



Ergon Energy Corporation Limited

Technical Specification for Three Core 6.35/11kV Copper/TR-XLPE Underground Cable

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Technical Specification for Three Core 6.35/11kV Copper/TR XPLE Underground Cable

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1. Purpose and Scope

This specification sets out the technical requirements for the manufacture, testing at works, supply and delivery of three core, 240mm² Cu, tree-retardant cross-linked polyethylene (TR-XLPE) insulated, 6.35/11 (12) kV underground cable.

The cable will be used in underground distribution systems in Queensland.

The following item is covered by this specification:

Item Number	Description	Stock code
1	CABLE,POWER,ELECTRICAL U/Ground, 6.35/11kV, 3C, 240mm ² Cu, XLPE Insulated/HD Screen/Insect Protected/PVC Sacrificial Sheath Black, FNTS Q1922 (MOQ 350m)	2407000

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 2857	Timber drums for insulated electric cables and bare conductors
AS 3191	Approval and test specification – Electric flexible cords
AS 3983	Metal drums for insulated electric cables and bare conductors
ISO 9001	Quality management systems - Requirements
ASTM D1603	Carbon black in ethylene plastics

3. Drawings

3.1 Drawings by the Purchaser

There are no drawings attached to this specification.

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3.2 Drawings by the Tenderer

The Tenderer shall supply with the tender, drawings, sketches or pamphlets showing the cross-sections of the cable. The various components of the cable shall be labeled and dimensioned. The overall diameter of the cable and the diameter over the insulation shall be given.

4. Service Conditions

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

Description	Condition
Installation	Directly buried in selected thermal bedding material or, in conduits at a nominal depth of up to 1 200 mm, with cable ends attached to concrete or steel structures and exposed to direct sunlight.
Ambient Air Temperature	Not exceeding 45°C as determined by a shaded thermometer.
Ambient Ground Temperature	Not exceeding 35°C.
Altitude	Not exceeding 500 metres above sea level.
Humidity	A high humidity (90%) combined with a high temperature (40°C) followed by a sudden drop in temperature of up to 10°C.

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

Description	Condition
Solar Radiation Level	Solar radiation intensity of 1 100W/m with high ultraviolet content
Precipitation	Tropical summer storms with high winds and an annual rainfall in excess of 1 500mm.
Atmospheric Classification	Areas of coastal salt spray and/or industrial pollution with equivalent salt deposits densities in the range of 2.0 - 3.0g/m ² .

The power cable will operate in Ergon Energy's three phase, 50 Hertz HV distribution network having a nominal system voltage of 11kV with the star point effectively earthed. The lightning impulse insulation withstand level of the system is 95kVp.

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5. Design and Construction

5.1 General

The cable shall be designed and manufactured in accordance with Section 2 of AS1429.1 and the specific requirements set out below.

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

The conductor screen, insulation and insulation screen shall be manufactured using a 3 in 1 extruder head with all three layers applied in the same extruder head.

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). Tenderers 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. The cable core must be dry cured.

The cable is not expected to be installed in an environment where subterranean termite, *Mastotermes darwiniensis* and the coastal brown ant, *Pheidole megacephala* are present.

5.2 Core Conductors

The conductors shall be stranded circular compacted plain annealed copper in accordance with Section 2 of AS1125.

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.

The conductor size is 240mm². Tenderers are requested to provide stranding details in **Attachment 1**.

The conductor shall be screened in accordance with Clause 2.2 of AS1429.1. The screen should be fully bonded to the cable insulation.

5.3 Insulation

Insulation of the cable shall be cross linked polyethylene (XLPE) in accordance with clause 2.3 of AS1429.1 for the nominated voltage.

The insulation shall have a screen of extruded thermosetting, semi conductive cross linked polyethylene in accordance with clause 2.4 of AS1429.1, and shall be hand strippable with an adhesion value not exceeding 30 N.

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5.4 Metallic Screen

The cores shall be screened using helically applied plain annealed copper wires in accordance with Section 2.5 of AS1429.1.

The metallic screen shall have a total cross-sectional area of 90.79mm². The fault rating of the cable screen based on a core conductor temperature of 90°C shall be stated in **Attachment 1**.

5.5 Water Blocking

Water blocking in accordance with Clause 2.14 of AS1429.1 shall be provided.

Full details of water blocking arrangement, including testing carried out to prove the effectiveness of the system, shall be provided with the tender documentation.

5.6 Non -Metallic Sheath

The non-metallic sheath of the cable shall be a composite sheath consisting of an inner layer of 5V-90 PVC and an outer layer of HDPE in accordance with Clause 2.13 of AS1429.1 with the exception of the outer layer of HDPE which shall be 1.8mm minimum. The HDPE sheath shall have a minimum shore D hardness of 60 and a density not less than 0.955g/cm³. The over sheath shall be black in colour and shall be UV stabilized by the addition of a minimum of 2% carbon black evenly distributed throughout the HDPE.

5.7 Cable Markings and Laying-up

The 240mm² cable shall be supplied as a three core cable.

Each core shall be identified by numbers 1 ONE, 2 TWO, 3 THREE, printed as numerals and words on the outer surface of the cores in accordance with clause 2.6 of AS 1429.1.

The outer sheath of the cable shall be indelibly marked in a contrasting colour with sequential metre markings at one metre intervals. The markings need not start at zero and the starting and finishing metre markings shall be recorded on the drum flange.

To permit identification of cables, the following information shall also be printed or embossed on the outer sheath at regular intervals:

Manufacturer's name or identifying initials
Year of Manufacture
Size / Type of Cable

The individual cores shall be laid up with a right hand direction of lay to form a substantially compact cable assembly. Where necessary, fillers and binders/barrier tapes shall be used to form substantially compact and circular cross-section core assembly with a reasonably smooth surface without creasing of the tapes.

5.8 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. Note the minimum acceptable means of sealing cable ends is by either coldshrink or adhesive lined heatshrink caps.

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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 AS1429 shall be submitted with the tender.

The Tenderer 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. If cables are supplied without changes being approved, the cable delivery will be treated as a non-conformance.

A "Certificate of Compliance" is to be supplied with each cable delivery. Sample and Routine test certificates shall be held by the manufacturer and provided to the Purchaser within 1 working day upon request. In addition the Tenderer 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 types and lengths recorded on a compact disc on an annual basis.

6.2 Tests on Completed Cable

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

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 DC and the results recorded after 10 minutes.

The results will be recorded and submitted with each delivery.

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.

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

Tenderer's attention is drawn to the **MP000801F100**: Management Systems Information Schedule (Form) which forms an integral part of this specification.

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

Cable may be supplied on either timber drums complying with the requirements of AS 2857 or steel drums complying with the requirements of AS 3983.

For handling purposes the drum dimensions and mass shall not exceed the following:

Parameter	Value
Drum Diameter over Lagging	2 600mm
Overall Width (excluding bolt projections)	1 250mm
Gross Mass	5000kg
Spindle Hole Diameter	108mm

The cable shall be of one length on each drum.

The cable drums shall be sufficiently sturdy 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. Sheet form wrapping alone is NOT acceptable.

The tenderer shall provide details concerning the method to be used.

Drums must be of suitable quality to withstand without deterioration a minimum of twenty four months (24) 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 information detailed in Clauses 2.19 of AS1429.1.

The following information shall also be provided:

- (a) Manufacturer's name
- (b) Drum reference number
- (c) ERGON ENERGY
- (d) Contract number (to be advised)

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- (e) Size and complete description of the cable
- (f) Year of Manufacture
- (g) Length of the cable wound onto the drum
- (h) The gross weight of the cable and the drum
- (i) An arrow with the words "ROLL THIS WAY" to indicate the direction the drum may be rolled on its flanges (if relevant)
- (j) Any special handling or storage instructions

Note: Cable length is the route length.

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 Tenderer shall ensure that the procedure does not produce any deleterious effects to the cable supplied on the drum.

11. Service Performance

Tenderers shall state:

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

Tenderers 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 40 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

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- Installation, including cable hauling and methods of attachment of hauling rope to cable core
- Maintenance
- Environmental performance
- Electrical performance
- Mechanical performance
- Disposal

14. Environmental Considerations

Tenderers 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.

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.

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16. Attachment 1 – Technical Details

PARTICULARS		RESPONSE
		240mm ²
Rated Voltage	(kV)	
Conductor material		
Cross-sectional area of core	(mm ²)	
Number and size of strands in each core		
Nominal diameter of core	(mm)	
Extruded semi-conductive conductor screen material		
Average radial thickness of semi-conductive conductor screen	(mm)	
Minimum average radial thickness of XLPE insulation	(mm)	
XLPE material designation		
Method of curing insulation		
Semi-conductive screen material over the insulation		
Average radial thickness of the semi-conductive insulation screen	(mm)	
Number and size of strands in the copper wire screen		
Is the material annealed copper	Yes/No	
1 second short circuit rating of copper wire screen based on core conductor temperature of 90 ⁰ C	(kA)	
Minimum radial thickness of the composite sheath over the screen wires	(mm)	
Grade of PVC		
Radial thickness of PVC sheath	(mm)	
Shore D hardness of HDPE material	(mm)	
Radial thickness of HDPE sheath	(mm)	
Density of HDPE sheath material	(g/cm ³)	

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17. Attachment 1 – Technical Details... (cont'd)

PARTICULARS	RESPONSE
	240mm ²
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 (mH/km)	
Capacitance of conductor to screen at 20°C (mF/km)	
Positive sequence impedance per phase in R+jX format @ maximum conductor operating temperature (Ohms/km)	
Zero sequence impedance per phase in R+jX format @ maximum conductor operating temperature (Ohm/km)	
Fault rating of screen for one second (kA)	
Power frequency withstand voltage five minutes (kVrms)	
Overall diameter of three core cable (mm)	
Minimum bending radius of three core cable (a) pulling (mm) (b) setting (mm)	
Maximum pulling tension of three core cable Stocking grip on sheaths (kN) Pulling eye on 3 conductors (kN)	
Mass of three core cable (tonnes/km)	
Cable drum size – 240mm ² (F x B x W)	
Cable route length per drum (m)	
Spindle hole diameter (mm)	
Gross mass (kg)	
Manufacturer's product catalogue no.	
Manufacturer's 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	30°C	Summer
	20°C	Winter
Air Temperature	45°C	Summer
	25°C	Winter
Burial Depth*	750 mm	

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

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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 @ 0.45 M SPACING		DOUBLE CIRCUIT, BURIED in CONDUIT @ 0.45 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 a burial depth of 750mm to top of cable or conduit (as applicable) as follows:
 - 240mm² 3 core cable in one 100mm diameter light duty PVC conduit.

SIGNATURE OF TENDERER: _____

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19. Attachment 3 – Technical Documentation Checklist

CLAUSE Ref.	PARTICULARS	RESPONSE
Have full and comprehensive details been submitted WITH the tender documents associated with each of the following items?		
3.2	Drawings showing the details of the cables offered	Yes/No
5.1	Method of controlling the thickness and concentricity of screen/insulation	Yes/No
5.2	Core conductor stranding details	Yes/No
5.4	Fault rating of cable screen(s)	Yes/No
5.5	Water blocking details	Yes/No
5.8	Sealing of cable ends	Yes/No
6	Technical Details- Completed Attachments 1,2 and 3	Yes/No
6	Type test reports included in tender documentation Availability of routine and sample test reports on CD	Yes/No Yes/no
8	Quality systems of BOTH the TENDERER and the MANUFACTURER	Yes/No
10	Method of cable protection on the drum	Yes/No
11	Service Performance including any proposals for improving the service life of the cable	Yes/No
12	Reliability	Yes/No
13	Training Materials	Yes/No
14	Environmental Considerations	
15	Technical Details – Completed Attachments 1, 2, 3	Yes/No

NAME OF TENDERER:

ADDRESS OF TENDERER: _____

SIGNATURE: _____ FOR AND ON BEHALF OF TENDERER

DATE: _____