

220 kV Transmission Line GTPs

Functional Guarantee and Technical Particulars	Required	Proposed by the Bidder
Minimum factors of safety to be applied to assumed simultaneous maximum loadings		
Line and earth conductors, based on ultimate strength	2.5	
Line and earth conductors at everyday temperature, still air, based on ultimate strength	5.0	
Complete insulators and fittings	2.5	
Steel supports, foundation structures, based on elastic limit of members in tension and on crippling loads of compression members, or on tests on complete supports (but not tests on the foundations):		
Suspension supports		
a. Normal conditions	2.5	
b. Unbalanced conditions (except cascade)	1.5	
c. Cascade collapse condition	1.0	
Tension supports		
a. Normal conditions	2.0	
b. Unbalanced conditions	1.5	
Foundations		
a. Normal conditions	2.5	
b. Unbalanced conditions	1.75	
Maintenance and Erection	2.0	
Particulars of spans		
Basic span	380 m	
Maximum sum of adjacent spans	880 m	
Maximum single span	600 m	
Wind span for tower design		
a. Tension towers	450 m	
Maximum weight spans		
a. Tension towers	900 m	
Minimum weight spans (for design purposes)		
a. Tension towers (uplift net)	- 450 m	
Particulars of line conductors and fittings		
Nominal area per conductor	455 mm ²	
Numbers of conductors per phase	2 nos.	
Distance between conductor centres of one phase	400 mm	
Conductor code name	ACSR Condor	
Applicable standard	IEC 61089	
Applicable standard (Metric system, Condor)	ASTM B 232	
Material of conductor	Aluminum/ Galvanised steel	

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Numbers and diameters of wires	Al 54/3.08 St 7/3.08 (No/mm)	
Overall diameter of stranded conductor	27.73 mm	
Resistance of conductor (dc) at 20deg.C	0.07173 ohm/km	
Mass of conductor (without grease)	1,522 kg/km	
Total mass of greased conductor (greased to Case 2 of IEC 61089)	- Kg/km	
Ultimate rated strength of conductor	125,440 Newton	
Maximum tension of conductor in still air at "everyday" temperature 25deg.C	25,088 Newton	
Assumed equivalent modulus of elasticity of conductor	68,650 N/mm ²	
Assumed equivalent coefficient of linear expansion of conductor	1.93 x 10 ⁻⁵ per deg.C	
Maximum length of conductor on drum	3 km	
Conductor grease		
Type		
Minimum drop-point temperature	120 deg.C	
Mass of grease per kilometre of conductor (all inner layers greased – Case 2 to IEC 61089)	- kg	
Vibration damping system		
Type of system (vibration damper + spacer or spacer damper)	Stockbridge type	
Type of vibration damper (if proposed and used)		
Standard applied	IEC 61897	
Conductor diameter range	- mm	
Mass of damper	- kg	
Maximum span length for		
a. One vibration damper at each end of span (2 in the span)	- m	
b. Two vibration dampers at each end of span (4 in the span)	- m	
c. Three vibration dampers at each end of span (6 in the span)	- m	
Distances from clamp mouth to vibration damper attachment		
a. First damper	- m	
b. Second damper when required	- m	
c. Third damper when required	- m	
Spacer or spacer damper		
Type of spacer or spacer damper		
Standard applied	IEC 61854	
Conductor diameter range	- mm	
Mass	- kg	
Symmetrical or asymmetrical in-span spacing		
Maximum sub-span length (distances between spacers)		
Particulars of earth conductor and fittings		

Functional Guarantee and Technical Particulars	Required	Proposed by the Bidder
Number of ACS earth conductors	1 no.	
International Standard No. applied	ASTM B416	
Material of earth conductor	Aluminium clad steel (ACS)	
Number and diameter of wires	7/3.26 No/mm	
Total area of earth conductor	58.6 mm ²	
Overall diameter of earth conductor	9.78 mm	
Mass of earth conductor	390 kg/km	
Ultimate strength of earth conductor	71,000 Newton	
Maximum tension of earth conductor in still air at "everyday" temperature	- Newton	
Assumed equivalent modulus of elasticity of earth conductor	162,000 N/mm ²	
Assumed equivalent coefficient of linear expansion of earth conductor	12.96 x 10 ⁻⁶ per deg.C	
Minimum bending radius	- mm	
Minimum length of earth conductor on drum	4 km	
Individual wires before stranding		
Standard for Aluminium-clad steel	ASTM B415	
a. Grade of steel	20SA	
Vibration damping system for earth conductor		
Maximum span for		
a. One vibration damper at each end of span (2 in the span)	- m	
b. Two vibration dampers at each end of span (4 in the span)	- m	
c. Three vibration dampers at each end of span (6 in the span)	- m	
Particulars of OPGW and fittings		
Number of OPGW earth conductors	1 no.	
International Standard applied	IEEE 1138 IEC60794-4	
Material of OPGW conductors	Aluminium Alloy/ Aluminium clad steel	
Number and diameter of wires	- No/mm	
Total area of OPGW conductor	- mm ²	
Overall diameter of OPGW conductor	- mm	
Mass of OPGW conductor	< 850 kg/km	
Ultimate strength of OPGW conductor	>= 93,000 Newton	
Maximum tension of OPGW conductor in still air at "everyday" temperature 25 deg.C	> 18,500 Newton	
Assumed equivalent modulus of elasticity of OPGW conductor	>= 70,000 N/mm ²	
Assumed equivalent coefficient of linear expansion of OPGW conductor	<= 1.98 x 10 ⁻⁵ per deg.C	
Minimum bending radius	- mm	

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Short circuit current rating	496 kA ² s	
Minimum length of OPGW conductor on drum	4 km	
Individual wires before stranding		
Aluminium alloy Standard applied	IEC 60104	
Minimum conductivity of aluminium wires at 20deg.C	52.5 % IACS	
Aluminium-clad steel Standard applied	IEC 60232	
Grade of Steel	20SA	
Vibration damping system of OPGW		
Maximum span for		
a. One vibration damper at each end of span (2 in the span)	- m	
b. Two vibration dampers at each end of span (4 in the span)	- m	
c. Three vibration dampers at each end of span (6 in the span)	- m	
Particulars of Fibre Optic Transmission System		
Type of Fibre optic data	Non-Zero Dispersion- Shifted Single-Mode as per ITU-T G.655	
Wavelength	1550/1625 nm	
Number of fibres	48 nos.	
Transmission attenuation		
a. at 1550 nm	< 0.22 dB/km	
b. at 1625 nm	< 0.24 dB/km	
Transmission bandwidth	> 10,000 MHz/km	
Fibre identification by	Colour code	
Chromatic dispersion		
a. at 1550 nm	< 2 ps/nm.km	
b. at 1625 nm	<12.4 ps/nm.km	
Splicing loss	< 0.1 dB	
Polarisation Mode Dispersion (PMD)	< 20 √ km	
Minimum bending radius	- mm	
Particulars of Insulators and fittings		
Type of Insulator units	Long rod polymeric insulator	
Suspension units		
Shed profile	Aerodynamic, Compression (One-piece) molding type	
Appropriate IEC Number	IEC 61109	
Material	High temperature vulcanization silicone elastomer	

Functional Guarantee and Technical Particulars	Required	Proposed by the Bidder
Coupling		
a. Standard applied	IEC 60120	
b. Type	Ball/Socket	
c. Size (recommended only)	16 mm	
Minimum failing load of unit	210 kN	
Outside diameter:	- mm	
Mass of unit	- kg	
Minimum dry lightning impulse withstand voltage (1.2/50 μ s, negative)	1323 kV	
Minimum dry lightning impulse withstand voltage (1.2/50 μ s, positive)	1323 kV	
Minimum dry power frequency withstand voltage (1 min.)	823 kV	
Minimum wet power frequency withstand voltage (1 min.)	621 kV	
Creepage distance	10160 mm	
Tension units		
Shed profile	Aerodynamic, Compression (One-piece) molding type	
Appropriate IEC Number	IEC 61109	
Material	High temperature vulcanization silicone elastomer	
Coupling		
a. Standard	IEC 60120	
b. Type	Ball/Socket	
c. Size (recommended only)	16 mm	
Minimum failing load	210 kN	
Outside diameter	- mm	
Mass of unit	- kg	
Minimum dry lightning impulse withstand voltage (1.2/50 μ s, negative)	1323 kV	
Minimum dry lightning impulse withstand voltage (1.2/50 μ s, positive)	1323 kV	
Minimum dry power frequency withstand voltage (1 min.)	823 kV	
Minimum wet power frequency withstand voltage (1 min.)	621 kV	
Creepage distance	10160 mm	
Particulars of Insulator set complete		
Suspension sets		
Number of insulator strings in parallel	1 and 2	
Minimum failing load, complete set (double string)	2 x 210 kN	
Minimum failing load, complete set (single string)	1 x 210 kN	
Overall length of set including clamps and all fittings	- mm	

Functional Guarantee and Technical Particulars	Required	Proposed by the Bidder
Arcing Gap (recommended only)	2720 mm	
Mass of set, complete with all fittings	- kg	
Overall length of creepage path per string	10160 mm	
50 Hz voltage tests All withstand voltage levels corrected from 2500 m altitude at site to test voltages under normal temperature and pressure in accordance with BS 137 and IEC 60383.		
a. One minute dry withstand voltage of complete set	823 kV	
b. One minute wet withstand voltage of complete set :	621 kV	
50% Impulse withstand voltage tests All withstand voltage levels corrected from 2500 m altitude at site to test voltages under normal temperature and pressure in accordance with BS 137 and IEC 60383.		
a. 1.2/50 μ s negative wave:	1323 kV	
b. 1.2/50 μ s positive wave:	1323 kV	
Corona test voltage	- kV	
Set RI test voltage	- kV	
Set radio noise level	45 dB	
Tension sets		
Number of insulator strings in parallel	2	
Elastic limit load of set fittings:		
a. Common to each string	- kN	
b. Common to conductor	- kg	
c. Separate for each sub-conductor	- kg	
Minimum failing load, complete set	2 x 210 kN	
Overall length of set including clamps and all fittings	- mm	
Arcing Gap (recommended only)	2720 mm	
Mass of set, complete with all fittings	- kg	
Overall length of creepage path per string	10160 mm	
50 Hz voltage tests All withstand voltage levels corrected from 2500 m altitude at site to test voltages under normal temperature and pressure in accordance with BS 137 and IEC 60383.		
a. One minute dry withstand voltage of complete set	823 kV	
b. One minute wet withstand voltage of complete set :	621 kV	
50% Impulse withstand voltage tests All withstand voltage levels corrected from 2500 m altitude at site to test voltages under normal temperature and pressure in accordance with BS 137 and IEC 60383.		
a. 1.2/50 μ s negative wave:	1323 kV	
b. 1.2/50 μ s positive wave:	1323 kV	
Corona test voltage	- kV	
Set RI test voltage	- kV	
Set radio noise level	45 dB	
Earth conductor sets		
Minimum failing load		

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a. Suspension set	- kN	
b. Tension set	- kN	
Particulars of Tower Design		
Maximum tension per phase, for purposes of tower design		
a. Tension towers	- N	
b. Downleads per conductor bundle	- N	
Maximum tension per earth conductor for purpose of tower design and application: ACS Earthwire		
a. Tension towers	- N	
b. Earth conductor downleads	- N	
Maximum tension per earth conductor for purpose of tower design and application: OPGW		
a. Tension towers	- N	
b. OPGW downleads	- N	
Minimum clearance between live metal and tower steelwork:-		
a. with suspension insulator set swing, at 65°	- mm	
b. with suspension insulator set swing, 0 - 10°	- mm	
c. with suspension insulator set swing 10 - 35°	- mm	
Minimum clearance to steelwork on which a man may stand for live line maintenance (crossarm floor)	- m	
Downleads – minimum clearances:		
a. phase to phase clearance in still air	- mm	
b. phase to phase clearance under conditions of maximum (opposing) swing and sag	- mm	
Earth conductor suspension clamps, unobstructed transverse swing angle from vertical	- deg.	
Earth conductor maximum shielding angle from vertical at tower attachment point over outer line conductors	- deg.	
Maximum ratio of unsupported length of steel compression member to their least radius of gyration:		
a. Main members	120	
b. Stressed bracings	200	
c. Unstressed bracings	250	
d. Tension only members	500	
Maximum ultimate stresses, for checking tower designs not subjected to test (unless otherwise approved):-		
Mild Steel		
a. Compression members, Tenderer to indicate his design assumptions	ASCE 10-97	
b. Tension members (elastic limit)	220 N/mm ²	
c. Shear on bolts Bolt Grade 5.6	- N/mm ²	
d. Material Bearing	- N/mm ²	
High Yield Steel:		
a. Compression members, Bidders to indicate his design assumptions	ASCE 10-97	
b. Tension members (elastic limit)	325 N/mm ²	

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c. Shear on bolts	Bolt Grade 8.8	- N/mm ²	
d. Material Bearing		- N/mm ²	
Particulars of Double Circuit Towers			
Type of Tower		220T10bb	
Type of insulator sets		Tension	
Angles of deviation		0 - 10 deg.	
Basic span length		- m	
Minimum ground clearance of line conductor at 80deg.C, normal ground		- m	
Sag of line conductor in span length at 80deg.C		- m	
Maximum distance of line conductor below crossarm		- m	
Height above ground of bottom conductor crossarm (Standard height tower)		- m	
Minimum height of earth conductors above upper line conductor at tower		- m	
Minimum horizontal spacing between adjacent conductors		- m	
Vertical spacing between line conductors at tower		- m	
Overall tower height (Standard height tower)		- m	
Maximum differential, foundation movement permitted under ultimate loads		- mm	
Clearance between conductors of one circuit and tower climbing leg of the other circuit:		- m	
Horizontal distance, from tower centre line to insulator attachments		- m	
Horizontal distance, from tower centre line to earth conductors		- m	
Tower body dimensions at bottom crossarm level (transverse x longitudinal)		- m x - m	
Overall tower base dimensions at ground line (transverse x longitudinal):		- m x - m	
Total transverse overturning moment at ground line of standard height tower, load case 1 (normal) with factor of safety		- kN-m	
Mass of complete tower above ground line			
a. Minus 3 metre height tower		- kg	
b. Standard height tower:		- kg	
c. 3 metre extended tower		- kg	
d. 6 metre extended tower		- kg	
e. 9 metre extended tower		- kg	
f. 12 metre extended tower		- kg	
Particulars of Quality of Tower Materials			
Steel members			
Grade/standard:		EN 10025-2	
a. Mild steel		S235	
b. High tensile steel		S355	

Functional Guarantee and Technical Particulars	Required	Proposed by the Bidder
Tensile breaking stress:		
a. Mild steel	235 N/mm ²	
b. High tensile steel	355 N/mm ²	
Elongation on breaking		
a. Mild steel	- %	
b. High tensile steel	- %	
Yield point as percentage of breaking stress		
a. Mild steel	- %	
b. High tensile steel	- %	
Steel nuts and bolts		
Grade/standard:		
a. Mild steel	5.6	
b. High tensile steel	8.8	
Tensile breaking stress		
a. Mild steel	- N/mm ²	
b. High tensile steel	- N/mm ²	
Elongation on breaking		
a. Mild steel	- %	
b. High tensile steel	- %	