAX shall support exclusive Load Dispatch Express type communication network with all to one and one to all type of trunk access. This feature shall be in addition to the normal All to All type.

7.5.1.11. THE EQUIPMENT SHOULD BE HOUSED IN A STANDARD STEEL CABINET WITH PROPER VENTILATION, AND IT SHOULD BE DUST AND VERMIN PROOF HOUSING. IT SHOULD BE PAINTED AS PER RELEVANT IS AND MUST HAVE PROVISION FOR ACCESS TO THE CIRCUITRY FROM BOTH THE FRONT AND REAR SIDES. THE VENTILATION FAN SHALL WORK ON 48V DC ONLY.

7.5.1.12. THE EPAXS SHALL BE GOT WIRED FOR A MINIMUM CAPACITY OF 128 UNIVERSAL PORTS. REQUIRED NUMBER OF JUNCTION CARDS AND LINE CARDS MAY BE PROVIDED AS PER THE SCHEDULE OF MATERIALS.

7.5.1.13. PROGRAMMING THE REQUIRED FACILITIES ON THE EPAX WITH AN ORDINARY TELEPHONE THROUGH THE SERVICE LINE IS PREFERRED. FOR EPAXS, WHICH CANNOT BE PROGRAMMED WITH AN ORDINARY TELEPHONE, THE BIDDER SHALL INCLUDE THE SUPPLY OF THE REQUIRED

PROGRAMMER (EXAMPLE: EPROM PROGRAMMER OR CONSOLE) WITHIN THE SCOPE OF SUPPLY WITH A DETAILED WRITE-UP OF THE PROGRAMMING SCHEDULE THROUGH THE OPERATOR CONSOLE/ PROGRAMMER.

7.5.1.15. The Bidders are requested to quote as mandatory for one set of spare PCB modules as stated below:

I. POWER SUPPLY UNIT
II. CENTRAL PROCESSING UNIT
III. LINE INTERFACE CARD
IV. E&M TRUNK INTERFACE CARD
V. SWITCHING MATRIX CARD

7.5.2. **ELECTRONIC PUSH BUTTON TELEPHONES**

7.5.2.1. THE ELECTRONIC PUSH BUTTON TELEPHONES (DESK TOP TYPE) SHALL HAVE THE APPROVAL OF TELECOM ENGINEERING CENTRE OF DOT AND SUITABLE TO WORK WITH ~~PLCC SYSTEM.~~

7.5.2.2. THE TELEPHONES SHALL BE PROVIDED WITH THE FOLLOWING FEATURES:

I. DECADIC / DTMF DIALING
II. LAST NUMBER REDIAL
III. REDIAL CAPACITY UP TO 32 DIGITS
IV. RINGER WITH VOLUME CONTROL
V. INTERCHANGEABLE TRANSDUCERS OF ELECTRODYNAMIC TYPE
VI. ELECTRONIC SPEECH CIRCUITRY WITH REGULATED SPEECH LEVELS
VII. SPEAKER PHONE

**7.6.0.** TESTS

7.6.1. TYPE/ACCEPTANCE AND ROUTINE TESTS SHALL BE CARRIED OUT ON THE EPAX AND ELECTRONIC PUSH BUTTON TELEPHONES PROPOSED FOR PURCHASE UNDER THIS PACKAGE IN ACCORDANCE WITH TEC SPECIFICATION APPLICABLE AS PER CLAUSE 7.2.1.

7.6.1.1. EMI / EMC TEST

THE EPAX IS REQUIRED TO PERFORM IN A WORKING ENVIRONMENT OF HIGH VOLTAGE POWER SYSTEM WITH HIGH LEVEL OF ELECTROMAGNETIC INTERFERENCE AND CALLS FOR HIGH DEGREE OF ELECTROMAGNETIC COMPUTABILITY FOR ACHIEVING MAXIMUM THROUGHOUT OF TRAFFIC. THE WORKING ENVIRONMENT IS RIDDLED WITH FAST TRANSIENTS, CURRENTS, HIGH VOLTAGE LIGHTNING & SWITCHING SURGES AND SEVERE SHORT CIRCUIT CURRENT FAULTS. THE EPAX IS THEREFORE REQUIRED TO BE TESTED THOROUGHLY FOR ITS FUNCTIONAL PERFORMANCE AS PER THE EMI/EMC STANDARDS MENTIONED IN CLAUSE NO 7.2.1. BIDS OF BIDDERS WHO DO NOT ENCLOSE COPY OF AUTHENTICATED CERTIFICATE BY A REPUTED LABORATORY EITHER IN INDIA OR ABROAD OF TESTING THE PERFORMANCE OF THE OFFERED EPAXS UNDER SEVERE ELECTROMAGNETIC INTERFERENCE CONDITIONS WILL BE REJECTED.

7.6.2. **TYPE TESTS:**

THE FOLLOWING TYPE TESTS SHALL BE CONDUCTED ON A SELECTED SAMPLE OF EPAX

7.6.2.1. EPAX

I. POWER SUPPLY TEST
II. PROTECTION TEST
III. ENGAGE PULSE TIMING TEST
IV. PRIORITY TIMING TEST
V. DIGITAL PULSE TIMING TEST
VI. INTERDIGIT PULSE TIMING TEST

VII. RELEASING PULSE TIMING TEST
VIII. TEST CALLS - SUBSCRIBER TO SUBSCRIBER
SUBSCRIBER TO TRUNK
TRUNK TO TRUNK

7.6.2.2. TELEPHONES
I. CLIMATIC TEST
II. VIBRATION TEST
III. BUMP/FALL/TOPPLE TEST
IV. CORROSION TEST
V. PROTECTION TEST

7.6.3. **ACCEPTANCE/ROUTINE TESTS**

7.6.3.1 EPAX
I. POWER SUPPLY TEST
II. PULSES TIMING TEST
III. TEST CALLS - SUBSCRIBER TO SUBSCRIBER
SUBSCRIBER TO TRUNK
TRUNK TO TRUNK

7.6.3.2. TELEPHONES
I. CLIMATIC TEST
II. VIBRATION TEST
III. CORROSION TEST
IV. PROTECTION TEST

7.6.4. **TESTING EXPENSES**

7.6.4.1. THE BIDDER SHALL FURNISH CHARGES FOR CONDUCTING SPECIFIED TYPE TESTS AS PER PRICE SCHEDULE.

7.6.4.2. IN CASE OF FAILURE IN ANY OF THE TYPE TESTS, THE SUPPLIER IS REQUIRED TO MODIFY THE DESIGN OF THE MATERIAL AND THE MATERIAL SHALL BE TYPE TESTED SUCCESSFULLY FOR THE MODIFIED DESIGN.

7.6.4.3. BIDDERS SHALL INDICATE THE LABORATORIES IN WHICH THEY PROPOSE TO CONDUCT THE TYPE TESTS. THEY SHALL ENSURE THAT THE TESTS CAN BE COMPLETED IN THESE LABORATORIES WITHIN THE TIME SCHEDULE GUARANTEED BY THEM IN THE APPROPRIATE SCHEDULE.

7.6.4.4 ENTIRE COST OF TESTING FOR THE ACCEPTANCE AND ROUTINE TESTS AND TESTS DURING MANUFACTURE SPECIFIED HEREIN SHALL BE TREATED AS INCLUDED IN THE QUOTED UNIT PRICE OF EPAX AND ELECTRONIC PUSH BUTTON TELEPHONES.

**7.6.5 ADDITIONAL TESTS:**

THE PURCHASER RESERVES THE RIGHT OF HAVING AT HIS OWN EXPENSES ANY OTHER TEST(S) OF REASONABLE NATURE CARRIED OUT AT BIDDER'S PREMISES, AT SITE, OR IN ANY OTHER PLACE IN ADDITION TO THE AFORESAID TYPE, ACCEPTANCE AND ROUTINE TESTS, TO SATISFY HIMSELF THAT THE MATERIAL COMPLY WITH THE SPECIFICATIONS.

7.6.6 **TEST REPORTS:**

A. I. COPIES OF THE TYPE TESTS SHALL BE ENCLOSED WITH THE BID
II. BEFORE DISPATCH OF THE EQUIPMENT AT LEAST SIX (6) COPIES ALONG WITH ONE ORIGINAL SHALL BE SUBMITTED. ONE COPY SHALL BE RETURNED DULY CERTIFIED BY THE PURCHASER ONLY AFTER WHICH THE MATERIAL WILL BE DISPATCHED.

B. RECORD OF ROUTINE TEST REPORTS SHALL BE MAINTAINED BY THE BIDDER AT HIS WORKS FOR PERIODIC INSPECTION OR AS AND WHEN DESIRED BY THE PURCHASER'S REPRESENTATIVE.

C. TEST CERTIFICATES OF TESTS CONDUCTED DURING MANUFACTURE SHALL BE MAINTAINED BY THE BIDDER. THESE SHALL BE PRODUCED FOR VERIFICATION AS AND WHEN DESIRED BY THE PURCHASER.

**TECHNICAL SPECIFICATION FOR FUSION SPLICING MACHINE:**

Fusion splicer shall be of state of the art single mode and multimode which can complete a splice sequence together with a detailed loss estimation in less than 15 seconds. Fusion splicer shall have the following Features:

1. Core-to core Fiber alignment using profile alignment system technology
2. Environmental resistance features
3. most compact and lightest
4. Arc calibration-free system
5. 4.1'' TFT Color LCD monitor
6. Dual directional operation system
7. Long life Battery
8. Fiber holder option
9. Software upgrade via internet
10. Detachable work table

**Specification:**

| | | | |
|---|---|---|---|
| i. | Applicable Fiber | : | SM / MM/DS and other single mode fibers |
| ii. | Fiber Count | : | Single |
| iii. | Fiber cleaved length | | |
| | Standard | : | 16 mm |
| | Fiber holder | : | FH-60-250 and FH-60-900 (10mm cleave) |
| iv. | Average Fusion loss | : | 0.01 d B (SM), 0.01 d B (MM), 0.04 d B (DS) |
| v. | Storage of splice result | : | 2000 or more splice results |
| | Working mode | : | Auto & Manual |
| vi. | Splicing time | : | < 15 sec. |
| vii. | Return loss | : | > 60 d B |
| viii. | No. of splice modes | : | 100 modes. |
| ix. | Splice loss estimating function | : | should be available. |
| | Attenuation splicing function | : | Auto attenuation mode:0.1 d B to 15 d B (0.1 dB step) |
| x. | Tension test | : | 1.96 to 2.25N |
| xi. | Fiber Magnification | : | 132 (X/Y Simultaneous view) or 264 (high magnification view) |
| xii. | Operational environmental condition: | | 0 to 5000 m above sea level, 0 to 95% RH and10 to 50°C and up to 15m/s wind velocity. |
| xiii. | Storage condition | : | 0 to 95% RH and –40 to 80°C respectively |
| xiv. | Tube heater | : | Built-in tube heater with 30 programmable heating modes. |
| xv. | Applicable protection sleeve length | : | 60 mm, 40 mm and micro sleeves |
| xvi. | No. of splice cycles with battery | : | Typical 160 cycles |
| xvii. | Electrode life | : | 2500 arc discharges. |
| xviii. | Viewing method and display | : | Two CMOS cameras and 4.1'' TFT Color LCD monitor |
| xix. | Power supply | : | 100 to 240 V AC, with Battery pack; shall operate on battery at least for 4 hours. |

**Standard Accessories (These accessories should be supplied in FSM package)**

1. AC adapter / Battery charger
2. AC power cord
3. DC Power cord
4. Spare electrodes
5. USB cable
6. user manual
7. Battery pack
8. Battery charge cord
9. **High precision fiber cleaver**
10. J plate
11. Carrying case

## OPTICAL POWER METER TECHNICAL SPECIFICATION

THE OPTICAL POWER METER OFFERED SHOULD BE OPERATABLE IN WINDOWS USED IN TELECOMMUNICATION SYSTEM AND SHALL BE SUITABLE FOR MEASURING THE POWER OF OPTICAL SIGNAL SOURCES AND THE ATTENUATION OF OPTICAL CABLES. THE EQUIPMENT SHALL BE SUITABLE FOR INSTALLATION AND MAINTENANCE OF OPTICAL LINKS AND FOR COMPONENT CHARACTERIZATION.

**TECHNICAL SPECIFICATION:**

| | | |
|---|---|---|
| WAVELENGTH RANGE | : | 850 TO 1550 NM |
| ACCURACY | : | ± 5% ± 1 NW |
| MEASUREMENT RANGE | : | -70 TO +10 DBM |
| OPERATING TEMPERATURE | : | - 10 TO + 50° C |
| STORAGE TEMPERATURE | : | - 20 TO + 70° C |
| OPTICAL CONNECTOR TYPE | : | FC |
| OPERATING TIME WITH BATTERY | : | AT LEAST 10 HOURS |

OPTICAL POWER METER SHOULD BE OPERATED ON DC VOLTAGE. SUITABLE AC/DC ADAPTER AND BATTERY SHALL BE PROVIDED.

ACCESSORIES ALONG WITH POWER METER:

1. FC/PC, SC/PC, ST/PC INTERCHANGEABLE CONNECTORS
2. BATTERY PACK
3. CARRYING BAG
4. AC/DC ADAPTER.
5. USER GUIDE

# SECTION - 3

## PROJECT DETAILS AND GENERAL SPECIFICATIONS

### GENERAL TECHNICAL REQUIREMENTS

## 1.0 PROJECT DETAILS

| | | |
|---|---|---|
| Customer | : | M/s Telangana State Power Generation Corporation Ltd. |
| Project Title | : | 5x800MW Yadadri Thermal Power Station |
| Project Location | : | Veerlapalem Village, Damercherla Mandal, Nalgonda District, Telangana |
| Nearest Railway station | : | Vishnupuram railway station. |
| Nearest Road Head | : | NH-9 is at 45km North<br>SH-2 is at 7km South |
| Nearest Airport | : | Hyderabad (about 120 Km) |
| Postal Address | : | Chief Engineer (O&M), 5X800MW Yadadri Thermal Power Station, TSGENCO, Village - Veerlapalem, Mandal- Dameracheral, Dist. – Nalgonda, Telangana |

## 1.1 SITE CONDITIONS (FOR DESIGN PURPOSES)

**1.1.1** SITE CONDITIONS

| | | | |
|---|---|---|---|
| a). | Average rainfall per year | : | 1124 mm |
| b). | Maximum hourly rainfall intensity | : | 102 mm |
| c). | Altitude | : | 1000 m |

**1.1.2** DESIGN AMBIENT

| | | | |
|---|---|---|---|
| a). | Minimum Temperature | : | 13.5°C |
| b). | Maximum Temperature | : | 45°C |
| c). | Design Ambient Temperature | : | 50 °C |

**1.1.3** RELATIVE HUMIDITY

| | | | |
|---|---|---|---|
| a). | Maximum | :: | 85% |

**1.1.4** WIND PRESSURE (AS PER IS:875-1987)

a). Design wind speed : 44 m/sec.

**1.1.5** SEISMIC FACTORS

a). Horizontal Seismic Coefficient : As per latest IS : 1893

b). Vertical Seismic Coefficient : As per latest IS : 1893

} ***Zone – III***

**1.1.6** ELECTRICAL DATA

| | | 400 kV System | 415V AC System | 240V AC System | 220 V DC System | 48 V DC System |
|---|---|---|---|---|---|---|
| 1. | Nominal Voltage | 400 kV | 415 V | 240 V | 220 V | 48 V |
| 2. | Highest System Voltage | 420 kV | 457 V | 264 V | 242 V | 55 V |
| 3. | No. of phases | 3 | 3 | 1 | NA | NA |
| 4. | Frequency | 50 Hz | 50 Hz | 50 Hz | NA | NA |
| 5. | Voltage variation | ± 5% | ± 10 % | ± 10 % | +10 % to -15% | ± 10 % |
| 6. | Neutral Earthing | Effectively Earthed | Solidly Earthed | Solidly Earthed | - | - |
| 7. | Fault Level | 50 kA for 1 sec. | 50 kA for 1 sec. | 50 kA for 1 sec. | 15 kA for 1 sec. | - |

**1.1.7** SYSTEM PARAMETERS

| | |
|---|---|
| Dry and wet one minute power frequency withstand voltage | 630 kVrms |
| Dry impulse withstand voltage positive and negative | 1425 kVpeak |
| Minimum Total Creepage | 25 mm/kV |

**1.1.8** MINIMUM CLEARENCE (AS PER IS: 10118)

| | |
|---|---|
| Phase to phase (PP) | 4200 mm |
| Phase to earth (PE) | 3500 mm |
| Section clearance | 6500 mm |
| Minimum ground clearance from plinth level (Plinth level : 300 mm) | 8000 mm |

| | |
|---|---|
| Vertical ground clearance to nearest part not at earth potential of an insulator supporting live conductor/ equipment | 2440 mm |

## 1.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification. It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

## 1.3 STANDARDS

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

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other. When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner's approval. The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

## 1.4 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. Purchaser reserves the option for getting any or all the type tests repeated on the equipment. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the technical specification or any/all additional type tests not carried out without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

The purchaser intends to repeat the type tests and additional type tests on cables for which test charges shall be payable as per provision of contract.

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

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

The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Manufacturer, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The

Manufacturer shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser/ inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

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

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

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

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

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

## 1.5 MATERIAL/WORKMANSHIP

### 1.5.1 GENERAL REQUIREMENT

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purposes for which they are intended.

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

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

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be construed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances /instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture’s limits. Suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.
All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

### 1.5.2 **PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to

the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

## 1.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The contractor shall propose a colour scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

## 1.7 PAINTING

a) All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of practice for Phosphating Iron and Steel".

b) Oil, grease, dirt and swerve shall be thoroughly removed from emulsion by cleaning.

c) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

d) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and over drying.

e) The phosphate coating shall be sealed by the application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "Flash dried" while the second coat shall be stoved.

f) After application of the primer, two coats of finishing epoxy paint shall be applied, each coat followed by stoving. The panel shall have colour conforming to shade 631 of IS-5 for outside and inside of the panel with black colour for base frame.

g) Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.

h) Finished painted appearance of panel shall present an asthetically pleasing appearance free from dents and uneven surface.

i) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

## 1.8 PROTECTION

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

b) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

c) The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

d) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

## 1.9 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

## 1.10 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

## 1.11 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

## 1.12 AUXILIARY POWER SUPPLY

1.12.1 A.C power supply for auxiliaries will be available at 240 V, 50 C/s 1-phase, 2 wire and 415V, 50 C/s, 3-phase, 4 wire, neutral solidly earthed with variation in frequency of +/-5% and variation in voltage +/-10%

1.12.2 D.C. power supply at 220 V, 2-wire ungrounded will be available 187 V to 242 V.

## 1.13 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of purchaser. Wherever equipment similar to the one being offered has already been type tested within 5 years from the date of opening the bid. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

## 1.14 PACKAGING

Aluminium Tube shall be partially packed with Hessians cloths. Similar items shall be grouped and tied with steel wires/strip for convenient handling during transits.

**MARKINGS**

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.

b) Purchase order number.

c) Name of supplier/s.

d) Description of equipment / material.

e) Tare weight.

f) Gross weight.

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

## 1.15 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser.

Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the contractor at his own expenses.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the

purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the Contractor' account.

The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance to the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of such nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipments which require indoor storage.

The words erection and installation used in the specification are synonymous. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

## 1.16 TOOLS AND TACKLES

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

## 1.14 EQUIPMENT BASES

A cast iron or welded steel base-plate shall be provided for all rotating equipment, which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base-plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units shall have a raised lip all around, and shall have threaded drain connections.

## 1.15 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

## 1.16 DOCUMENTATION

### 1.16.1 DRAWINGS

All drawings shall be prepared in AutoCAD and ultimate documentation would include drawings/documents on CDs. All dimensions and data shall be in SI metric units.

All items of the equipment should be clearly identified by proper part nos. in the contract drawings. Such parts, which are to be dispatched to site from works in dispatchable units and are reassembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. The shipping list should be sent along with the general arrangement drawings for engineer's approval. All the items of the shipping list should be identified in the drawing.

The drawing submitted by the supplier shall be reviewed by the purchaser as far as practicable within two weeks of receipt of drawings and shall be modified by the sub-contractor if any modifications and/or corrections are required by the purchaser. The sub-contractor shall incorporate such modifications and / or corrections and submit the final drawings for approval. Any delay arising out of failure of the subcontractor to rectify the drawings shall not alter the contract completion date.

Further work by the subcontractor shall be in strict accordance with these drawings and no deviation shall be allowed without the written approval of the purchaser.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at supplier's risk.

Approval of drawing or work by the purchaser/consultant shall not relieve the subcontractor of any of his responsibilities and liabilities under the contract.

In case of any modifications that may be necessary during erection or commissioning of the equipment, the subcontractor shall carry out modifications in the original drawing & submit 'As Built drawings' and required no. of prints thereof.

### 1.16.2 INSTRUCTION MANUALS

The supplier shall submit to the purchaser, draft instruction manuals for approval within 30 days of placement of order. The final instruction manuals complete in all respects shall be submitted 60 days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing, operation & maintenance procedures of the equipment.

If after the commissioning and initial operation of the plant, the instruction manuals require any modification/ addition / changes, the same shall be incorporated and the up- dated final instruction manuals shall be submitted as required.

1.16.3 **TITLE BLOCK & DRAWING/ DOCUMENT NUMBERING SCHEME**

Title block for drawing / document should be followed as per ANNEXURE-3

1.16.4 **DOCUMENTATION SCHEDULE AT CONTRACT STAGE**

| | | |
|---|---|---|
| A. | <u>For approval</u> | <u>No of Copies</u> |
| | Copies of all drawings with project details, dimension, shipping weights, No. of cases & dimensions, fixing details, tolerance etc. | 10 |
| | Copies of type test reports. | 5 |
| | Copies of works quality plan & field quality plan. | 5 |
| | Copies of installation, operation & maintenance manual. | 5 |
| | Copies of drawings on floppies/CDs | 1 set |
| B. | <u>After approval and for information / distribution</u> | |
| | Copies of all drawings | 15 |
| | Copies of installation, operation & maintenance manual including Routine test reports | 15 |
| | Sets of RTF of drawings | 2 |
| | CDs of Drgs and O & M Manuals | 4 |
| C. | <u>As Built Drawings</u> | |
| | Hard copies of Drawings | 15 |
| | CDs | 4 |

**NOTE:**

1. Any revision of drawings / documents shall be submitted in the same no. of copies submitted first time for approval
2. Final drawings / documents shall be submitted in bound volume with customer and project details etc. written on the top.

**SECTION 4**

## GUARANTEED TECHNICAL PARTICULARS FOR DIGITAL TELEPROTECTION COUPLER (DTPC) EQUIPMENT:

| | | | |
|---|---|---|---|
| 1. | Make &Model | : | |
| 2. | Commands capacity | : | |
| 3. | Compatible to Optical Equipment | : | Yes / No |
| 4. | Type of Command Input Interfacing | : | |
| 5. | Type of Command output Interfacing: | | |
| 6. | No. of commands capability | : | |
| 7. | Type of Trip counters (event registers) | | : |
| 8. | Power Supply redundancy | : | Yes / No |
| 9. | Operating time for Protection couplers: | | |
| 10. | Interfacing through Potential free contacts: | | Yes / No |
| 11 | Monitoring through MUX NMS for the DTPCs offered: | | |
| 12 | Whether the offered DTPCs are an integral part of OLTE/MUX eqpt: | | |
| 13 | Visible counters for each command (Input/Output) provided: Yes/No. | | |

| GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE) SDH STM-4<br>**Manufacturer:**<br>**Model:** | | | |
|---|---|---|---|
| **S.No** | **Technical parameter** | **Unit** | **Particulars** |
| 1. | Capacity<br>Aggregate Bit-rate:<br>CEPT E-1 Ports: | Mbps<br>nxE1<br>nx10/100 Ethernet ports | |
| 2. | Cross connect redundancy | Yes / No | |
| **3** | Control unit redundancy | Yes / No | |
| 4. | Protection<br>OLTE = 1:1 APS<br>E-1 Ports = 1:1 APS | Yes / No | |
| 5. | Unprotected System Gain for<br>BER $10^{-3}$ :<br>BER $10^{-6}$: | DBm | |
| 6. | 1 + 1 APS System Gain for<br>BER $10^{-3}$:<br>BER $10^{-6}$: | DBm | |
| 7. | MTBF<br>Unprotected:<br>1+1APS Protected: | Hours | |
| 8. | Code Format: | | |
| 9. | List Optical Coupling options: | | |
| **OPTICAL TRANSMITTER:** | | | |
| 10. | Source (LED or Laser) | | |
| 11. | Source wavelength: | Nm | |
| 12. | Source spectral width: | Nm | |
| 13. | Mean launched power<br>Maximum:<br>Nominal: | dBm | |
| 14. | Launch power during safety<br>Power-down due to fibre break: | dBm | |

| | | | |
|---|---|---|---|
| 15. | Stability (nominal power variation due to temperature and/or biasing): | % | |
| 16. | Source rise time: | | |
| 17. | Source estimated life span: | Hours | |
| 18. | Source extinction ratio: | | |
| 19. | Low power alarm Threshold: field adjustable | | |
| **Optical receiver:** | | | |
| 20. | Nominal receive signal strength: | dBm | |
| 21 | Receiver Threshold BER 10-6: BER 10-9: | dBm | |
| 22 | Receiver overload limit: | dBm | |
| 23 | Spectral Bandwidth (3 Db point): | Nm | |
| 24 | Digital Bandwidth: | mbps | |
| 25 | Signal-to-noise @ center wavelength: @ 3 dB points: | | |
| 26 | AGC range: | | |
| **SERVICE CHANNELS AND ORDER WIRE UNIT Engineering Orderwire** | | | |
| 27 | Omnibus calling available Describe: | Yes/No | |
| 28 | Selected station calling available? Describe: | Yes/No | |
| 29 | Signalling scheme Describe: | | |
| 30 | Tx/Rx level | DBm | |
| 31 | Speech coding method & bit rate | Kbit/s | |
| 31 | Distortion: Noise performance: | S/N | |

## GUARANTEED TECHNICAL PARTICULARS for Multiplexer

| S.No | Technical parameter | Unit | Particulars |
|---|---|---|---|
| **Voice Channels** | | | |
| 1 | Are Service channel requirements specified met? | Yes/No | |
| 2 | No. of VF Channels: | Ea | |
| 3 | Pass band: | KHz | |
| 4 | Subscriber side interface: | | |
| 5 | Input & Output level | dBm | |
| 6 | Idle channel noise | DBmOp | |
| 7 | Distortion: | | |
| **Data and Supervisory Channel** | | | |
| 8 | No of data channels: | Ea | |
| 9 | Interfaces/Connectors: | | |
| 10 | Data rates: | Kbps | |
| **ELECTRICAL INPUT/OUTPUT INTERFACES** | | | |
| 11 | List ITU-T Standards in compliance With: | | |
| 12 | Tributary bit rate (nominal): | Mbit/s | |
| 13 | Tolerance in bit rate: | Ppm | |
| 14 | Line code: | | |
| 15 | No. of ports: | | |

| | | | |
|---|---|---|---|
| 16 | Impedance of coax cable used for Input/Output port: | ohms | |
| 17 | Type of Connector | | |
| 18 | Input jitter acceptance<br>100 Hz to 10 KHz:<br>10 KHz to 800 KHz: | UI (p-p) | |
| 19 | Maximum output jitter in the absence of i/p jitter<br>100 Hz to 10 KHz:<br>10KHz to 800 KHz: | UI (p-p) | |
| 20 | Jitter transfer characteristic: | | |
| **OUTPUT PORT** | | | |
| 21 | Line impedance<br>Balanced:<br>Unbalanced: | □ | |
| 22 | Test load impedance (Unbalanced): | □ | |
| 23 | Peak pulse amplitude (nominal + tolerance): | V dc | |
| 24 | Pulse width (nominal + tolerance): | Ns | |
| 25 | Ratio of +ve & -ve pulses at the<br>center of a pulse interval | | |
| 26 | Ratio of width of +ive & -ive pulses at nominal half<br>Amplitude | | |
| 27 | Maximum insertion loss | dB | |

| INPUT PORT | | | |
|---|---|---|---|
| 28 | Attenuation Char. of inter-connecting cable for digital signal presented at input port | | |
| 29 | Return loss (at 1.024 MHz) | dB | |
| 30 | Admissible i/p signal attenuation | dB | |
| 31 | Cable loss Equalization Range | dB | |
| 32 | Maximum insertion loss | dB | |

| GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE) SDH STM-4 | | | |
|---|---|---|---|
| **PROTECTION SWITCHING**<br>Manufacturer:<br>Model name : | | | |
| **S.No** | **Technical parameter** | **Unit** | **Particulars** |
| 1 | Switching modes available<br>Auto?<br>Manual?<br>Remote/network management? | Yes/No | |
| 2 | Switching priority: | | |
| 3 | Tx switchover & switchback criteria: | | |
| 4 | Rx switchover & switchback criteria: | | |
| 5 | Inbuilt Mux (if applicable) switchover & switchback criteria: | | |
| 6 | Switch option mode & status indicators: | | |
| **MECHANICAL AND ENVIRONMENTAL PARAMETERS** | | | |
| 7 | Number of chassis (including. DC/DC converters, O/W muldem etc.,) required<br>for Unprotected Terminal: I: 1 Protected Terminal | | |
| 8 | Chassis Dimensions (L *W*H): | cm | |
| 9 | Chassis Weight: | Kg | |
| 10 | Chassis mounting options: | | |
| 11 | Chassis clearance | m | |

| | | | |
|---|---|---|---|
| | requirements<br>Top * Bottom * Sides:<br>Front Access:<br>Rear Access: | | |
| 12 | Chassis colour and finish | | |
| 13 | Rack options available<br>19" ETSI?<br>Slim rack?<br>Others (specify)? | <br>Yes/No<br>Yes/No<br>Yes/No | |
| 14 | Protection Class (IP Class): | | |
| 15 | Rack Colour and Finish: | | |
| 16 | Temperature range<br>Guaranteed performance:<br>Operation without damage:<br>Storage/ transport: | □C | |
| 17 | Relative humidity<br>Minimum:<br>Maximum: | % | |
| 18 | Altitude<br>Installed:<br>Transport/storage: | M | |
| 19 | Describe Ventilation requirements: | | |
| 20 | Describe dust proofing provisions: | | |
| 21 | Electromagnetic compatibility (List standards & severity levels) | | |

| GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE) SDH STM-4 | | | |
|---|---|---|---|
| POWER supply unit (dc/dc converter)<br><br>Manufacturer:<br>Model name : | | | |
| **S.No** | **Technical parameter** | **Unit** | **Particulars** |
| 1. | Nominal supply voltage: | Vdc | |
| 2. | Power supply variation Guaranteed performance: Operation without damage: | Vdc | |
| 3. | Polarity: | +/- | |
| 4. | POWER Supply redundancy | YES/NO | |
| 5. | List derived DC voltages: | Vdc | |
| | Total power consumption (Fully equipped incl. Service channels) Unprotected terminal: 1+1 Protected terminal: | Watt | |
| 6. | 1+1 APS protection provided? | Yes/No | |
| 7. | MTBF of Power supply unit: | Hours | |
| 8. | Ultimate Power delivery capacity | Watt | |
| 9. | Ultimate Power delivery capacity | Watt | |
| 10. | Are the following protections Provided<br>Over voltage?<br>Under voltage?<br>Overload?<br>Reverse polarity?<br>Other(specify)? | Yes | |

| GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE) SDH STM-4/16 | | | |
|---|---|---|---|
| **Main Distribution Frames**<br>Manufacturer:<br>Model name : | | | |
| **S.No** | **Technical parameter** | **Unit** | **Particulars** |
| 1. | Dimensions<br>Height:<br>Width:<br>Depth: | <br>Cm<br>cm<br>cm | |
| 2. | Weight; | Kg | |
| 3. | Colour and Finish: | | |
| 4. | Method(s) of Mounting | | |
| 5. | Clearances required for Installation:<br>Ceiling:<br>From:<br>Rear: | <br>mtr.<br>mtr.<br>mtr. | |
| 6. | Cable entry(s): | | |
| 7. | Cable Glanding: | | |
| 8. | Frame material & Guage: | | |
| 9. | Locking Arrangement | | |
| 10. | Frame capacity:<br>Number of Horizontal Rows:<br>Number of Vertical Rows:<br>Number of Terminal Blocks per Row: | <br>Each | |

11. Provide details on installation, cabling, cross connections and patching facilities (if any)

| GUARANTEED TECHNICAL PARTICULARS for OPTICAL LINE TERMINATION EQUIPMENT (OLTE) SDH STM-4 | | | |
|---|---|---|---|
| **Digital Distribution Frames**<br>Manufacturer:<br>Model name : | | | |
| **S.No** | **Technical parameter** | **Unit** | **Particulars** |
| 1. | Dimensions<br>Height:<br>Width:<br>Depth: | <br>cm<br>cm<br>cm | |
| 2. | Weight; | Kg | |
| 3. | Colour and Finish: | | |
| 4. | Method(s) of Mounting | | |
| 5. | Clearances required for Installation:<br>Ceiling:<br>From:<br>Rear: | <br>mtr.<br>mtr.<br>mtr. | |
| 6. | Cable entry(s): | | |
| 7. | Cable Glanding: | | |
| 8. | Frame material & Guage: | | |
| 9. | Locking Arrangement | | |
| 10. | Frame capacity: (No. of co-axial panels) | Each | |
| 11. | Co-axial panel capacity: (Number of PCM Systems) | Each | |
| 12 | No. of E1s termination capacity | | |
| 13. | Co-axial connectors:<br>Type:<br>Characteristic impedance:<br>Return loss (up to 90 MHz):<br>Transfer impedance:<br>Test voltage (1 Minute):<br>Maximum current rating: | <br><br><br>□<br>dB<br>□<br>V<br>A | |

13. Provide details on installation, cabling, cross connections and patching facilities (if any).

STATION WISE BILL OF MATERIAL FOR IMPORTANT CARDS

| SL.NO. | DESCRIPTION | | |
|---|---|---|---|
| 1 | STM-4 OPTICAL LINE CARDS FOR 1+ 1 | | |
| 2 | CONTROL UNIT CARDS | | |
| 3 | CROSS CONNECT CARDS | | |
| 4 | POWER SUPPLY CARDS | | |
| 5 | 32 x E1 Trib. cards | | |
| 6 | 8 x 10/100 Mbps ETH cards | | |
| 7 | 4W E&M cards | | |
| 8 | HOT LINE CARDs | | |
| 9 | V.24 I/F cards | | |
| 10 | V.11 I/F cards | | |
| 11 | G.703 I/F cards | | |
| 12 | V.35 I/F cards | | |
| 13 | Channel i/f card for DTPCs | | |
| 14 | Ext. Alarm i/f cards | | |
| 15 | Any other cards needed to meet spec. requirement. | | |

**List of mandatory spares for OLTE / MUX**

| SL.NO. | DESCRIPTION | Quantity |
|---|---|---|
| 1 | STM-4 OPTICAL LINE CARDS FOR 1+ 1 | |
| 2 | CONTROL UNIT CARDS | |
| 3 | CROSS CONNECT CARDS | |
| 4 | POWER SUPPLY CARDS | |
| 5 | 32 x E1 Trib. cards | |
| 6 | 8 x 10/100 Mbps ETH cards | |
| 7 | 4W E&M cards | |
| 8 | Any other cards needed to meet spec. requirement as a mandatory spare | |

**List of mandatory spares for Digital Teleprotection equipment**

| SL.NO. | DESCRIPTION | Quantity |
|---|---|---|
| 1. | CONTROL UNIT CARDS | |
| 2. | POWER SUPPLY CARDS | |
| 3. | Channel Interface card. | |
| 4 | Any other cards needed to meet spec. requirement as a mandatory spare | |

Date: Signature:

Place: Name:

Seal: Designation:

## SECTION 5

## CHECKLIST FOR TECHNICAL EVALUATION

Along with the Technical Bids of the offers, the Bidder should submit this checklist confirming the inclusion of the enclosures as listed below. (Shall tick as ✓ )

| Sr No | Documents to be enclosed | Bidder to check & confirm |
|---|---|---|
| 1 | Copy of Unpriced BOQ as enclosed in the Technical Specification to confirm that bidder has quoted in the same format | |
| 2. | Schedule of Technical Deviation format duly signed | |
| 3. | Technical parameters as per Section-4 of Technical Specification duly filled and signed. | |

**NOTE:- If the Bidder fails to submit any of the documents as asked in the above check list, their bid is likely to be rejected / not evaluated.**

The above checklist is verified for:-

NIT Ref No. :

Name of Equipment :

Name of Project :

Name of Bidder :

Signed with Seal of Bidder

Date ……..

582967/2021/TBG-TB_HVDC

## TECHNICAL QUALIFYING REQUIREMENT

Bidder should be manufacturer or its authorized representative of the offered Synchronous Digital Heirarchy (SDH) Equipment.

The manufacturer whose SDH Equipment are offered (or its earlier version), must have designed, manufactured & supplied at least 1 Nos. of OLTE / FOTE during the last Ten years prior to the scheduled date of technical bid opening of this tender.

**Remark:**

1. Necessary P.O. copies in respect of OLTE / FOTE, SDH equipment in their name shall be submitted along with the bid.

2. If the bidder is not the manufacturer of offered SDH, Necessary documentary evidence for being the authorized representative of manufacturer shall be enclosed.

07/12/2021

07/12/2021

7/12/21