

VOLUME-2
PART- I
Section-18
Optical Line Terminal
Equipment System

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18. OLTE System

18.1 General

The scope of work comprises of supply, installation, testing and commissioning of Optical Line Terminal Equipment (OLTE), including necessary accessories for fiber termination and splicing, for both Keyi Switchyard and Zero substation, establish connection with the existing Zero substation Remote terminal Unit (RTU) at the Substation, establish connection with RTU to be installed at Keyi switchyard. The scope also covers integration of the new communication system of this region into the existing SCADA system located at the project/ grid system.

For the above scope of work, the contractor shall make necessary studies and investigations of the existing SCADA systems in order to design and supply of appropriate equipment. The Contractor shall co-operate and coordinate with other related Contractor employed by the Employer in this connection for data, voice and protection communications.

Bidders shall offer the OLTE and their accessories from reputed manufacturer. The bidder shall confirm that the proposed OLTE shall be compatible with the existing OLTE in the system in that region. The contractor shall ensure complete supervision by competent technical personnel(s) of the OLTE manufacturer during installation, testing and commissioning of the whole OLTE system in totality under the project. The supervision shall also include the on-site training to the Employer's Representative(s).

The bidder shall study the requirement for OLTE system for voice, data and protection communication requirement as stipulated in Indian Grid Code and comply accordingly. The scope/ technical requirement shall be covered as per the requirement of Indian Grid Code.

The scope covered is voice, data and protection communication to Zero substation.

18.2 Life Expectancy

The Optical Line Termination Equipment (OLTE) and digital multiplexer equipment shall have a life expectancy of 15-20 years of service and shall not suffer system unavailability other than planned outage that may be required for system enhancements.

18.3 Power Line Description

A single circuit 132 kV transmission line will be constructed from Keyi HEP to Zero SS to evacuate power. The OPGW of required specification shall be laid by transmission line contractor from gentry to gentry. All other equipment and termination for successful completion & commissioning of this communication system shall be in the scope of this EM Contractor.

18.4 Equipment to be furnished

The Communication system equipment to be furnished and shall comprise but not limited to the following at both the ends:

- Optic line termination equipment (OLTE)

- Multiplexer (MUX)
- Indoor splicing Boxes
- Outdoor Splicing Boxes
- Optical Distribution Frame
- Approach/ optical Cable
- Telephones

18.4.1 Optical Line Termination Equipment (OLTE)

Construction and Design-

The Optic Line Termination Equipment (OLTE) performs electrical to optical conversions and vice versa and consists of optical transmitting and receiving parts, including the Engineering Order Wire (EOW).

The OLTE shall meet the latest recommendations of the ITU-T and operate at 8 Mbps as minimum.

Electrical Specifications-

The OLTE equipment shall comply with the followings as minimum requirements:

(a)	Optical wave-length	1550 or 1310 nm
(b)	Optical fiber type	Single mode
(c)	Optical source life span	Better than 15 years
(d)	Optical source	Laser
(e)	Jitter performance	ITU-T G823
(f)	Power supply voltage	DC 48V

Optical Approach Cable:

Optical approach cable shall be employed in connecting the optic fibre of OPGW from outdoor splice box to the Optical Distribution Frame inside the communication room of the Control Building. They shall be laid in the conduit pipe or in the cable trench.

Optical fibers shall have necessary mechanical and thermal characteristics. Optic fiber unit shall meet the ITU recommendations G652 and the material of them shall also meet the requirements of IEC 60739-1 and 2. The general features are as follows.

a)	Type	Single mode type
b)	Wave length	1310 05 1550
c)	Number of cores	24

d)	Optical attenuation	max. 0.45dB/km
e)	Concentricity	less than 1 [^] m

18.4.2 Multiplexer (MUX)

Construction and Design-

Transmission capacities shall always be a multiple of PCM 30 channels (primary and second order multiplexers).

The multiplexers shall be in accordance with the following ITU-T recommendations:

(a)	G.700	Terminal Equipment
(b)	G.731	Primary Multiplex Equipment
(c)	G.741	Second Order Multiplex Equipment
(d)	G.823	Multiplexing Gate Order Selection for External Equipment
(e)	G.703.1	For 64 KB Tele protection Signaling

All digital multiplexers shall be equipped with internal clock and interfaces for external clock synchronization based on the relevant ITU-T recommendation. Preferably, station GPS receivers shall be used to synchronize all multiplexers in the network.

All multiplexers shall have interfaces for connection of the control, monitoring, protection signalling and utility communication equipment. For transmission of protection signals, the multiplexers shall be equipped with special interfaces ensuring electromagnetic compatibility according to IEC 60255-5 (2000-12).

The minimum capacity of the fiber links multiplexer is 2.04 Mbps (30 x 64kbps).

The protection signals shall be transferred using dedicated fibers or priority channels or by bypassing the multiplexing stage.

Electrical Specification-

(a)	Transmission system	Pulse code modulation (PCM)
(b)	Sampling frequency	8 kHz
(c)	Encoding law	A - law
(d)	Bit rate	2.048 Mbits/sec
(e)	Code format	HDB3
(f)	Number of channels	30 channels (x 64 kb/s)
(g)	Power supply voltage	DC 48 V \pm 10%
(h)	Supervisory and alarm function	Provided

In case of the accident or failure due to cut down of the optic fiber, the alarm shall be displayed/annunciated at the equipment and can be transmitted to other equipment by non-voltage contact.

18.4.3 Optical fiber termination and splicing

Suitable splice boxes (enclosures) shall be provided to encase the optical cable ends and fusion splices in protective, moisture and dust free environment. The splice boxes shall be designed for the storage and protections of a minimum of 12 fibers cables and provide access through locked doors.

Fiber-optic cable of adequate length shall be provided so that all splicing can be performed at ground level at the towers. All splicing and necessary material shall be included in the price schedule presented by the Contractor.

18.4.4 Outdoor splice boxes

Splice boxes provided by the Contractor for outdoor use shall be suitable for use with the cable type provided as part of this Contract. The splice boxes shall be appropriate for mounting on steel structures and accommodate pass-through splicing and fiber terminations.

The splice box, including organizer/ splice trays, shall be designed to seal and protect the fiber cable splices from the environment defined in this specification and it shall provide easy access for any maintenance function.

All splice boxes shall be of metal construction that are clean and smooth finished, treated to resist rust, accommodate the storage of a minimum of 3 meters of coiled fiber and allow easy access to the splice trays. In addition, there shall be a steel frame to coil up about 10 meters of OPGW outside the protection box.

18.4.5 Communication channel for Tele Protection Signalling Equipment

Specification-

The type of communication channel shall be as specified. Channels are required for line protective relaying and breaker failure transfer trip.

The channel time shall be equal to or less than the channel time specified. The channel time is defined as the elapsed time between trip voltage pulse at the transmitter keying circuit and the derived trip output voltage pulse from the receiver.

The channel shall be suitable for operation in the type of bearer circuit as specified.

The channel shall include a noise-monitoring feature, which shall function so as to block the trip signal in the event of excessive line noise. The channel receiver shall preferably have a channel status logic circuit, which will monitor (a) guard signal, (b) trip signal, (c) received signal level, (d) signal-to-noise ratio (SNR), and (e) spike noise.

Design and Construction for FO system-

The tele-protection signalling equipment ensures full duplex transmission of trip commands (direct or permissive) or blocking command with high security and reliability.

The tele-protection signalling equipment shall be preferable for digital communication links and equipped with the same OLTE/MUX.

Electrical Specification-

(a)	Operation mode	1+1 operation (redundancy)
(b)	Digital line	
	- Number of command	Up to 8 independent commands
	- Interface	V.11 / X.11 / X/24, RS-422A / RS-530 / RS-94 ITU-T G.703.1 (64 kbps, co-directional) E1 / T1 for direct connection to SDH/SONET
(c)	Transmission time	4 ms
(d)	Power supply	DC 48V

18.5 Telephone system

The telephone system shall be used for voice communications, intended for system operation purposes.

18.5.1 Wiring

Secondary control wiring, windings, coils and resistors shall be insulated for 600 volts and shall withstand 1500 volts, one (1) minute dielectric test. All circuits shall terminate on adequately marked approved screw type terminal blocks mounted in accessible locations in the mechanism housing. Not more than two terminations to a single terminal point will be permitted.

The diameter of the control wiring shall not be smaller than 0.5 mm. All wiring shall be tinned, standard copper, 600-volt insulation. Both ends of all wires and all terminal block points shall be clearly marked with the designation shown on manufacturer's wiring diagram.

All termination shall be made with crimped type, ring-tongue terminal connectors with insulated shanks. The crimping tool shall be designed to prevent opening of the handles until full pressure has been applied and staking action is completed.

Adequate space shall be allowed in terminal boxes for the pulling, bending and proper grouping of all external power and control cables and a suitable removable drilling plate shall be provided for external conduits or cables. All external conduits and cables shall be furnished and installed by the Contractor. A bare copper ground-bus not less than 25mm by 6mm shall be furnished in the vicinity of the external cable entrances. A ground bus shall be provided for the connection of external control cable shields. Terminal boxes shall be weatherproof.

All internal wiring shall be connected to terminal blocks in a manner to allow the external cables to be terminated on consecutive points of the blocks.

18.6 Spare Parts

The spare parts mentioned here under are meant for use by the Employer during operation and maintenance stage and shall not be used as erection spares required during installation.

18.6.1 Special Spare Parts

Mandatory spare parts shall be supplied in accordance with the list mutually agreed between the Owner and Contractor, which is furnished by the Contractor in their final offers.

18.6.2 Recommended Spare Parts

The Bidder shall furnish the list of recommended spare parts as per "General Technical Particular (GTS)".

18.7 Tests

a) Routine Tests

All modules and subassemblies shall be energized and tested individually as well as in assembled form at the factory.

b) Type test

The equipment offered shall have been type tested at a well-recognized independent laboratory and evidence / statement for this shall be provided with the offer.

18.8 Factory Tests

All design tests, if required, and production tests shall be conducted in the presence of an authorized representative of the Employer, unless waived in writing by him. The Contractor shall notify the Employer at least fifteen (15) days in advance as to the date of the tests, and the place at which the tests are to be conducted so that arrangements may be made for his representative to be present. Prior to shipment of the equipment, the Contractor shall furnish the Employer five (5) certified copies of all design and production test reports.

18.9 Training for Operational Staffs

SCADA and associated communication systems require specialized hardware and software knowledge for its purposeful operation, and for the maintenance aspect. Therefore, the Contractor shall design and arrange a training program in the manufacturer's premises for two concerned the Employer personnel so as to make them competent enough to operate and maintain the proposed equipment/system. The overview of such program shall be proposed by the prospective Contractor along with its technical proposal. The cost of this training shall be included in the overall bid price.