

	BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT										
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SECTION 1 SCOPE AND QUANTITIES

1.0 GENERAL SCOPE

This technical specification covers the requirements of Survey, planning, design, manufacture, testing at works, packing, dispatch, supervision of erection and site testing and commissioning of the Telecommunication equipments/items, complete in all respect for 400/220/132kV Shamli S/s . The detailed technical specification is enclosed under Section II of this specification.

Bidder is responsible for the designing, engineering, testing and supply including transportation & insurance, at site and testing instruments for telecommunication equipments.

This section covers the specific technical requirements of Telecommunication Equipment System. This constitutes minimum technical parameters for the telecommunication system as specified by the customer (UPPTCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-4 of this specification.

DTPC considered in PLCC Package However interfacing with DTPC and any necessary E1/optical converters at both ends along with necessary E1 cables/patch cords/LIUs/FO cables or any other interfacing equipment's or material as required shall be in bidder's scope of supply and prices for the same shall be included in the price of FOTE.

The specification comprise of following sections:

Section-1: Scope & Bill of Quantities

Section-2: Equipment Specification

Section-3: project details

Section-4: GTP

Section-5: Checklist

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

1.1 A) THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

The equipment is required for the following Projects.

Name of Customer : Uttar Pradesh Power Transmission Corporation Ltd.

Name of the Project: 400/220/132kV Shamli S/s

Refer Section - 3 for Project Details and General Specifications

1.1 B) SCOPE

The scope shall include equipment's supply, installation, testing and commissioning. To fulfil complete system commissioning any item Hardware/software/service support/site –survey related to these equipment's installation and commissioning is in the scope of bidder.

For the completeness of the system all items/ materials/services are deemed to be included in the offer and no claim whatsoever shall be entertained at later stage.

If any of the item supplied by bidder is found not meeting the technical specification requirement, the item shall be replaced without any price implication to BHEL and the technical requirement shall be met. SDH to PMU communication will be through Ethernet to coaxial convertor or FO to Ethernet convertor. Bidder has to give space for LIU and LAN switch in equipment cabinet for Communication with PMU. LAN switch and LIU is supplied in separate contract. Communication equipments shall be placed in the Telecom room/ Switchyard panel room.

1.2 BILL OF QUANTITIES

Telecommunication equipment for 400/220/132kV Shamli S/s .

The BOQ mentioned below.

Sr. No.	Description	Unit	Shamli S/s	Aligarh S/s	Total Quantity
	Telecom Equipments				
1	FOTE (4 Directions with redundancy STM-16 with 4 Nos. STM-1 SFP as spare) as per technical specification & list of FOTE equipments	SET	2	1	3
2	Services: Site survey, design engineering, integration, FAT of communication equipment's, site installation, SAT and testing and commissioning of communication equipment's (Station wise)	LOT	1	1	2

1.3 General Notes

- Please Consider Line length from Shamli to Mysore 235Km +/- 5 % Extra to design Optical Interface
- Kindly submit link budget along with BOQ
- Kindly submit Detailed BOQ as per TS
- DTPC considered in PLCC Package However interfacing with DTPC and any necessary E1/optical converters at both ends along with necessary E1 cables/patch cords/LIUs/FO cables or any other interfacing equipment's or material as required shall be in bidder's scope of supply and prices for the same shall be included in the price of FOTE.
- Qty variation shall be +/- 50%.
- Doing site survey is also in the scope of bidder.
- It is to be noted that: "Digital Tele protection coupler used as one of the two teleprotection channel on the lines between the stations covered under the scope of PLCC supplier. FOTE Equipment are placed in Substation control building where as DTPC is placed in GIS Building (approximate distance will be 500m). The connection between FOTE equipment and each DTPC shall be through Optical fibre. Necessary converter(s) for converting E1 signal to optical fibre at both ends along with FODP shall be in the scope of the Bidder". Proper interfacing of the DTPC with offered FOTE equipment under this tender shall be ensured by the bidder
- Splicing of Fibres 1 Lot = Splicing as required at FODP ,both local and remote ends for successful commissioning of the system shall be included in the offered price.
- Successful commissioning of all the Communication Links with the Remote end stations shall be in bidder's scope, Necessary co-ordination, modification and interfacing with remote end equipment's as applicable shall be in bidder's scope

1.4 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 equipment's/ material already accepted in UPPTCL 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 UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of original bid opening, i.e. **(07-09-2018)**. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of original 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.

1.5 INSPECTION, TESTING AND ACCEPTANCE

Bidder has to follow Technical specification and UPPTCL approved Manufacturing Quality Plan FAT/SAT procedure.

1.6 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.

1.7 DOCUMENTATION

Final Documentation (after approval) shall be separate for each Substation. List of documents to be submitted is mentioned in section-2 of specification.

1.8 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
- e) Documents in support of PQR

1.9 Technical Requirements

A) OPERATIONAL EXPERIENCE

Offered equipment should have given three years of proven trouble free operational service in tropical climate. However in case of equipment manufactured in India under valid foreign collaboration, operating experience# in tropical climate of offered collaborator's equipment, shall also be acceptable provided copy of valid collaboration agreement for the offered equipment is submitted with the proposal. Further in case of offer of imported equipment, three year operating experience# shall be considered in respect of those areas only which are similar to the tropical conditions prevailing in India.

AND

B) MANUFACTURING EXPERIENCE

The indigenous manufacturers or their foreign collaborator must have manufactured at least 20% of the specified quantities of each item of identical or similar equipment. **

AND

C) TESTING FACILITIES

The manufacturer must have all necessary facilities at their works for carrying out such routine and acceptance tests as prescribed in the relevant ISS/IEC and any other routine and acceptance test as specified in the specification. Documentary evidence of existence of such facilities will be submitted along with the proposal.

AND

D) TYPE TEST FOR INDIGENOUS OR FULLY IMPORTED EQUIPMENTS

The offered equipment's must have been fully type tested as per relevant ISS and/or any other specified international standards, during the last 10 years period to be reckoned from the original scheduled date of opening of tender, i.e. **(07-09-2018)**. Photo copy of such type test reports/ certificates must be submitted along with the proposal. The test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment.

#: Operating experience means certificate issued by the Employer/ Utility certifying the operation without any adverse remark.

****:** 20% of the specified quantities of each item of identical or similar equipment means 20% of the specified quantity (decimals to be rounded off to nearest higher integer) of FOTE system main items.

Please note: Forms of undertaking if any (as per customer/BHEL format) shall be furnished to successful bidder during contract stage.

2.0 PACKING

- 2.0.1 All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 2 years) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 2.0.2 The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.
- 2.0.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.
- 2.0.4 The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 2.0.5 Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- 2.0.6 Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 2.0.7 All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 2.0.8 Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 2.0.9 Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

FOTE system main items.

Please note: Forms of undertaking if any (as per customer/BHEL format) shall be furnished to successful bidder during contract stage.

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- 2.0.7 All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 2.0.8 Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 2.0.9 Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

SECTION-2

FIBRE OPTIC EQUIPMENTS

Network Configuration and Equipment Characteristics

6.1.0 Introduction

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

- (1) Fibre Optic Transmission System (FOTS)
- (2) Termination equipment Subsystems
- (3) Network Management System (NMS)
- (4) MDF, DDF and Cabling
- (5) **Digital Tele-Protection Coupler (DTPC)**

The requirements described herein are applicable to and in support of network configurations depicted in Appendix and Network Management System (NMS) for monitoring and control of this communication network. TMN and NMS have been interchangeably used in this specification.

The manufacturer shall take care the security related requirements of the equipment as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time to time basis shall be followed/complied by the vendor at no additional cost to Employer till the implementation of the project.

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

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

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

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

forensics, Network hardening, Network penetration test, Risk assessment, Actions to fix problems and to prevent such problems from recurring etc. shall be covered under network audit.

The Contractor shall ensure that all the documents, including software details are supplied to the Employer in English language. A record of all the software updation and changes shall be given to the Employer and any major updation and changes shall be done with the prior approval of the Employer.

During maintenance period the Contractor shall keep a record of all operation and maintenance procedure in the form of manual and shall also maintain a record of all command logs (actual command given, who gave the command, time & date and from where) for a period of 12 months. For next 24 months the same information shall be stored/retained in a non-online mode. A list of all User ID linked with name and other details of the user duly certified by the Employer shall also be maintained.

A record of all supply chains of the products (hardware/software) shall be given to the Employer.

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

6.2.0 General Network Characteristics

6.2.1 Description

UPPTCL is having a Wide Band Fibre Optic network, spread geographically throughout Uttar Pradesh, consisting of FOTE (Fibre Optic Terminal Equipments) equipments of different makes. A Network Management System (NMS) is installed at SLDC, Gomti Nagar, Lucknow. The makes of existing equipments have been shown in appendix.

UPPTCL further wishes to procure FOTE equipments to be installed at different 400KV, 220KV and 132KV substations within Uttar Pradesh connected through OPGW.

The proposed Fibre Optic Communication network shall support the voice, data & digital protection communication requirements of RTU/SAS and the SCADA/EMS system. The communication system shall provide data & voice connectivity across the various locations or connectivity of RTU/SAS with Sub-LDCs, Sub-LDCs with SLDC and SLDC with RLDC. The RTUs located at various locations will report to Control Center using IEC 870-5-101 or IEC 870-5-104 Protocol. The proposed communication system shall provide connectivity of some RTU/SAS over TCP/IP protocol using Ethernet interface and other RTUs over serial interface. The offered communication System shall support the communication requirements of RTUs and the SCADA/DMS system described in point to multi point and/or multipoint to multipoint configurations using Ethernet over SDH.

The fibre optic network shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-16. The network shall consist of overhead fibre optic links with a minimum bit rate of Synchronous Transport Module-16. The tentative list of Fiber Optic links to be implemented under this package are given in Appendix. The Contractor can propose a system based on higher bit rate

systems, if required, so as to meet the link budget requirements or any other specification requirement.

6.2.2 Functional Requirement

The primary function of the equipment is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS, RTUs, Teleprotection & PMUs and for new technological requirements of Power System Operation such as Special Protection Scheme, Grid Security Expert System, Load Management, Advanced Protection System & Substation Automation System. A brief summary of the communication system requirements is as follows:

- (a) High speed E1 channel support
- (b) 64kbps & nx64kbps data channel support
- (c) Low speed (300 -1200 baud) data channel support
- (d) Voice (2 wires, 4 wires) channel support and integration with Employer's/SLDC's EPABX system. The details of EPABX System shall be provided during detailed engineering.
- (e) Data transport supporting Network Management channels
- (f) The connectivity envisaged between Substation and Control Centre over TCP-IP using Ethernet interface for various services of data and voice such as for PMUs, RTUs, VOIP etc.
- (g) Tele Protection Commands: 4 per line.

6.2.3 General System Requirements

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

6.2.3.1 System Synchronization

The Contractor shall synchronize all the new equipments under the contract using GPS Clock. In addition to GPS input reference, the synchronization clock must have provision to take INPUT reference coming from other clock. The Contractor shall submit the synchronization plan as per standard ITU-T G.811. All sync equipments proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-T G.812 standard requirements.

The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipments new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-T G.803.

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

The Contractor shall propose an additional requirement of GPS Clock(s) after studying the employer's fibre optic network.

6.2.3.2 System Maintainability

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

Preventive and problem oriented maintenance of the communication systems shall be performed using diagnostic tools such as TMN and test equipment. They shall support complete maintenance of all system elements and shall permit the diagnosis of any fault without requiring additional test equipment. The Contractor shall provide specialized training required to operate above mentioned

diagnostic tools. For all redundant systems, disconnection and repair of any failed device shall not interrupt the operation of the system.

6.2.3.3 System Upgradability and Expandability

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

6.2.3.4 Equipment Availability

The Contractor shall ensure the availability for subscriber to subscriber where they are providing the new equipments (MUX/Drop-Insert) under this contract. The availability requirements are as follows, which shall be demonstrated at site for the equipments being provided under this contract:

- (1) The availability of each fibre optic link (E1 to E1) shall be at least 99.999%.
- (2) The availability of network end to end (E1 to E1) shall be at least 99.998%.
- (3) The average per link subscriber to subscriber availability shall be at least 99.97%. The per link subscriber to subscriber availability is defined as the availability between any two data or voice subscribers between RTU to reporting Control Centre and between control centres.
- (4) The network-wide subscriber to subscriber availability shall be at least 99.8% . The network-wide subscriber to subscriber availability is defined as the availability between any two data or voice subscribers on the wideband network.

The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations.

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

6.2.4 General Equipment Characteristics

All Contractor supplied equipment shall be new and of the finest production quality. The Purchaser will not accept modules or printed-circuit boards that are modified by appending wires or components. Wired strapping options shall be incorporated in the board design to meet the above requirement.

All applicable requirements stated in this section shall equally apply to the TMN equipment as specified in this Section.

6.2.4.1 Revision Levels and Modifications

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

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

6.2.4.2 Equipment Capacities

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

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

6.2.4.3 Redundancy Requirements and Protection Schemes

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

**Table 2-1
Equipment Redundancy Requirement Summary**

Fiber Optic transmission Equipment : SDH equipment Power Supply & Converters ----- Common Control* Cards ----- DACS (Cross Connect) Power Supply ----- common control* cards----- MUX, DROP/INSERT Power Supply ----- * = Common control cards which are essentially required for operation of the equipment.	 1:1 APS or distributed power supply 1:1 APS 1:1 APS or distributed power supply 1:1 APS 1:1 APS or distributed power supply
Power Supply Voltage:	110/48V DC-DC converter of adequate capacity to be provided a power supply source on each equipment in addition to the 48V DC power supply source. 110V DC system is with floating earth whereas 48 V DC required for FOTE is with +ve ground.

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

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

6.2.4.4 Lost Signal Recovery

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

6.2.4.5 Software Upgrades

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

6.2.5 General Site Considerations

All fiber optic links upto 225 kms. transmission line length for STM-16 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 at the end stations. The Contractor may provide the optical amplifier, wave length translator, optical cards or high capacity SDH equipment with suitable rack/subrack to meet the maximum distance limit. All the provided equipments shall be monitored by centralized NMS.

6.2.6 Fibre Optic Link Lengths

Tentative fiber optic link lengths are as specified in appendices.

6.2.7 Fibre Optic Transmission System

The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-1,4,16 equipped with minimum 2 nos. E1 interface cards (32 interfaces) (G.703) and minimum 02 nos. Fast Ethernet interface cards (16 interfaces) (IEEE 802.3/IEEE 802.3u) supporting layer 2 switching as tributaries. In addition, Gigabit Ethernet interface shall also be required as specified in the BPS. Ethernet shall support LCAS feature. It shall support full throughput upto 1000 Mbps on Ethernet port by virtual concatenation of requisite no. of VC-12. There shall be the provision of "Auto Negotiation" and "Flow control" Enabling/disabling through NMS of the system. Also there shall be provision of configuring the equipment for unrestricted nxVC12 bandwidth (upto 1000Mbps). The Ethernet interfaces shall support

VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. Protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032.

All software and hardware shall support IPv4 and IPv6 simultaneously (dual stack).

The Contractor shall provide (supply and install) connectorized jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection.

6.2.7.1 SDH Equipment

6.2.7.1.1 Functional Requirement

For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary interfaces (Electrical tributaries such as E1, Fast Ethernet 10/100 Mbps, Gigabit Ethernet interface & Optical tributaries such as Gigabit Ethernet etc.) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card(s), Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary cards).

If Contractor is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications. Further, main and protection channel shall be terminated on separate cards and there should be no single point of failure.

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

STM-16 (MADM) with 4 MSP protected direction.

The aggregate interfaces shall be (at least) STM-16 towards at least four protected directions (Protected as specified in this specifications). At present the equipment shall be equipped with two (2) nos. E1 interface card with minimum 16 interfaces per card & two (2) nos. Fast Ethernet interface card with minimum 8 interfaces per card, as tributaries. Gigabit Ethernet (optical/electrical) interface shall also be provided if specified in BPS. The equipment shall provide non blocking cross connect capability of 256 STM-1 (bi-directional) at high order VC-4 level and 128 STM-1 (bi-directional) at low order VC-12 level.

6.2.7.1.2 Redundancy and Protection

Two fibre rings shall be implemented wherever the network permits. On linear sections of the network, protected links using 4 fibres shall be implemented.

6.2.7.1.3 Service Channel

Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Muldem's that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. There shall be a facility to extend the line system order-wire to any other system or exchange lines.

6.2.7.1.4 Supervision and Alarms

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

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

6.2.7.1.5 Synchronization

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

6.2.7.1.6 Electrical and Optical I/O Characteristics and General Parameters

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

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

Optical Wavelength ^{NOTE (1)}	1310/1550nm
Optical Source ^{NOTE (2)}	Laser
Optical Source Lifespan	Better than 5 X10 ⁵ hours
Optical Fibre Type	G.652 D
Optical Connectors	Type FC-PC
Transmission Quality	Per ITU-T G.821, G.823, G.826
Source Primary Power	-48 Vdc
Equipment Specifications	Per ITU-T G.783
Tributary, Electrical Interface	Per ITU-T G.703, 75 Ω
Ethernet Interface	10/100 Mbps
SDH Bit Rates	Per ITU-T G.703
Optical Interfaces	Per ITU-T G.957, G.958
Frame and Multiplexing Structure for SDH	Per ITU-T G.707
Synchronization	Per ITU-T G.813
Management Functions	Per ITU-T G.774, G.784
Protection Architectures	Per ITU-T G.841
Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784

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

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

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

6.2.7.2 Optical Link Performance Requirements

The optical fibre link performance requirements are specified as follows:

6.2.7.2.1 Link Budget Calculations

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

- (1) Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.
- (2) Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.
- (3) Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.
- (4) Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed “End of Life (EOL)” parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered.
- (5) Optical path Penalty: An optical path penalty of at least 1 dB shall be considered to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.
- (6) Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.
- (7) Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.
- (8) Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm.Km @1550 nm & 6 ps/nm.km @ 1310 nm for DWSM fibres.
- (9) Bit Error Rate: The link budget calculations shall be done for a BER of 10^{-10} .

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each category of fibre optic link **in the Bid**.

6.2.7.2.2 Link Performance

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

6.2.7.2.3 FODP to SDH Equipment/Optical Amplifier Connectivity

The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall also provide FC PC coupled patch cords.

The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.

6.2.8 Termination Equipment Subsystem

The Termination Equipment Subsystem is defined to include the equipment that interfaces (adapts) the subscriber (user) to the Fibre Optic Transmission System (FOTS). The interfaces for Termination Equipment Subsystem may be supplied either in the same equipment as SDH or as independent PDH equipment. Functional descriptions of these equipments are as follows:

6.2.8.1 Functional Description

The transmission network node provides subscriber interface to the transmission network and/or switching/routing. For clarity, the basic functions accomplished at the network nodal points, are described briefly as follows:

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

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

Digital Cross connect Equipment (DACS) shall be used to provide software controlled dynamic routing/rerouting of the primary (E-1) bit stream as well as the 30 channels of the E1 bit stream.

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

6.2.8.2 First Order (Primary) Multiplexing

The Contractor shall be required to provide E-1 Drop & Insert Multiplexer and E-1 Channel Bank primary multiplexing in compliance with the electrical input-output characteristics provided in Table 2-3.

6.2.8.2.1 Drop & Insert Primary Multiplexing

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

**Table 2-3
CEPT E-1 Standard First Order Multiplexing
Electrical Input/Output Characteristics**

Applicable Standards:	CEPT per CCITT Recommendation G.702, G.703, G.711 and G.712
Number of Tributaries:	30 X 64 Kbps
Alternative Sub-rate Tributaries:	n X 64 Kbps V.36 64Kb/s V.11/V.36
Output Aggregate Rate: Interface Code: Impedance: Peak Level @ 120 ohm: Peak Level @ 75 ohm: Maximum Insertion Loss:	2.048 Mb/s $\pm$ 50 ppm HDB3 75 ohm unbalanced 3.0 volts $\pm$ 10% 2.37 volts $\pm$ 10% 6 db

Signal Waveform:	Per CCITT G.703
Frame Structure:	Per CCITT G.742
Jitter Performance:	Per CCITT G.823
Power Supply Voltage:	110/48V D C-DC co nverter o f adequate c apacity to b e provided a s power s upply s ource on e ach e quipment i n addition to the 48V DC power supply source. 110V DC system is with floating earth whereas 48V DC required for FOTE is with +ve ground.

6.2.8.2.2 Channel Banks (Mux, Drop/Insert)

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

6.2.8.2.3 Subscriber Line Units\Subscriber Line Interface Cards

The terms Subscriber Line Interface Cards and Subscriber Line Units have been used interchangeably throughout the specification. Multiple configurations of SLUs shall be required to provide subscriber to primary multiplexer Bank interfacing for a variety of voice and data communications.

The SLU interface requirements are discussed in the following subparagraphs:

(A) Voice Channels

The voice channel requirement is for (I) 4-Wire E&M trunking in support of PABX trunks & PLC VF and (II) 2-Wire telephonic interfaces. 2 wire SLUs shall be DTMF/TP optioned for 2-wire loop start or 2-wire GND start. The voice cards shall utilize ITU.T A - law companded PCM G.711, 64 kbits/s encoding.

(B) Sub-Channel Data Multiplexing

The RTU data interface to the wideband telecommunications network node shall be defined at the DTE level at low-speed rates of 300, 600 and 1200 baud. The port shall be compatible with RS232C interface. The Contractor shall be required to furnish 64 Kbps SLU asynchronous dataplexing for at least 4 selectable low speed DTE interfaces whenever multiple asynchronous data circuits are required.

(C) Nx64 kbps Synchronous Data

There is also a requirement for N x 64 kbps V.35, X.21 interfaces.

6.2.8.3 Digital Access Cross connect System

The Contractor shall be required to provide Digital Access Cross Connect Systems (DACS) (if required) capable of switching 16 or more E-1 lines in compliance with the electrical input-output characteristics provided in Table 2-4. DACSs shall be fully compatible with CEPT E-1 tributary standards.

DACSs 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 signalling 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 signalling. The DACS shall support the Channel Associated Signalling (CAS) and Common Channel Signalling (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 2-4
CEPT E-1 Digital Access Cross Connect System
Required Operating Characteristics

E-1 Trunk Capacity:	Minimum 16-Port Switch Matrix 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 Maximum < 2 frames
E-1 Port Interface: Interface Code: Impedance: Peak Level @ 75 ohm: Maximum Insertion Loss:	2.048 Mb/s $\pm$ 50 ppm HDB3 75 ohm unbalanced 2.37 volts $\pm$ 10% 6 db
Signal Waveform: Frame Structure: Jitter Performance:	Per CCITT G.703 Per CCITT G.742 Per CCITT G.823
Synchronisation:	Internal, external source and synchronized on incoming E-1
Routing: Routing Table Capacity:	Fully non-blocking tributary to/from E-1 channel Minimum of 9 routing tables for reconfiguration
Supervisory Ports: Supervisory Port Interface: Interface:	Serial Com Ports RS-232 Standard ASCII ANSI compatible terminal
Supervisory Channel:	Async data rates, software selectable: speed of 110-9600 bps, odd or even parity 7 or 8 bits.
Power Supply Voltage:	110/48V DC -DC converter of adequate capacity to be provided as power supply source on each equipment in addition to the 48V DC power supply source. 110V DC system is with floating earth whereas 48V DC required for FOTE is with +ve ground.

6.2.8.3.1 Required DACS Applications

The DACS provided shall be fully capable of implementing standard applications such as "Groom and Fill", Drop & Insert/Bypass, Broadcast and Alternative Routing.

6.2.8.3.2 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 colours based on the importance of the alarm.

6.2.9 MDF, DDF and Cabling

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

6.2.9.1 MDF and DDF Patching Facilities

The Contractor shall supply and install all cabling, wiring, connectors, cross connects, Digital Distribution Frames (DDF) and Main Distribution Frames (MDF) associated with the installation and interconnection of equipments procured under this package and existing/constituent owned equipment as follows:

- (i) DDFs for termination of new SDH equipment E-1 ports
- (ii) Cabling (including connectors) for E1 level connections from DDF to existing SDH equipments, DDF to Existing & new PDH equipments and DDF to un-licensed Radio equipment. To the extent possible, existing cable at site shall be used.
- (iii) All Ethernet ports shall be terminated with RJ-45 connector. Provision for 100% expansion with connector for terminating additional Ethernet ports shall be provided.
- (iv) MDFs for termination of all the subscriber channels at new PDH node
- (v) Cabling and connectors required to enable subscriber-to-subscriber circuits over the telecom network. The Line side of the MDF shall be cabled to the Primary Multiplex and the equipment side shall be cabled to the MDF of the assigned subscriber (PLCC, PABX, Telephone at wideband locations etc).
- (vi) Any other cables, connections etc required for a fully functional, integrated telecom system.

The connections among various equipment such as FOTS, termination equipment and subscriber MDFs etc shall always be routed through DDF and MDF to provide maintenance access.

6.2.9.1.1 Digital Distribution Frame Functional Requirements

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

- (i) "Normally thru" circuit routing

- (ii) Circuit rerouting via patch cord assemblies
- (iii) Circuit disconnect and termination

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

6.2.9.1.2 Main Distribution Frames

The Contractor shall make provision for cross connection of subscriber services to the subscribers utilizing Krone type or equivalent and shall provide full connectivity up to and terminated on the equipment side of the appropriate DDFs and line side of MDFs. The Contractor shall terminate on the equipment side of patching facilities provided by other contracts and shall provide DSX type patching facilities supporting aggregate bit streams (i.e. dataplexers and E-1 Channel Banks). Separate Patch panels or MDFs shall be provided for Data and Voice. All cross connects shall be accomplished utilizing one, two or three pair patch cords. Patch plugs are permissible for direct one-to-one circuit "cut-thru".

6.2.10 PATCH CORDS

The Contractor has to supply FC PC coupled Patch cords as described in BOQ. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.

6.2.11 Physical Specifications of Cabinet:

1. **Code & Standard**
Enclosures/cabinets are indoors, dust-proof and conform to current applicable Indian standards. Degree of protection shall be IP41
2. **Description of Material**
The cubicles shall be suitable for tropical climate with IP41 degree of protection.
- 2.1 **Sheet Thickness/Material**
 - Frame: 1.6mm thick CRCA with 8 Fold Profile.
 - Front Door: The front door should be 2mm thick CRCA either having a full size glass or at least a glass window to make visible the status of LEDs provided to indicate the health of the RTU.
 - Rear Door: 2mm thick CRCA
 - Side & Top Cover: 1.6mm thick CRCA
 - Gland Plate: 3mm thick CRCA
- 2.2 **Gaskets**
Neoprene gaskets all along the doors between gland plates and between any two plates for proper sealing.
- 2.3 **Base Frame**
3mm thick CRCA steel sheet as per standards with suitable cover at front & rear side.
- 2.4 **Lock**
Four point safety lock ensures authentic access to the system.

- 2.5 **Lifting Hook**
Minimum 4 nos. of eyebolts shall be provided with suitable arrangement to take care of minimum 600 Kg of load.
- 2.6 **Cable Entry**
Cable entry should be from bottom side of the cabinet.
- 2.7 **Document holder**
A document holder shall be provided inside the cabinet to keep the reference drawing & papers.
- 2.8 **Incandescent Bulk Head Light**
Suitable arrangement for panel light for interior illuminator maintenance lamp & 5A, 3 pin socket with switch shall be provided.
- 2.9 **Earthing**
Earthing shall be of following Type.
“SAFETY” earth strip shall be made of copper; 25x3mm of full length of cubicles with M4 tapped holes and shall be connected to door, gland plate & top plate with yellow green cable.
- 3. **Painting**
Painting process will be as per standard practice of Powder Coating.
 - a) Paint withstands the typical weather conditions.
 - b) Shade
 - Exterior: RAL7032 (Siemens Grey)
 - Base Frame: Color Black
 - c) Paint thickness: 60 microns average
 - d) Paint Finish: Textured finish
- 4. **Dimension**
Cabinet height shall be 2200mm including the 100mm base frame
- 5. **Fan**
Cabinet must be fitted with fan & trays.
- 6. **Rack**
19” or 23” rack.

6.2.12 Telecommunication Management Network/Network Management System

The Contractor shall provide a Telecommunications Management Network System (TMN) for operational support to the FOTS and associated Termination equipment subsystems. This TMN shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network from a centralized location and at each node of the network where equipment is located. This TMN system shall assist Employer/Owner in the operations and maintenance of the wideband communication resources of the including detection of degraded circuits, system performance, the diagnosis of problems, the implementation of remedial actions and the allocation or reallocation of telecommunications resources and addition/deletion of network elements.

The Contractor shall supply preferably a single TMN for all the NEs (Network Elements) such as SDH equipment, Mux, Drop-Insert, DTPC, DACS etc. In case a single TMN cannot be provided for all the NEs, the Contractor may supply separate TMNs. Each of the offered TMN shall meet the requirements indicated in this section. The bidder shall provide details of the offered TMN in

the bid. TMN and NMS (Network Management System) have been interchangeably used in this specification.

Applicable Standards

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

6.2.12.1 TMN Architecture

The TMN shall provide

- a. Collection of Management data from all Network Elements (NEs) supplied under this package. The minimum monitoring and control requirements for the communication equipment shall be as defined in this section.
- b. Processing of above management data by using processor(s) located at control Centre and additional intermediate station processor(s), wherever required.
- c. Monitoring and control of the NEs as defined below:-
 - i) The Control Centre for all the network elements being procured under this package (including local operator console) shall support management of all equipments supplied under this package. At minimum functions of Network management layer (NML) and Element management layer (EML) as defined in CCITT M3010. The detailed functions are listed in TS.
 - ii) Monitoring and control of NEs using Craft Terminals as defined in this Section.
- d. Supervisory monitoring and control of the following station associated devices:
 - I) Intrusion Detection Alarms
 - II) Power Failure
 - III) Fire and Smoke Detection
 - IV) Environmental Control (Temperature, Humidity etc.)
- e. Communication channel support for TMN System as specified in Technical Specifications (TS).

The supplied TMN system shall be capable of handling all management functions for at least 150% of the final network elements. The NMS location indicated here are tentative and the same shall be finalized during detailed engineering. TMN system should not be dependent on each other for their working.

The TMN system hardware shall be so designed that failure of single processor/component (router, switch, converter etc.) shall not inhibit any of the functionality of the TMN system. The Contractor shall submit for Employer's approval the TMN architecture describing in detail the following subsystems/features:

- i. Database used in TMN
 - ii. Master Processor, server/workstation, LAN, Peripherals and hardware
- f. Software and operating system
- g. Local Consoles/remote consoles
- h. Craft Terminals
- i. Data communication between NEs, Remote/Local Consoles and TMN Processor(s)

- j. Routers/Bridges
- k. Expansion Capabilities

The offered TMN system shall be capable of integration to other supplier's Network Management System (NMS) upwardly through SNMP/CORBA - TMF418 complaint North bound interface. The interface shall accommodate all required functionalities to implement OSS but not limited to the following:

- i) Real time forwarding and synchronization
- ii) Provisioning of circuits
- iii) Upload of network topology
- iv) Monitoring of events for topology and circuit changes
- v) Alarm handling

6.2.12.2 Management Functions

The TMN shall support following Management functions:

6.2.12.2.1 Configuration Management

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

- a. Provide tools to establish and maintain the backbone topology and configuration information and provide graphical maps depicting the configurations.
- b. Gather descriptive information about the current configuration of the equipment, provide operator displays, and prepare reports.
- c. Provide tools for planning, establishing, and changing the static equipment configuration. Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.
- d. Provide verification testing to support new equipment installation.

6.2.12.2.2 Fault Management

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

- a. Display equipment status in a consistent fashion regardless of the source of the data on a graphical topological, map-type display. Status shall be displayed through the use of colours on links and nodes as well as through text.
- b. Obtain status and detect faults through periodic polling, processing of unsolicited alarms and error events, and periodic testing for connectivity.

- c. Maintain an alarm summary of unacknowledged alarm events on the management station display and maintain a log of all received alarms. The operator shall be able to acknowledge and clear alarms individually and as a group. The use of alarm correlation techniques is encouraged to minimize the proliferation of alarms caused by a single, common event. All alarms shall be configurable as critical alarms, major alarms and minor alarms with different colours.
- d. Provide the capability to diagnose and isolate failures through analysis of error and event reports and through the use of both on-line and off-line diagnostic tests and display of monitored data.
- e. The criteria for fail over shall be configurable as automatic fail over to redundant equipment wherever possible and through operator-initiated actions where automatic fail over is not possible. The status of fail over shall be reported to the NMS.
- f. Track network equipment failure history.

6.2.12.2.3 Performance Management

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

- a. Provide support for an operator to initiate, collect, and terminate performance metrics under both normal and degraded conditions. For example, BER of each link, together with other data measured at each node, shall be available on operator request.
- b. Monitor point to point & end to end signal quality and history. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:
 - 1. Select/deselect network equipments, events, and threshold parameters to monitor
 - 2. Set monitoring start time and duration or end time
 - 3. Set monitoring sampling frequency
 - 4. Set/change threshold values on selected performance parameters
 - 5. Generate alarm events when thresholds are exceeded.
 - 6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.
 - 7. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the Contractor's equipment.
 - 8. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
 - 9. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

6.2.12.2.4 Security Management

The TMN shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel. One access level of System Administrator and at least two levels of operator access shall be provided - read (view) only and write (configure). The system administrator shall be able to create, define and modify operators with different

access levels, network domains and perform all kind of maintenance and up gradation of the TMN system. With "read only" access level, network parameters should only be viewed. Access to database maintenance, command control and test functions shall be available with "write" access level. Means shall be provided to ensure only one authorized user has write capability for a selected domain of the network. It shall be possible to define multiple domains for purposes of monitoring and control.

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

6.2.12.3 Communication Channel Requirement and Integration

Communication requirements for TMN system have not been considered in Appendices and the Contractor shall provide these as a part of TMN system. The Contractor shall provide all required interface cards / devices, LAN, routers/bridges, channel routing, cabling, wiring etc. and interfacing required for full TMN data transport.

The TMN data transport shall utilize the wideband communications transmission system service channel in the overhead whenever possible. This will provide inherent critical path protection

Should the configuration requirements dictate multiple TMN station processors, the TMN Master Station shall require bidirectional data transport with its station processor(s). This communication interfacing shall be via critically protected data channels. It shall be the Contractor's responsibility to provide for and equip all necessary critically protected TMN data channel support.

In case supervisory channels are not available, the Contractor shall provide suitable interfaces in their supplied equipment for transport of TMN data. The Contractor shall also be responsible for providing suitable channels with appropriate interfaces to transport the TMN data.

The NMS information of existing PDH & SDH system shall be transported through the new communication network wherever required, up to the NMS location. The NMS information of the new SDH & PDH system being procured under the package shall be transported through the existing communication network using 64 kbps/2Mbps (G.703) interfaces. Any hardware required for above interfacing shall be provided by the Contractor.

The bidders shall describe in the proposal the TMN data transport proposed to be used by the bidder in detail including capacity requirements and various components/equipment proposed to be used.

6.2.12.4 Craft Terminal

Each equipment (SDH equipment, Mux, Drop/Insert and DACS etc.) on the fibre optic communication network shall include provision for connecting craft terminal (known as Personal Computer / Laptop) to support local commissioning and maintenance activities. Through the use of this PC / Laptop and local displays/controls, the operator shall be able to perform the following functions:

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

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

6.2.12.4.1 Hardware Requirements

6.2.12.4.1.1 Master Processor, Server/Workstation and Craft Terminal

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

The server shall have minimum configuration of 2.4 GHz Quad-Core processor, 3 GB RAM, DVD-RW drive, redundant 160 GB internal Hard Disk Drive, 101-Enhanced style keyboards, mouse, serial, USB (2.0) ports and hot swap redundant power supply. VDUs shall be 19" TFT active matrix color LCD with a minimum resolution of 1024 X 768. Appropriate network drive card shall also be provided wherever required. However, the internal hard disk drive for the server shall be redundant and all the data shall be mirrored. Further, the TMN software shall support data mirroring on redundant disk drives.

The workstation shall have minimum configuration of 3 GHz Core 2 Duo, 2 GB RAM, DVD-RW drive, 320 GB Hard Disk Drive, 101-Enhanced style keyboards, mouse, serial and USB (2.0) ports. VDUs shall be 19" TFT active matrix color LCD with a minimum resolution of 1024 X 768. Appropriate network drive card shall also be provided wherever required.

CPU enclosures shall be desktop type and shall include available expansion slots except for the Craft Terminal which shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse/trackball etc., serial/USB (2.0) ports to accommodate printers, and Internal/external Data/Fax modem and a battery back-up of at least 3 hours. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.

6.2.12.4.1.2 Peripherals and hardware

TMN system shall be provided with laser printers. The laser printers shall have a minimum print speed of 17 pages per minute and a minimum resolution of 1200 x 1200 dpi. The laser printer shall have parallel and LAN ports for connecting to TMN system.

All laser printers under this specification shall be black & white and include print enhanced buffering to prevent loss of print data in the event of a print failure.

6.2.12.4.1.3 Local/Remote Operator Consoles

The Contractor shall provide operator consoles sized and equipped to support the subsystem(s) furnished and in compliance with the specification. The console shall provide hardware interfacing for the TMN users to the software operating support systems. At a minimum, a console shall include the hardware similar to a workstation.

6.2.12.4.1.4 Power Supplies

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

6.2.12.4.2 General Software/Firmware Requirements

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

6.2.12.4.2.1 Operating System Software

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

2.12.4.2.2 Applications Software

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

6.2.12.4.2.3 Software Utilities

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

6.2.12.4.2.4 Revisions, Upgrades, Maintainability

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

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

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

6.2.12.4.2.5 Database(s):

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

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

6.2.13 Tele-Protection Coupler (Stand-Alone type)

- The coupler shall support the following features related to the protection commands:
 - 4 Command for 400 KV/ 220 KV lines. Each command shall be programmable for permissive, blocking or direct trip functions.
- Protection command signals shall be suitable for 110/220V DC (site programmable) directly from station battery without involving any intermediate converter.
- All inputs and outputs shall be independent and isolated with EMC immunity for harsh environment.
- Security and Dependability shall be selectable and programmable.
- It shall provide an integrated non-volatile event-recorder, which shall be synchronized either internally or by external Global Positioning System (GPS) clock.
- The coupler shall be equipped with non volatile mechanical / digital counter for independent transmit and receive commands.
- The coupler shall be equipped with all the necessary cables and connectors essentially required to connect with SDH equipment on E1.

The tele-protection module shall further support:

- Signal delay measurement.
- Point to point protection switching shall be done within less than 10 ms (typical value).
- Periodically automatically initiated loop-tests (e.g. every 60s).
- Command addressing: This function shall be used to prevent tripping if the signal is inadvertently re-routed through the telecommunication network.
- Under no circumstances the module of the coupler shall initiate trip-commands in case of power supply switching or when equipment is put into or taken out of service.
- The tele-protection module shall be E1compatible.

6.2.13.1 Additional optional features:

1. Whether a 4 command tele-protection unit can provide 2set of independent 2 input & output commands. Each set of commands can be connected to protection relays of different 220KV lines simultaneously and operate independently.
2. Whether a 4 command tele-protection unit can provide 2set of independent 2 input & output commands. One set of commands can be configure for digital output on E1 and other set of commands can be configure on analogue mode.
3. Whether a 4 command tele-protection unit connected to protection relay of 400KV line can provide 2 independent sets of 4 output commands. One set of commands for connecting to PLCC on analogue mode and other set of commands for connecting to SDH on E1.

If the bidder has a solution to the above three after putting some hardware and software in the offered protection couplers then he may quote his rates separately for consideration. He may further confirm that whether the same is being utilized by any Power Utility.

- 6.2.14** The SDH & PDH equipments should preferably be of the same make. However, the Contractor is free to offer different make SDH & PDH equipments, but in this case it will be the responsibility of the Contractor for the integration of PDH and other equipments with the SDH. It will also be the responsibility of the Contractor to integrate the supplied equipments with the existing equipments/systems of UPPTCL.

6.2.15 Help

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

6. 2.16 ANNUAL MAINTENANCE

The contractor shall be responsible for maintenance of all the equipments supplied for establishing Optical Fibre communication network during the guarantee period without any cost implication to the purchaser/owner. Contractor is however required to mention the recommended spares for 7 years maintenance period in schedule-‘K’. Contractor will have to either repair the defective part or replace the same in case it is beyond repair. The required spare to the extent of availability shall be provided by the purchaser to the contractor. Contractor has to return back to the purchase the same after repair or provide the new within 4 months.

After the completion of guarantee period owner (UPPTCL) wishes to enter into a separate agreement for maintenance of supplied OFC communication network for further 6 years under Comprehensive Annual Maintenance Contract for successful operation of the system. The contractor is accordingly required to quote their rates in **BoQ**.

The owner may ask the contractor to provide maintenance of the system under Comprehensive Annual Maintenance contract (AMC) including repair/replacement of component of Optical fibre communication Equipment. The Contractor shall accordingly quote their price for 6 years Comprehensive Annual Maintenance contract (AMC) on cost basis after the completion of guarantee period on per year basis. Under this AMC, the Contractor shall repair / replace the defective parts / component of Optical Fibre communication as required to maintain the Optical Fibre communication Equipment in healthy condition. Availability of the system has to be ensured as per clause no 6.2.3.4 of technical specification. On mutual consent the said agreement may be extended for further agreed period.

6.2.17 Service Support

Contractor shall locate his service engineer having minimum 3 years of experience in maintenance of similar type of system for site support at a place to be intimated later on by the owner at time of AMC contract. On call, contractor has to depute their service

engineer at site to attend the fault in the system within maximum allowable period as specified in the agreement for voice & data requirements of RTUs and SCADA/EMS system and CIT protection on fibre at 400kv & 220 kv substation.

The period shall be counted since the time of lodging of complaint by the operator. Bidder shall submit detailed service format for achieving above in the bid. Owner shall intimate the defects in the prescribed format. On receipt of these information contractor shall depute their service personnel at site. Fault reporting time shall start after requisite information in duly filled up FORMAT is informed to the contractor by fax /email/phone etc.

The support for maintenance shall be decided on the basis of priority of nature of fault. The priority of nature of fault is categorized as Urgent/ Serious/ Minor / Routine, which is described as under.

6.2.17.1 Urgent Service Support:

Complete system failure, server system instability, Loss of failure of any subsystem so as to adversely affect the system availability, performance or/and restriction in operational capability of Main SLDC at Lucknow/ Backup SLDC at Modipuram . On receiving the information the contractor shall take all steps to restore the functionality of the system at the earliest within the time specified in the agreement.

6.2.17.2 Serious Service Support:

The support not defined in 6.2.17.1 is included in this category. System failure at sub LDC at Panki, Moradabad and Varanasi, failure of alternate route to Main/Backup SLDC/sub LDCs, Network Monitoring system or any outage so as to affect the day to day working of the system/sub system.

6.2.17.3 Minor Service Support:

The service support not defined in 6.2.17.1 & 6.2.17.2 shall be included in this category where the outage or loss of any part of the system does not affect the functionality of the system, fault of non communication equipment etc.

6.2.17.4 Routine Service Support

Technical support, configuration, system enhancement, analysis of data, alarms from NMS, suggestions etc are covered in this category.

6.2.18 Reporting Response and Fault Resolution Time:

This section describes the time limit during which the contractor's engineer shall respond to support request from the owner and take action to attend the fault.

Priority Level	Acknowledgement of fault & response time	Fault attending time	Action
1	1 hour	4 hours	Urgent nature of fault requires round the clock (for 24 hours, 7days) service support till the restoration of the system. The fault attending duration of 4 hours is at SLDC Lucknow However restoration time for

			Backup SLDC or for outage of entire sub LDC could be up to 48 hours depending upon the travel time from SLDC to other locations.
2	1 day	2 days	Serious nature of fault at SLDC Lucknow should be restored within 2 days. However restoration time for Backup SLDC, sub LDC or any other location could be up to 3 days depending upon the travel time from SLDC to other locations.
3	2 days	3 days	Minor nature of fault at SLDC Lucknow should be restored within 3 days. However restoration time for Backup SLDC, sub LDC or any other location could be up to 4 days depending upon the travel time from SLDC to other locations.
4	2 days	5 days	Routine service support shall be provided within 5 days.

6.2.19 Working Hours

Normal service hours for onsite support shall be Monday to Saturday from 9.00 hours to 18.00 hours throughout the year excluding public and UPPTCL holidays. The timings of service support throughout the year for Urgent nature of fault shall be 24 hours a day, 7 days a week.

6.2.20 Fault Reporting Procedure

Operator shall intimate the defects in the system to the contractor by Fax/Email/Phone under prescribed approved format by the owner. However in case of urgent nature of fault, telephonic intimation will be deemed served to the Contractor

6.2.21 Availability Requirements

6.2.21.1 Communication System:

The availability of communication system shall be measured as indicated below on the basis of outage of channels. The system availability will be calculated as per following formula during the Maintenance period.

$$Tt * Cht - \sum Chn * Tn \quad (n=1 \text{ to } Cht)$$

$$S.A = \frac{\quad}{Tt * Cht} \times 100\%$$

Where

SA= System Availability (%)

Tt= Total test time (24* days in a month)

Cht= Total number of channel

Chn= Number of Channels affected by event En

T_n= Outage time on account of event E_n during the month

6.2.22 NMS System

The NMS system availability shall be calculated as follows

$$(NMS) A_v = \frac{T_t * NE_t - \sum NE_n * T_n}{T_t} * 100\%$$

Where

A_v=% NMS Availability

T_t= Total test time (24* days in a month)

Net= Total Number of Network Element

NE_n = Number of NE affected by an event

T_n= outage time of NE

6.2.23 Prices Basic

The Prices for the complete scope of work for maintenance of OPGW communication equipments installed under this project shall be on fixed price basis till completion of contract and no price adjustment/variation on any account shall be entertained by UPPTCL.

6.2.24 Terms of Payment for AMC

Payment shall be released to the contractor after submitting the bills to the concerned Executive Engineer Microwave once in a month after completion of the service for that month. Payment shall be released after submitting the following.

Availability calculation statement duly certified by the Superintending Engineer, EMTC.

Submission of Contract Performance Guarantee for 10% of the Contract price in the format mentioned in General Conditions of Form-A/B

6.2.25 Penalty for AMC

Under the contract 5% of the total monthly charges shall be deducted for every fall of 1% or part thereof in the availability of the system as specified in clause no 6.2.3,4 of technical specification.

In addition to the above, a penalty of Rs 1000/- (One thousand) per day shall be imposed for not attending the fault in specific period for all faults specified in category of Serious, Minor or of same nature as may be decided later on.

Contractor will maintain adequate level of qualified staff for carrying out this maintenance contract failing which Rs 50,000 per month will be deducted by UPPTCL from the amount due to Contractor under this Contract.

6.2.26 Termination of AMC

Notwithstanding the duration of the agreement UPPTCL shall have the right to terminate the agreement, without assigning any reasons on the happening of any of the following.

If contractor consistently fails (Continuously two months or more) to deliver the specified system availability. In the monthly review meeting reasons for low system availability shall be discussed and contractor shall have to give reasons and remedial measures to arrest any such shortfall in system availability.

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

Abbreviations

AL Adaptation Layer ADM Add-drop multiplexed ATM Asynchronous Transfer Mode ALS Automatic Laser Shutdown BIP Bit Interleaved Parity CAS Channel Associated Signaling CAP Carrier-less Amplitude and Phase CRC Cyclic Redundancy Check DTMF Dual Tone Multi-Frequency EN European Norm EOW Engineering Order Wire ETSI European Telecommunications Standards Institute GPS Global Positioning System HDSL High Density Subscriber Line IEC International Electrical Commission ITU International Telecommunication Union IP Internet Protocol ISDN Integrated Services Digital Network MCMI Multi Coded Mark Inversion MS Multiplex Section NE Network Element	NMS Network Management System LAN Local Area Network OS Optical Section OSPF Open Shortest Path First PDH Plesiochronous Digital Hierarchy PPP Point-to-Point Protocol RS Regenerator Section SDH Synchronous Digital Hierarchy SNMP Simple Network Management Protocol SNCP Sub Network Connection Protection MSP Multiple section Protection MTBF Mean time Between Failure MTTR Mean Time To Repair SOH Section Overhead STM Synchronous Transport Module TCP Transmission Control Protocol TTI Trail Trace Identifier VC Virtual Container VF Voice Frequency
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Appendix

Following make equipments are installed in UPPTCL.

1. Fiber Home
2. Tejas (installed by PGCIL)
3. ABB
4. ECI (to be installed shortly)

Notwithstanding the duration of the agreement UPPTCL shall have the right to terminate the agreement, without assigning any reasons on the happening of any of the following.

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SECTION-3

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

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GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under respective equipment sections and are not exclusive. However in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

Every effort will be made to supply all equipment as per the technical details furnished in the specification. However, due to the standard manufacturing practice of various equipment suppliers and depending on the selected vendor, there may be slight variations from indicated values at the contract stage. Such variations should not affect the quality and performance of the equipment.

It is not the intent to specify completely in technical specifications of equipments/ materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The Purchaser will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

2.0 COMPLETENESS OF EQUIPMENTS

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

2.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted 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 UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

3.0 STANDARDS

3.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.

3.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3 In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.

3.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.

3.5 Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the Purchaser.

3.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
IEC/ CISPR	International Electro technical Commission	Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe Geneva, Switzerland
IS	Indian Standards,	Bureau of Indian Standard, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi-110 002, INDIA

BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization For Standardization,	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50 ⁰ C
(b)	Minimum ambient air temperature in shade	0 ⁰ C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	Isoceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conducive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by $\pm 5\%$
(iii)	Number of phases	Three
(iv)	Neutral	Effectively Earthed
(v)	Auxiliary power supply:-	

Auxiliary electrical equipment shall be suitable for operation on the following supply system:

(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2wire ungrounded DC supplies
	(i)	400 kV S/S : 220V DC (ii)
		220/132kV S/S : 110V DC (iii)
		Communication : 48 V DC equipment

The above supply voltage is subject to variation as follows:

All devices must be suitable for a continuous operation over the entire range of voltage variations :

- (i) AC
 - Voltage may vary by $\pm 10\%$.
 - Frequency by $\pm 5\%$
 - Combined Voltage & frequency by $\pm 10\%$.
- (ii) DC
 - a) 220 V may vary between 187 & 242 V
 - b) 110 V may vary between 93 & 121 V
 - c) 48 V may vary between 41 & 53 V

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1.	Nominal system voltage	4000kV	220kV	132kV	33kV
2.	Maximum operating voltage of the system(rms)	420kV	245kV	145kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3	3
5.	Rated short time current	50 kA for 3 Sec.	40 kA for 3 sec	31.5 kA for 3 sec	25 kA for 3 sec
6.	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7.	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8.	Corona extinction voltage	320 kV	156 kV	105 kV	-
9.	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10.	Minimum total creepage	25mm/ kV (10500 mm)	25mm/ kV (6125 mm)	25mm /kV (3625 mm)	25mm/kV (1300 mm)
11.	Min. clearances				
	i. Phase to phase	4000mm (for Conductor-conductor) 4200mm (for rod - Conductor)	2100 mm	1300 mm	320 mm
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm

	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed	Effectively Earthed	Effectively Earthed	Effectively Earthed

Major technical parameters of bushings/ hollow column/ support insulators are given below:

Sl. No	Parameters	400 kV System	220 kV System	132 kV System	33 kV System
(a)	Max. System voltage Um (kV)	420	245	145	36
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 1425	± 1050	± 650	±170
(c)	Switching surge withstand voltage (dry & wet) (kVp)	1050	-	-	-
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	650	460	275	75
(e)	Total creepage distance(min) (mm)	10500	6125	3625	900

Insulator shall also meet requirement of IEC- 815 for 420kV, 245kV, 145kV and 36kV systems, as applicable having alternate long and short sheds.

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

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

The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.

All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.

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

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

- 8.3** Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.
- 8.4** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.
- 8.5** All casting shall be free from blow holes, surface blisters cracks and cavities. Sharp edges and corners shall be blurred and rounded off.
- 8.6** Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 8.7** The clamps/ connectors shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/ connector is designed with respect to specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.
- 8.8** All current carrying parts shall be designed and manufactured to have minimum contact resistant.
- 8.9** Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 420kV, 220kV and 132kV class clamps shall not be less than 320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000 and 500 micro volts for 420kV, 220kV and 132kV system at the test voltage specified.

9.0 SUPPORT STRUCTURES

- 9.1** The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.
- 9.2** All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.
- 9.3** The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ 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 with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5. The indoor cubicles, GIS enclosures and other miscellaneous items, the colour scheme shall be approved by the Purchaser during detailed engineering.

11.0 MATERIAL/ WORKMANSHIP

11.1 General Requirement

Where the specification does not contain references 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 purpose 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. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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 also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All 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 considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits. Suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder 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 Bidder 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 Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

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

11.2 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.

12.0 SPACE HEATERS

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulator wire or other component in the compartments.

13.0 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on 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 of the varnish.

14.0 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc. to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door : IP-55
- b) Installed indoor in air conditioned area : IP-31
- c) Installed in covered area : IP -52
- d) Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41
- e) For LT Switchgear (AC & DC distribution Boards): IP-52

The degree of protection shall be in accordance with :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

17.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under

the exclusions in these specifications and documents.

18.0 PACKAGING AND PROTECTION

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. The Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protectin device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly 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 painting 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 otherwise 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.

All external painting shall be as per shade No. 631 of IS: 5.

20.0 HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. 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 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off,

etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

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

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

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder 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.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 23.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 23.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 23.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 23.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 23.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion

and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.

23.6 All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.

23.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

23.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

23.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

23.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

23.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ wiring by pasting the same on the inside of the door.

23.12 a) The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted.

Check for wiring

Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

23.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

- (b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- (c) Heat run test on contacts.
- (d) IR/HV test etc.

24.0 TERMINAL BLOCKS AND WIRING

- 24.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 24.2** Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.
- 24.3** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 24.4** The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 24.5** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 24.6** The terminal blocks shall be of extensible design.
- 24.7** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 24.8** The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 24.9** Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|---------------------------------|---|
| a) | All circuits except CT circuits | Minimum of 2 nos. of 2.5 sq. mm copper flexible |
| b) | All CT circuits | Minimum of 4 nos. of 2.5 sq.mm copper flexible |
- 24.10** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

- 24.11** At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 24.12** There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 24.13** The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
- 24.14** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

25.0 LAMPS AND SOCKETS

25.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

25.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

25.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

25.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite silicon rubber insulator, conforming to IEC-61462.

26.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

26.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

26.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

26.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

26.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

26.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621.

27.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

27.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

27.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system.

27.3 Starting Requirements

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified, shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

27.4 Running Requirements

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729.

Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests alongwith list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

- (a) Insulation resistance.
- (b) Phase sequence and proper direction of rotation.
- (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

28.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

28.1 Circuit Breakers (Applicable for 400kV, 220kV & 132 kV)

- 28.1.(i) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and **40kA/ 50kA fault level or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.1.(ii)(a) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.1.(i) given above.

And

- 28.1.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.1.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.2 Isolators (Applicable for 400kV, 220kV & 132kV)

- 28.2.(i) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and **40kA/ 50kA fault level or above class** and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.2.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a

parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.2.(i) given above.

And

- 28.2.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.2.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.3 Instrument Transformers (Applicable for 400kV, 220kV & 132kV)

- 28.3.(i) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & VT and 40kA/ 50kA fault level or above class. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

- 28.3.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.3.(i) given above.

And

- 28.3.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

- 28.3.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.4 Surge Arresters (Applicable for 400kV, 220kV & 132kV)

- (a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

- (b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to

guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

28.5 220 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.6 132 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.7 33 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 33kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.8 1.1 kV Grade Power & Control Cables

28.8.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

28.8.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 kms of 1.1 kV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

28.8.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured,

tested and supplied in a single contract atleast 25 kms of 1.1 kV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

28.9 LT Switchgear

28.9.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designe manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (ie Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid opening.

28.9.2 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening.

28.10 Battery and Battery Charger

28.10.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 600 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

28.10.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of at least ten (10) kW and these should be in successful as on the date of bid opening.

28.11 LT Transformers

The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 800 kVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

28.12 Fire Fighting System

The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least one number fire protection system of the each type described in (i), (ii), (iii) and (iv) below in installations such as power plants, substations, refineries, fertilizer plants or other industrial or commercial installations. Such systems must have been designed to the recommendations of Tariff Advisory Committee of India or any other international reputed

authority like (FOC, London or NFPA, USA etc.) executed during last ten (10) years and should have been in successful operation for at least 2 (two) years as on the date of bid opening.

- i) Nitrogen Injection Fire Prevention cum Extinguishing System
- ii) Portable Fire Extinguishers
- iii) GI Buckets – 9.0 liters capacity and Steel stand for Buckets
- iv) Fire Detection and Alarm System

In case bidder himself do not meet the requirement of design, he can engage a consultant(s) who must have designed the above system, which must be in successful operation for at least two years as on the date of bid opening.

28.13 Control and Relay Panels (400 kV, 220 kV, 132 kV & 33 kV)

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation System (If applicable) are offered should have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation on specified voltage level or above for atleast 2 (two) years on the date of bid opening.

AND

The Manufacturer or their joint venture or subsidiary company must have established repair, testing and integration (for at least 4 bays) facilities for Control, Relay & Protection System and Sub-station Automation System in India.

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.

- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132 kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

India Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its Products.
IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 P2:1983	-	Insulation Coordination.
IS-3043	-	Code of Practice for Earthing
IS-6103	-	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	-	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	-	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.
IS-6792	-	Method for determination of electric strength of insulating oils.
IS-5578	-	Guide for marking of insulated conductors.
IS-11353	-	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	-	Methods for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test

IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHz
C36.4ANSI-C68.1	-	Techniques for Dielectric Tests
ANSI-C76.1/IEEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements

CSA-Z299.4-1979h - Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (part 1 to Part 8)	-	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of Oil immersed Transformers.
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100	-	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
IEC-62271-101	-	High-voltage switchgear and controlgear - Part 101:

Synthetic testing

- | | | |
|---------------|---|---|
| IEC-62155 | - | Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V |
| IEC-62271-110 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |
| IEC-62271-109 | - | High-voltage switchgear and controlgear - Part 110: Inductive load switching |

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING

CAPACITOR VOLTAGE TRANSFORMERS

- | | | |
|---------------------|---|--|
| IS-2705- (P1 to P4) | - | Current Transformers. |
| IS:3156- (P1 to P4) | - | Voltage Transformers. |
| IS-4379 | - | Identification of the Contents of Industrial Gas Cylinders |
| IEC-60044-1 | - | Current transformers. |
| IEC-60044-2 | - | Inductive Voltage Transformers. |
| IEC-60044-4 | - | Instrument Transformes : Measurement of Partial Discharges |
| IEC-60044-5 | - | Instrument transformers - Part 5: Capacitor voltage transformers |
| IEC-60358 | - | Coupling capacitors and capacitor dividers. |
| IEC-60481 | - | Coupling Devices for power Line Carrier Systems. |
| ANSI-C5713 | - | Requirements for Instrument transformers |
| ANSIC92.2 | - | Power Line Coupling voltage Transformers |
| ANSI-C93.1 | - | Requirements for Power Line Carrier Coupling Capacitors |
| BUSHING | | |
| IS-2099 | - | Bushings for Alternating Voltages above 1000V |
| IEC-60137 | - | Insulated Bushings for Alternating Voltages above 1000V |

SURGE ARRESTERS

- | | | |
|-----------------|---|---|
| IS-3070 (PART2) | - | Lightning arresters for alternating current systems |
|-----------------|---|---|

		: Metal oxide lightning arrestors without gaps.
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231, 3231 (P-3)	-	Electrical relays for power system protection
IS:5039	-	Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
IS: 8623: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical

measuring instruments & their accessories.

Disconnecting Switches

IEC-62271-102	-	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

PLCC and Line Traps

IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier systems.
IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee 34 & 35.
CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT	-	International Telegraph & Telephone Consultative Committee

EIA - Electric Industries Association

Protection and Control Equipment

IEC-60051 : (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297 (P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating Instruments

MOTORS

IS-325	-	Three phase induction motors.
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:)	-	Rotating electrical machines

IEC-Document 2 - Three phase induction motors
(Central Office) NEMA-MGI Motors and Generators

Electronic Equipment and Components

MIL-21B, MIL-833 & MIL-2750

IEC-60068 (P1 to P5) - Environmental testing
IEC-60326 (P1 to P2) - Printed boards
Material and workmanship standards
IS-1363 (P1 to P3) - Hexagon headbolts, screws and nuts of product grade C.
IS-1364 (P1 to P5) - Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138 - Hexagonal Bolts and Nuts (M42 to M150)
ISO-898 - Fasteners: Bolts, screws and studs
ASTM - Specification and tests for materials

Clamps & Connectors

IS-5561 - Electric power connectors.
NEMA-CC1 - Electric Power connectors for sub station
NEMA-CC 3 - Connectors for Use between aluminium or aluminum-Copper Overhead Conductors

Bus Hardware and Insulators

IS: 2121 - Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731 - Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4) - Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120 - Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137 - Insulated bushings for alternating voltages above 1000 V.
IEC-60168 - Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.

IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process procelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and Rigid Bus-Conductor

IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
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IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and Batteries Charger

Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IS:10918	-	Vented type nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid

Batteries

IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005	-	Code of practice for phosphating of Iron and Steel
IS:3231	-	Electrical relays for power system protection
IS:3842	-	Electrical relay for AC Systems
IS:5	-	Colours for ready mix paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and Cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	-	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

Air Conditioning and Ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC Ventilation Fans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for

		removing particle matter
IS:3069	-	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.
IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848 Fans	-	Method of Performance Test for Centrifugal Fans
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors
IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999 (Part-51)	-	Noise levels

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing

on iron and steel.

IS-2633	-	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A-123	-	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77	-	Zinc-coated (Galvanized) steel barbed wire

Painting

IS-6005	-	Code of practice for phosphating of iron and steel.
ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Fire Protection System

Fire protection manual issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS

IS:1520	-	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	-	Code for acceptance test for centrifugal & axial pumps
IS:5120	-	Technical requirement - Rotodynamic special purpose pumps
API-610	-	Centrifugal pumps for general services
	-	Hydraulic Institutes Standards
BS:599	-	Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for

		constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)

IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves
(Part-I)		
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines

IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	-	Standard on Automatic Fire Detectors
Fire Protection Manual by TAC (Latest Edition)		
NFPA-12	-	Standard on Carbon dioxide extinguisher systems
IS:3034	-	Fire of industrial building:
Electrical generating and distributing stations code of practice		

IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type

D.G. SET

IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion engines
IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932

Steel Structures

IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	Code of practice for use of structural steel in overhead transmission line towers.
IS-806	-	Code of practice for use of steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	-	Covered electrodes for manual arc welding of carbon of carbon manganese steel.
IS-816	-	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	-	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding.
IS-875 (P1 to P4)	-	Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161	-	Steel tubes for structural purposes.
IS-1182	-	Recommended practice for radiographic examination of fusion welded butt joints in steel

		plates.
IS-1363 (P1 to P3)	-	Hexagonal head bolts, screws & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods for bend test.
IS-1608	-	Method for tensile testing of steel products.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-1978	-	Line Pipe.
IS-2062	-	Steel for general structural purposes.
IS-2595	-	Code of practice for Radiographic testing.
IS-3063	-	Single coil rectangular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	-	Safety code for erection of structural steel work.
IS-9595	-	Recommendations for metal arc welding of carbon and carbon manganese steels.
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission

		tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy columbium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes

Piping and Pressure Vessels

IS-1239 (Part 1 and 2) steel	-	Mild steel tubes, tubulars and other wrought fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392	-	Steel pipe flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hotdipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbonsilicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threaded standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for

		high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

Other Civil Works Standards

IS-269	-	33 grade ordinary portland cement.
IS-2721	-	Galvanized steel chain link fence fabric
IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete.

IS-516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel.
IS-806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete.
IS-1566	-	Hard-drawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks.
IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National Buiding Code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel
(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of BS:443-1969 Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209-1966 steel reinforced extra high
BS:215(Part-II)	voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire

IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wires ASTM-A-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633 Coated	Methods for testing Uniformity of Coating of Zinc Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969 of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings.
IS:4012	Dust proof electric lighting fittings.
IS:4013	Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206 mines	Well glass lighting fittings for use under ground in

	(non-flameproof type).
IS:10322	Specification for flood light.
IS:10322	Specification for decorative lighting outfits.
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps.
IS:1258	Specification for Bayonet lamp fluorescent lamp.
IS:3323	Bi-pin lamp holder tubular fluorescent lamps.
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings.
IS:2215	Starters for fluorescent lamps.
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes

Conduits, Accessories and Junction Boxes

IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits.
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold
	and similar installations.
IS:5	Ready mix paints

IS:2551	Danger notice plates
IS:2705	Current transformers
IS:9224 (7)IS:5082 and	HRC Cartridge fuse links for voltage above 650V(Part-2) Wrought aluminium and Al. alloys, bars, rods, tubes sections for electrical purposes.
(8)IS:8623 Gear	Factory built Assemblies of Switchgear and Control for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293 3	pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732 (system	Code of practice for electrical wiring installation voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III.
IS:1944	Code of practice for lighting of public through fares.
IS:5571 hazardous	Guide for selection of electrical equipment for areas.
IS:800	Code of practice for use of structural steel in general building construction.
IS:2633 coated	Methods of Testing uniformity of coating on zinc articles.
IS:6005	Code of practice for phosphating iron and steel.
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I) gear	Specification for low voltage switchgear and control assemblies
IS:13947 (Part-I) gear,	Specification for low voltage switchgear and control Part 1 General Rules
IS:13947 (part-2) gear,	Specification for low voltage switchgear and control Part 2 circuit breakers.
IS:13947 (part-3) gear.	Specification for low voltage switchgear and control Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4) gear.	Specification for low voltage switchgear and control Part 4 Contactors and motors starters.
IS:13947 (part-5) gear.	Specification for low voltage switchgear and control Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) gear.	Specification for low voltage switchgear and control Part 6 Multiple function switching devices.
IS:13947 (part-7) gear.	Specification for low voltage switchgear and control Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 1 General Requirements
IS:13703 (part 2) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 2 Fuses for use of authorized persons

IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

SECTION-4

GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Particulars	Unit	Required
1	General		
a	Type of multiplexer		SDH
b	Complying to ITU-T rec.		Yes
c	Transmission Capacity	Mbit/s	STM-16
d	Redundant central processor		Shall be available
e	Digital cross connect function		Fully non blocking
f	PDH cross connect capacity		Minimum 40x2 Mbit/s
g	Equipment used in substation environment		List of 10 reference substations
h	The equipment is type tested		Yes
2	Tele protection Functionality:		
a	Distance teleportation functionality		Yes
b	Addressing system for commands		Yes
c	Loop test for delay time		Yes
d	Switch-over less than 10ms		Yes
3	Available STM-1,4&16 aggregates:		
a	SDH based on SFP technology		Yes
b	Electrical SDH aggregates		Yes
4	Available Trunk Interfaces:		
a	2Mbit/s E1 interfaces	No.	32 with minimum 2 cards
b	Complying to ITU-T rec.		G.703, transparent G.704, Selectable
5	Available user Interfaces:		
5.1	Voice Interfaces for trunk lines:		
a	1+1 com path protection, available for all		Yes
b	Minimum number of channels per card		4
c	Analogue, 4wire with E&M: Input level	dBr	+ 7.5 to -16
			+ 7.0 to -16.5
d	Analogue, 2wire with E&M: Input level	dBr	+6.5 to -12.5
			-1.0 to-20
	Output level		
e	Digital, 2Mbit/s CAS or PRI		Yes
5.2	Voice Interfaces for remote subscriber:		
a	2wire, subscriber side (Sub/Sub card)	dBr	-5....+4/-7.5-1
b	Minimum number of subscriber	No.	8
c	2wire, PABX side (Sub/Exchange card)	dBr	-5...+4/-7.5 ...-3

d	Minimum number of PABX	No.	8
6	Integrated teleprotection		
6.1	Interface for commands:		
a	Number of independent commands	No.	Equipped with 4 commands
b	Transmission time	ms	<10
c	Signal voltage	V peak	250
d	1+1 com path protection		Yes
7	Data channel per module		
a	V.24/V.28 (RS-232) (minimum 4 channels)	No.	4
b	Integrated LAN port available for DATA Interface		Yes
c	Software programmable board available		Yes, As option available
d	1+1 path protection, point-multipoint, performance monitoring, subrate multiplexing available for all data interface		Yes ,As option available
8	Ethernet Interface		
a	Ethernet: 10/100 Base T	No.	16 with minimum 2 cards
	WAN Capacity	Mbit/s	63xVC12 or 3xVC3
	Logical WAN ports	No.	Minimum 8
	GFP (acc. ITU-T G.7041)		Yes
	VCAT (acc. ITU-T G.707)		On VC-12 and VC-3
	LCAS (acc. ITU-T G.7043)		Yes
b	Ethernet	Router Functionality	Yes
		Routing protocols	Static IP route
c	Integrated Ethernet Hub 10/1000 Base T	No.	Min. 5
9	Integrated alarm gathering module:		
a	Number of external alarms per module	No.	Min. 20
b	Auxiliary power supply for ext. contacts		Yes
10	Configuration management:		
a	Type/name of configuration tool		
b	For local/remote operation		Yes/Yes
c	Data communication network (DCN)		Ethernet/IP or Ethernet/OSI
d	Integrated management of tele-protection commands		Yes
11	Network Management System:		
a	Type/name of configuration tool		
b	For local/remote operation		Yes/Yes
c	Data communication network (DCN)		Ethernet/IP or Ethernet/OSI
d	Integrated management of tele-protection commands		Yes
e	Remote access package		Yes , Please provide details
12	Ambient conditions		
a	Storage : ETS 300 019-1-1, class 1.2	°C/% hum.	- 25... +55°C/ class 1.2
b	Transport: ETS 300 019-1-2, class 2.2	°C/% hum.	-25...+70°C /class 2.2
c	Operation: ETS 300 019-1-3, class 3.1E		

	For operational applications For xDSL, ISDN and ATM applications	°C/% hum. °C/% hum.	-25...+55°C /class 3.1E -25...+55°C /class 3.1E	
13	Power Supply			
a	Operation	VDC	48/60 (-15/+20%)	
b	Fully redundant power supply		Yes	
c	Dual power feeder		Yes	
d	AC power supply	AC	115/230	
No.	Test name	Description	Basic Standard	Class
1	Radiated radio frequency	30 MHz to 1 GHz	EN 55022	A
2	Conducted radio frequency interference AC/DC Power supply	150 KHz to 30 MHz	EN 55022	A

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-2 of Technical Specification duly 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