

## Section-1

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## Section 1

### **Introduction, General Information and General Requirement**

#### **1.1 Introduction and General Information**

This Volume II of the Tender Document describes the technical specifications for Communication System Package which includes overhead fiber optic cabling and associated items, associated communication equipment, DC Power supply system. This specification describes the functional and performance requirements of communication system package. The intent of this Package is to implement a communication system network based on OPGW in India. The execution of the aforesaid project has been entrusted to Parbati Koldam Transmission Company Limited (PrKTCL).

The purpose of this section of the specification is to provide scope of work, general information about the existing systems and the proposed system under this project, requirements, responsibilities & obligations of contractor, Employer & Owner and general bidding requirements for the project.

#### **1.2 Proposed Communication System**

The proposed communication system shall be fiber optic based and shall consist of overhead fiber optic links with a bit rate of Synchronous Transport Module-4 (STM-4)/ Synchronous Transport Module-16 (STM-16).

#### **1.3 Scope and General Requirements under the Communication System Package**

The scope of work shall cover following:

Survey, planning, design, engineering, supply, testing at manufacturer's works, transportation, unloading and delivery at site including insurance & storage, supervision of erection/installation, installation of OPGW and its accessories in live line condition including all associated works, splicing, termination, testing, training, and demonstration for acceptance, commissioning and documentation for the Communication System defined below:

##### **1.3.1 Fiber Optic Cabling and associated items**

- a) OPGW including all associated hardware accessories & fittings
- b) Fiber Optic Approach Cable including installation hardware

- c) Underground Fiber Optic cable (UGFO)/All Dielectric Self Supporting (ADSS) cable including installation material, accessories and fixtures (if applicable)
- d) Fiber Optic Distribution Panels (FODP) & Joint Box
- e) Very Small Aperture Terminal (V-SAT) based Communication System (if applicable)
- f) Supply of spares
- g) All other associated work/items described in the technical specifications.

*“The existing earthwire along with its hardware & fittings shall be dismantled & taken away by the Contractor on installation of OPGW. The Contractor shall quote the buyback price for the dismantled earth wire (along with hardware fittings & accessories).”*

Standard OPGW designs are to be used for various voltage levels & wind zones of transmission lines that are mentioned at Section-02 of Technical Specifications. In case of constraints in adopting standard design for any of the transmission line(s) or for any specific sections such as higher spans (>600m), Valley crossings, snow covered sections or for other voltage levels & wind zones etc., the Contractor may propose customized design(s) during detailed engineering to meet the requirement.

Mostly, the OPGW Cable under this specification shall be installed under live line conditions, i.e. with all circuits of the transmission line charged to their voltage. Installation The bill of quantities for the same is specified in the appendices accordingly. However, the actual quantities for the requirement may vary during implementation which shall be finalized after detailed survey. The Contractor has to carry out the detailed survey and collect the required data for preparation of OPGW BoQ. Aviation Globules are to be removed and reinstalled from earth wire to OPGW wherever applicable during OPGW installation.

### **1.3.2 Communication Equipment and DC Power Supply System**

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

- a) SDH Equipment along with suitable interfaces & line cards etc.
- b) Associated Termination equipment system including E-1 channel banks & drop-insert multiplexer, subscriber line interfacing card and digital access cross-connect switching (DACS).
- c) Network Management System (NMS)
- d) All cabling, wiring, Digital Distribution Frame patch facilities, equipment MDF's and interconnections to the supplied equipment at the defined interfaces.
- e) MDF & DDF cross connects required to route and activate circuits.
- f) System integration of the supplied subsystems and also integration with existing communication equipment such as SDH, MUX etc.

- g) Integration of supplied system with existing and new PMUs, RTUs, SCADA system, PLCC equipment, PABX etc.
- h) Reconfiguration of communication channel in existing communication equipment.
- i) Repeater Shelter along with associated subsystem (if applicable)
- j) Maintenance of the supplied system

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

#### **1.4 Systems to be supported.**

The communication systems shall support Real time data transfer for SCADA system and other Power system operational requirements, voice communication between Substations/Generating stations and Control Centers.

The scope of work specified herein shall be applicable to for following two broad categories:

##### **CATEGORY A:**

These are the new links with new equipments such as SDH, PDH, DDF, MDF & DCPS to be implemented under the package. The work involves in this category is highlighted as below:

- Inter connection of subscribers such as RTUs, PLCC, PABX with PDH equipments thru MDF.
- Inter connection of SDH with FODP & SDH to PDH equipments through DDF.

##### **CATEGORY B:**

Fiber Optic links shall be implemented under the package which shall be integrated with the existing communication equipment. The work involves in this category is highlighted as below:

- Integration of SDH equipment with the existing SDH/PDH equipments
- Integration of PDH equipment with the existing SDH equipments
- NMS channel of existing PDH/SDH equipments to be transported on new interconnected FO links.
- Power supply connection to new equipments with existing -48 V DCPS.

In addition to above mentioned works, any other work required for a fully functional system shall also be in the scope of the contractor.

#### **1.5 General Technical Requirements**

### **1.5.1 Communication Equipment**

- (i) The SDH equipment shall be offered from a manufacturer(s) who is manufacturing SDH equipment for the last three (3) years and, at least five (05) nos of SDH Equipments manufactured by such manufacturer(s) shall been in satisfactory operation in one or more projects of 110 KV or higher voltage power substation for at least two (02) years as on the date of opening of bids.
- (ii) The Primary/Drop-Insert Multiplexers shall be offered from a manufacturer who is manufacturing Primary/Drop-Insert Multiplexer for the last three (3) years and at least five (5) Primary/Drop-Insert Multiplexers manufactured by such manufacturer shall have been in satisfactory operation in one or more projects for at least two (2) years as on the date of opening of bids. In addition, at least two (2) Primary/Drop-Insert Multiplexer manufactured by such manufacturer shall be in operation in 110 kV or higher voltage Power substations as on the date of opening of bids.
- (iii) The installation of communication equipment shall be done by a firm who has previous experience of installation, testing and commissioning of at least 20 nodes of Fiber Optic Transmission System based on SDH technology and at least 5 no. of these nodes must be in satisfactory operation for at least two (2) years as on the date of opening of bids.

### **1.6 General Requirements**

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

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

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

The Bidder's proposal shall clearly identify all features described in the specifications or in any supporting reference material that will not be implemented; otherwise, those features shall become binding as part of the final contract.

An analysis of the functional and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude

that additional items are required that are not specifically mentioned in this specification. The Contractor shall be responsible for providing at no added cost to the Employer, all such additional items such that a viable and fully functional Communication System is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items in their proposal.

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

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

The Contractor shall demonstrate a specified level of performance of the offered items during well-structured factory and field tests.

The Bidders are advised to visit sites (at their own expense), prior to the submission of a proposal, and do surveys and assessments as deemed necessary for proposal submission. The successful bidder (Contractor) is required to visit all sites. The site visits after contract award shall include all necessary surveys to allow the contractor to perform the design and implementation functions.

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

- a) Suitability of transmission line for live line OPGW cable installation on the present infrastructure, towers, earth wire, etc.
- b) Identification of higher spans exceeding 600 m and submission of earth wire/conductor sag details for checking suitability of OPGW for such span.
- c) Details of power line crossing using diamond configuration.
- d) Proposed routing of the approach FO cable from the end tower / gantry to the communication room to be marked on the site layout drawing. The existing cable trenches/ cable raceways proposed to be used shall be identified.
- e) The positions of fiber optic distribution panel (FODP) to be finalized during survey and the same shall be indicated in the survey report.
- f) Proposed layout of all Communication equipments in the existing rooms and buildings.
- g) Proposed routing of power, earthing, signal cables and patch cords etc.
- h) Identification of facility modifications, if required.



- i) Confirmation of adequacy of Space and AC/DC Power supply requirements
- j) Proposals for new rooms/buildings if required.
- k) Availability of Air-conditioning, Earthing and MCBs for AC Power Supply Input.
- l) Identify all additional items required for integration for each site/location.

### **1.7 Communication System Integration**

The Contractor shall be responsible for integration with various communication network subsystems viz. Fiber Optic transmission subsystem, Termination subsystem, FO Cabling system, and also integration with existing fiber optic communication network to ensure satisfactory overall wideband network performance. The Contractor shall ensure that end-to-end data and voice channel requirements of RTUs and control centers are satisfied. Integration shall consist of activities at wideband nodes as listed but not limited to the following:

- a) All necessary interconnections and interfacing including supply and installation of cables, wires, MDF/DDF to MDF/DDF cross connects, additional cards/equipment required for establishing proper inter connections for data, voice, synchronization etc. Connections may also be required between MDF/DDF located in different buildings/nearby sites.
- b) Detailed channel routing at subscriber channel level, E-1 channel plan etc. and equipment configuration.
- c) System wide synchronization
- d) Consolidated floor plans indicating the location (to be approved by the Employer) of supplied equipment as well as the equipment which interfaces are required/provided.
- e) Necessary programming/modifications to ensure compatibility between signaling for voice channels interfaces with other equipment such as PABX etc.
- f) The contractor shall integrate the new termination equipment subsystem with the existing termination equipment. Alternatively, contractors may also provide any other solution for seamless transmission of communication channels.

The details for the interconnection & integration shall be collected from each site during the survey and shall be finalized during detailed engineering.

#### **1.7.1 Details of Existing Equipment**

Details of existing equipment shall be collected during the survey.

### **1.8 General Responsibilities and Obligations**

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

### **1.8.1 Responsibilities for the Implementation Plan**

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

### **1.8.2 Contractor's Responsibilities and Obligations**

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

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

- (1) Provide a working system that meets the functional and performance requirements of this specification.
- (2) Engineering and design specific to each location including review of, and conformance with local environmental and earthing requirements.
- (3) Inputs for finalization of installation and safety guidelines and procedures for the stringing, mechanical installation
- (4) Obtaining statutory clearances from regulatory bodies, statutory bodies such as municipality, highway authority, electrical utilities, forest department, gas authorities etc.
- (5) Development of installation and safety guidelines and procedures for the complete system.
- (6) Development of procedure for splicing of all fiber optic cable, including testing and documentation.



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- (7) Project management, project scheduling, including monthly progress reports documenting progress during the contract period.
- (8) Coordination with other Project Contractors for phased implementation and system integration & commissioning of the overall communications network
- (9) Engineering and technical assistance during the contract and warranty period and annual maintenance contract (AMC) period.
- (10) Site visits, surveys, and studies necessary to identify and provide all equipment needed to implement the FO Cable installation and communication network.
- (11) For any renovation, expansion or construction of facilities required to be carried out by Employer, the Contractor shall provide in the survey report the details necessary to enable such work to be carried out.
- (12) Assessment of suitability for live line installation of overhead FO cable on the present infrastructure, tower etc.
- (13) Design and Installation of the mechanical assemblies and accessories, including vibration dampers required for installation of all overhead fiber cable. To conduct structural analysis and to carry out tower strengthening if required, any or all additional steel work or modifications required to attach the overhead fiber cables shall also be carried out by the Contractor. Design data of towers shall be provided by the Employer.
- (14) Supply, installation and termination of cables and cabling for all interconnections.
- (15) Intimate source power requirements within 30 days after receipt of the order for each cabinet/ rack of equipment provided at each location.
- (16) An availability analysis showing MTBF (mean-time-between-failure) and MTTR (mean-time-to-repair) figures for all system components.
- (17) Factory and site acceptance testing of all items including hardware, software & firmware provided.
- (18) Conduct type tests or provide documented evidence of satisfactory Type Test performance to the Employer.
- (19) Provide a Quality Assurance Plan ensuring the Employer access to the manufacturing process.

- (20) Providing earthing system and extension of earthing system
- (21) Supply of cable & all equipment/items required for Terminal equipment system.
- (22) Shipment of all equipment and documentation to the Employer designated locations and/or staging areas.
- (23) Storing, Staging, maintenance and security of the staging area up to the operational acceptance including the full responsibility for protection from fire and theft of the supplied equipment.
- (24) Inter-connection among provided equipments
- (25) All cabling, wiring including supply, laying and termination etc. of the cables at terminal equipment nodes required for full interconnectivity and proper operation of the telecommunications network including equipment supplied under this package and the connectivity and interfacing of equipment supplied separately (PABX, SCADA interface, RTUs etc.).
- (26) Connectivity with the FODP and SDH equipment.
- (27) All Fiber Optic Distribution frame patch facilities.
- (28) Installation and integration of network management software, hardware and firmware.
- (29) Provide all additional Equipment necessary to ensure compatibility with the equipment to be interconnected.
- (30) Implement all minor civil works as per Technical Specification.
- (31) All hardware, software, and firmware required to satisfy the requirements of this Specification.
- (32) Overall integration of communication equipments/subsystem procured under this package.
- (33) All documentation and drawings as specified.
- (34) All required spare parts, maintenance aids, etc.
- (35) Training of Employer personnel

- (36) Maintenance and support of the items through final acceptance, and maintenance throughout the warranty period.
- (37) Hardware, software, and firmware maintenance, debugging, and support of the equipment through final acceptance, and maintenance on all new equipment throughout the warranty period and for a period of six (6) years after warranty period.
- (38) Due diligence in properly planning and executing the work so as to minimize any physical damage.
- (39) The Contractor shall appoint key personnel for the project such as Project Manager, Site Manager, Design Engineer, Installation Engineer and Commissioning Engineer only after approval of the experience data by the Employer. Approval of the Employer shall be obtained whenever the Contractor wants to change key personnel.
- (40) Availability of service, spare and expansion parts for the supplied items for the designed life of the communication equipment or eight (8) years after the declaration of withdrawal of equipment from production, whichever is earlier. However, the termination of production shall not occur prior to Operational Acceptance of the system by the Employer.
- (41) Notification services for field updates to the hardware, software, and firmware for ensuring the availability of the supplied hardware & software including NMS for entire lifespan.
- (42) Provision to be complied as per latest guidelines of GOI/ MOP. The

Contractor shall ensure following things and at their own cost:-

- (i) *Any imported equipment/material/item/parts/component to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the contractor.*
- (ii) *The equipment offered by the contractor shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standards, provisions of IS shall prevail. The Contractor shall also note that the list of standards presented*

*in this specification is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable international standard (IEC/Equivalent), as per the specification, shall be accepted."*

- (iii) The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract.*
- (iv) The Bidder shall have to furnish a certificate regarding cyber security/safety of the equipment/ process to be supplied/services to be rendered as safe to connect.*

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

### **FACILITIES TO BE INCORPORATED FOR LABOUR.**

The Contractor shall, on his/their own cost, provide his/their labour with sufficient number of the following facilities with the indicated specifications: -

#### **Tents:**

- i. The tent should be with double layer canvas, the outer layer being waterproof. The size / number should be sufficient to accommodate the required number of people comfortably.
- ii. The preferred size of tent should be 20ft x 20ft with Centre height of 7 ft and side height of 2.5 ft.
- iii. Tent windows should have an arrangement for mosquito net with waterproof outer covering.
- iv. Doors of the tents shall have Velcro or any other closing system.
- v. The site selected for the camp shall be on high ground, removed from Jungle.
- vi. Efficient arrangements for draining away stagnant water should be provided so as to keep the camp neat and tidy.
- vii. The tents should have illumination at night by providing battery operated LED lanterns or equivalent lighting system.

#### **Portable (Tyre- mounted) Bio toilet**

- i. The toilet seats should be 'Indian.'
- ii. The number of Toilets should be not less than 2 per 50 laborers with separate toilets for female laborers.
- iii. Bio-tank should be of sufficient capacity to allow bacteria present to decompose the excreta and only wastewater (odorless and harmless) gets

discharged out of the toilet through a sewerage channel away from the tent areas and working areas.

- iv. A water tank of adequate capacity should be installed with the Portable Toilet.

### **1.8.3 The Employer Responsibilities and Obligations**

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

- 1) Review and approval of the Contractor's designs, drawings, survey reports and recommendations.
- 2) Participation in and approval of "Type", factory and site acceptance tests.
- 3) Review and approval of training plans.
- 4) Assistance in obtaining statutory clearances from regulatory bodies.
- 5) Approval of key personnel for the project.
- 6) Overall project management of the project
- 7) Provide to the extent possible the details of the survey carried out by the Transmission Line Contractor along with tower spotting data, snow load details and other mechanical loads etc.

## **1.9 General Bidding Requirements**

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

- (1) The Technical Proposal includes the documents listed in Table 1-1: Bid Documents Checklist shall be provided in the bid.
- (2) A detailed project implementation plan and schedule that is consistent with the scope of the project and Employer's specified objectives. The plan shall include the activities of both the Contractor and Employer, show all key milestones, and clearly identify the nature of all information and project support to be provided by Employer.
- (3) The bidder shall submit, with their proposal, performance certificates for all the offered equipments (other than QR items and the items for which General Technical Requirements have been specified in this section) from at least one customer. The performance certificates shall provide evidence of successful operation of the proposed equipment for at least one year as on date of NOA.
- (4) A commitment and a clearly defined plan to develop a system support

organization, based in India and capable of providing a full range of local services (including software and hardware maintenance and upgrade support) for the life of the delivered telecommunications systems.

- (5) The bidder may offer the bought-out items from more than one manufacturer. In the case of QR items and the items for which General Technical Requirements has been specified in this section, the bidder shall provide supporting qualification document also.
- (6) The General Technical Requirements data of the Manufacturer (in support of meeting the requirements at clause 1.5 of this section) shall be furnished in the bid.

**Table 1-1;  
Bid Documents Checklist**

S. No.	Description:	Enclosure Reference	
1	Completed Data Requirement Sheets (As per Appendix of Technical Spec Volume II)	Page no. Ref no.	
2	Performance certificate	Page no. Ref no.	
3	Quality Assurance Program (As per relevant Sections of Technical Specs Volume II)	Page no. Ref no.	
4	Detailed Project Implementation Plan (As per relevant Sections of Technical Specs Volume II)	Page no. Ref no.	
5	General Technical Requirements data of the Manufacturer. (As per relevant Sections of Technical Spec Volume II)	Page no. Ref no.	

## 1.10 Organization of the Technical Specification Document

Sections 2 through 11 and Appendices provide the project requirements of the fiber optic cabling system to be provided.

Section 2 contains specifications and functional description of OPGW cabling & associated hardware & fittings.

Section 3 contains Network Configurations and Characteristics for the Telecom Equipment & NMS (Network Management System)

Section 4 contains the specifications and functional description for Repeater Shelter



- Section 5 contains the specifications and functional description of DC Power Supply Requirements
- Section 6 contains the requirement for Environment, EMI, Supply, Cabling and Earthing
- Section 7 contains the requirement for Inspection & Testing
- Section 8 contains the requirement for Training and Support Services
- Section 9 contains the documentation and deliverables requirements.
- Section 10 describes project management, schedule and implementation plan
- Section 11 contains specifications for Aerial cabling (ADSS) and associated hardware & fittings.

TS for UGFO was also provided.

The following is a list of the Volume II Appendices:

<u>Appendix A</u>	- General Information
<u>Appendix B</u>	- Data Requirement Sheets (DRS)
<u>Appendix C</u>	- Guidelines for Live Line Installation
<u>Appendix D</u>	- Guidelines for Offline Installation
<u>Appendix E</u>	- Splicing Guidelines
<u>Appendix F</u>	- Type Test Procedure
<u>Appendix G</u>	- FAT Procedure
<u>Appendix H</u>	- SAT Procedure
<u>Appendix I</u>	- Guidelines for Approach Cable Installation

### **1.11 Applicable Standards**

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

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

In the event the Contractor offers to supply material and/or equipment in compliance to any standard other than Standards listed herein, the Contractor shall

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include with their proposal, full salient characteristics of the new standard for comparison.

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

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

- (i) IEEE 802.3, 1138-2021
- (ii) ITU-T/CCITT Recommendations, G.652, G.701, G.702, G.703, G.711/ 12/ 14/ 35/ 36, G.721, G.742, G.811 and G.823
- (iii) ITU-T/CCITT Recommendations, G.801, G.821, G.822, G.823, G.826.
- (iv) ITU-T/CCITT Recommendations of the V Series
- (v) ITU-T/CCITT Recommendations R35, R37, and R38A (or R38B)
- (vi) ITU-T/CCITT Recommendations M3010, G771
- (vii) Internet Activities Board, RFC-1157 (SNMP)
- (viii) International Electrotechnical Commission standards, IEC 60801-2/3/4/5, IEC-60255-4, IEC-60255-5, IEC-60870-2-1, IEC-60721-3-3, IEC-60529.
- (ix) International Electrotechnical Commission standards, IEC 1000-4-xx series.
- (x) IEC publication 60068, 60068-2-2, 60068-2-3, 60068-2-14, 60068-2-27, 60068-2-32.
- (xi) ITU-T/CCITT Recommendations K.11, K.17, K.20.
- (xii) International CISPR standards

### 1.12 References

- (1) CIGRE Guide for Planning of Power Utility Digital Communications Networks
- (2) CIGRE Optical Fiber Planning Guide for Power Utilities
- (3) CIGRE New Opportunities for Optical Fiber Technology in Electricity Utilities
- (4) CIGRE guide to fittings for Optical Cables on Transmission Lines

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