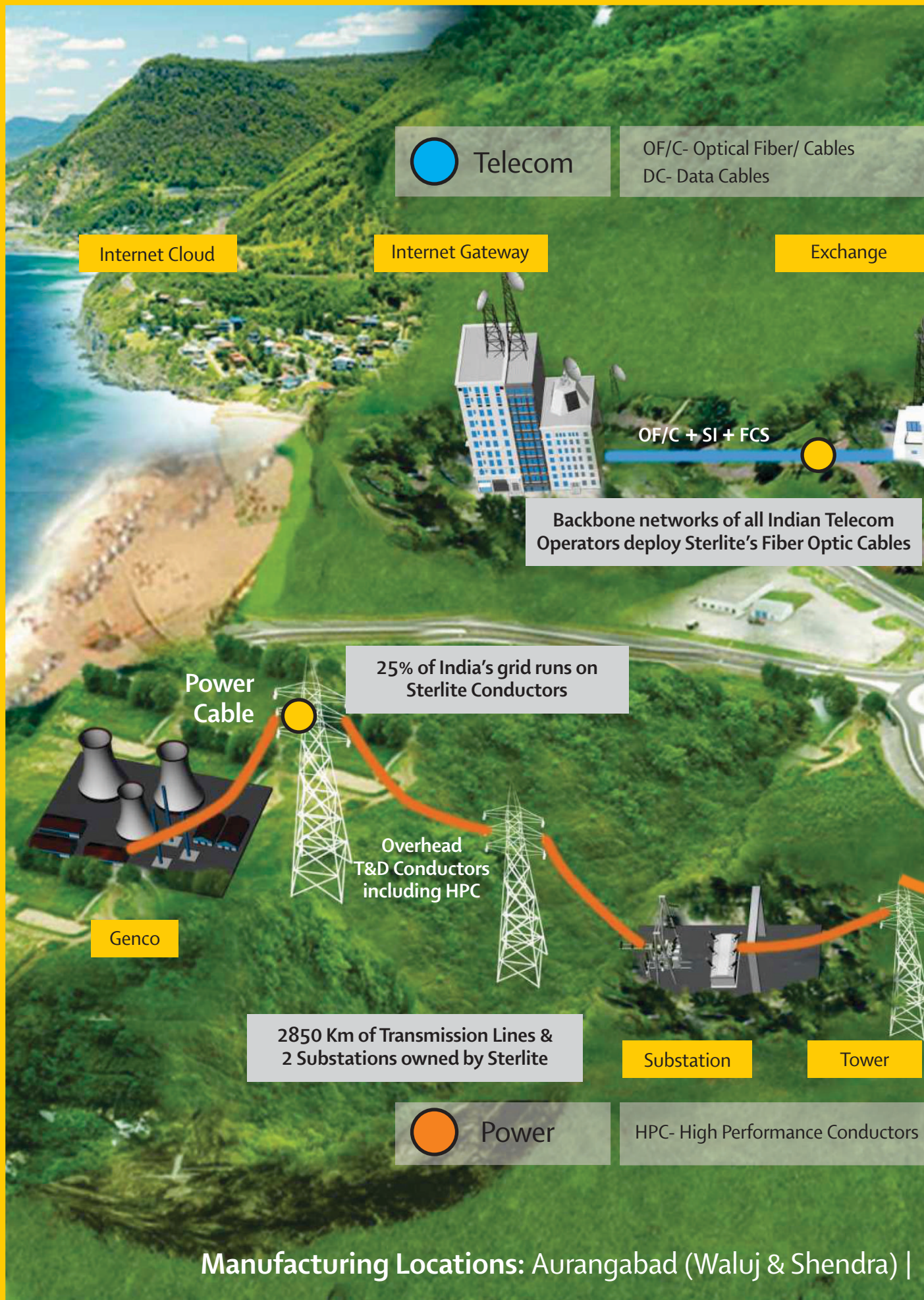




Optical Ground Wire

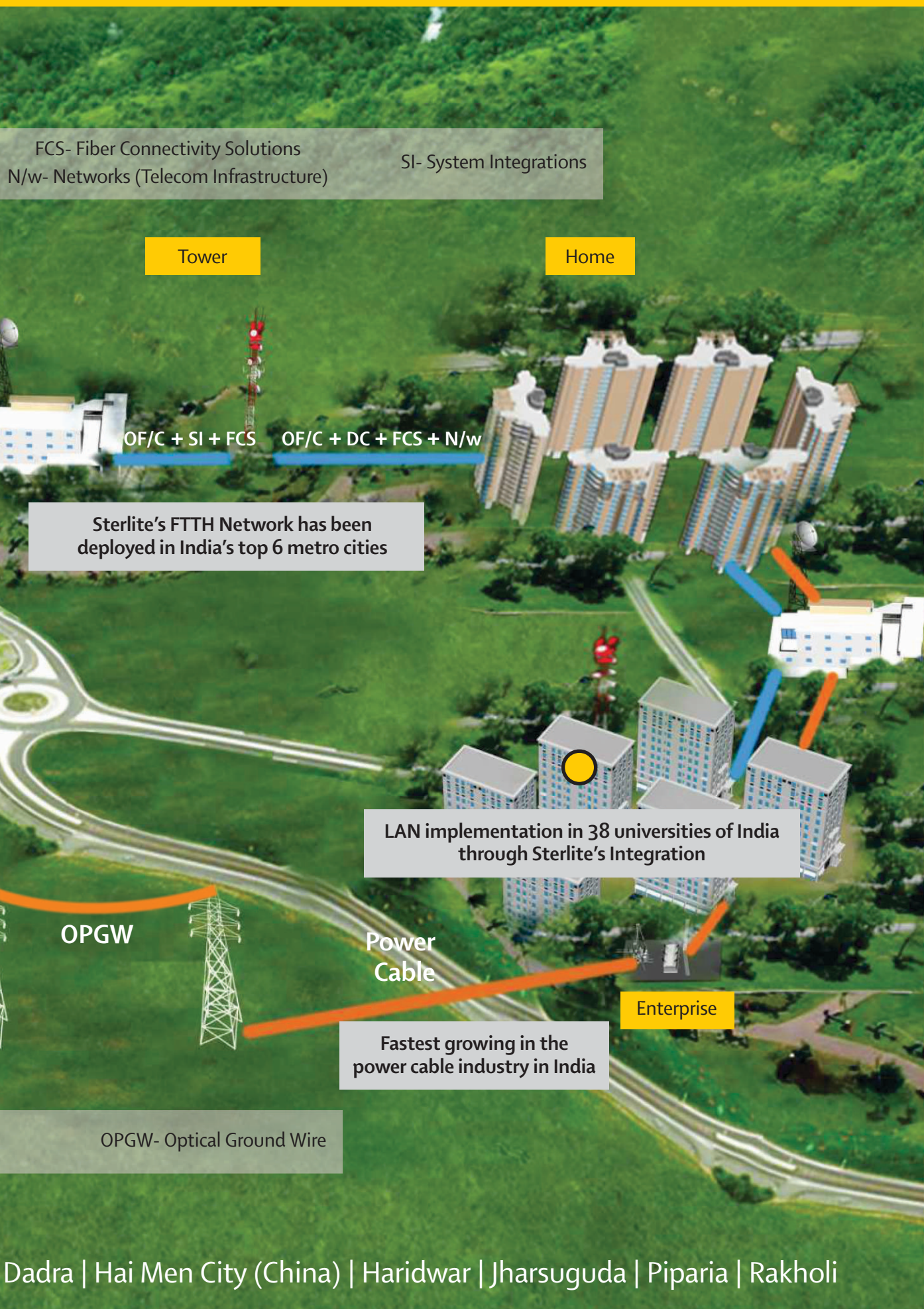
The Smart Energy Management Solution

Your Partners in High Speed



Connecting Every

Data and Energy Transmission



Dadra | Hai Men City (China) | Haridwar | Jharsuguda | Piparia | Rakholi

Home on the Planet

About Sterlite

Progress has been defined by a fundamental need for connectivity- connectivity between people, between places, of thoughts and of ideas. Power and Telecommunication are the two primary infrastructure platforms that have defined the progress of individuals, enterprises and nation.

Sterlite Technologies Limited facilitates progress across the planet, through connectivity- by making it faster, easier, and more cost-effective (for service providers) to build power and telecom networks. Sterlite does it through its suite of products, solutions and infrastructure.

Global Solutions

Sterlite Technologies Limited is a leader in providing transmission solutions for the power and telecom industry, globally. Equipped with a comprehensive portfolio that includes products such as overhead transmission & distribution conductors, high performance conductors, OPGW, power cables, optical fibers, telecommunication cables, solutions for system integration, fiber connectivity and building power & telecom infrastructure, Sterlite's vision is to "Connect every home on the planet". We are committed to providing the lowest per unit cost of energy transmission over the life cycle.

Positioned strongly in high growth geographies and high growth industries, we are recognized as one of the most cost-effective manufacturers in the world. This gives us a competitive edge to effectively address sales in our chosen focus markets. We have also invested in several projects for backward integration of our manufacturing processes, as well as forward integration of our technology solutions.

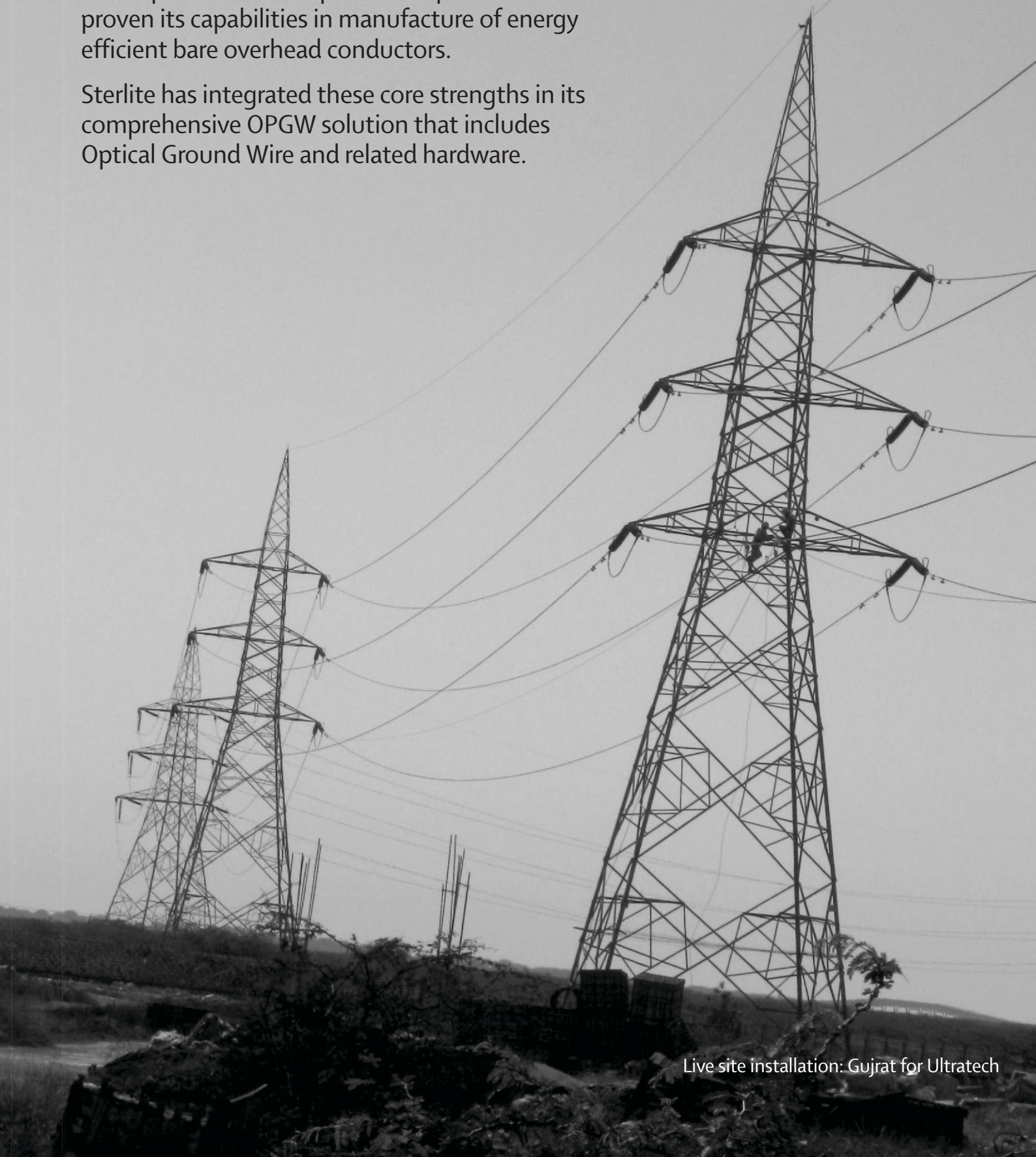
Today, Sterlite is the only company offering products for ultra high voltage power transmission and extra high speed data transmission. Our products are suitable for use in Power, Telecom, Defense, Aviation, Oil & Gas and Transportation sectors. Sterlite is also executing multi-million dollar power transmission system projects, pan-India and has been awarded three projects for building transmission lines and substations in India, as a developer, on a Build-Own-Operate-Maintain (BOOM) basis.

We share a common lineage with Vedanta Resources Plc., a globally diversified natural resources group.

Sterlite integrates its core expertise in fiber optic cables and bare overhead power conductors

Since the past two decades, Sterlite has developed technical expertise in optic fiber and proven its capabilities in manufacture of energy efficient bare overhead conductors.

Sterlite has integrated these core strengths in its comprehensive OPGW solution that includes Optical Ground Wire and related hardware.



Live site installation: Gujrat for Ultratech

Sterlite manufactures & installs OPGW for the first time in India

The smart energy management solution

Development of smart energy management systems is the need of the hour, aimed to alleviate the burgeoning demands from today's power infrastructures.

As the grid gets smarter, each part of the grid needs to communicate with each other more efficiently. For this, large volume of data needs to be transmitted over a long distance to different components of any grid faster. For achieving the desired results, optical fiber becomes the most efficient solution and for a transmission line owner/operator OPGW is the most preferred solution.

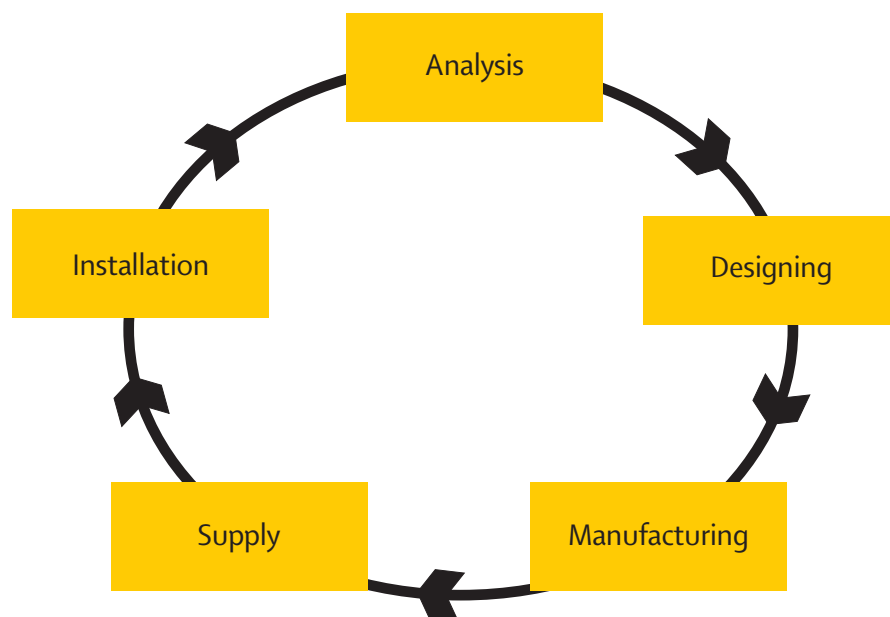
What is OPGW?

Optical Ground Wire (OPGW) is a revolutionary solution that enables synergies between efficient power distribution grids and high speed optical fiber based Supervisory Control and Data Acquisition (SCADA) networks, giving power utility companies the unique capabilities of a telecom carrier or service provider.

Advantages of OPGW

- ★ Replaces a conventional ground wire (or earth wire) to protect the transmission system from lightning strikes and serves as a conductive medium for carrying fault currents to ground
- ★ Acts as a medium for real-time monitoring and security of the transmission system over which it is installed- doubling up SCADA controls and network
- ★ Provides telecommunication capability utilizing the fibers

Scope of Service for OPGW Solution includes:



Sterlite OPGW Cables

Sterlite OPGW cables are made up of optical fibers contained in one or more protective fiber optic units combined with concentrically stranded metallic wires in single or multiple layers

Advanced technology is applied to produce stainless steel tubes which are then filled with a special hydrogen absorbent, theotropic filling compound and made resistant to high permeability due to the seam laser welded, hermetically sealed construction.

The cable is of compact structure reducing both the ice load and wind load and ensures quick dissipation of heat generated by short circuit.

The cable is designed to match the existing ground wires in more or less equal outer diameter and pulling force-to-weight ratio. Hence, the cable can replace the existing ground wire with no need to change the route or towers.

Sterlite's OPGW cable is produced strictly according to IEEE 1138, IEC60794 and relevant international standards pertaining to its construction.

Sterlite Approach Cables

As Sterlite is inclined towards providing a wholesome solution under one roof we provide the customers with the approach cables that connect the OPGW to the FODP (fiber optic distribution panel) in the substation. Sterlite being one of the largest Optical Fiber Cable (OFC) manufacturers in the world, can provide a wide range of OFCs for this requirement and the most commonly used approach cable is steel tape armored OFC.

Sterlite OPGW Hardware

The portfolio includes customized Suspension sets, Tension set assemblies, Vibration Dampers, Joint Boxes and Bonding Clamps

Sterlite Aerial-Lite™ OPGW Cable Series

01

Central Steel
Tube Design

02

Central Core Aluminium
Sheathed Tube Design

03

Aluminium Clad Central
Steel Tube Design

04

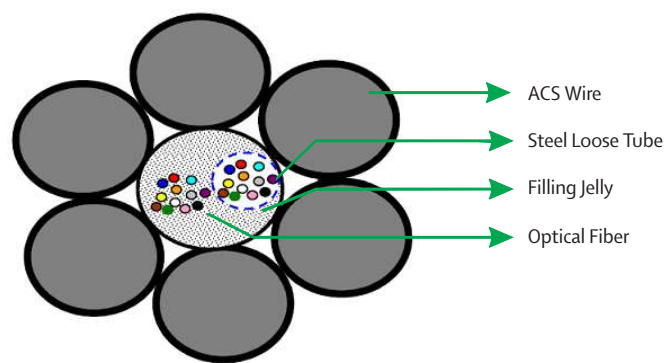
High Strength Design

05

High Fault
Current Design

Central Steel Tube Design

Sterlite AERIAL-LITE OPGW cable with central steel tube is a very simple, but robust design with a scope of upto 48 fiber counts and a solid design resulting in good protection to the fiber.

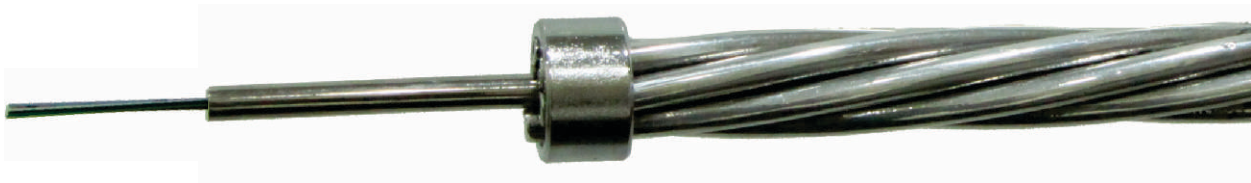


Product Features

- Optical Fibers are housed in a hermetically sealed, stainless steel tube filled with jelly
- High RTS of the cable
- Designed to have a larger stress-strain window to the fibers ensuring longevity of performance over the years
- The stranded wires can be customized in diameter, number or wires and conductivities or a combination of AA/AS wires is worked out to meet the individual customer requirements of electrical and mechanical properties

” A perfect solution for easy installation, short hauls and basic layouts which need minimum design complications ”

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA ² .sec	mm ²	inch ²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
48	40	81	0.1256	12.3	0.4843	490	0.33	64	18210	0.72	1.16
48	25	62	0.0961	10.9	0.4291	393	0.26	60	13488	0.66	1.06

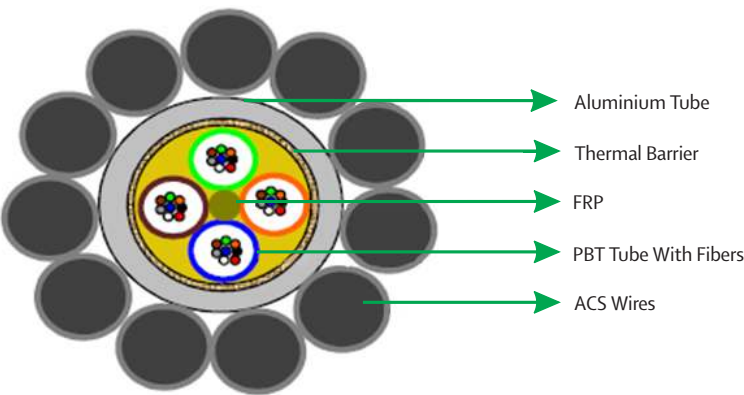


Central Core Aluminum Sheathed Tube Design

Sterlite AERIAL-LITE OPGW cable with central core aluminium sheathed design is made up of polymer loose tubes and the outer layer can be a suitable combination of ACS and AA wires for the right ratings as required by the end user.

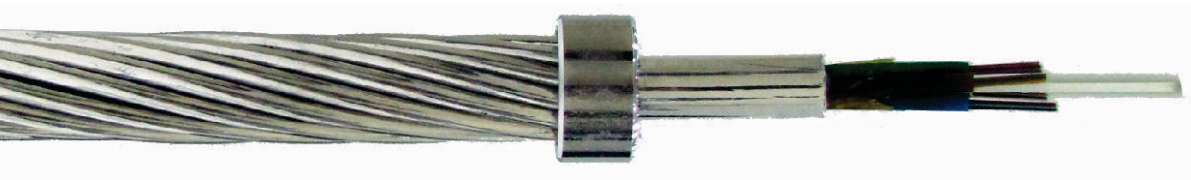
Product Features

- Ideal for very high fiber count requirements- fiber count upto 96 fibers
- Optical units sheathed with Aluminium which provides high mechanical protection for the fiber and excellent moisture proofing
- The extruded aluminium tube also adds to the fault current receptivity of the cable
- The stranded wires can be customized to the individual customer requirements of electrical and mechanical properties by adjusting AA/AS combination



“ This design is suitable for high fiber counts under high heat dissipation requirements. The cable is ideal for lower span lengths & distribution transmission lines ”

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA².sec	mm²	inch²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
48	40	77	0.1194	12.3	0.4843	485	0.33	79	17760	0.83	1.34
48	40	79	0.1225	10.9	0.4291	481	0.26	60	19783	0.83	1.34
48	44	92	0.1426	13.5	0.5315	657	0.26	60	26752	0.98	1.58
48	44	92	0.1426	13.5	0.5315	657	0.26	60	26752	0.98	1.58
48	395	173	0.2682	17.5	0.6890	725	0.26	60	22480	0.23	1.77
48	390	210	0.3255	19.1	0.7520	804	0.26	60	22480	0.18	1.96
96	298	194	0.3007	19.1	0.7520	762	0.26	60	22480	0.20	2.27

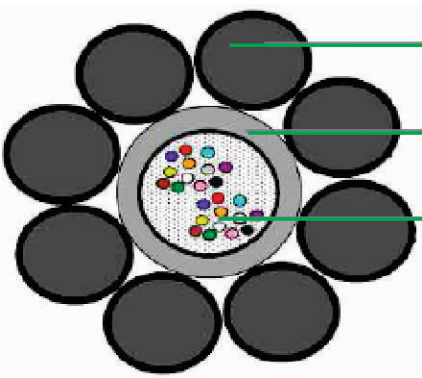


Aluminium Clad Central Steel Tube Design

Sterlite AERIAL- LITE OPGW cable with aluminium clad central steel tube is available in fiber counts upto 24 fibers and due to its unique small size, this becomes the perfect solution for overhead towers with its small diameter and light weight construction. The fibers are protected from environmental conditions to ensure reliability and long life.

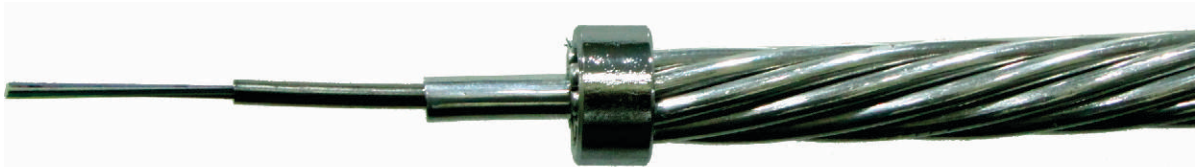
Product Features

- Very small, low weight cable resulting in low added load to the poles/towers
- Central tube provides mechanical and thermal protection for optical fibers
- High fault current rating with good crush resistance
- Obtaining the best balance of electric & mechanic performance by adjusting AA/AS combination
- The stranded wires can be customized to the individual customer requirements of electrical and mechanical properties by adjusting AA/AS combination. Single or dual layered designs available as per strength and fault current requirements



“ Ideal for installation in highly corrosive environments ”

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA².sec	mm²	inch²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
24	39	59	0.0915	12.5	0.4921	530	0.36	78	17535	0.9	1.45
24	47	65	0.1008	13.4	0.5276	545	0.37	88	19783	0.6	0.97
24	47	81	0.1256	11.8	0.4646	437	0.39	69	15511	0.6	0.97

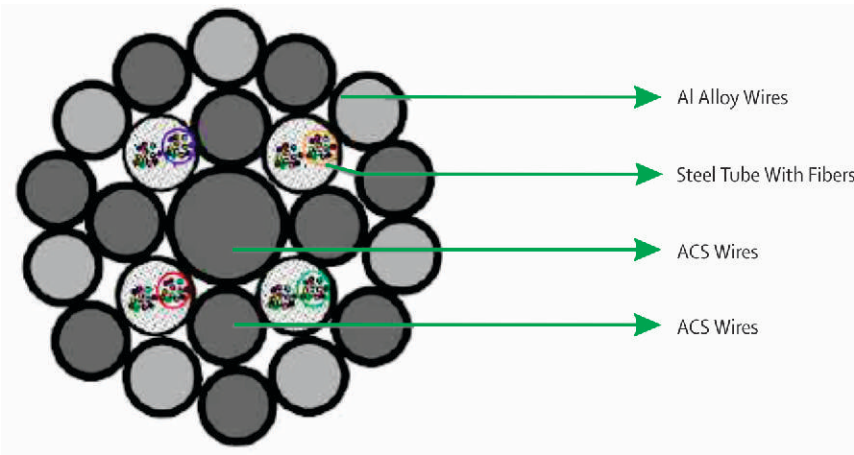


High Strength Design

Sterlite AERIAL-LITE high strength OPGW cable is available upto 96 fibers making it suitable for application i.e. high fiber count and super-high voltage power lines. Steel tubes are stranded with high strain steel wires to create a dual-layer design suitable for a range of high strength applications. The layer of aluminium gives the product a high fault rating current values.

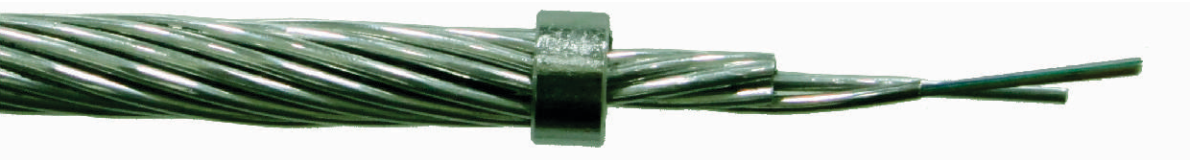
Product Features

- High fiber counts and flexible as per customers requirements
- Optimum stranding makes secondary fiber excess length available
- Laser welded stainless steel provides mechanical and thermal protection for optical fibers
- Have maximum allowable tension due to high cable strain as a result of its unique design
- High load and long span capabilities
- Each stainless steel tube is uniquely identified for organization at splice locations
- The stranded wires can be customized to the individual customer requirements of electrical and mechanical properties by adjusting AA/AS combination



“Ideal design for transmission lines above 400kV”

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA².sec	mm²	inch²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
24	41	82	0.1271	12	0.4724	420	0.28	81	18210	0.61	0.98
48	43	86	0.1333	12.5	0.4921	520	0.35	83	18659	0.73	1.16
96	82	100	0.1550	13.7	0.5394	548	0.37	96	21582	0.55	0.89

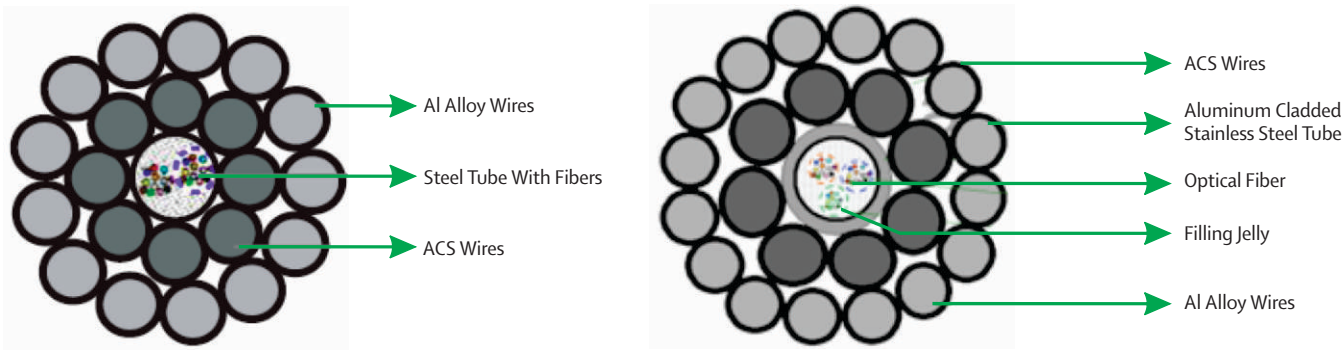


High Fault-Current Design

Sterlite AERIAL-LITE high fault-current OPGW cable is available upto 96 fibers making it suitable for application i.e. high fiber count and super-high voltage power lines. Steel tubes are stranded with high strain steel wires to create a dual-layer design suitable for a range of high fault applications.

Product Features

- High fiber counts and flexible as per customers requirements
- Typically have higher cable diameter
- Laser welded stainless steel provides mechanical and thermal protection for optical fibers
- High load and long span capabilities
- Each stainless steel tube is uniquely identified for organization at splice locations
- The stranded wires can be customized to the individual customer requirements of electrical and mechanical properties by adjusting AA/AS combination



“ Ideal design for transmission lines with very high fault-current requirement ”

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA².sec	mm²	inch²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
24	464	180	0.2790	17.9	0.7047	756	0.51	103	23155	0.23	0.38
48	146	120	0.1860	14.5	0.5709	504	0.34	76	17086	0.34	0.55

Dual Layer Aluminium Clad Steel Tube

Fiber Count upto	Fault Current	Effective Area		Overall Diameter		Weight		UTS		DC Resistance @ 20°C	
	kA².sec	mm²	inch²	mm	inch	kg/km	lbs/ft	KN	lbs	Ω/km	Ω/mile
48	170	160.5	0.2488	16.9	0.6654	686	0.46	100	22481	0.27	0.38



Design Considerations

OPGW cables are required to withstand the effects from installation and long term in-service exposure to mechanical, electrical and environmental loads without allowing any significant degradation in its performance. OPGW cable would need to fulfill basic performance criteria to enable selection of an appropriate design.

a) Electrical performance

- Fault current performance to overcome the line-to-tower short circuits or system unbalances
- Lightning performance so that lightning arc does not impair the long term functionality of the cable

b) Mechanical performance

- Sag and tension
- Vibration
- Galloping and Sheave

c) Environmental performance

- Range of temperatures and wind zones
- Corrosion levels at the installation sites including the pollution level (1-4)
- Salinity levels

d) Packing

The end-user needs to determine the length per reel depending on:

- The terrain of the installation site
- The type of installation to be carried out ('Live Line' or 'On Outage')
- Capacity of unreeling facility with installer

Additionally, considerations should be noted for excessive contact pressure under hardware, the current transfer capability of the connection of hardware with the OPGW cable and contact between dissimilar materials that may cause excessive corrosion in some environments.

Supply Length

Maximum length per reel is 4 km. Length per reel as per customer request is also available

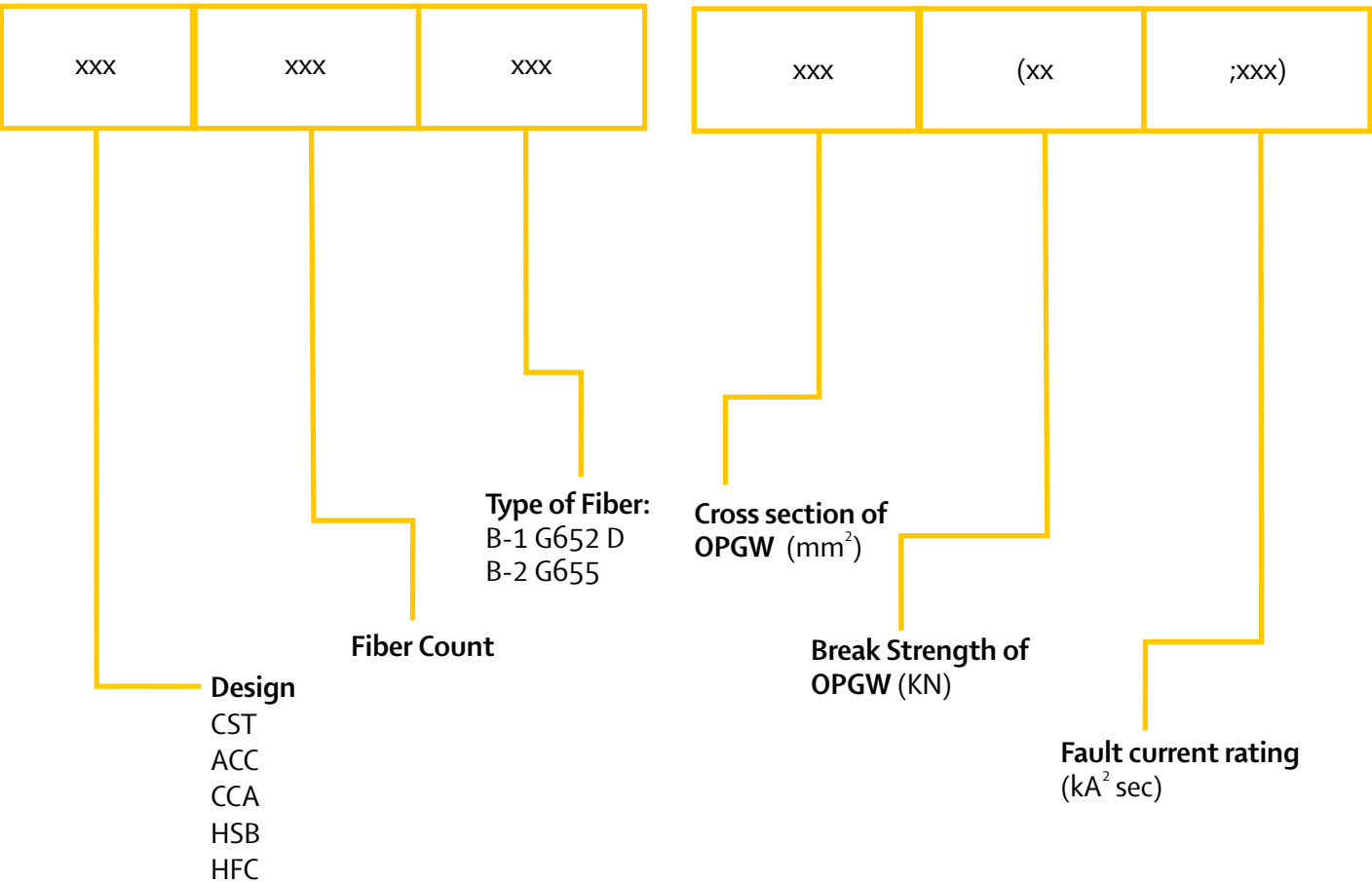
OPGW Ordering

Product Options

- Optical fiber options:
ITU G 652 D < 0.350/0.210 db/km @ 1310/1550 nm
ITU G 655 D < 0.220/0.250 db/km @ 1310/1550 nm
- Identification options:
EIA/TIA 598
Black ring marking for > 12 fibers in a tube
Bundle binders for each 12 fiber
- Operating temperature range: -40 to +85° C
- Installation temperature range: -20 to +70° C

OPGW Ordering Guide

Example: CST24B1- 108 (65;120)



Quality & Reliability

Our state-of-the-art facility has the capability of the following tests:

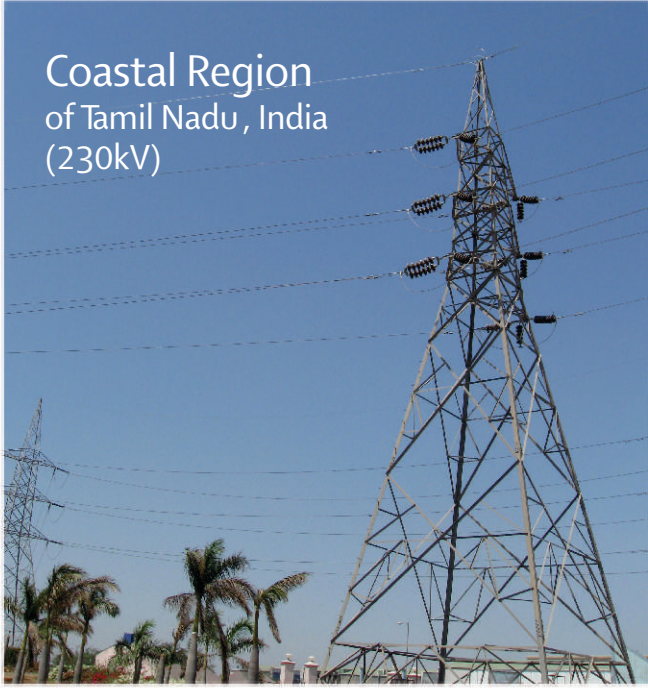
Test Parameters	Reference Standards	Sterlite's Performance Results
Stress-Strain	IEEE-1138 Ch. 5.1.1.11 IEC 61089, Annexure B	No visual damage to the cable; fiber showed no significant strain and induced attenuation.
Tensile Strength	IEEE-1138 Ch. 4.2.2.3 IEC 60794-1-2, Method E1	Cable breaking strength is $\geq 95\%$ RTS and no single wire was broken.
Sheave	IEEE-1138 Annexure D IEC 60794-1-2, Method E9	No significant damage to any component of the cable; fiber attenuation is ≤ 0.1 dB/Km at 1550 nm.
Aeolian Vibration	IEEE-1138 Annexure B IEC 60794-1-2, Method E19	No significant damage to any component of the cable; fiber attenuation is ≤ 0.1 dB/Km at 1550 nm.
Galloping	IEEE-1138 Annexure C	No significant damage to any component of the cable; fiber attenuation is ≤ 0.12 dB/Km at 1550 nm.
Creep	EIA/TIA 455-25A-1989 and EIA 455-41-1985 IEC 61395	Fiber attenuation is ≤ 0.02 dB/km at 1550 nm. Cable elongation Ratio: 0.02%.
Temperature Cycling	EIA/TIA 455-3A-1989, using a modified version of temperature cycling Test Condition B, -40°C to $+85^{\circ}\text{C}$ two cycles. IEC 60794-1-2, Method F1	Fiber attenuation is ≤ 0.03 at 1550 nm.
Seepage of Flooding Compound	FOTP EIA/TIA 455-81A-1991 IEC 60794-1-2, Method E15	The compound did not flow or drip.
Short Circuit	IEEE-1138 Annexure A IEC 60794-1-2, Method H1	No significant damage to any component of the cable; fiber attenuation is 0.05dB/km at 1550 nm.
Lightning Arc	IEEE-1138 Ch.6.4.3.4 IEC 60794-1-2, Method H2	Fiber attenuation < 0.05 db/km at 1550 nm. Remaining RTS $> 75\%$ of cable RTS.

Sterlite's policy of continuous improvement may result in a change in specifications without prior notice.

Any warranty of any nature relating to any Sterlite product is only contained in the written agreement between Sterlite Technologies Limited and the direct purchaser of such product(s).

Sterlite's OPGW Installations

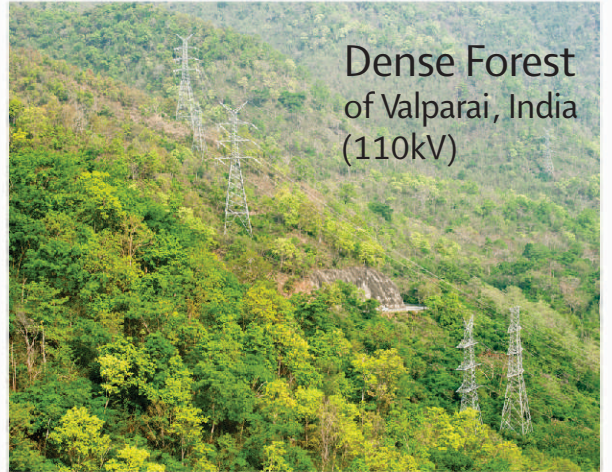
Coastal Region
of Tamil Nadu, India
(230kV)



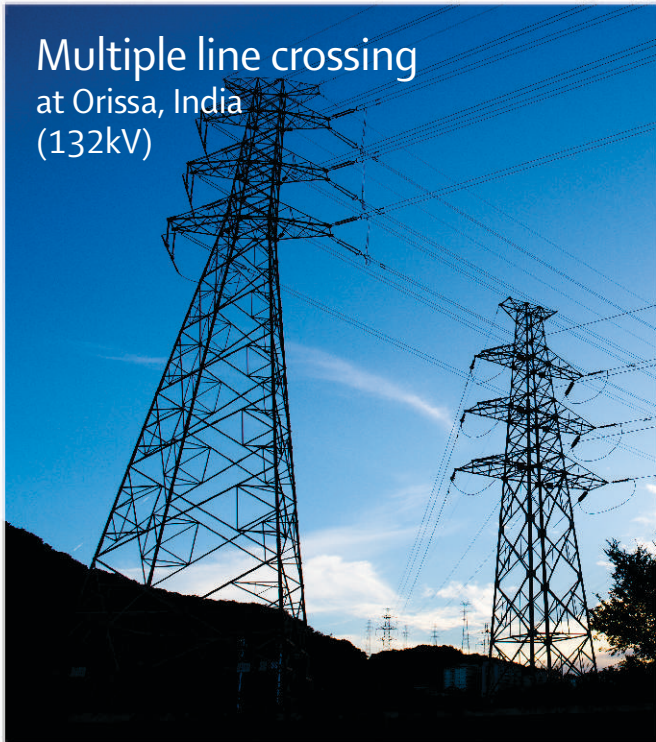
Dessert Region
of Gujarat, India
(220 kV)



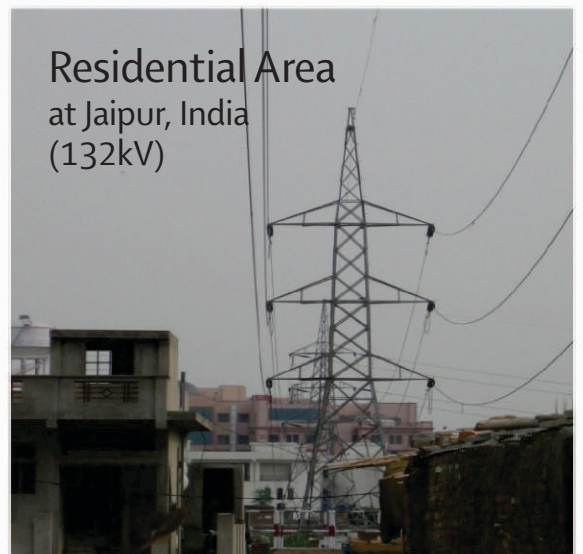
Dense Forest
of Valparai, India
(110kV)



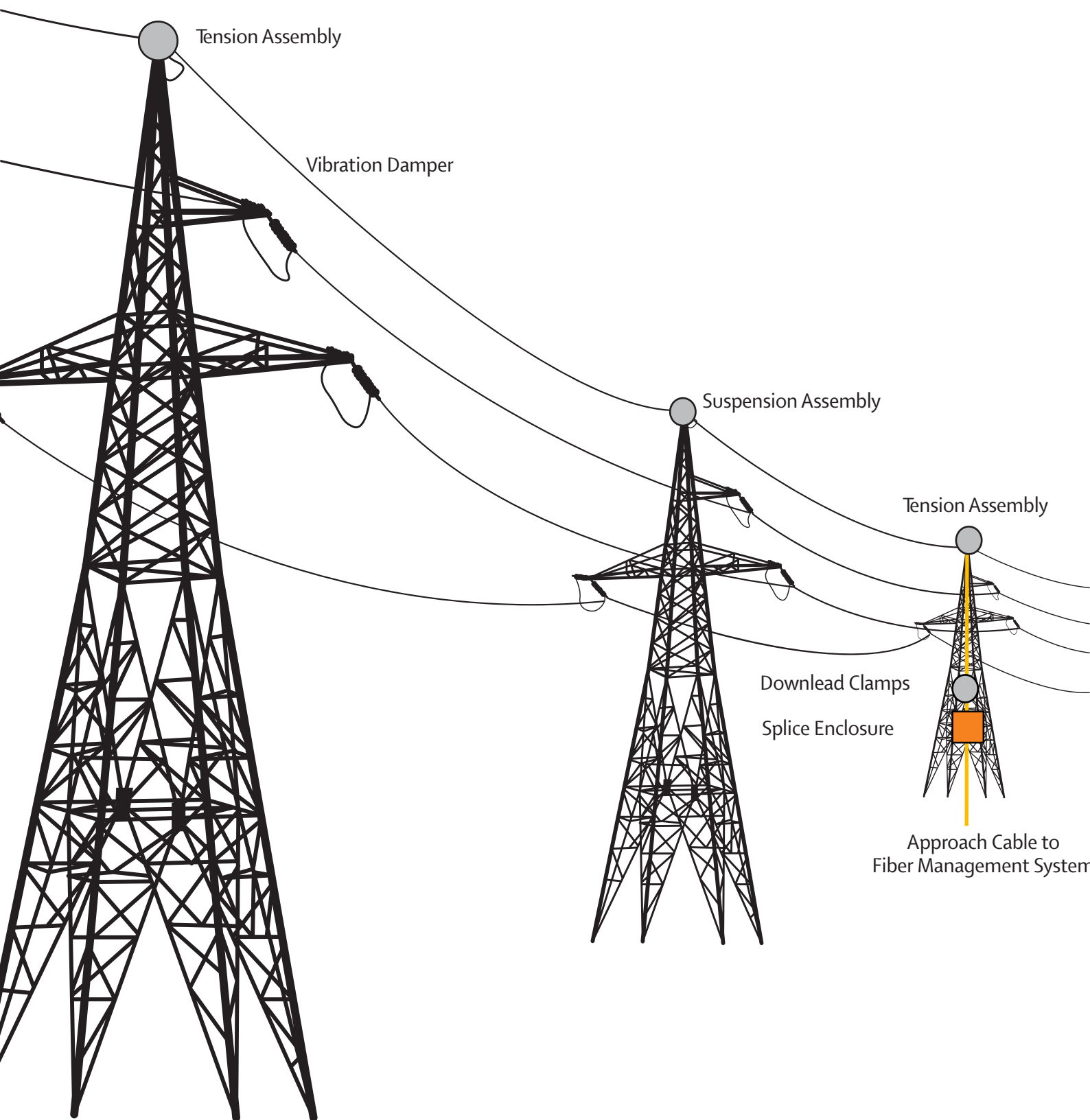
Multiple line crossing
at Orissa, India
(132kV)



Residential Area
at Jaipur, India
(132kV)

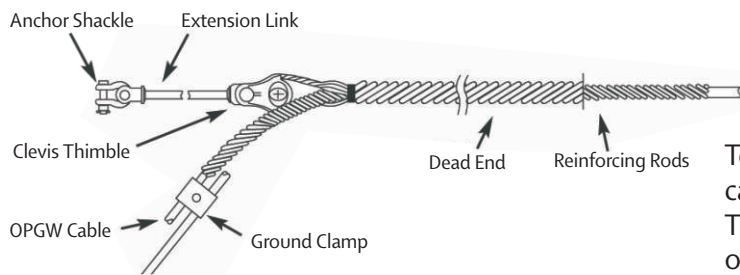


Installation Hardware



Sterlite® OPGW Accessories

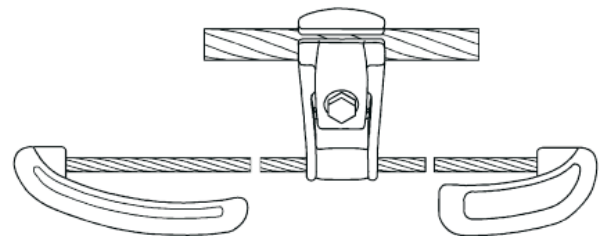
Tension Assemblies



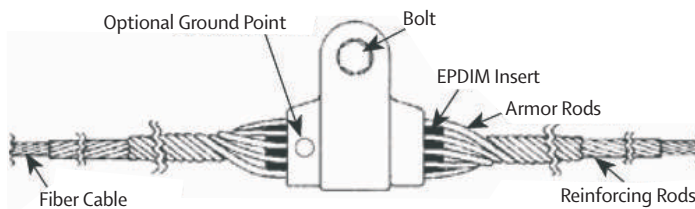
Tension Assemblies are designed for use with OPGW cable at termination, section and joint tower positions. They will hold upto 95% of the OPGW RTS and maintain optical integrity over the operating load range.

Vibration Dampers

Vibration Dampers effectively reduce the level of Aeolian vibrations on Optical Ground Wire (OPGW) cables. They respond to wind induced line vibrations that is characterized by high frequency, low amplitude motion.

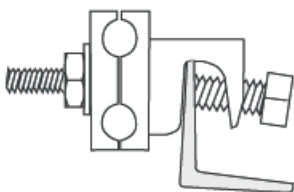


Suspension Assemblies



Suspension Assemblies are designed for use with OPGW cable at Suspension tower positions. Suspension Assemblies reduce static compressive stresses at the support point and cushion the OPGW cable against the dynamic stress of Aeolian vibration.

Down Lead Clamps



Fixing Clamps are used to guide OPGW cables from the top of the structure to the splice box or for grounding the cable. They provide proper spacing and holding strength without damaging the cable.

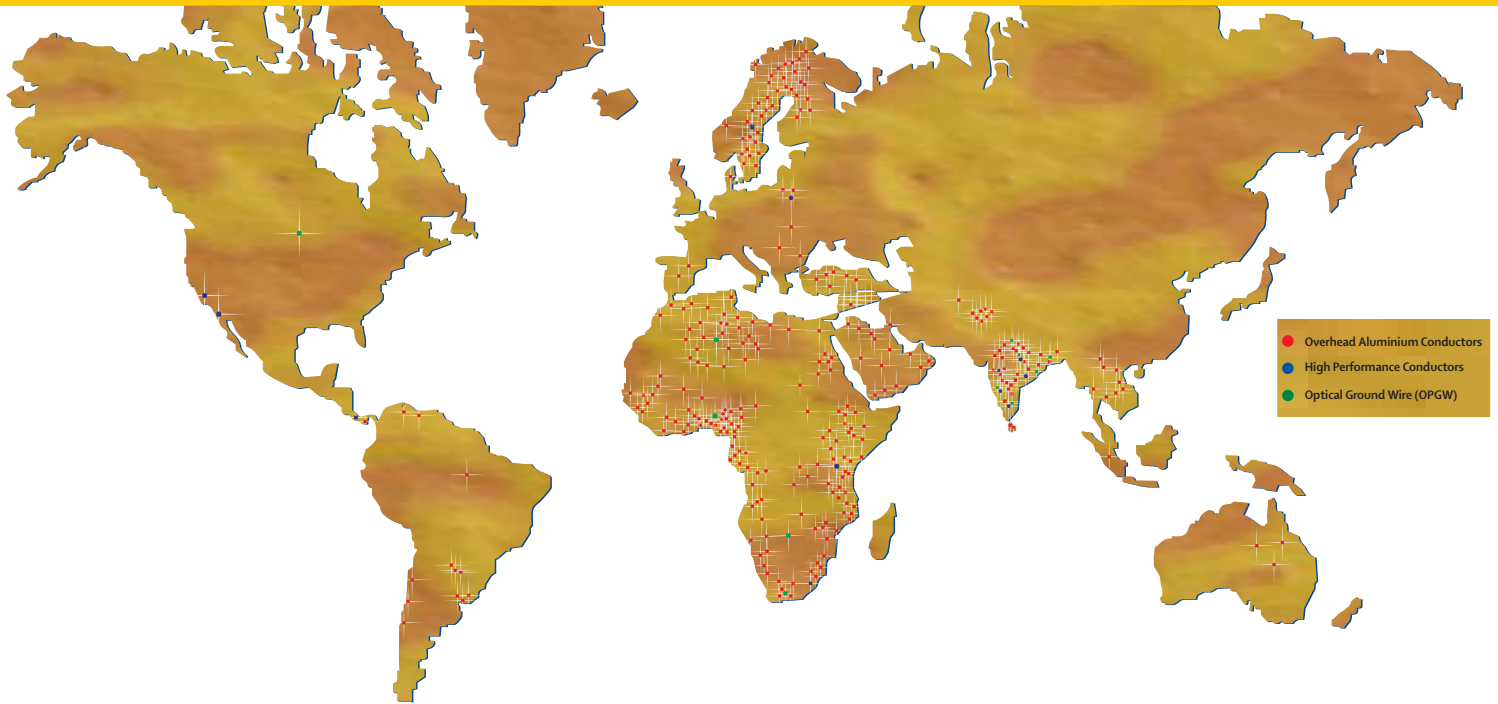
Splice Enclosure



Splice Enclosure can be used for the storage of splicing of fiber and storing the same on the transmission tower.

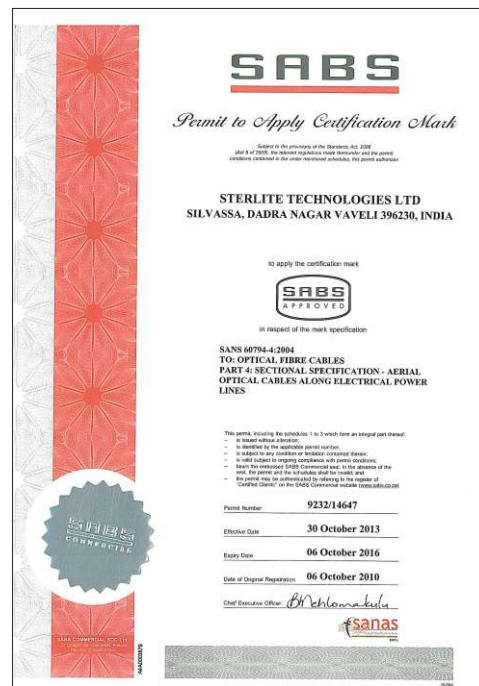
Hence this splice enclosure is specifically made of metal from the outside to protect the enclosure from electrical field.

Global Footprints of Power Offerings



Key Milestones- OPGW

- ★ The 1st integrated manufacturer of OPGW in India
- ★ Complete Turnkey Solution provider on 220, 400KV Live Lines as well as Offline
- ★ Supplies made to major State Transcos & State Distribution Companies in India
- ★ Successfully Partnered Fortune 500 T&D Companies in their OPGW projects
- ★ Significant supplies to international power generators in Americas, Middle East & Africa
- ★ Products type tested in labs eg: CPRI, DRDO, ERDA, SAG (Germany)



The Sterlite Advantage

Global experience

- Expert in providing customized solutions to business challenges in the transmission industry, worldwide
- Significant supply record
- In India, 25% of the national grid runs on Sterlite's conductors

Building Infrastructure

On BOOM Basis,

- 2850 Kms of transmission lines & 2 substations across India
- Over 3000 Kms of OPGW Live line being developed by MTCIL, 1st of its kind Joint Venture with state owned utility of Maharashtra, India
- Fiber brought to over 1 million homes in top 6 Metro cities of India

End-to-end project implementation

Sterlite ensures complete control over the value chain and delivers end-to-end project management services.

Sterlite's project management suite:



Qualified and experience talent pool

Sterlite has a qualified talent pool, experienced in network design, project management, network implementation and network maintenance.

Credible partners

Sterlite has partnered with reputed project management companies and Original Equipment Manufacturers (OEMs), to ensure that the delivery of the project is streamlined.

Solution development for newer applications

Sterlite continues to enhance its portfolio taking into account the bandwidth need evolving from client applications.

Fully integrated Company

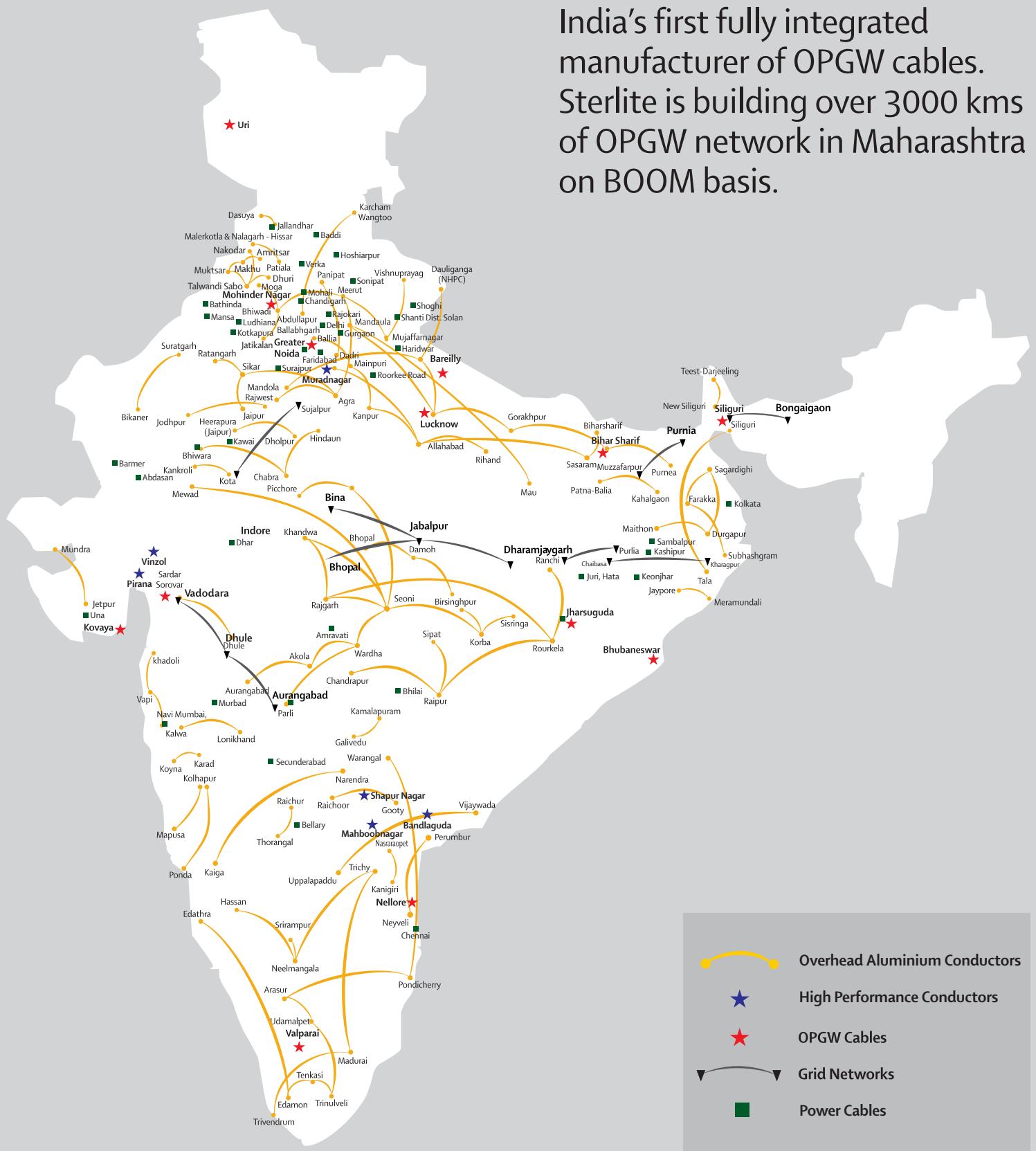
Backward integration of manufacturing processes and forward integration of our technology solutions

Local support

With offices in 10 countries, Sterlite always has a relationship manager who is a mere phone call away, to understand your growth aspirations and to explore areas where value can be added to your business.

Partnering India's growth in Power sector

India's first fully integrated manufacturer of OPGW cables. Sterlite is building over 3000 kms of OPGW network in Maharashtra on BOOM basis.



We make it easier, faster and more cost effective to build infrastructure for power transmission and distribution.

Power Business

Sterlite provides power transmission & distribution companies a holistic one stop window for assessment, development & implementation of solutions for their power transmission & distribution(T&D) networks.

T&D Network Assessments

- Assessment of existing & potential power demand
- Technical Analysis
- Assessment of suitable solution options

Development

- T&D Solution Development
- T&D Solution Testing

Implementation

- T&D Solution Manufacture
- Inventory Management & Supply
- Technical Support and Service

Sterlite's portfolio also includes:

Overhead T&D Aluminium Conductors

Supported by a fully integrated manufacturing facility that converts ingots to bare overhead conductors, Sterlite's range of standard and custom-designed power solutions deliver superior transmission quality and performance reliability.

High Performance Conductors

As these new generation conductors enhance the current carrying capacity, they are favourable for use in re-conductoring as well as new lines. This provides the user high corridor intensity and reduces congestion in existing lines.

Power Cables

Sterlite's single integrated Power Cables facility at Haridwar, manufactures and supplies MV, HV and EHV cables. The plants have complete facilities for sheathing, rod rolling, wire drawing, heat treatment and stranding to ensure precise tolerance to all international standards and stringent specification 6.6 to 220 kV.

Power Infrastructure

Sterlite has been awarded five projects for building power transmission systems (line and substations) in India, as a developer, on a Build-Own-Operate-Maintain (BOOM) basis. For these projects, Sterlite undertakes designing, financing, construction, and maintenance of the transmission systems for concession periods ranging from 25 to 30 years.

These transmission lines would help facilitate power evacuation and would be used for SEBs, Power Gencos for which Sterlite would earn a fixed transmission tariff.

Key Highlights:

- Total value: Approx US \$ 1014 Mn
- Approx 2850 Km of transmission lines + 2 substations
- India's first 765 kV D/C transmission line

Sterlite's Power Infrastructure portfolio of the five projects would evacuate and transmit power through a network of 2850 km of transmission lines and 2 substations in the Indian states of Maharashtra, Gujarat, Madhya Pradesh, Chattisgarh, West Bengal, Bihar, Assam and Rajasthan.

These EHV projects represent significant advancements in the field of power transmission. These projects would enhance the overall grid capacity significantly and substantially reduce transmission power losses, thus assisting the economic development of the nation.

"Enabling lowest cost of Energy Transmission over the life cycle"

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