



# Equipment Strategy for Optical Fibre Ground Wire (OPGW)

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## 1. Introduction

### 1.1 Purpose

Equipment Strategies document Powerlink’s vision for equipment technologies, to provide both Powerlink and Suppliers with consistent planning and project management platforms for the life of the Strategy. The document expresses Powerlink’s vision of the equipment performance requirements. It is not a detailed contract specification.

Equipment strategy documents are intended to be shared with potential suppliers and therefore consideration has been given to the principles outlined in the Procurement Standard in the development of the documents.

The Equipment Strategy for Optical Fibre Ground Wire (OPGW) has been developed with input from the relevant teams in Powerlink.

### 1.2 Scope

This document defines the strategy for Optical Fibre Ground Wire (OPGW) for application on the HV and EHV overhead transmission line network for the purpose of providing an earthwire with communication capabilities.

Optical Fibre Ground Wire (OPGW) for use at different voltages other than the range mentioned can be purchased on an ad-hoc basis but following the same strategic principles in this document.

It is intended that the equipment strategy will be reviewed on a regular basis so that changes can be incorporated at the most opportune time. The Equipment Strategy will have a life of five (5) years, with a significant review in the third (3<sup>rd</sup>) year reviewing service experience and if there are new alternative technology solutions.

### 1.3 Defined terms

Terms	Definition
EHV	Extra- high voltage, taken as greater than 230kV and up to 500kV
HV	High-voltage, taken as nominal line voltage between 35kV and 230kV
OHEW	Overhead earth wire
OPGW	Optical Fibre Ground Wire
SCADA	System Control and Data Acquisition
OpsWan	Operations Wide Area Network
SC/AC	Steel Core / Aluminium Clad
WAMPAC	Wide Area Monitoring Protection and Control



### 1.4 Monitoring and compliance

This equipment strategy will guide development of the technical specification and tender specification. The success of this strategy is measured by monitoring life cycle costs as well as availability and service history associated.

OPGW is typically purchased on a project by project basis with smaller quantities being purchased for warehouse safety stock. The minimum records required are:

- Technical specification
- Tender evaluation report
- Period contract or standing offer
- Purchase orders
- Manufacturers test reports

### 1.5 Risk management

This document has been developed to clarify necessary requirements of the equipment strategy for the procurement of OPGW. It sets out the technical requirements to manage the risks associated with OPGW in a manner that will achieve the safety, operational, financial and business development objectives. Risks are mitigated by adhering to this strategy.

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## 2. Strategy

This Equipment Strategy intends to cover all transmission line OPGW purchased over the next five years for use on Powerlink and customer network pole and lattice tower structures up to 500kV. The function of OPGW is to shield the phase conductors from direct lightning, form part of the interconnected earthing system and transmits data through optical fibres.

Communication channels are provided by optical fibres housed in specially constructed ground wire strung on the transmission structure earthpeaks. This ground wire variant is known as Optical Ground Wire (OPGW), providing reliable and high bandwidth communications for all Powerlink purposes with some surplus bandwidth (via otherwise dark fibres) used by others for commercial traffic.

OPGW functions on transmission lines as an earthwire (OHEW) providing both fault current return capacity and shielding phase conductors from lightning strikes. OPGW's have particular requirements concerning design so that the cable, mechanically and electrically, behaves in the similar manner to any conventional OHEW installed in parallel. This includes similar sag characteristics and electrical resistances. This facilitates a controlled share of fault current when multiple OHEW's, multiple OPGW's or a combination of OHEW and OPGW's is installed.

The vision that drives equipment strategy documents is based on historical experience, research and investigations into new products available on the market, reliability centred maintenance analysis and lifecycle cost experience over the expected service life. The main features of Powerlink's vision for OPGW for transmission lines are as follows:

#### General

- Evaluation and assessment through life cycle cost analysis (LCCA).
- Meet a 40 year service life for in Queensland climatic conditions.
- Compliance with all relevant international standards.
- Adequate thermal capacity to meet current and future fault levels to backup clearing times.
- Resilient to damage from lightning.

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- High availability, reliability and cost competitive on a whole of life basis.
- Support Powerlink’s protection schemes of WAMPAC, SCADA and remote monitoring of equipment through OpsWan.
- Designed to have no (or minimal) maintenance requirements.
- Supports current maintenance practices.

**Safety and environmental**

- High reliability to minimise the risk of major injury or fatality or environmental risk due to a dropped OPGW.

**Maintenance level**

Powerlink's preference is to procure equipment which has:

- No or minimal maintenance requirements.
- Simple, reliable and proven technology.

**2.1 Project use of equipment**

Four OPGW applications are specified:

ITEM	DIAMETER RANGE (mm)	THERMAL CAPACITY i <sup>2</sup> t	MIN. FIBRES	TYP. EARTHWIRE COMPATIBILITY	APPLICATION
1	11 – 12	45	24	Volleyball	Brownfield projects only where structural tower capacity dictates a light-weight, small diameter OPGW. <u>Note:</u> There are only limited situations where it can be used due to low thermal capacity and pronounced susceptibility to lightning strand damage.
2	14 – 14.5	100	48	Volleyball	Greenfield and brownfield applications with moderate fault level.
3	17 - 18	260	48	Wrestling, Opal	Preferred default item for greenfield and brownfield applications with high fault level.
4	20 – 21	350	48	Lemon	Suitable for 500kV applications requiring up to 63kA fault capacity shared across two EW/OPGWs for a backup clearing time. SC/AC strands required on outer layer to minimise strand breakage from lightning.

**2.2 Technologies available now**

OPGW is more reliable than other available technologies such as microwave radio, which is subject to adverse weather conditions, or Power Line Carrier that can present reliability issues during faults.

**2.3 Equipment strategy elements**

OPGW should include the following main features:

- Designed to have no maintenance requirements.

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- Easy handling.
- Able to withstand fault level for clearing times applicable to the Powerlink network.
- A minimum of 48 single-mode fibres, with the exception of Item 1 above.
- Meet a 40 year service life in all corrosion regions and climatic conditions in QLD.
- Compliance with all relevant international standards.
- In the case of brownfield applications, OPGW product that can reliably replace existing non-standard in-service items.
- In the case of greenfield applications, OPGW products to simplify the spare, logistics and tooling considerations.
- Sag characteristics that support matching the sag of the earthwire in combination, 80% of the conductor sag and supports span lengths up to 1000m.
- Resilience to damage from lightning, meeting lightning class type tests.
- Central core fibre shall meet the chromatic dispersion requirements.
- High availability, reliability and cost competitive on a whole of life basis.
- Resilience to broken or crushed fibres.
- Capability with the use of Clampstar™ or similar approved repair device for restoration of mechanical and electrical properties.
- Stainless steel and aluminium tubes are to be sealed to prevent movement during installation and general operation.

## 2.4 Concurrent investigations

In view of continuous technological improvement, it is important that close examination of the available technologies be made to ensure that they meet Powerlink's requirements and adopt the most appropriate technology. Prior to the commencement of adopting new technology, either a trial project or a review of fleet performance and maintenance costs within the industry be performed.

## 2.5 Summary

The equipment strategy detailed in this document will be applied to all future requirements for transmission line OPGW, unless otherwise specified for reasons not identified in this document.

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