



**Ergon Energy Corporation Limited**

**Technical Specification for  
Substation 11kV and 22kV Single  
Core Underground Cable**

**ETS04-05-01**

# Technical Specification for Substation 11kV and 22kV Single Core Underground Cable



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# Technical Specification for Substation 11kV and 22kV Single Core Underground Cable

## 1. Purpose and Scope

### 1.1 General

This specification sets out the technical requirements for the design, manufacture, testing at works, supply and delivery of substation 11kV and 22kV single core tree-retardant cross-linked polyethylene (TR-XLPE) underground cable.

### 1.2 Goods to be supplied

Cables to be supplied are listed in the following table:

ITEM NO	DESCRIPTION	ERGON II NO
1	Cable, Electrical, Underground 11kV, 1 Core, 630mm <sup>2</sup> Cu, TR-XLPE Insulated insect protected and fire retardant underground cable.	2426070
2	Cable, Electrical, Underground 11kV, 1 Core, 800mm <sup>2</sup> Cu, TR-XLPE Insulated insect protected and fire retardant underground cable.	2426088
3	Cable, Electrical, Underground 22kV, 1 Core, 630mm <sup>2</sup> Cu, TR-XLPE Insulated insect protected and fire retardant underground cable.	2426096

Lengths of cable to be supplied are shown in **Appendix A.1**.

### 1.3 Installation Design Parameters

For purposes of calculation the following installation parameters may be assumed:

- Cables will be direct buried in a touching trefoil arrangement, in PVC conduits or in direct sunlight
- The cables maybe single-point bonded or solidly bonded.
- Depth of burial will be - 1200mm
- Maximum Soil Temperature will be – 35°C
- Maximum ambient air Temperature – 45°C
- Soil Thermal Resistivity will be – 1.2 0C-m/watt
- Nominal Short Circuit Duty of Cable Screen - 10kA for 1 second

Also refer to the clause 4, Service Conditions.

### 1.4 Special Conditions

The area in which the cable will be installed is home to subterranean termite, *Mastotermes darwiniesis* and the coastal brown ant, *Pheidole megacephala*. A protective jacket has been specified for the cable.

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## 2. References

### 2.1 Applicable Standards

The cables shall be constructed, manufactured and tested in accordance with the relevant parts of the following Standards and all amendments issued from time to time except where varied by this specification.

STANDARD	TITLE
AS 1125	Conductors in insulated electric cables and flexible cords
AS 1429	Electric cables - Polymeric insulated
AS 1660	Test methods for electric cables, cords and conductors
AS 1931	High-voltage test techniques
AS/NZS 3013	Electrical installations – Classification of the fire and mechanical performance of wiring system elements
AS/NZS 4507	Cables – Classification of characteristics when exposed to fire
AS 2857 - 1986	Timber drums for insulated electric cables and bare conductors
AS 3983	Metal drums for insulated electric cables and bare conductors
AS/NZS 3808	Insulation and sheathing for electric cables
AS/NZS ISO 9001	Quality management systems – requirements
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics

## 3. Drawings

### 3.1 Drawings by the Purchaser

There are no drawings attached to this specification.

### 3.2 Drawings by the Tenderer

The Supplier shall supply with the Invitation to Offer, drawings, sketches or pamphlets showing the cross sections of the cable in a similar manner to that shown in AS1429.2. The various components of the cable shall be labelled and dimensioned. The overall diameter of the cable and the diameter over the insulation shall be given.

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## 4. Service Conditions

### 4.1 The conditions under which the cables will be required to operate are:

DESCRIPTION	CONDITION
<b>Installation</b>	Installed, directly buried in fine grain bedding material, or, in PVC conduits at a nominal depth of up to 1200 mm, with cable ends rising up concrete or timber poles and exposed to direct sunlight.
<b>Ambient Air Temperatures</b>	Not exceeding 45°C as determined by a shaded thermometer
<b>Ambient Ground Temperatures</b>	Not exceeding 35°C
<b>Altitude</b>	Not exceeding 1000 metres above sea level
<b>Humidity</b>	90% high humidity combined with a high temperature (45°C) followed by a sudden drop in temperature of up to 10°C

### 4.2 Exposed sections of the cable will be subject to the following additional service conditions:

DESCRIPTION	CONNDITION
<b>Solar Radiation Level</b>	1100 watts per square metre with high ultraviolet content
<b>Precipitation</b>	Tropical summer storms with gust wind speeds above 160km/h and an annual rainfall in excess of 1500mm
<b>Atmospheric classifications</b>	Areas of coastal salt spray and / or industrial pollution with equivalent salt deposit densities in the range of 2.0 – 3.0 g/m <sup>2</sup>

The power cable will operate in Ergon Energy's three phase, 50 Hertz 11kV and 22kV network which has the star point effectively earthed. The lightning impulse insulation withstand level of the system is 95 kVp and 125kVp.

## 5. Design and Construction

### 5.1 General

The cable shall be constructed and manufactured in accordance with AS1429.1 except where specified otherwise in this specification.

During the contract period, the Supplier shall not change the design, manufacturing process or compounding of the materials without the written approval of the Purchaser.

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## 5.2 Core Conductors

The conductor shall have a nominal cross-sectional area of 630mm<sup>2</sup> and 800mm<sup>2</sup> for 11kV conductors, and 630mm<sup>2</sup> for 22kV conductor. The conductor shall be comprised of multi-stranded circular, compacted or compressed, plain annealed copper wires. The individual wires shall be of the same nominal diameter before stranding into the compacted circular formation. Successive layers of wires shall have opposite directions of lay.

Any lubricants used during compaction of the conductor shall be removed from the conductors prior to application of the core screen. Greasing of the conductors is not permitted.

## 5.3 Insulation

The insulation shall be tree-retardant cross-linked polyethylene (TR-XLPE) complying with AS3808.

The insulation shall be applied by an extrusion process; simultaneously with the semi-conductive conductor and insulation screens within one crosshead.

It is desirable that the process has facilities at the point of extrusion to monitor and control the thickness of the extruded screens and the insulation and the concentricity of the cable (this may be done by X Ray scanning and control or similar techniques).

Suppliers must state in the tender submission how they will control the concentricity of the cable and the thickness of the extruded cable screens and the cable insulation. This will be considered in assessing tenders.

## 5.4 Water Blocking

Semi-conductive water blocking tapes shall be applied over the insulation screen. The Tenderer shall submit with their tender submission the results of tests carried out in accordance with Appendix C of AS 1429.1 demonstrating the effectiveness of water-blocking method and materials proposed.

## 5.5 Metallic Screen

The metallic screen shall be designed and constructed for a system fault level of 10kA for 1sec.

The screen wires shall be applied over the bedding of semi-conductive water blocking tapes.

## 5.6 Non -Metallic Sheath

The non-metallic sheath of the cable shall be a composite sheath consisting of an inner layer of HFS-90-TP and an outer layer of HFS-90-TP in accordance with Clause 2.13 of AS1429.1.

The HFS-90-TP sheath shall be black in colour. A graphite coating shall be applied on the over-sheath to allow for present and future testing of the integrity of the cable sheath.

## 5.7 Protection from Insect Attack

The insect protection layer consists of helically applied double brass tape. The insect protection layer will be helically wound over the non-metallic sheath as per Clause 5.6

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above. Full details of double brass tape protection jacket shall be included with the tender including evidence of effectiveness.

The double brass tape must be capable of being removed without damage to the HFS-90-TP sheath.

Alternative methods of insect protection will not be considered.

## 5.8 Fire Retardant

The cables shall be fire retardant in accordance with AS/NZS 1660.5.1 Section 3 for Category A F/R tests.

Tenderers shall provide full details of the test method and results in the tender documentation.

## 5.9 Cable Markings

Cable identification markings and meter markings shall be provided on the outer sheath of the cable in accordance with Clauses 2.16 and 2.17 respectively of AS 1429.1.

## 5.10 Sealing of Cable Ends

Cables shall be free of water or corrosion at the time of dispatch from the manufacturer's premises.

All cable ends shall be sealed to prevent moisture ingress. This shall seal the individual layers of the cable construction from one another to avoid water transfer to the conductor strands in the event of damage to the outer sheaths

Tenderers shall provide full details of the method used for sealing the cable ends with the tender documentation.

## 6. Performance and Testing

### 6.1 General

The cable shall be tested in accordance with the section 3 of AS1429.1

Type Test Certificates to AS/NZS1429.1 shall be submitted with the tender. The contactor must advise Ergon Energy's responsible officer of any changes in the composition of the materials and processes used for manufacture of the cables and Ergon Energy's responsible officer will decide on the necessity for a new Type Test.

Sample and Routine test certificates to AS/NZS1429.1 shall be supplied with each delivery. In addition the supplier is required to submit all Sample and Routine test certificates relating to the cables supplied under the contract, including the Purchaser's Order Numbers and the associated cable drum numbers and lengths recorded on a compact disc on completion of the contract.

### 6.2 Tests on Completed Cable

The following Routine tests will be carried out, on each completed drum of cable, in addition to those required by A/NZS1429.1.



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- An insulation resistance test between the cable conductor core and the metallic screen. The test will be carried out at a voltage level of 5kV d.c. and 10kV d.c. for 11kV and 22kV cables respectively. The results shall be recorded after 10 minutes.
- An insulation resistance test between the metallic screen and the graphite coating covering the outer sheath cable. The test will be carried out at a voltage level of 2.5kV DC and the results recorded after 10 minutes.

The results will be recorded and submitted with the results of other “Routine” tests.

## 6.3 Carbon Black Test

Carbon black content of the outer sheath shall be tested in accordance with ASTM D1603. Test certificates are not required to be despatched with each delivery of cable but shall be made available to the purchaser when requested, within 1 working day.

## 7. Risk Assessment

There is no requirement for manufacturer provided safety risk assessments for the items covered by this specification.

## 8. Quality Assurance

### 8.1 Purchasers Policy

It is the Purchaser’s policy to procure goods, equipment and services from sources that demonstrate the ability to supply quality products.

### 8.2 Documentary Evidence

Tenderers are required to submit evidence that the design and manufacture of the cable is in accordance with AS/NZS ISO 9001 and shall include the Capability Statement associated with the Quality System Certification.

If the Tenderer is a non-manufacturing supplier, the documentary evidence shall include the quality system certifications of both the supplier and the manufacturer.

## 9. Samples

### 9.1 Production Samples

When requested, production sample(s) shall be submitted to assist in the evaluation of the offer.

## 10. Packaging and Marking

### 10.1 General

Cable may be supplied on either timber drums complying with the requirements of AS2857 or steel drums complying with the requirements of AS3983.

Operational difficulties are anticipated with the use of timber drums manufactured in accordance with AS 2857-1996. Hence this specification is based on cables supplied on

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timber drums manufactured in accordance with the requirements of superseded standard AS 2857-1986.

The nominal length of cable on each drum shall be 500m for tendering purposes. The lengths of cable required on each drum will be specified on the order.

The cable drums shall be sufficiently robust to ensure that the cable is delivered undamaged, giving due consideration to the method of transportation and the distances involved.

The cable on the drum shall be protected by suitable external lagging to ensure that it is delivered undamaged giving due consideration to the methods and distance of transportation and handling. Further, additional cushioning material such as “corflute” shall be provided between the cable and the external laggings in order to minimize the risk of cable sheath damage during the removal of the latter.

**The Tenderer shall provide details concerning the method lagging to be used.**

Drums must be of suitable quality to withstand without deterioration a minimum of twenty-four (24) months exposure to all types of weather conditions during outdoor storage.

Each drum of cable shall be indelibly and legibly marked on both flanges with the following information:

- (a) The name Ergon Energy and the relevant stores stock code.
- (b) Contract number.
- (c) Order release authority or purchasing order number.
- (d) Manufacturer's traceability number – derived from Manufacturer's first letter, hyphen, batch number, hyphen, drum number for this batch.
- (e) Manufacturer's name
- (f) Size and complete description of the cable
- (g) Year of Manufacture
- (h) Length of the cable wound onto the drum
- (i) The gross weight of the cable and the drum
- (j) An arrow with the words “ROLL THIS WAY” to indicate the direction the drum may be rolled on its flanges (if relevant)
- (k) Any special handling or storage instructions

Should the cable be supplied from overseas manufacturers, then it is mandatory that all conditions and inspections required by the Australian Quarantine Act be met and that all these costs be included in the tendered price. In particular, timber drums must be fumigated with methyl bromide with a concentration of 48 grams per cubic metre for 24 hours at 21°C. The supplier shall ensure that the procedure does not produce any deleterious effects to the cable supplied on the drum.

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## 11. Service Performance

Suppliers shall state:

- a) The period of service achieved by the items offered within Australian service conditions;
- b) Australian electricity supply authorities who have a service history of the items offered;
- c) Contact names and phone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

**The suppliers are also requested to submit proposals for improving the service life of the cables.**

## 12. Reliability

### 12.1 Service Life

Comments on the reliability and performance of the items offered for a minimum service life of 50 years under the specified environmental conditions shall be submitted with the offer.

### 12.2 Evidence in Support of Reliability

Such comments shall include evidence in support of the reliability and performance claimed including information on Failure Mode and Effect Analysis.

## 13. Training

Training material in the form of drawings, instructions and/or audio visuals shall be provided for the items accepted under the offer.

This material shall include but is not limited to the following topics :-

- Handling
- Storage
- Installation, including cable hauling and methods of attachment of hauling rope to cable cores
- Maintenance
- Environmental performance
- Electrical performance
- Mechanical performance
- Disposal
- Cable rating software

## 14. Environmental Considerations

Suppliers are required to comment on the environmental soundness of the design and the materials used in the manufacture of the items offered. In particular, comments should address such issues as recyclability and disposability at the end of service life.

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## 15. Information to Be Provided

### 15.1 Specific Technical Requirements

The specific technical requirements for the items offered shall be as stated in **Attachments 1 and 2** of this specification. The tenderer shall fill in all data requested by these Attachments and shall guarantee such data.

### 15.2 Checklist of Supporting Documentation

**Attachment 3** details a checklist of supporting technical documentation which is required to be submitted with the tender.

## 16. Appendix A.1 – Cable Lengths

- Length of cable to be supplied -xxxxm (route length xxxxxxm)\*\*
- Preferred number of cable drums -vvvv
- Spare cable to be supplied- 1 additional drum of zzzzzm

\*\* The final route length of the cable is still subject to change and dependent on negotiations regarding physical obstructions. Consequently there may be some marginal change to the route length

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## 17. Attachment 1 – Technical Details

PARTICULARS	ITEM NO:
Rated Voltage (kV)	
Conductor material	
Cross-sectional area of conductor core (mm <sup>2</sup> )	
Number and size of strands in each conductor core	
Nominal diameter of conductor core (mm)	
Extruded semi-conductive conductor screen material	
Average radial thickness of semi-conductive conductor screen (mm)	
Minimum average radial thickness of TR-XLPE insulation (mm)	
TR-XLPE material designation	
Method of curing insulation	
Semi-conductive screen material over the insulation	
Average radial thickness of the semi-conductive insulation screen (mm)	
Nominal diameter over insulation (mm)	
Water blocking tape material	
Average thickness of water blocking tape (mm)	
Metallic sheath material	
Thickness of the metal sheath (mm)	
Number and size of strands in the copper wire screen	
Is the material annealed copper Yes/No	
Minimum radial thickness of the composite sheath over the screen wires / water blocking barrier (mm)	
Radial thickness of HFS-90-TP sheath	
Minimum radial thickness of Double Brass Tape (mm)	
Maximum continuous conductor operating temperature of the cable (deg C)	
Three-phase symmetrical fault rating of conductor for one second (kA)	
D.C. Resistance of conductor at 20°C (Ohms/km)	
A.C. Resistance at maximum conductor operating temperature (Ohms/km)	
DC resistance of the copper wire screen at 20°C (Ohms/km)	
Inductance per conductor when installed in trefoil and touching (mH/km)	
Capacitance of conductor to screen at 20°C (mF/km)	

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PARTICULARS	ITEM NO:
Positive sequence impedance per phase in R+jX format @ maximum conductor operating temperature when installed trefoil and touching (Ohms/km)	
Zero sequence impedance per phase in R+jX format @ maximum conductor operating temperature when installed in trefoil and touching (Ohm/km)	
Fault rating of screen for one second (kA)	
Power frequency withstand voltage five minutes (kVrms)	
Overall diameter of cable (single core) (mm)	
Overall diameter of 3 single core cables in trefoil formation (mm)	
Minimum bending radius (a) pulling (mm) (b) setting (mm)	
Maximum pulling tension - Stocking grip on sheaths (straight pulls) (kN)	
Maximum pulling tension - Stocking grip on sheaths (pulling around bends with minimum recommended bending radius) (kN)	
Mass of cable (tonnes/km)	
Cable drum type (timber/steel)	
Cable drum size (F x B x W)	
Cable route length per drum (m)	
Spindle hole diameter (mm)	
Gross mass (kg)	
Maximum continuous operating temperature	
Minimum bending radius for coated optical fibre Under no tension mm	
Under maximum tension mm	
Maximum protrusion of outer sheath due to optic fibre cable mm	
Manufactures Name	
Manufacturers Address:	

**SIGNATURE OF TENDERER:** \_\_\_\_\_

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## 18. Attachment 2 – Underground Cable Current Rating

The tenderer shall provide details of the "Summer" and "Winter" current ratings of the cables offered under the installation conditions specified below:

INSTALLATION CONDITIONS		
Ground Thermal Resistivity	1.2°C m/w	
Ground Temperature	35°C	Summer
	20°C	Winter
Air Temperature	45°C	Summer
	25°C	Winter
Burial Depth	1200 mm	

**Note:** Tenderers are required to nominate the designed maximum continuous current rating of the cable.

Tenderers are also required to additionally nominate the **Emergency** rating of the cables which is defined as the maximum current carrying capacity of the cable for a period of 2 hours immediately following having been loaded for 70% of the nominated maximum continuous load.

ITEM NO.	SEASON	SINGLE CIRCUIT, DIRECT BURIED		SINGLE CIRCUIT, BURIED in CONDUIT *		DOUBLE CIRCUIT, DIRECT BURIED @ 1.0 M SPACING		DOUBLE CIRCUIT, BURIED in CONDUIT @ 1.0 M SPACING *	
		Maximum Continuous Current Rating (amps)	Emergency current rating (amps)	Maximum Continuous Current Rating (amps)	Emergency current rating (amps)	Maximum Continuous Current Rating (amps)	Emergency current rating (amps)	Maximum Continuous Current Rating (amps)	Emergency current rating (amps)
		Solid bonded screen							
a	Summer								
	Winter								
b	Summer								
	Winter								
		Single point bonded screen							
a	Summer								
	Winter								
b	Summer								
	Winter								

\* Calculations to be based on installed in trefoil arrangement in light duty PVC conduits of 150 nominal size.

**SIGNATURE OF TENDERER:** \_\_\_\_\_



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## 19. Attachment 3 – Technical Documentation Checklist

CLAUSE Ref.	PARTICULARS	Response
Have full and comprehensive details been submitted <b>WITH</b> the tender documents associated with each of the following items?		
3.2	Drawings showing the details of the cables offered	Yes/No
5.3	Method of controlling the thickness and concentricity of screen/insulation	Yes/No
5.10	Sealing of cable ends	Yes/No
5.4	Details of water blocking systems including test reports	Yes/No
5.8	Details of fire retardant test method and results	Yes/No
6	Type test reports included in tender documentation	Yes/No
	Availability of routine and sample test reports on CD	Yes/no
8	Quality systems of <b>BOTH</b> the <b>TENDERER</b> and the <b>MANUFACTURER</b>	Yes/No
10	Method of cable protection on the drum	Yes/No
11	Service Performance <b>including any proposals for improving the service life of the cable</b>	Yes/No
12	Reliability	Yes/No
13	Training Materials	Yes/No
14	Environmental Conditions	
15	Technical Details- Completed <b>Attachments 1,2 and 3</b>	Yes/No

NAME OF TENDERER :

ADDRESS OF TENDERER :

SIGNATURE :

DATE :

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_