Section-02
Specification for Fibre Optic cabling & associated items

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Section-02

Specification for OPGW cabling and associated hardware & fittings

This section of the technical specification describes the functional and technical specifications of Fibre Optic cabling and associated items.

2.1 Fibre Optic Cabling

In this section of the technical specification, the functional & technical specifications of OPGW cable, Fibre Optic Approach Cable, Joint Box and associated hardware & fittings for the requirements for G.652D Dual-window Single mode (DWSM) telecommunications grade optical fibre is specified. Bidders shall furnish with their bids, detailed descriptions of the fibres & cable(s) proposed.

All optical fibre cabling including fibre itself and all associated installation hardware shall have a minimum guaranteed design life span of 25 years.

2.1.1 Required Optical Fibre Characteristics

The optical fibre to be provided should have following characteristics :

2.1.1.1 Physical Characteristic

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 2-1(a).

2.1.1.2 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 2-1 (a) shall be "guaranteed" fibre attenuation of any & every fibre reel.

Table 2-1(a)
DWSM Optical Fibre Characteristics

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter @ 1310nm:	8.6 to 9.5 μm (± 0.6μm)
Cladding Diameter:	125.0 μm ± 1 μm
Mode field concentricity error	≤ 0.6μm
Cladding non-circularity	≤ 1%
Cable Cut-off Wavelength λ_{cc}	≤ 1260 nm

Table 2-1(a)
DWSM Optical Fibre Characteristics

1550 nm loss performance	As per G.652 D
Proof Test Level	≥ 0.69 Gpa
Attenuation Coefficient:	@ 1310 nm ≤ 0.35 dB / km @ 1550 nm ≤ 0.21 dB / km
Chromatic Dispersion; Maximum: **Zero Dispersion Wavelength:** **Zero Dispersion Slope:**	18 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) 1288-1339nm 5.3 ps/(nm x km) 1271-1360nm 1300 to 1324nm 0.092 ps/(nm^{2}xkm) maximum
Polarization mode dispersion coefficient	≤ 0.2 ps/km^½
Temperature Dependence:	Induced attenuation ≤ 0.05 dB (-60°C to +85°C)
Bend Performance:	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB/km @ 1550 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.10 dB/km @ 1550 nm (32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise ≤ 0.50 dB/km

2.1.2 Fibre Optic Cable Construction

The OPGW (Optical Ground Wire) cable is to be installed on the transmission lines in place of Earth wire for 765/400/220/132kV lines. The design of cable shall account for the varying operating and environmental conditions that the cable shall experience while in service. The OPGW cable to be supplied shall be meeting the design parameters specified in Technical Specifications.

2.1.2.1 Optical Fibre Cable Lengths in Customised or Standard drums

(a) Supply in Customised Drums:

The estimated optical fibre cable length for F.O. link(s) shall be inclusive of cable length required to meet OPGW sag which is not more than 1% of the route length. Other such as splicing lengths (upto 10m per OPGW drum), loop length (upto 10m per OPGW drum), tower heights/down lead length (as per actuals) are included in the actual length.

Contractor shall supply the OPGW cable in customised drum lengths preferably as mentioned below:

(i) 3km to 3.5km drum size for 765kV voltage lines.

(ii) 4km to 5km drum size for 400kV and below voltage lines in plain terrain and 3km to 3.5km drum size for hilly terrain lines for all voltage levels.

Contractor to preplan termination/ splicing of OPGW on tension towers based on approved tower schedule provided by POWERGRID during detailed engineering. In case of constraints, termination/ splicing of OPGW at Suspension towers may be accepted in consultation with Project Manager.

(b) Supply in Standard Drums:

The estimated optical fibre cable length for F.O. link(s) are provided in BPS considering 5% for plain and 7% for hilly areas over and above route length of the transmission line. The permissible extra consumption is inclusive of cable length required to meet OPGW sag which is not more than 1% of the route length. Other such as splicing lengths (upto 10m per OPGW drum), loop length (upto 10m per OPGW drum), tower heights/down lead length (as per actuals), wastages (if any) are included in the actual length.
The contractor shall supply the OPGW cable in standard drum length mostly in 5 km (with ±5% tolerance) for plain terrain & 3 km (with ±5% tolerance) for hilly terrain in consultation with Project Manager.
For 765kV voltage lines, Standard Drum size of 3km (with ±5% tolerance) may be preferred for Standard Drum BoQ.

BoQ for Supply of OPGW & its associated items (i.e. Hardware fittings, vibration dampers, Joint box, Approach cable & its installation hardware, FODP etc.) along with mandatory spares shall be released by Project Manager for purpose of supply in consultation with contracting agency.

2.1.2.2 Optical Fibre Identification

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 or IEC 60304 or Bellcore GR-20 colour-coding scheme.

Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing.

Each cable shall have traceability of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified number of fibres is included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

2.1.2.3 Optical Fibre Strain& Sag-Tension chart

The OPGW cable the optical fibres shall experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep. For the purpose of this specification, the following definitions shall apply:

- *Maximum Working Tension (MWT)* is defined as the maximum cable tension at which there is *no fibre strain*.

- The *no fibre strain* condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ ETSI (FOTP) specified optical reflectometry
- The *Cable strain margin* is defined as the maximum cable strain at which there is no fibre strain.
- The cable *Maximum Allowable Tension (MAT)* is defined as the maximum tension experienced by the Cable under the worst case loading condition.
- The cable *max strain* is defined as the maximum strain experienced by the Cable under the worst case loading condition.
- The cable *Every Day Tension (EDT)* is defined as the maximum cable tension on any span under normal conditions.
- The *Ultimate Tensile Strength (UTS/* breaking strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.

While preparing the Sag-tension charts for the OPGW cable the following conditions shall be met:

- The Max Allowable Tension (MAT) / max strain shall be less than or equal to the MWT/ Strain margin of the cable.
- The sag shall not exceed the earth wire sag in all conditions.
- The Max Allowable Tension shall also be less than or equal to 0.45 times the UTS.
- The 25 year creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 year creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
- The everyday tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The Sag-tension chart of OPGW cable indicating the maximum tension, cable strain and sag shall be calculated and submitted under various conditions mentioned below:

1. 53° C , no wind and no ice
2. 32° C, no wind and no ice
3. 0°C, no wind and no ice
4. 32° C, full wind and no ice
5. 32° C, 75% full wind and no ice
6. 0° C, 2/3rd / 36% of full wind (IS 802:1977 / 1995)

The above cases shall be considered for the spans from 100 m to 600 m or higher span length in the range of 50 m spans. Max. Vertical sag, max. tension and max sag at 0° C & no wind shall be considered in line with the design parameter of transmission line. The full wind load shall be considered as the design wind load for all the specified transmission lines as per relevant IS 802 version and the sag-tension chart shall be submitted considering the transmission lines.

2.1.2.4 Cable Materials

The materials used for optical fibre cable construction, shall meet the following requirements:

2.1.2.4.1 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC 60794-1-F-5.

The filling compound used shall be a non-toxic homogenous waterproofing compound that is free of dirt and foreign matter, non hygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

2.1.2.4.2 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

2.1.2.5 Marking, Packaging and Shipping

This section describes the requirements for marking, packaging and shipping the overhead fibre optic cable.

(a) Drum Markings: Each side of every reel of cable shall be permanently marked in white lettering with the vendors' address, the Purchaser’s destination address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line & segment no., factory inspection stamp and date.

(b) Cable Drums and Packing: The OPGW shall be supplied in returnable steel drums for main supply & non-returnable steel drums for spare supply. These painted steel drums shall be corrosion free, shall be of adequate strength, and constructed to protect the OPGW against all damage and displacement during transit, storage ,subsequent handling & stringing operations in the field.The supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The ownership of the empty OPGW drums shall lie with the OPGW supplier who shall ultimately take back the empty OPGW drums Both ends of the cable shall be sealed as to prevent the escape of filling compounds and dust & moisture ingress during shipment and handling. Spare cable caps shall be provided with each drum as required.

There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on standard drum length.

2.1.3 Optical Ground Wire (OPGW) construction

OPGW cable construction shall comply with IEEE-1138, 2021. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose.

2.1.3.1 OPGW design

Buffer Tube

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel. The individually coated optical fibre(s) shall be provided directly in stainless steel tube in case stainless steel tube design.

(a) Central Aluminium tube type

The composite fibre optic overhead ground wire shall be made up of multiple buffer tubes embedded in a water tight aluminium/aluminium alloy protective central fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. Each buffer tube shall have maximum 12 no. of fibres. All fibres in single buffer tube or directly in central fibre optic unit is not acceptable. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre.

(b) Central Stainless Steel tube type

The composite fibre optic overhead ground wire shall consist of a central fibre optic unit made up of stainless steel with aluminium coating/tube surrounded by concentric-lay stranded metallic wires in single or multiple layers. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre

Central Fibre Optic Unit

(a) Central Aluminium tube type

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibre units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning and fault current, as well as environmental effects which may produce hydrogen.

The OPGW design of dissimilar materials for stranded wires and tubes are not allowed. Central fibre optic unit may be of aluminium / aluminium alloy tube. There shall be no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions, etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

(b) Central Stainless Steel tube type

The central fibre optic unit shall be designed to house and protect optical fibres provided in single buffered tube of stainless steel tube from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning and fault current, as well as environmental effects which may produce hydrogen.
The OPGW design of dissimilar materials for stranded wires and tubes are not allowed. Central fibre optic unit shall be of stainless steel tube with aluminium protective coating or stainless steel tube with Al protecting outer tube. In case of aluminium protective coating, the coating must completely cover the tubes leaving no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions, etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

2.1.3.2 OPGW Parameters to be considered for different line voltage and wind zones

Transmission Line Voltage and wind zone	OPGW Cable Parameters						
	UTS (Kg)	Area (sqmm)	Wt. (Kg/m)	Dia.(mm)	Modulus of Elasticity (Kg/sqmm)	Coeff. Of linear Expansion (per deg C)	Central Fibre optic unit design
765 kV S/C & D/C WZ 1-4 765kV S/C & D/C WZ 5 400kV M/C WZ 1-5 400kV S/C & D/C WZ 1-5	9350± 150	56.5± 2.5	0.45± 0.01	12 ± 0.2	14290±110	0.0000138± 0.0000003	Al tube*
765 kV WZ 5	9098± 150	57.5±2.5	0.49 ± 0.01	11.5 ± 0.2	14114 ± 110	0.0000136 ± 0.0000003	Stainless Steel Tube
220 kV S/C & D/C WZ 1-4 132kV **S/C &** D/C WZ 1-5	7376±50	51±2	0.355±.01	11.4 ± .02	12344±100	0.0000149± 0.0000003	Al Tube*

Transmission Line Voltage and wind zone	OPGW Cable Parameters						
	UTS (Kg)	**Area (sqmm)**	**Wt. (Kg/m)**	**Dia.(mm)**	**Modulus of Elasticity (Kg/sqmm)**	**Coeff. Of linear Expansion (per deg C)**	**Central Fibre optic unit design**
River Crossing Section	20059±100	118±5	0.884±0.01	14.7 ± 0.2	16355±100	0.0000127± 0.0000003	Stainless Steel Tube
800kV HVDC	10369.0112	72.66	0.5719	13.5	13788.99	0.00001404	Al tube*
	Or suitable to tower design				Or suitable to tower design		
Special cable (For Ladakh WZ-6 with snow, 25mm snow in Arunachal Pradesh, high UTS special applications, etc)	15316 to 15300.72	90.50 to 107	0.715 to 0.750 (Mass tolerance of 2%)	13.6 (tolerance of 3%)	15973.4 to 15989	0.0000125	Stainless Steel Tube

*-Note: In case of 96Fiber OPGW, Stainless Steel tube is also acceptable.

For Al tube & Stainless steel tube design details refer clause 2.1.3.1 above.

Basic Construction

The OPGW cable construction shall conform to the applicable requirements of this specification, applicable clauses of IEC 61089 related to stranded conductors and Table 2.2(a) OPGW Mechanical and Electrical Characteristics. In addition, the basic construction shall include bare concentric-lay-stranded metallic wires with the outer layer having left hand lay. The wires may be of multiple layers with a combination of various metallic wires within each layer. The direction of lay for each successive layer shall be reversed. The finished wires shall contain no joints or splices unless otherwise agreed to by the Employer and shall conform to all applicable clauses of IEC 61089 as they pertain to stranded conductors.

The wires shall be so stranded that when the complete OPGW is cut, the individual wires can be readily regrouped and then held in place by one hand.

Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength.

The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the

total rated breaking strength of the composite conductor.

Electrical and Mechanical Requirements

Table 2-2(a) provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics.

Table 2.2(a)

OPGW Electrical and Mechanical Requirements

(1)	Everyday Tension	≤ 20% of UTS of OPGW
(2)	D.C. Resistance at 20ºC:	< 1.0 ohm/Km
(3)	Short Circuit Current	≥ 6.32 kA for 1.0 second (for 220 kV & above lines) ≥ 5.6 kA for 1.0 second (for 132 KV & 66KV lines) Short Circuit shall be applicable as per the Voltage level of the lines

2.1.4 Installation Hardware

Installation Hardware includes all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps, splice enclosure etc. The estimated quantity for hardware fittings are provided in BPS. Initially 70% of total hardware shall be supplied based on quantities in BPS or as directed by Project Manager and balance 30% shall be supplied as directed by Project Manager.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284: 1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e. level 1 drawing and (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

(a) Suspension Assemblies: Preformed armour grip suspension clamps and aluminium alloy armour rods/ reinforcing rods shall be used. The suspension clamps shall be designed to carry a vertical load of not less than 25 KN. The suspension clamps slippage shall occur between 12kN and 17 kN as measured. For river crossing and special transmission lines (where heavier earthwire used e.g. 7/4.5) OPGW installation hardware design slippage shall occur between 9% and 14% of UTS of OPGW.

The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, etc. The total drop of the suspension assembly shall not exceed 150 mm (measured from the centre point of attachment to the centre point of the OPGW). The design of the assembly shall be such that the direction of run of the OPGW shall be the same as that of the conductor.

(b) Dead End Clamp Assemblies: All dead end clamp assemblies shall preferably be of performed armoured grip type and shall include all necessary hardware for attaching the assembly to the tower strain plates. Dead end clamps shall allow the OPGW to pass through continuously without cable cutting. The slip strength shall be rated not less than 95% of the Ultimate tensile strength of the OPGW.

(c) Clamp Assembly Earthing Wire: Earthing wire consisting of a 1500 mm length of aluminium or aluminium alloy conductor equivalent in size to the OPGW shall be used to earth suspension and dead end clamp assemblies to the tower structure. The earthing wire shall be permanently fitted with lugs at each end. The lugs shall be attached to the clamp assembly at one end and the tower structure at the other.

(d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves for the OPGW, one on either side of the connecting bolt. The clamps shall be such that clamping characteristics do not alter adversely when only one OPGW is installed. The tower attachment plates shall locate the OPGW on the inside of the tower and shall be attached directly to the tower legs/cross-members without drilling or any other structural modifications.

(e) Tension Fitting for Suspension Tower**:** The OPGW cable sections shall also be terminated & spliced or pass through(as an interim arrangement) on suspension towers as per requirement. For this, a special fitting namely Yoke plate alongwith tension fittings shall be provided for termination/jointing of OPGW on Suspension tower. Typical drawing of suspension fitting where cable may be terminated on suspension tower is given in Appendices.

(f) Vibration Dampers: Vibration dampers type 4R Stockbridge or equivalent, having four (4) different frequencies spread within the Aeolian frequency bandwidth corresponding to wind speed of 1m/s to 7 m/s, shall be used for suspension and tension points in each span. The Contractor shall determine the exact numbers and placement(s) of vibration dampers through a detailed vibration analysis.

Two dampers minimum on each side per OPGW cable for suspension points and Three dampers minimum on each side per OPGW cable for tension points shall be used for nominal design span of 400 meters. For all other ruling spans, the number of vibration damper shall be as per manufacturer recommendation and damper placement chart.

The clamp of the vibration damper shall be made of high strength aluminum alloy of type LM-6. It shall be capable of supporting the damper and prevent damage or chaffing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the OPGW cable without damaging the strands or causing premature fatigue failure of the OPGW cable

under the clamp. The clamp groove shall be in uniform contact with the OPGW cable over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or other materials which could cause damage to the OPGW cable when the clamp is installed. Clamping bolts shall be provided with self locking nuts and designed to prevent corrosion of threads or loosening in service.

The messenger cable shall be made of high strength galvanised steel/stain less steel. It shall be of preformed and post formed quality in order to prevent subsequent droop of weight and to maintain consistent flexural stiffness of the cable in service. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS: 4826 for heavily coated wires.

The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blow holes etc. The surface of the damper masses shall be smooth.

The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses made of material other-than zinc alloy shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion. The damper mass made of zinc alloy shall be casted over the messenger cable and have sufficient and permanent grip on the messenger cable under all service conditions.

The contractor must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 kN and 5 kN. The clamp when installed on the OPGW cable shall not cause excessive stress concentration on the OPGW cable leading to permanent deformation of the OPGW strands and premature fatigue failure in operation.

The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed in Technical Specification, shall have to be submitted. The technical particulars for vibration analysis and damping design of the system are as follows:

Sl. No.	Description	Technical Particulars
1	Span Length in meters (i) Ruling design span: (ii) Maximum span: (iii) Minimum Span:	400 meters 1100 meters 100 meters
2	Configuration:	As per Specifications
3	Tensile load in each:	As per sag tension calculations
4	Armour rods used:	Standard preformed armour rods/AGS
5	Maximum permissible dynamic strain:	+/- 150 micro strains

The damper placement chart for spans ranging from 100m to 1100m shall be submitted by the Contractor. Placement charts should be duly supported with sample calculations and manufacturer recommendation.

The damper placement charts shall include the following

(1) Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per OPGW cable per span.

(2) Placement distances clearly identifying the extremities between which the distances are to be measured.

(3) Placement recommendation depending upon type of suspension clamps (viz Free center type/Armour grip type etc.)

2.1.5 Fibre Optic Splice Enclosures (Joint Box)

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply with ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of required number of optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. No more than 12 fibres shall be terminated in a single splice tray. Minimum number of 04 splice trays shall be provided in a Joint Box. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures.

Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. The actual mounting height and location shall be finalised after Survey

2.1.5.1 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful Contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

(a) All fibre splices shall be accomplished through fusion splicing.

(b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.

(c) All splices and bare fibre shall be neatly installed in covered splice trays.

(d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.

(e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

2.1.6 Fibre Optic Approach Cables

For purposes of this specification, a fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length requirements are indicated in the BoQ. Actual supply to be done as per directives of Project Manager.

2.1.6.1 Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways

2.1.6.2 Jacket Construction & Material

The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall conform to ASTM D1248 for density.

2.1.6.3 Optical, Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

2.1.6.4 Fibre Optic Approach cable Installation hardware

The required GI pipe (light grade) of suitable size (minimum 32mm), conforming to IS 1239 or BS 1378, along with required bends, joints, conduit etc. required for laying and installation of approach cable shall be supplied and installed by the Contractor.

2.1.7 Fibre Optic Distribution Panel

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

(a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to pre-connectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings.

(b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations. No more than 12 fibres shall be terminated in a single splice tray.

(c) FODPs shall be supplied in suitable cabinets/racks with locking arrangement. The dimension of FODP cabinet shall be minimum 2200mm x 600mm x 600mm (HxWxD) and shall meet or exceed ingress protection class IP55 specifications.

(d) All FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded.

(e) Flexible protection shall be provided to the patch cord bunches going out from FODP to other equipment.

2.1.8 Optical Fibre Connectors

Optical fibres shall be connectorised with FC-PC type connectors preferably. Alternatively connector with matching patch cord shall also be acceptable. Fibre optic couplings supplied with FODPs shall be appropriate for the fibre connectors to be supported. There shall be no adapters.

2.1.9 Check points to be insured during OPGW installation in sections having crossing of transmission lines

In case of crossing locations of power transmission lines (over/under/ diamond configuration), prior measurement of clearances such as between existing earth wire of lower transmission line with bottom conductor of upper transmission line, etc. is to be surveyed by contractor. Post survey, contractor to submit the proposal to employer's project manager for approval before OPGW installation. In case diamond crossing is required, contractor with prior permission of project manager shall set up the same while maintaining clearances at such location(s) in liveline/offline condition without any additional cost to employer to avoid trippings during or post installation. This provision will also be applicable during of installation of OPGW for repeater links. Minimum clearances are specified in the Live Line OPGW installation guidelines.

……..……..…End of this Section……...