



positive energy



Joint Ergon Energy/Energex

**Technical Specification for
Underground Power Cables
and Accessories
for Nominal System
Voltages of 66kV and 132 kV**

JTS04-01-10

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1. Purpose and Scope

1.1 General

This specification sets out the Joint Energex and Ergon Energy requirements for the manufacture, testing and delivery of Single Core Underground Power Cables with Copper and Aluminium Conductors for use in electricity sub-transmission networks at system voltages of 66kV and 132kV.

1.2 Conforming Tenders

Offers strictly in accordance with the requirements of this specification as summarised below will be regarded as conforming tenders.

1.3 Alternatives

Tenderers are encouraged to submit alternative tenders based on their standard products provided that the cables so offered will provide current ratings and in-service performance equivalent to the cables conforming to this specification. Departures from this specification shall be fully documented in the tender.

The Tenderer is also required to offer a recommendation for the two voltage classes of cable based purely on a performance outcome under the stated Service Conditions, including compliance with AS/NZS 1429.2 and considering Australian National and International best practice as well as AER (Australian Energy Regulator) requirements for best practice in terms of safety, technical, environmental and economic performance. Departures from AS/NZS 1429.2 should be noted.

The items covered by this technical specification are listed as follows:

ITEM	DESCRIPTION	STOCK CODE
38/66 (66) kV CABLES:		
1	1C 1000mm ² Milliken stranded compacted WB Aluminium/XLPE/ WBT/CWS/WBT/ CorrAl sheath/LLDPE/NYLON/ MDPE with graphite coating/ Insect Protected	2448181
2	1C 1000mm ² Milliken stranded compacted WB Aluminium/XLPE/ WBT/CWS/OF//WBT/ CorrAl sheath/LLDPE/NYLON/ MDPE with graphite coating/ Insect Protected	2448199
76/132 (132) KV CABLES:		
3	1C 630mm ² compacted WB Aluminium/XLPE/ WBT/CWS/WBT/ corrugated Al sheath/LLDPE/NYLON/MDPE with graphite coating/ Insect Protected	2448207
4	1C 630mm ² compacted WB Aluminium/XLPE/ WBT/CWS/OF//WBT/ corrugated Al sheath/LLDPE/NYLON/MDPE with graphite coating/ Insect Protected	2448215
5	1C 1200mm ² Milliken stranded compacted WB Aluminium/XLPE/ WBT/CWS/WBT / corrugated Al sheath/MDPE with Termite Repellent & Graphite Coating	ENERGEX
6	1C 1200mm ² Milliken stranded compacted WB Copper/ XLPE/	ENERGEX

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ITEM	DESCRIPTION	STOCK CODE
	WBT/corrugated Al sheath/MDPE with Termite Repellent & Graphite Coating	
7	1C 1600mm ² Milliken stranded compacted WB Copper/ XLPE/ WBT/CorrAl sheath/MDPE with Termite Repellent & Graphite Coating	ENERGEX
8	1C 1200mm ² Milliken stranded compacted WB Copper/ XLPE/ WBT/CorrCu sheath/MDPE with Termite Repellent & Graphite Coating	ENERGEX
9	1C 1600mm ² Milliken stranded compacted WB Copper/ XLPE/ WBT/CorrCu sheath/MDPE with Termite Repellent & Graphite Coating	ENERGEX

Abbreviations in above table:

CWS – Copper Wire Screen
 CorrAl – Corrugated Aluminium
 CorrCu – Corrugated Copper
 LLDPE – Linear Low Density Polyethylene
 MDPE – Medium Density Polyethylene
 OF – Optical Fibre
 WB - Water Blocked Conductor
 WBT – Water Blocking Tapes (and Yarns as required)
 XLPE – Cross Linked Polyethylene

2. Applicable Standards

The cables must comply with the latest revision of all relevant Queensland Acts / Regulations and Australian Standards, and all amendments issued from time to time except where varied by this specification.

Should inconsistencies be identified between standards and / or this specification, the Tenderer shall immediately refer such inconsistencies to the Purchaser for resolution.

Standards that are applicable to this specification include the following:

Standard	Title
AS 1931	High-voltage test techniques
AS 60270	High-voltage test techniques - Partial discharge measurements
ASTM D1603	Carbon black in ethylene plastics
AS/NZS 1125	Conductors in insulated electrical cables and flexible cords
AS/NZS 1429.2:2009	Electric cables - Polymeric insulated - For working voltages above 19/33 (36) kV up to and including 87/150 (170) kV
AS/NZS 1660	Test methods for electric cables, cords and conductors
AS/NZS 2053.2:2001	Conduits and fittings for electrical installations – Part 2: Rigid plain conduits and fittings of insulating material

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Standard	Title
AS/NZS 2857 - 1986	Timber drums for insulated electric cables and bare conductors
AS/NZS 3808	Insulating and sheathing materials for electric cables
AS/NZS 3983	Metal drums for insulated electric cables and bare conductors
AS/NZS 60840:2006	Power Cables with extruded insulation and their accessories for rated voltages above 30kV ($U_m = 36kV$) up to 150kV ($U_m=170 kV$) – Test methods and requirements
Electricity Association Services Ltd. Engineering Recommendation C.55/4	Insulated Sheath Power Cable Systems
ELECTRA No. 24, Oct. 1972	Current Ratings of Cables for Cyclic and Emergency Loads (Part 1)
IEC 60228	Conductors for insulated cables
IEC 60229	Tests on cable over-sheaths which have a protective function and are applied by extrusion
IEC 60230	Impulse tests on cables and their accessories
IEC 60287-Parts 1 and 2	Electric cables – Calculation of the current rating – Part 1: Current rating equations and calculation of losses – Part 2: Thermal resistance
IEC 60684	Flexible insulating sleeving
IEC 60811-1-1	Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 1: Measurement of thickness and overall dimensions – Tests for determining the mechanical properties
IEC 60811-1-2	Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 2: Thermal ageing methods
IEC 60811-1-3	Insulating and sheathing materials of electric cables – Common test methods - Part 1: General application – Section 3: Methods for determining the density - Water absorption tests – Shrinkage test
IEC 60811-1-4	Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature
IEC 60811-2-1	Insulating and sheathing materials of electric and optical cables – Common test methods - Part 2-1: Methods specific to elastomeric compounds –Ozone resistance, hot set and mineral oil immersion tests
IEC 60811-4-1	Common test methods for insulating and sheathing materials of electric cables – Part 4: Methods specific to polyethylene and polypropylene compounds –Section One: Resistance to environmental stress cracking – Wrapping test after thermal ageing in air – Measurement of the melt flow index – Carbon black and/or mineral content measurement in PE

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Standard	Title
IEC 60885-3	Electrical test methods for electric cables – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables
IEC 60287	Calculation of Continuous Current Rating of Cables (100% LF)
IEC 60793-2	Optical fibres – Part 2 – Product specification for multimode fibres
ISO 48	Rubber, vulcanised or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)
ISO 9001	Quality systems - Model for quality assurance in production, installation and servicing
ISO 14644-1	Cleanrooms and associated controlled environments – Part 1 – Classification of air cleanliness
Cenelec Document HD632 S2:2008	Power cables with extruded insulation and their accessories for rated voltages above 36kV up to 150kV
ITU-T G651 ITU-T G652	International Telecommunications Union –Telecommunications (ITU-T) Recommendations G651 and G652
TS008	Austel Technical Standard 008 – Requirements for Authorising Cabling Products

3. Drawings

No drawings are provided with this specification.

4. Service Conditions

4.1 General Operating Conditions

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

- Installed in a touching trefoil arrangement, either directly buried; or in a single way duct comprised of :
 - PVC conduit; or
 - polyethylene pressure pipe; or
 - fibre-cement conduit;

at a nominal depth between 900mm and 1,200mm in a:

- fine grain bedding material; or
- in cement stabilised bedding and backfill; or
- flowable fill;
- Cable ends rising up concrete, timber, or metal poles and exposed to direct sunlight;
- Ambient air temperature not exceeding 50°C summer day time and -50°C winter night time as determined by a shaded thermometer;
- Ambient soil temperature not exceeding 35°C;
- An altitude not exceeding 1,000m above sea level;

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- A high humidity (90%) combined with a high temperature (45oC); followed by a sudden drop in temperature of up to 10oC;
- An area in which the cables may be installed is home to subterranean termite, Mastotermes Darwiniesis and the coastal brown ant, Pheidole Megacephala.

4.2 Operating Conditions – Exposed Cable

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

- Solar radiation intensity of 1,100W/m²;
- Tropical summer storms with high winds above 160km/h and an annual rainfall in excess of 1,500mm;
- Areas of coastal salt spray and/or industrial pollution with equivalent salt deposits densities in the range of 2.0 - 3.0g/m².

4.3 Cable Application

The power cables required are for use on 66kV and 132kV, three phase, 50Hz systems.

4.3.1 132kV Systems

The neutral points of Powerlink's transformers supplying Energex and Ergon Energy's 132 kV system are directly earthed.

The maximum system voltage (phase to phase) on the systems is 145 kV and the required impulse insulation level is 650 kVp.

4.3.2 66kV Systems

The neutral points of the transformers supplying Ergon Energy's 66kV system are directly earthed.

The maximum system voltage (phase to phase) on the systems is 72 kV and the required impulse insulation level is 350 kVp.

5. Design and Construction

5.1. 66kV and 132kV Insulated Cables

5.1.1 General

The 66kV and 132kV cables shall be designed and manufactured to comply with the test requirements set out in AS/NZ 1429.2.

During the contract period, the Tenderer shall not change the design, supplier, 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).

The Tenderer 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 Tenderer must provide details of cable accessories that the manufacturer used for the compliance testing of tendered cables to requirements of AS/NZS 60840 and is requested to

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advise of any other accessories used by the manufacturer with demonstrated compatibility with the tendered or similar cable construction.

5.1.2 Conductors

The conductors shall be stranded plain annealed copper or aluminium, as specified and of circular compacted construction complying with IEC 60228. For conductors of 800 mm² cross sectional area or larger, compacted Milliken type construction shall be used.

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.

5.1.3 Water Blocking of Conductors

Water blocking of the conductor stranding shall be provided by the use of non-biodegradable water swellable yarns and tapes to preclude the longitudinal migration of moisture along the conductor.

Non-conductive water blocking yarns and / or non-conductive water blocking tapes are acceptable for use inside conductors. Water blocking yarns used inside conductors must be spun yarns containing super-absorbent staple fibre and suitable strength elements. Water blocking tapes used internally in conductors must be less than 0.20mm thick and consist of a single polyester web and a suitable super-absorbent powder mixture. The water blocking material shall not affect the performance of the conductor and conductor connections in terms of the ratings calculated in accordance with IEC 60287.

Water blocking tapes used peripherally around conductors must be semi-conductive, readily removable and consist of one or two webs, a suitable super-absorbent powder mixture and carbon black.

For Milliken type construction, water blocking tapes shall also be included between conductor sectors.

All water blocking materials must have proven long term thermal stability at power cable operating conditions.

Water absorbent materials in a class of polymers described as "neutralised cross-linked polyacrylate acid" and also known by the generic term "polyacrylate absorbents" are acceptable.

Water absorbent materials in a free powder form are not acceptable.

Mastic type water blocking materials are not acceptable.

The Tenderer shall provide details of the proportion of the cross-sectional area of the free space within the conductor envelope occupied by the water blocking tapes and / or yarns.

The Tenderer shall submit with their tender submission the results of tests carried out in accordance with Appendix F of AS/NZS 60840 and additional tests specified in Clause 6.4.1 of this specification, demonstrating the effectiveness of water-blocking method and materials proposed.

5.1.4 Conductor Screen

The cables cores shall have an extruded, cross-linked, semi-conductive conductor screen applied over the conductor. A non-hygroscopic semi-conductive tape shall be applied as part of the conductor screen and shall be applied directly on the conductor, preceding the extruded layer.

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The conductor screen shall be fully bonded to the insulation and readily removable from the conductor.

The minimum thickness at any point of the extruded layer of conductor screen shall be not less than 0.8mm determined by the method specified in AS/NZ1660.2.1

5.1.5 Insulation

The insulation shall be super clean grade cross-linked polyethylene complying with the requirements of IEC 60840, IEC 60811 Parts 1 to 4 inclusive and IEC 60885-3 applied by an extrusion process; simultaneously with the semi-conductive conductor and insulation screens within one crosshead.

The insulation shall be free from faults and imperfections larger than the resultant values given by the maximum extruder filter mesh size stated by the Tenderer in Attachment 6.

All manufacturing rooms and areas where PE, additives and peroxides are handled and mixed shall be suitably sealed and provided with air-dryers and filtering systems corresponding to clean room conditions in accordance ISO 14644-1 Class 5 to Class 6 or the equivalent provisions in the USA Fed. Gov. Standard 209a (Class 1,000 to 10,000) as applicable.

The Tenderer is required to submit, with the tendering documentation, copies of manufacturing and purchasing specifications of raw materials and detailed quality procedures in relation to sampling and testing conditions and requirements. The Principal shall have access to inspect the manufacturers' works should he elect to do so.

Insulation thickness and concentricity requirements shall be in accordance with the requirements of AS1429.2 with the exception of the nominal insulation thickness of the 132kV cables.

The nominal insulation thickness of 132kV cables shall be 16.00mm and the minimum thickness shall not be less at any point than that derived from the equation prescribed in Clause 2.4.3 of ASNZ1429.2.

Alternatively, the nominal insulation thickness may be based on a design stress as agreed between the supplier and the purchaser. For an agreement of this nature to be considered the Tenderer must provide evidence of accelerated testing carried out to demonstrate the expected life of the cable

The expected service life of the cable under the specified environmental conditions shall be stated.

De-gassing of the insulation shall be effected before the metallic sheath is applied to the cables. The cable cores shall be dry nitrogen cured and de-gassed to the manufacturer's recommendations, but in any case as a minimum, at ambient temperature for 1 day per millimetre of insulation thickness prior to the further laying up of the cable core.

The Tenderer shall provide details with the tender documentation of the de-gassing process, stating the temperatures and periods of time that manufactured core material of the cable is exposed to allow gasses to ventilate.

At the end of the de-gassing process the residual gases shall be identified and quantified by measuring the cross-linking by-product concentration in cable samples using the tests conducted in a thermo gravimetric analyser (TGA) in accordance with the procedure and meeting the requirements of Clause 2.4.15 of CENELEC Document HD 632 S2:2008 Part 2.

5.1.6 Insulation Screen

The screen shall consist of a layer of extruded, cross-linked, semi-conductive compound applied directly over the insulation so that it is fully bonded to the insulation.

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5.1.7 Water Blocking of the Insulation Screen

Non-biodegradable, water-swellaable semi-conductive tape(s) 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 F of AS/NZ 60840 demonstrating the effectiveness of water-blocking method and materials proposed.

5.1.8 Metal Sheath

The metal sheath comprising the moisture barrier shall provide an impervious barrier and be either:

- Aluminium; or
- Copper.

Corrugated sheaths shall be extruded, or welded in a continuous process from rolls of sheet metal without joins in any one drum length.

Annular corrugations are preferred to assist with the prevention of water permeation along the cable and to facilitate the cutting and removal of the metallic sheath without damage to the core of the cable.

Alternative offers for a metallic sheath with a thickness less than that specified in AS/NZ 1429.2 will be considered. For such offers to be accepted it must be demonstrated that the thickness and profile of the metallic sheath in the constructed cable will withstand the rated mechanical and thermal stresses during installation and under the specified operating conditions.

5.1.9 Metallic Screen

If required, a metallic wire screen shall be provided to carry, in combination with the metallic sheath, the full short-circuit current specified in Section 5.1.11. The fault rating of the cable screen, based on an initial core conductor temperature of 90°C, shall be stated in Attachments 1.1 to 1.4.

The screen shall be comprised of plain or tinned annealed copper wires complying with AS/NZS 1125.

The minimum screen strand size shall be 1.35mm.

The tender shall determine the placement of the copper wire screen in relation to the metallic sheath and shall show this on the cable construction drawing.

The screen wires shall be applied on the bedding of non-biodegradable, semi conductive, water-swellaable tapes, and further, water-swellaable semi-conductive tape(s) shall be applied over the copper wires to effectively restrict water permeation along the cable.

The Tenderer shall provide details of the water blocking measures being offered and include details of the proportion of the cross-sectional area of the free space between layers of the cable construction that sandwich the metallic wire screen.

5.1.10 Protective Layers, Over-Sheaths and Outer-Sheaths

Where a nylon jacket is specified for insect protection, a LLDPE sheath (colour orange) shall be applied over the cable core. The nylon jacket shall consist of continuously UV stabilised black nylon (polyamide 12) with a radial thickness of not less than 0.8mm. It must have a smooth glossy surface, free from defects or scratches. Full details of the nylon jacket shall be included with the tender.

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An extruded over-sheath shall be applied to the cable. The over-sheath shall be comprised of a layer of black MDPE complying with the requirements of IEC 60840 and IEC 60229 and have the properties specified in the table below.

The compound shall have a minimum of 2% carbon black and shall be capable of operating continuously at 900C.

A graphite coating shall be applied on the over-sheath to allow for present and future testing of the integrity of the cable sheath. The Tenderer shall give details of the graphite coating being offered.

The cable may be installed in acid sulphate soil. The Tenderer shall advise of the suitability of the specified non-metallic sheath in this environment and shall advise of any additional requirement for the sheath, if required, and shall include this cost in the offer.

Where termite repellent is specified the MDPE outer sheath shall be impregnated with an effective termite repellent. Material Safety Data Sheets (MSDS) quoting the active ingredient, toxicity level and safety information shall be submitted with the tender.

For the purposes of this specification the term MDPE refers to an over sheath that shall have the following properties:

Table 5.1.10	
Property	Value for MDPE
Density	0.930 – 0.950 g/cm ³
Hardness - Shore D	54 – 58

The Tenderer shall provide sample test results of shrinkage tests carried out on the MDPE outer sheath insulation using the test procedure and meeting the requirements of Clause 12.4.13 of AS/NZS 60840.

5.1.11 System Earth Fault Duties

The specified cables shall be designed to meet the system earth fault duties as follows:

Voltage	Energex	Ergon Energy
66 kV	NA	25 kA for 1 sec
132 kV	40 kA for 0.5 second	25 kA for 1 sec

5.2 Option to include Optical Fibres in the Cable Construction

For Items 2 & 4, and as an optional inclusion in the power cable construction for all other items, the Tenderer shall offer the addition of multi-mode and single mode optical fibres to enable distributed temperature sensing (DTS). The Tenderer shall recommend the location for the placement of the OF cables within the cable construction. The Tenderer shall document the following details:

1. How it is proposed that the OF cable will be mechanically protected
2. How the integrity of the OF cable will be ensured during cable installation
3. How the integrity of the cable can be maintained where access to the OF cable is required for repair
4. How the OF joints will be incorporated into cable joints

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5. How the water moisture proofing of the cable system will be ensured with the inclusion of the OF cable

The maximum operating temperature may range from 85°C continuously to 100°C under 2-hour emergency conditions.

The optical fibre cable shall have optic fibres in accordance with ITU-T Recommendation G.652.

The cable will be comprised of 2 multi mode and 2 single mode fibres shall be completely metal free and shall comply with IEC Publication 60793-2 and Austel Technical Standard 008 with the following characteristics.

5.2.1 Multi Mode

The multi mode cable will be used for Distributed Temperature Sensing (DTS). Alternative characteristics may be considered if the Tenderer can demonstrate better performance for DTS. The Tenderer must provide full details of any alternative offer in the tender submission.

- Transmission wavelength 850nm and suitable for 1,300nm
- Mode field diameter $50 \pm 3.0\mu\text{m}$ at a transmission wavelength of 850nm.
- Bandwidth >500Mhz at 850nm and >500Mhz at 1,300nm

- Numerical aperture $0.2 \pm .015$
- Attenuation Not greater than 2.4dB/km at an optical wavelength of 850nm and 0.6dB/km at 1,300nm

- Core Eccentricity Less than 6%
- Optical cladding diameter $125\mu\text{m} \pm 2.0\mu\text{m}$
- Life span Greater than 50 years

5.2.2 Single Mode

The characteristics of each single mode optical fibre in the optical fibre cable will adhere to the ITU-T's recommendation G.652 and as follows:

- Transmission wavelength 1,310nm and suitable for 1,550nm
- Mode field diameter 9.2 ± 0.4µm at a transmission wavelength of 1,310nm.
10.4±0.8µm at a transmission wavelength of 1,550nm.
- Attenuation Not greater than 0.40 dB/km at an optical wavelength of 1310 nm and 0.30 dB/km at 1,550nm
- Total dispersion Not greater than 6 ps/(nm · km) at optical wavelength in the range 1,270nm to 1,360nm for a zero dispersion wavelength of 1,310nm and 20 ps/ (nm · km) at 1,550nm
- Optical cladding diameter 125 µm ± 2.0µm
- Life span Greater than 50 years

5.2.3 Fibre Coatings

The secondary coating is required to be a tight UV Acrylate or Polyamide coating and shall be easily removed by mechanical means for jointing purposes. Preference is likely to be given to fibres, which have a primary buffer coating of 250µm ± 15µm low modulus UV, cured Acrylate or Polyamide material. Thus the Tenderer is encouraged to offer prices for totally UV cured Acrylate or Polyamide coated fibres where possible.

The Tenderer may offer more than one primary, buffer coating material. In such cases the Tenderer should provide as much information as possible regarding the physical, mechanical, and transmission performance of such fibres, with particular regard to the relative susceptibility to hydrogen degradation compared with UV Acrylate or Polyamide coated fibre.

5.2.4 Identification of Individual Fibres

The colours of individual fibres as well as other cable components shall allow for the unique identification of individual fibres within the cable.

5.2.5 Factory Joints

The fibres shall not be jointed within any un-installed cable length without prior approval by the Purchaser. Where such approval is given, there shall be a maximum of one (1) joint allowed in any continuous length. This joint shall have a two way average splice loss of less than 0.2dB at 1,064nm.

5.2.6 Point Loss in Uninstalled Cable

5.2.6.1 Multi Mode

For the un-installed optical fibre cable there shall be no point loss (of any cause) in any single fibre, whose average two way attenuation exceeds 0.05dB at 850nm and 1,300nm.

5.2.6.2 Single Mode

For the un-installed optical fibre cable there shall be no point loss (of any cause) in any single fibre, whose average two way attenuation exceeds 0.05dB at 1,310nm and 1,550nm.

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5.2.7 Water Immersion

As the cable may be subjected to total water immersion, a clear water blocking compound shall be used around the optical fibre to prevent the ingress of moisture and other impurities to the optical fibres.

The water blocking compound shall:

- not inhibit movement of the fibre within the interstices of the cable;
- be compatible with the other materials used in the cable;
- remain pliable and maintain its water resistance over the operating temperature range and over the service life of the cable;
- be free of air entrapment;
- not cause hydrogen gas generation over the operating temperature range and service life;
- be toxicologically safe.

The cable sheath shall be resilient to ageing and embrittlement from heat.

The entire cable shall consist of electrically insulating material.

The cable will incorporate a strength member of glass reinforced plastic or equivalent.

The optical fibres shall not be constrained firmly against other fibres, strength members, moisture barrier compound or any other cable components. The preferred construction type is "loose tube".

5.3 Jointing Techniques

The Tenderer shall provide details of the fibre performance to different jointing techniques (including arc fusion and mechanical splicing), preferably in the form of histograms showing minimum obtainable splice losses.

5.4 Fibre Integrity and Test Certificates

Integrity of the fibre shall be tested by measuring the total attenuation by using a 850nm and 1,310nm multimode light source at one end of the fibre and an optical level metre at the other end.

Continuity shall be tested at 850nm and 1,310nm by measuring backscattered light using an Optical Time Domain Reflectometer (OTDR), which is adjusted to see the whole length of the fibre. This measurement shall be done from both ends of each fibre.

The overall attenuation and the OTDR traces shall be recorded and shall form part of the test certificates.

The optical fibre attenuation and continuity for each fibre of each cable drum length shall be measured and recorded prior to shipment from the manufacturing plant. The test results shall include date of test, drum number, drum-length and names of test personnel.

5.5 Purchaser Testing

The cables may be subject to tests after delivery at the Purchasers' expense. The Purchaser reserves the right to reject all cables not in conformance with this Specification or the successful Tenderer's guaranteed parameters. All rejected cables shall be replaced by the successful Tenderer at the successful Tenderer's expense.

The Tenderer offering this option shall provide details of the mechanical protection for the OF cable incorporated into the overall cable design and shall complete Attachment 1.3.

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5.6 Sealing of Cable Ends

5.6.1 Water Corrosion

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

5.6.2 Moisture Ingress

All cable 'Z' ends shall be sealed to prevent moisture ingress by the application of heat-shrink caps. 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. The "A" end of cables shall be fitted with a sealed pulling eye so attached to the sheath and cable cores as to withstand safely the recommended maximum allowable pulling tension during installation. The pulling eye shall firmly grip both conductor and sheath to stop differential movement between the cable core and outer sheath. The pulling eye shall have a tapered front to allow it to readily travel around rollers and conduit bends without catching. Any gaps in the pulling eye that may allow moisture penetration into the cable shall be filled with a suitable silicon/mastic sealant.

5.6.3 Sealing Methods

The Tenderer shall provide full details with the tender documents concerning the method used for sealing the cable ends.

5.7 Cable (Length) Markings

5.7.1 Colour

All power cable sheaths shall be indelibly marked in a contrasting colour with sequential metre markings at one metre intervals.

5.7.2 Drum Flange

The markings need not start at zero and the starting and finishing metre markings shall be recorded on the drum flange.

5.7.3 Identification Printing

To permit identification of cables, the following information shall be printed or embossed on the outer sheath at regular intervals, in accordance with AS/NZS1429.2

- Manufacturer's name or identifying initials.
- Year of manufacture.
- Type of cable (including the conductor size and type, rated voltage and insulation type).
- Metre markings.
- The Purchasers' Brand i.e. either "Energex", or "Ergon Energy"
- (Ergon Energy only) The unique cable code number (typically 4 numerals)

6. Performance and Testing

6.1 General

The cables shall be type, sample, and routine tested in accordance with the requirements of IEC 60840, and Section 3 of AS1429.2 as appropriate.

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Frequency for selection of sample tests shall be in accordance with Table D1 of AS1429.2

BASIS FOR NUMBER OF SAMPLES

Cable Length Ordered (km)	Number of Samples
<2	1
2 < 10	2
10 < 20	3
20 < 30	4
Continued in this sequence	

The Purchaser reserves the right to witness any test. The Tenderer shall give reasonable notice of when each and every test is to be carried out.

6.2 Type Testing

Type test certificates that qualify all items offered, in accordance with the Standards as specified in Clause 6.1 above, shall be submitted with the tender in a Qualification Test Report. The Tenderer shall advise the Purchasers' responsible officer of any changes in the composition of the materials and processes used for manufacture of the cables and the Purchasers' responsible officer will decide on the necessity for a new Type Test.

The "Weld Integrity Test of Welded Corrugated Metal Sheaths" as referenced in Clause 6.5 of this specification shall be included as a Type Test and conducted after the bending test on the sample length.

A list of the cable accessories, joints and terminations, that have been satisfactorily tested with each cable offered, giving details of the manufacturer and product identification, shall be provided with the tender.

6.3 Routine Tests

A "Certificate of Compliance" shall be supplied with each cable delivery. Routine test certificates shall be held by the Manufacturer and provided to the Purchaser within 24 business hours 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 Purchasers' Order Numbers and the associated cable drum numbers and lengths recorded on a compact disc on completion of the contract.

The Tenderer may be required to provide a sample and/or a photograph of each core, taken from each manufacturing run.

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6.4 Additional Tests

6.4.1 Additional Tests Under AS 1429.2

The following additional tests are required as per Table 3.1 AS1429.2.

Schedule of Additional Tests

Test	Criteria	Category of Test	Reference for test method
1 Conductor Screen (a) Thickness of extruded screen (b) Projection of irregularities at conductor screen/insulation interface	The minimum thickness at any point shall comply with Clause 2.3.2 Any projections or irregularities at the conductor screen/insulation interface shall not protrude more than 0.075mm into the insulation	Sample Sample	AS/NZS 1660.2.1
2 Insulation Determination of – (a) Number of voids (b) Size of contaminants (c) Size of discoloured transluents (d) Number of contaminants	Voids $\geq 0.05\text{mm}$ shall be zero Contaminants $\leq 0.125\text{mm}$ Discoloured transluents $\leq 0.25\text{mm}$ Contaminants ≤ 5 per 16cm^3	Sample	AS/NZS 1660.2.5
3 Insulation screen a) Thickness of extruded screen (b) Projection of irregularities at insulation screen/insulation interface	As specified in Clause 2.5.2 Any projections or irregularities at the insulation screen/insulation interface shall not protrude more than 0.125mm into the insulation	Sample Sample	AS/NZS 1660.2.1 AS/NZS 1660.2.5
4 Metallic wire screen Diameter of wires	Wires shall not vary from the nominal diameter by more than 5% (except for protective wires adjacent to fibre optic components)	Sample	By measurement
5 Cable (a) Partial discharge test (b) Partial discharge test after bending (i) Bending test (ii) Partial discharge test (c) Spark test of oversheath (only applies to oversheath without outer	The magnitude of the discharge shall not exceed 10pC at the voltage specified in Table 3.2 (AS1429.2) To be completed The requirements as for Test 5(a) apply No breakdown of the oversheath shall occur.	Routine Type Type Routine	AS/NZS 1660.3 AS/NZS 60840 AS/NZS 1660.3 AS/NZS 1660.3, as for insulation

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(d) Corrosion spread test (applicable to aluminium moisture barrier not bonded to the oversheath)	As defined in IEC 60229	Type	IEC 60229
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6.4.2 Water Penetration Tests

Water penetration tests shall be conducted for all water blocked cables in accordance with Appendix F of AS/NZS 60840 with the additional requirement to expose 50mm of the conductor at the centre of the cable test piece as shown in Figure F1 of Appendix F of AS/NZS 60840.

6.4.3 Weld Integrity Test of Welded Corrugated Metal Sheaths

The corrugated metal sheaths of at least one in ten completed drums of 66 kV and 132 kV cables shall withstand the integrity pressure test in accordance with the requirements of Attachment 7 as a sample test.

6.4.4 Routine Cable Over-Sheath tests

The following Routine tests shall be carried out, on each completed drum of cable, in addition to those specified in accordance with applicable Standards nominated in Clause 6.1.

- An insulation resistance test between the cable conductor core and the metallic screen. The test shall be carried out at a voltage level of 10kV D.C. and 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.

6.4.5 Fibre Routine Test

Each fibre of a manufactured lot shall be tested for integrity and continuity immediately after drawing and cladding.

Integrity of the fibre shall be tested by measuring the total attenuation by using:

- an 850nm and 1,310nm light source at one end of the fibre for multi mode fibres;
- a 1,310nm and 1,550nm light source at one end of the fibre for single mode fibre; and
- an optical level meter at the other end.

Continuity shall be tested at 850nm and 1,310nm for multi mode fibres and 1,310nm and 1,550nm for single mode fibres, by measuring backscattered light using an Optical Time Domain Reflectometer (OTDR), which is adjusted to see the whole length of the fibre. This measurement shall be done from both ends of each fibre.

The overall attenuation and the OTDR traces shall be recorded and shall form part of the test certificates.

6.4.6 Tests on Delivery of Cable

A cable integrity test may be carried out by the purchaser at the designated point of delivery.

7. Risk Assessment

7.1 Legislation

The Tenderer must comply with the requirements of the Workplace Health and Safety Act 2011, Queensland Electrical Safety Act 2002 and associated regulations, codes of practice and compliance/advisory to Attachment 3.

7.2 Documentation

Tendered items shall be subjected to a formal risk assessment. The Plant Code of Practice 2005 requires the Tenderer to perform a risk assessment and provide the resultant documentation to the Purchaser with their tender in accordance with the 'Risk Assessment' schedule (Attachment 3) included with this specification. Where required by some questions, full details to support answers must be furnished.

If the complete risk assessment documentation is not provided with the tender, or does not meet the required standard, the tender may either be rejected, or may have their price loaded with the estimated costs associated with the Purchaser conducting the assessments. Any documented risk assessment that accompanies the tender must meet the requirements of the Risk Management Advisory Standard 2000 as a minimum standard and address the five main steps of the risk management process. It is preferred that the risk assessment methodology uses an energy model to identify hazards.

The risk assessment/s must both state recommended practices and identify hazards to the Purchaser's personnel, public and property associated with the items offered as follows:

- The Installation of the cable.
- Transport, handling and storage of the cable.
- The Operation and Maintenance of the cable during life expectancy.
- Dismantling / disposal of cable at end of life.
- The range of uses for which the cable is intended.
- Effects of environmental conditions on the cable.

7.3 Tie Down Restraint

The risk assessment must address and describe the means of tie-down restraint to be employed to secure the drums during transport. Where tie-down chains are passed through drum spindle holes, the edges of the holes are to be protected from damage by the use of removable collars that will leave a smooth cylindrical surface to accommodate the spindle.

7.4 Cable Fastening

The risk assessment must address and describe the means of fastening the A and Z ends of the cable to the drum flanges to prevent dislodgement during transportation, unpacking and paying out of cable from the drum.

8. Quality Assurance

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

It is expected that the Tenderer and manufacturer will have a quality system certified to ISO 9001 in operation.

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Documentary evidence shall be provided concerning the level of Quality System Certification associated with the Tenderer and/or Manufacturer. This documentation shall include the Capability Statement associated with the Quality System Certification.

The Tenderer shall complete Attachment 4 in documenting the above requirements and shall include it with their Tender submission.

9. Samples

9.1 Production Samples

When requested, production samples of each item offered shall be submitted, at no cost to the Purchaser, to assist in the evaluation of the offer.

9.2 Delivery and Purchase

Production samples of the items offered shall be delivered freight free, suitably packaged and labelled including this Contract Number and Contract Item number. Samples must be delivered within two weeks of the date requested to a location nominated at time of request.

10. Packaging and Marking

10.1 General

10.1.1 Drums

The cable shall be of one length on each drum and shall be supplied on steel drums complying with the requirements of AS/NZS 3983.

10.1.2 External Lagging

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. Further, additional cushioning material 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 to be used.

10.1.3 Exposure

Drums must be of suitable quality to withstand a minimum of twenty-four (24) months exposure to all types of weather conditions during outside storage.

10.2 Drum Sizes and Lengths

10.2.1 Quantity

The cables shall be of one length on each drum. The length of cable shall not exceed 105% of the nominal length specified.

10.2.2 Drum Sizes and Cable Lengths

These cables will primarily be required for specific projects; consequently cable drum lengths shall be supplied to suit the cable installation layout and pre-determined joint positions for the specific projects.

The matter of drum sizes and cable lengths will therefore be specified on the purchase order on a project to project basis following consultation between the tender and Project Manager

10.2.3 Drums with Flange Height over 1,800mm

The spindle holes of drums having a flange height of over 1,800mm shall have a tubular spindle liner between spindle holes with no shoulders in the liner between the outside drum cheeks.

10.2.4 Lifting Chains

The spindle liner shall not be damaged by lifting chains passed through the drum spindle liner.

10.3 Drum Marking

Each drum of cable shall be indelibly and legibly marked on both flanges with the appropriate information required by the relevant Australian Standard, AS/NZS 1429.2 including the following information:

- The name or registered trade name or mark of the manufacturer or other distinguishing mark.
- The rated operating voltage expressed in the form '38.1/66 (72) kV' or '76.2/132(145) kV'
- The number of cores and size of the conductors and the conductor material.
- Wording to identify the insulation and sheath.
- Year of Manufacture
- A manufacturer's drum traceability number.
- The gross mass of the drum and cable.
- An arrow to indicate the direction for rolling cable onto the drum
- Any special handling instructions
- The number of the Standard, i.e. AS/NZS 1429.2, with which the cable complies.
- The start and finish numbers of the metre marking.
- Length of the cable wound onto the drum
- The Purchasers' brand i.e. "Energex", or "Ergon Energy"
- The Purchasers' Contract Number (to be advised)
- Purchase Order Number
- The Purchasers' Stock Code Number
- (Ergon Energy only) Manufacturer's traceability number – derived from Manufacturer's first letter, hyphen, batch number, hyphen, drum number for this batch.

10.4 Quarantine Requirements

Should the cable be supplied from overseas manufacturers, it is mandatory that all conditions and inspections required by the Australian Quarantine Act are met and that all these costs are included in the tendered price. In particular, timber drums must be fumigated with methyl bromide with a concentration of 48g/m³ 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 History

The Tenderer shall, for the items offered, state: -

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

The Tenderer is also requested to submit proposals for improving the service life of the cables.

12. Reliability

12.1 Guarantee

The Tenderer is required to provide comment and submit evidence in support of the reliability and performance claimed including detailed information on Failure Mode and Effect Analysis.

The Tenderer is required to guarantee the reliability and the performance of the cables offered for a service life of 60 years under the specified system and environmental conditions by specifying the guaranteed service life in the Attachments of Technical Details.

Where the specified guaranteed service life is less than 60 years The Tenderer is required to provide comment and submit evidence in support of the reliability and performance claimed including detailed information on Failure Mode and Effect Analysis.

13. Traceability

Details of the subcomponents of the Cables that are traceable shall be provided by the Tenderer by completion of Attachment 5.

The Tenderer shall determine which sub-components in their plant require traceability and shall indicate these in Attachment 5. The criteria for traceability shall be based on previously identified failure modes which may necessitate the recall of plant from service for rework or replacement should they occur either in the field or are discovered during manufacture or testing at works.

The Purchaser will give due recognition to the number of sub-components incorporating traceability when assessing conformance of the Tenderers' Quality Assurance System to the specified requirements.

14. Training

Training material in the form of drawings, instructions and/or audio visuals shall be required for the items accepted under this offer. The Tenderer shall provide an optional price for the provision of training to the Purchasers' staff. Brief details of the training offered shall be provided in the tender documents. 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 cores
- Application (particularly in areas of heavy coastal pollution)
- Maintenance
- Environmental performance
- Electrical performance
- Mechanical performance
- Cable rating software
- Disposal

15. Environmental Considerations

The Tenderer is required to complete Attachment 4 and comment on the environmental soundness of the design and the materials used in the manufacture of the items offered (including additives such as Termite Repellents). In particular, comments should address such issues as recyclability and disposability at the end of service life and also disposal of packaging materials. The Tenderer is required to document Environmental Management particulars in Attachments 3 and 4.

16. Information to be provided

16.1 General

The specific technical requirements for the items offered shall be as stated in Attachments 1 and 2 of this specification. The Tenderer shall provide all details requested by Attachments 1 and 2 and shall guarantee such data. A separate Schedule/ Column of a Schedule shall be completed for each item offered.

16.2 Drawings

The Tenderer shall provide, with the tender, full scale, dimensioned, cross sectional drawings detailing the construction of the cables in a similar manner to that shown in AS/NZS1429.2. The various components of the cable shall be labelled on the drawing together with the diameter over each layer of the cable construction. Risk Assessment

The Tenderer shall complete a risk assessment and respond to the referenced items in Attachment 3 of this specification.

16.3 Management Systems

The Tenderer shall complete Attachment 4 including details of Quality, Environmental, and Workplace Health & Safety Management Systems.

16.4 Traceable Item Reliability Performance Guarantee

The Tenderer shall complete Attachment 5 including details of performance reliability of traceable items per Section 13.

16.5 Technical Documentation Checklist

Attachment 6 details a checklist of supporting technical documentation which is required to be submitted with the tender.

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17. Attachment 1.0 – Technical details – 38/66kV XLPE Cables

PARTICULARS	UNIT	ITEM 1	ITEM 2
Cable Details - mm ² , Conductor Type, Cable Type		1000mm ² WB Al XLPE/ WBT/CWS / WBT /Corr Al/ Nylon/ MDPE	1000mm ² WB Al XLPE/ WBT/CWS/ OF /WBT/Corr Al/ Nylon/ MDPE
Number and size of strands in conductor			
Number and size of strands in screen (If applicable)			
Diameter over conductor ± manufacturing tolerances	(mm)		
Diameter over conductor screen	(mm)		
Construction of conductor - helical or Milliken			
D.C. Resistance of conductor at 20°C	(Ω/km)		
A.C. Resistance of conductor at 90°C	(Ω/km)		
Inductance per conductor	(mH/km)		
Capacitance of conductor to screen at 20°C	(µF/km)		
Maximum charging current at nom. Voltage, 50Hz	(mA/km)		
Positive sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Zero sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Effective surge impedance	(Ω/km)		
Nominal thickness of XLPE insulation	(mm)		
Diameter over insulation and manufacturing tolerance	(mm/±mm)		
Diameter over insulation/core screen	(mm)		
Dielectric loss/φ at 50Hz,90°C) cond. temp., direct buried)	at 55 kV at 66 kV	(kW/km) (kW/km)	
Insulation impulse level		(kVp)	
Diameter over Aluminium sheath	(mm)		
Minimum thickness of Aluminium sheath	(mm)		
Diameter over screen wires	(mm)		
Combined metal sheath/screen DC resistance at 20°C	(Ω/km)		
Radial thickness of LLDPE and nylon sheath	(mm)		
Minimum thickness of MDPE over-sheath –	(mm)		
Overall diameter of cable	(mm)		
Minimum bending radius pulling/setting	(mm)	/	/
Maximum pulling tension - Stocking grip/pulling eye	(kN)	/	/
Maximum side wall bearing pressure	(kN/m)		
Mass of cable	(tonnes/km)		
Cable drum size	(F x B x W)		
Spindle hole diameter	(mm)		
Gross mass	(kg)		
Service life	(years)	60	60

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18. Attachment 1.1 – Technical Details 76/132kV XLPE Cables

PARTICULARS	UNIT	ITEM 3	ITEM 4
Cable Details - mm ² , Conductor Type, Cable Type		630mm ² WB Al/ XLPE/ WBT/ CWS / WBT /Corr Al/ Nylon/ MDPE	630mm ² WB Al XLPE/ WBT/CWS/ OF /WBT/Corr Al/ Nylon/ MDPE
Number and size of strands in conductor			
Number and size of strands in screen (If applicable)			
Diameter over conductor ± manufacturing tolerances	(mm)		
Diameter over conductor screen	(mm)		
Construction of conductor – helical or Milliken			
D.C. Resistance of conductor at 20°C	(Ω/km)		
A.C. Resistance of conductor at 90°C	(Ω/km)		
Inductance per conductor	(mH/km)		
Capacitance of conductor to screen at 20°C	(µF/km)		
Maximum charging current at nom. Voltage, 50Hz	(mA/km)		
Positive sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Zero sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Effective surge impedance	(Ω/km)		
Nominal thickness of XLPE insulation	(mm)		
Diameter over insulation and manufacturing tolerance	(mm/±mm)		
Diameter over insulation/core screen	(mm)		
Dielectric loss/φ at 50Hz,90°C) at 110 kV cond. temp., direct buried) at 132 kV	(kW/km)		
Insulation impulse level	(kVp)		
Radial thickness of corrugated aluminium sheath	(mm)		
Diameter over crest of corrugated aluminium sheath	(mm)		
Root diameter of corrugated sheath	(mm)		
Pitch of helical corrugation (if applicable)	(mm)		
Metal sheath DC resistance at 20°C	(Ω/km)		
Radial thickness of LLDPE and nylon sheath	(mm)		
Minimum thickness of MDPE over-sheath	(mm)		
Overall diameter of cable	(mm)		
Minimum bending radius pulling/setting	(mm)	/	/
Maximum pulling tension - Stocking grip/pulling eye	(kN)	/	/
Maximum side wall bearing pressure	(kN/m)		
Mass of cable	(tonnes/km)		
Cable drum size	(F x B x W)		
Spindle hole diameter	(mm)		
Gross mass	(kg)		
Service life	(years)	60	60

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19. Attachment 1.1 – Technical Details – 76/132kV XLPE Cables

PARTICULARS	UNIT	ITEM 5	ITEM 6
Cable Details - mm ² , Conductor Type, Cable Type		1200mm ² WB Al/ XLPE/ WBT/ CWS / WBT /Corr Al/ impregnated MDPE	1200mm ² WB Cu XLPE/WBT/Corr Al/ MDPE
Number and size of strands in conductor			
Number and size of strands in screen		N/A	N/A
Diameter over conductor ± manufacturing tolerances	(mm)		
Diameter over conductor screen	(mm)		
Construction of conductor – helical or Milliken			
D.C. Resistance of conductor at 20°C	(Ω/km)		
A.C. Resistance of conductor at 90°C	(Ω/km)		
Inductance per conductor	(mH/km)		
Capacitance of conductor to screen at 20°C	(µF/km)		
Maximum charging current at nom. Voltage, 50Hz	(mA/km)		
Positive sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Zero sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Effective surge impedance	(Ω/km)		
Nominal thickness of XLPE insulation	(mm)		
Diameter over insulation and manufacturing tolerance	(mm/±mm)		
Diameter over insulation/core screen	(mm)		
Dielectric loss/φ at 50Hz,90°C) cond. temp., direct buried)	at 110 kV at 132 kV	(kW/km) (kW/km)	
Insulation impulse level	(kVp)		
Radial thickness of corrugated aluminium sheath	(mm)		
Diameter over crest of corrugated aluminium sheath	(mm)		
Root diameter of corrugated sheath	(mm)		
Pitch of helical corrugation (if applicable)	(mm)		
Metal sheath DC resistance at 20°C	(Ω/km)		
Minimum thickness of MDPE over-sheath	(mm)		
Overall diameter of cable	(mm)		
Minimum bending radius pulling/setting	(mm)	/	/
Maximum pulling tension - Stocking grip/pulling eye	(kN)	/	/
Maximum side wall bearing pressure	(kN/m)		
Mass of cable	(tonnes/km)		
Cable drum size	(F x B x W)		
Spindle hole diameter	(mm)		
Gross mass	(kg)		
Service life	(years)	60	60

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20. Attachment 1.3 – Technical details- 76/132kV XLPE Cables.

PARTICULARS	UNIT	ITEM 7	ITEM 8
Cable Details - mm ² , Conductor Type, Cable Type		1600mm ² WB Cu XLPE/WBT/Corr Al/ MDPE	1200mm ² WB Cu XLPE/WBT/Corr Cu/ MDPE
Number and size of strands in conductor			
Number and size of strands in screen		N/A	N/A
Diameter over conductor ± manufacturing tolerances	(mm)		
Diameter over conductor screen	(mm)		
Construction of conductor – helical or Milliken			
D.C. Resistance of conductor at 20°C	(Ω/km)		
A.C. Resistance of conductor at 90°C	(Ω/km)		
Inductance per conductor	(mH/km)		
Capacitance of conductor to screen at 20°C	(μF/km)		
Maximum charging current at nom. Voltage, 50Hz	(mA/km)		
Positive sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Zero sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Effective surge impedance	(Ω/km)		
Nominal thickness of XLPE insulation	(mm)		
Diameter over insulation and manufacturing tolerance	(mm/±mm)		
Diameter over insulation/core screen	(mm)		
Dielectric loss/φ at 50Hz,90°C) at 110 kV cond. temp., direct buried) at 132 kV	(kW/km) (kW/km)		
Insulation impulse level	(kVp)		
Radial thickness of corrugated aluminium sheath	(mm)		
Diameter over crest of corrugated aluminium sheath	(mm)		
Root diameter of corrugated sheath	(mm)		
Pitch of helical corrugation (if applicable)	(mm)		
Metal sheath DC resistance at 20°C	(Ω/km)		
Minimum thickness of MDPE over-sheath	(mm)		
Overall diameter of cable	(mm)		
Minimum bending radius pulling/setting	(mm)	/	/
Maximum pulling tension - Stocking grip/pulling eye	(kN)	/	/
Maximum side wall bearing pressure	(kN/m)		
Mass of cable	(tonnes/km)		
Cable drum size	(F x B x W)		
Spindle hole diameter	(mm)		
Gross mass	(kg)		
Service life	(years)	60	60

NAME OF TENDERER _____

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



21. Attachment 1.4 – Technical Details – 76/132kV XLPE Cables.

PARTICULARS	UNIT	ITEM 9	ITEM
Cable Details - mm ² , Conductor Type, Cable Type		1600mm ² WB Cu XLPE/WBT/Corr Cu/ MDPE	
Number and size of strands in conductor			
Number and size of strands in screen		N/A	N/A
Diameter over conductor ± manufacturing tolerances	(mm)		
Diameter over conductor screen	(mm)		
Construction of conductor – helical or Milliken			
D.C. Resistance of conductor at 20°C	(Ω/km)		
A.C. Resistance of conductor at 90°C	(Ω/km)		
Inductance per conductor	(mH/km)		
Capacitance of conductor to screen at 20°C	(μF/km)		
Maximum charging current at nom. Voltage, 50Hz	(mA/km)		
Positive sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Zero sequence impedance per phase in R+jX form at maximum conductor operating temperature	(Ω/km)		
Effective surge impedance	(Ω/km)		
Nominal thickness of XLPE insulation	(mm)		
Diameter over insulation and manufacturing tolerance	(mm±mm)		
Diameter over insulation/core screen	(mm)		
Dielectric loss/φ at 50Hz,90°C) at 110 kV cond. temp., direct buried) at 132 kV	(kW/km) (kW/km)		
Insulation impulse level	(kVp)		
Radial thickness of corrugated copper sheath	(mm)		
Diameter over crest of corrugated copper sheath	(mm)		
Root diameter of corrugated sheath	(mm)		
Pitch of helical corrugation (if applicable)	(mm)		
Metal sheath DC resistance at 20°C	(Ω/km)		
Minimum thickness of MDPE over-sheath –	(mm)		
Overall diameter of cable	(mm)		
Minimum bending radius pulling/setting	(mm)	/	/
Maximum pulling tension - Stocking grip/pulling eye	(kN)	/	/
Maximum side wall bearing pressure	(kN/m)		
Mass of cable	(tonnes/km)		
Cable drum size	(F x B x W)		
Spindle hole diameter	(mm)		
Gross mass	(kg)		
Service life	(years)	60	60

NAME OF TENDERER _____

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



22. Attachment 1.5 – Technical Details – Fibre Optic Cables

PARTICULARS	UNITS	FIBRE OPTIC CABLE
Cable Details		
Multi Mode:		
Mode field diameter at 850nm	(μm)	
Tolerance	(%)	
Attenuation (at zero fibre tension) @ 850nm	(dB/km)	
@ 1,300nm	(dB/km)	
Maximum permissible fibre strain	(% strain)	
Fibre Proof test strain	(% strain)	
Attenuation (at Maximum permissible fibre strain) @ 850nm	(dB/km)	
@ 1,300nm	(dB/km)	
Optical cladding diameter and Tolerance	(μm) (%)	
Dispersion @ 1,270 to 1,340nm	(ps/km.nm)	
@ 1,550nm	(ps/km.nm)	
Maximum continuous operating temperature	($^{\circ}\text{C}$)	
Minimum bending radius for coated optical fibre (a) Under no tension	(mm)	
(b) Under maximum tension	(mm)	
Single Mode:		
Mode field diameter at 1,310nm and Tolerance	(mm) (%)	
Attenuation (at zero fibre tension) @ 1,310nm	(dB/km)	
@ 1,550nm	(dB/km)	
Maximum permissible fibre strain	(% strain)	
Fibre Proof test strain	(% strain)	
Attenuation (at Maximum permissible fibre strain) @ 1,310nm	(dB/km)	
@ 1,550nm	(dB/km)	
Optical cladding diameter and Tolerance	(μm) (%)	
Dispersion 1,270 to 1,340nm	(ps/km.nm)	
1,550nm	(ps/km.nm)	
Maximum continuous operating temperature		
Minimum bending radius for coated optical fibre (a) Under no tension	(mm)	
(b) Under maximum tension	(mm)	
Maximum protrusion of outer sheath due to optic fibre cable	(mm)	
Service life	(years)	
Manufacturer's Name and Address		

23. Attachment 2

23.1 Underground Cable Current Rating

INSTALLATION CONDITIONS		
Ground Thermal Resistivity	1.2°C.m/W	
Bedding and Backfill (flowable fill)	0.9°C.m/W	
Soil Temperature	28°C	Summer
	18°C	Winter
Air Temperature	40°C	Summer
	25°C	Winter
Burial Depth		
	900mm 1200mm	66kV and 132kV
Single phase cables up to 132kV are laid in trefoil and are either single-point bonded (and cross-bonded), or, solid bonded.		
For double circuit construction, calculate current ratings based on 1000mm spacing between circuit centres for single point and solid bonded screens/sheaths.		

Note:

The Tenderer is required to nominate the designed maximum Continuous current rating of each cable type. The continuous current ratings shall be determined by the methods and formulae given in Publication 287 of the International Electrotechnical Commission (IEC).

The Tenderer is also required to nominate the Cyclic and Emergency ratings of the cables.

The “Cyclic rating” is defined as the maximum permissible peak daily load current, for the given daily load cycle, that the cable may conduct without the conductor temperature exceeding 90oC for XLPE insulated cables;

The “Emergency rating” is defined as the maximum current carrying capacity of the cable for a period of 2 hours immediately following having been loaded for 50% of the nominated maximum continuous load.

The cyclic current and emergency ratings shall be calculated by the method recommended in CIGRE Current Ratings of Cables for Cyclic and Emergency Loads (Part 1), - (Study Committee No. 2, Electra No. 24, October 1972).

Cable current ratings for cables in conduit shall be determined for cables in light duty PVC conduits to AS/NZS 2053.2:2001 as follows:

- 66kV and 132kV Single Core cables installed in either 125, 150 or 200mm conduit such that $d_{\text{cable}} / d_{\text{conduit}} < 0.7$

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



23.2 Underground Cable Current Rating (Continued)

The daily load cycle is given in the following table.

Time	Load (p.u.)
00:00	0.70
00:30	0.61
01:00	0.61
01:30	0.61
02:00	0.61
02:30	0.61
03:00	0.61
03:30	0.62
04:00	0.62
04:30	0.63
05:00	0.65
05:30	0.70
06:00	0.74
06:30	0.82
07:00	0.88
07:30	0.96
08:00	1.00
08:30	1.00
09:00	1.00
09:30	1.00
10:00	1.00
10:30	1.00
11:00	1.00
11:30	1.00

Time	Load (p.u.)
12:00	1.00
12:30	1.00
13:00	1.00
13:30	1.00
14:00	1.00
14:30	1.00
15:00	1.00
15:30	0.98
16:00	0.94
16:30	0.90
17:00	0.88
17:30	0.88
18:00	0.88
18:30	0.88
19:00	0.86
19:30	0.86
20:00	0.84
20:30	0.82
21:00	0.80
21:30	0.78
22:00	0.76
22:30	0.74
23:00	0.73
23:30	0.72

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23.3 Underground Cable Current Rating (Continued)

CABLE DESCRIPTION:	Items 1 to 9	Season	SINGLE CIRCUIT DIRECT BURIED			SINGLE CIRCUIT BURIED in CONDUIT		
			Maximum Continuous Current Rating (amps)	Emergency Current Rating (amps)	Cyclic Current Rating (amps)	Maximum Continuous Current Rating (amps)	Emergency Current Rating (amps)	Cyclic Current Rating (amps)
		Summer						
		Winter						
		Season	DOUBLE CIRCUIT DIRECT BURIED @ 450mm Spacing			DOUBLE CIRCUIT BURIED in CONDUIT @ 650mm Spacing		
			Maximum Continuous Current Rating (amps)	Emergency Current Rating (amps)	Cyclic Current Rating (amps)	Maximum Continuous Current Rating (amps)	Emergency Current Rating (amps)	Cyclic Current Rating (amps)
		Summer						
		Winter						

Ratings required for:

All Cables types and sizes described in **Section 1.3 Items 1 to 9**

Conduit sizes to be determined in accordance the requirements specified above

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24. Attachment 3

24.1 Risk Assessment

Ref.	Particulars	Response
1.	<p>Does the Equipment offered comply with the Queensland Workplace Health and Safety Plant Code of Practice 2005? (http://www.dir.qld.gov.au/workplace/law/codes/plant/) If so, have the following obligations been fulfilled for Manufacturers and/or Tenderers of Plant to ensure (according to the definitions under the Workplace Health and Safety Act 2011 s. 23): that the Equipment offered has been examined and tested to ensure it is safe and without risk to health when used properly? the Equipment offered is accompanied by information about the way the equipment must be used to ensure health and safety? In particular, information relating to the following points? (http://www.dir.qld.gov.au/workplace/law/codes/plant/Tenderers/#provision) If so, please provide provision of appropriate information?</p>	
2.	<p>Does the Equipment offered comply with the Queensland Electrical Safety Act 2002? (http://www.dir.qld.gov.au/electricalsafety/law/legislation/act/)</p>	
3.	<p>Has a Risk Assessment been performed on the Equipment offered, which meets the requirements of the How to Manage Work Health & Safety Risks Code of Practice 2011? (http://www.dir.qld.gov.au/workplace/law/codes/riskman/) If so, please include a copy of the risk assessment with the tender.</p>	
4.	<p>Do any of the items offered involve assembly of components from a variety of sources? If so, are the components compatible to ensure the item is safe and without risk to health and safety when used properly?</p>	
5.	<p>Has the Equipment been examined and tested to ensure it is safe when used properly? In particular, have all Test Certificates specified in this Technical Specification been supplied? Is information available for safe operation and maintenance of the Equipment?</p>	
6.	<p>Comment on the environmental soundness of the design and the materials used in the manufacture of the items offered (including additives such as Termite Repellents). In particular, comments should address such issues as recyclability and disposability at the end of service life and also disposal of packaging materials.</p>	

NAME OF TENDERER	
SIGNATURE (FOR AND ON BEHALF OF TENDERER)	
DATE	

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



25. Attachment 4

25.1 Management Systems Information Schedule

1) Tenderer Details

Tenderer:-	Representative's Name:-
Address:-	Telephone:- Facsimile:- Mobile / Other:-
Product / Service:-	ABN:-

2) Quality Assurance

Do you have a fully implemented Quality Management System in place which has been certified by an external certification body? (3 rd Party Industry Specific Certification)	YES / NO
If YES, advise name of certification body and Certificate number. Attach copy of the certificate and Standard number.	Certified by: Certificate Number:
Copy of Certificate and Schedule(s) attached?	YES / NO
Do you hold a current Energex / Ergon Energy, or other Electricity Authority and/or the Queensland Government Contractor Rating? (2 nd Party)	YES / NO
If YES, advise Electricity Authority, Certificate Number and rating.	Elec. Authority: Number: Rating:

If you answered "YES" to having 3rd Party Industry Specific Quality Certification and

- This is not "by association" with another entity please complete Parts 5 and 6.
- This is "by association" with another entity please complete Part 3.

If you answered "NO" to having 3rd Party Industry Specific Quality Accreditation, please complete Part 4.

3) Quality Assurance Certification by Association

If you have answered "YES" to having Quality Assurance Certification, and have used another entity in providing this answer please provide details of this entity below.

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Registered Company Name:	
Address:	
ABN:	

Please complete Parts 5 and 6.

4) Internal Quality System Questions

Have you developed and implemented your own internal non-certified Quality Management System?	YES/NO
-----------------------------------------------------------------------------------------------	--------

If you answered "NO" to the above question please complete Part 5.

If you answered "YES" to the above question please complete the remaining questions in Part 4.

Do you have a Quality Manual?	YES/NO						
Do you have procedures in place to ensure Quality of product and / or service?	YES/NO						
Do you have a sample Quality Inspection and Test Plan or similar that you could provide on request?	YES/NO						
Do you have an Internal Audit System?	YES/NO						
Do you produce Internal Audit Reports that have suitable corrective action mechanisms?	YES/NO						
Do you require your Tenderers / contractors to have a documented Quality Management System in place?	YES/NO						
How do you evaluate your Tenderer's / contractor's quality performance?	<table border="0"> <tr> <td>Audit</td> <td>Yes/No</td> </tr> <tr> <td>Inspections</td> <td>Yes/No</td> </tr> <tr> <td>Performance History</td> <td>Yes/No</td> </tr> </table>	Audit	Yes/No	Inspections	Yes/No	Performance History	Yes/No
Audit	Yes/No						
Inspections	Yes/No						
Performance History	Yes/No						
If requested, would your company be able to provide a copy of its Internal Quality Management System to the Purchaser?	YES/NO						

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5) Environmental

Do you have a fully implemented Environmental Management System in place which has been certified by an external certification body? If YES attach a copy of the certificate.	YES/NO
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------

If YES go to Part 6.

Do you have an Environmental Management Policy that is available to the Purchaser within 7 days of request?	YES/NO
Do you have a formal Environmental Management Plan that is available to the Purchaser within 7 days of request that outlines how you will address environmental risks relevant to your activities and conditions?	YES/NO
Are the requirements of your Environmental Management Plan incorporated into your Work Procedures?	YES/NO
Do you have a fully implemented Environmental Management System in place in accordance with ISO14001 which has been certified by an external certification body?	YES / NO
If YES, advise name of certification body and Certificate number. Attach copy of the certificate and Standard number.	Certified by: Certificate Number:
Copy of Certificate and Schedule(s) attached	YES / NO

6) Workplace Health and Safety

Do you have a formal Workplace Health and Safety Management Plan that is available to the Purchaser within 7 days of request that outlines how you will address safety risks relevant to your activities and conditions?	YES/NO
Are the requirements of your Workplace Health and Safety Management Plan incorporated into your Work Procedures?	YES/NO
Do you have a Workplace Health and Safety Policy that is available to the Purchaser within 7 days of request?	YES/NO

NAME OF TENDERER	
SIGNATURE (FOR AND ON BEHALF OF TENDERER)	
DATE	

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



27. Attachment 6

27.1 Technical Documentation Checklist

The following information shall be supplied by the Tenderer whose attention is drawn to the relevant Clauses of the Specification.

Tenderer to answer each question “Yes” or “No”

Clause No.	PARTICULARS	Response
	Have full and comprehensive details been submitted WITH the tender documents associated with each of the following?	
1.3	Recommended “performance based” cable design	Yes/No
1.3	A list of all departures of the tender from this specification and from Australian Standards	Yes/No
5.1.1	Statement regarding concentricity control.	Yes/No
5.1.5	XLPE Type, Source, and Test Information (including n-Test for electric field design)	Yes/No
5.1.5	Clean room documentation, extruder filter mesh	Yes/No
5.1.10	Material Safety Data Sheets for Termite Repellent	Yes/No
	Full details of nylon jacket (if applicable)	Yes/No
5.2	Option of Optical Fibre Cables – Details of Mechanical Protection Design	Yes/No
5.6.3	Sealing of cable ends	Yes/No
6.2	Weld integrity Test of Metallic Sheaths	Yes/No
6.3	Type Test Reports for all items offered	Yes/No
6.3	Detailed list of cable accessories tested with each cable offered	Yes/No
7	Risk Assessment	Yes/No
8	Documented evidence of the Quality systems of both the Tenderer and the Manufacturer (including Capability Statement), and also the Tenderer / Manufacturer’s programme to update the QA system to ISO 9001:2000	Yes/No
9	Samples	Yes/No
11	Service History	Yes/No
12	Reliability	Yes/No
13	Traceability	Yes/No
14	Training	Yes/No
15	Environmental Considerations	Yes/No
16	Information to be provided including Full Scale Drawings	Yes/No

28. Attachment 7

28.1 Integrity Test of Corrugated Metal Sheaths

28.1.1 Introduction

This document describes a proposed test procedure to be applied to a completed cable that has been rolled onto a cable drum after manufacture.

The welding of the sheath is tested as it passes an eddy current tester after welding and before corrugation and subsequent extrusion of the oversheath. This test is proposed to detect any small pinholes that have not been detected by the eddy current tester and any cracks or tears in the sheath that have occurred during corrugation or subsequent handling in manufacture.

28.1.2 General Principle

The general principle is to effectively seal the ends of the corrugated sheath, apply a dry nitrogen gas pressure and note any drop in pressure after a specified time. A higher pressure is required to test the integrity of the sheath of the completed cable than would be required to test the integrity of the sheath after corrugation and before application of the oversheath.

28.1.3 Pressure Test Method

This test requires the fitting of high strength (metal) caps to the ends of the cable, as the pressure involved would dislodge a standard heat shrink cap. The test should be conducted only in a place where suitable safety precautions can be taken. The operator should cordon off the test area and stand well clear of the cable drum and not in a direct line with the end cap that may become dislodged or rupture under pressure.

The following procedure should be followed:

- 3.1 The inner end seal of the cable must be removed and a copper end cap with a Schrader valve must be fitted. Begin by cutting the end of the cable off square.
- 3.2 Strip 500 mm of the polymeric over-sheathing layer(s) away from the end of the corrugated sheath.
- 3.3 Fit the copper end cap over the end of the cable and plumb the copper cap to the corrugated sheath.
- 3.4 Pressurise the corrugated sheath using dry nitrogen to a pressure of 600 kPa. Check that the copper end cap and the pulling eye are not leaking. If either end is leaking then release pressure immediately. Re-plumb the end cap to the corrugated sheath or reseal the pulling eye as necessary. Check to see that the cable can be pressurised to the required pressure. If the pressure may be attained, note the time and applied pressure and proceed to step 3.5.

(Note that if both ends of the corrugated sheath are sealed and the required pressure cannot be attained, there is a leak in the cable and it must be further investigated and repaired.)

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- 3.5 Maintain safety and security of the test area for two (2) hours and then check and record the reading on the pressure gauge. If the pressure drop is no more than 20 kPa, maintain surveillance of the test rig for a total period of twenty four (24) hours and then again check and record the reading on the pressure gauge. If the pressure reading is 580 kPa or greater the integrity of the corrugated sheath is sound.
- 3.6 If after the first two (2) hours the pressure drop is greater than 20 kPa then there are leaks in the corrugated sheath and the cable must be further investigated and repaired.
- 3.7 The test should be performed on cable that is stored out of direct sunlight, away from heating or cooling appliances and subject to ambient air temperatures only with cable temperatures recorded at each measurement of retained dry nitrogen pressure.

28.1.4 Record of Test Results

PRESSURE TEST OF CORRUGATED METAL CABLE SHEATH

DRUM No.	DATE	TIME	ELAPSED TIME (hours)	TEMPERATURE DEGREES C	DRY NITROGEN PRESSURE (kPa)
			Initial – 0 hours		600
			2 hours		580 minimum
			4 hours		
			8 hours		
			12 hours		
			16 hours		
			20 hours		
			24 hours		580 minimum

Attachment 8 - Cable Accessories Technical Specification

Technical Specification

for

Cable Accessories, Termination and Jointing Materials for Underground Electrical Power Cables With Nominal System Voltages of 66kV and 132 kV

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



1. Scope

1.1 General

This Specification is an accompanying specification to the Joint Workings Cable specification which specifies the requirements for the manufacture, supply, testing and delivery of Single Core Underground Power Cables with Aluminium and Copper conductors for use in electricity sub-transmission at system voltages of 66 and 132kV.

This specification sets out the requirements for the manufacture, supply, testing and delivery of cable accessories, terminating and jointing materials set out in the tables below for use with the cables described in the accompanying specification.

Accordingly items offered in accordance with this technical specification shall be matched dimensionally and functionally to each of the cables being offered by the Tenderer for items in the accompanying cable specification only.

ITEM	DESCRIPTION	STOCK CODE
	38/66 (66) kV CABLE JOINT:	
	Straight Through	
1	Joint Straight Through 1000 Al Corr Al sheath	
	Screen-Break	
2	Joint Screen-Break 1000 Al Corr Al sheath	
	76/132 (132) KV CABLE JOINT:	
	Straight Through	
3	Joint Straight Through 630 Al /Corr Al sheath	
	Screen-Break	
4	Joint Screen-Break 630 Al /Corr Al sheath	
5	Joint Screen-Break 1200 Al /Corr Al sheath	
6	Joint Screen-Break 1600 Cu /Corr Al sheath	
7	Joint Screen-Break 1200Cu /Corr Cu sheath	
8	Joint Screen-Break 1600Cu /Corr Cu sheath	
	76/132 (132) KV CABLE TERMINATIONS INDOOR GIS:	
	Complete Connector	
9	Indoor Connector GIS 630 Al /Corr Al sheath	
10	Indoor Connector GIS 1200 Al /Corr Al sheath	
11	Indoor Connector GIS 1600 Cu /Corr Al sheath	
12	Indoor Connector GIS 1200Cu /Corr Cu sheath	

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ITEM	DESCRIPTION	STOCK CODE
13	Indoor Connector GIS 1600Cu /Corr Cu sheath	
	Plug In Connector	
14	Indoor Connector GIS 630 Al /Corr Al sheath	
15	Indoor Connector GIS 1200 Al /Corr Al sheath	
16	Indoor Connector GIS 1600 Cu /Corr Al sheath	
17	Indoor Connector GIS 1200Cu /Corr Cu sheath	
18	Indoor Connector GIS 1600Cu /Corr Cu sheath	
	38/66 (66) kV CABLES TERMINATIONS OUTDOOR:	
19	Outdoor Terminations Porcelain 1000 Al Corr Al sheath	
20	Outdoor Terminations Polymeric 1000 Al Corr Al sheath	
	76/132 (132) KV CABLES TERMINATIONS OUTDOOR:	
21	Outdoor Terminations Porcelain 630 Al /Corr Al sheath	
22	Outdoor Terminations Polymeric 630 Al /Corr Al sheath	
23	Outdoor Terminations Polymeric 1200 Al /Corr Al sheath	
24	Outdoor Terminations Polymeric 1600 Cu /Corr Al sheath	
25	Outdoor Terminations Polymeric 1200Cu /Corr Cu sheath	
26	Outdoor Terminations Polymeric 1600Cu /Corr Cu sheath	
	Link Boxes	
27	Cross – bonding link box complete with three sheath voltage limiters	
28	Sheath-break link box complete with six sheath voltage limiters	
29	Solid (Direct) – earthing link box	
30	Non-linear resistor for transient voltage limitation between GIS and 132 kV cable termination	

1.2 Conforming Tender

Offers strictly in accordance with the technical and commercial requirements of this specification as summarised below will be regarded as conforming tenders.

1.3 Alternatives

Suppliers are encouraged to submit alternative tenders based on their standard products provided that the accessories so offered will provide electrical and mechanical in-service performance equivalent to the accessories conforming to this specification. Type Test Certificates or Qualification Test Reports shall be submitted to verify performance. Departures from this specification shall be fully documented in the tender.

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



Alternative tenders may be submitted for consideration without a conforming tender being submitted.

1.4 Conductor Connectors

The Tenderer must nominate the method/s to be employed in joints and terminations to connect the copper and aluminium conductor sizes specified for cables in the accompanying specification.

The Tenderer shall provide evidence of testing that demonstrates the suitability of the connection method under the operational and service described in Sections 3 and 4 below.

2. Standards

The items shall be designed, 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 60270	High Voltage Test Techniques - Partial Discharge Measurements
AS/NZS 1429 Part 2	Electric cables - Polymeric insulated
AS 1660 All Parts	Test methods for electric cables, cords and conductors
AS 1931	High-Voltage Test Techniques
AS 2629	Separable insulated connectors for power distribution systems above 1 kV
AS 4068	Flat pallets for materials handling
AS 62271.301	High voltage switchgear and control gear Part 301: Dimensional standardization of terminals
AS/NZS 4325. 1	Compression and mechanical connectors for power cables with copper or aluminium conductors.
ISO 9001	Quality systems - Model for quality assurance in design, development, production, installation and servicing
IEEE 48	Standard test procedures and requirements for high voltage alternating current cable terminations
IEEE 404	Standard for power cable joints
IEC 60840 Ed. 2.0 b	Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um=36 kV) up to 150 kV (Um =170 kV) – Test methods and requirements

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STANDARD	TITLE
IEC 60684	Flexible insulating sleeving
IEC 60229	Tests on cable over-sheaths which have a protective function and are applied by Extrusion
IEC 62271-209	High voltage switchgear and control gear – Part 209 : cable connectors for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid –filled and dry-type terminations
ASTM D1603	Carbon black in ethylene plastics
ASK141	Electroplated Coatings of tin
Energy Networks Association Engineering Recommendation C.55/4	Insulated sheath Power Cable Systems
Energy Networks Association Engineering Recommendation C.66/1	Type approval testing procedure: Protective boxes for use with buried accessories employed on 33 kV – 400 kV insulated sheathed power cables (and for sheath sectionalising insulation embodied in such accessories)

The following abbreviations are used in the appendices and body of the text to indicate cable constructions features as follows:

- Al – aluminium conductor
- Cu – copper conductor
- WB – water blocked
- WBT – water blocking tape (and/or yarns)
- XLPE – cross-linked polyethylene
- CWS – copper wire screen
- CorrCu – corrugated copper sheath
- CorrAl - corrugated aluminium sheath
- MDPE – medium density polyethylene

3. Environment and Service Conditions

The conditions under which the terminating and jointing materials will be required to operate are:

- Installed directly buried in fine grain bedding material, at a nominal depth of up to 1 000 mm.
- Ambient air temperature not exceeding 45oC as determined by a shaded thermometer.

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



- Ambient ground temperature not exceeding 30oC.
- An altitude not exceeding 500 metres above sea level.
- A high humidity (90%) combined with a high temperature (35oC) followed by a sudden drop in temperature of up to 10oC.

Exposed terminating materials will be subject to the following additional service conditions: -

- Solar radiation intensity of 1 000W/m².
- Tropical summer storms with high winds and an annual rainfall in excess of 1 500 mm.
- Areas of coastal salt spray and/or industrial pollution with equivalent salt deposits densities in the range of 2.0 3.0g/m².

4. Operating Conditions

The cable accessories required are for use on 66kV and 132kV, three phase, 50Hz systems

The neutral points of Powerlink's transformers supplying Energex and Ergon Energy's 132 kV system are directly earthed. The maximum system voltage (phase to phase) on the systems is 145 kV and the required impulse insulation level is 650 kVp.

The neutral points of the transformers supplying Ergon Energy's 66kV system are directly earthed. The maximum system voltage (phase to phase) on the systems is 72 kV and the required impulse insulation level is 350 kVp.

Assembled components forming part of a supply system shall perform without distress under the following conditions: -

(1) Normal Operation:

Polymeric Insulated Cables - Continuous operation at a conductor temperature of 90°C

(2) Emergency Operation :

Polymeric Insulated Cables - Operated at a conductor temperature of 105°C

(3) Fault Conditions:

Able to withstand an earth fault duty of –

40 kA for 0.5 second on the 132 kV system; and
25 KA for 1 second on the 66kV system

Polymeric Insulated Cables - Operation at a conductor temperature of 250°C

5. Design and Construction

5.1 General

The Tenderer shall advise in the tender documents which if any of the accessories being offered have been used for the type testing of the cables being offered in the accompanying cable specification.

All cables are screened with a metallic sheath unless otherwise stated.

Cables are installed either direct buried, or in tunnels, or in unfilled conduits.

Joints are generally supported on sandbags on a concrete floor and back-filled with bedding sand.

5.2 Cable Types

The Table in Section 1 of the accompanying cable specification lists the nominal cable sizes and construction of the cables for which Energex and Ergon Energy require cable accessories.

Tendered accessories shall be offered as items sized to fit the dimensions of the cables being tendered and the construction of these cables

5.3 66 kV and 132 kV Straight Joints (XLPE cable)

Joints offered shall comply with IEC60840 Ed. 2.0 b, the performance requirements of Clause 10.1.1, be of the pre-fabricated type and designed for use with a cross bonded system.

Joints are also required for straight through applications without a screen-break.

A pre-moulded joint comprising a single piece of stress control insulation is preferred.

Taped Joints will NOT be accepted

The Tenderer shall supply details of the maximum working stress in kV/mm in all critical areas of joints. The working stress levels shall be included on sectional drawings of joints.

The pre-fabricated joint shall be enclosed in a copper joint sleeve designed for a cross bonded system. Steel or alloy steel joint sleeves will NOT be accepted.

The copper joint sleeve shall be enclosed in a suitable resin-bonded fibreglass outer box or an equivalent box filled with outer box compound for underground burial. The outer box and compound shall support, insulate and waterproof the sleeve.

In lieu of an outer box, as described in above, for cable basement installations or other similar places above ground, alternative outer sleeves will be considered, however preference will be given to compound filled outer boxes.

Outer box compound shall be supplied in tins of not more than 20kg weight.

All necessary joint materials shall be supplied with each joint.

The Tenderer shall give details of the means by which insulation shrink-back forces are contained by the joint design.

The Tenderer shall provide details of shelf life and storage conditions of jointing materials where required in Attachment 1.

Tenderer shall complete Attachment 1 to state overall length of the completed joint and the required cable pit length to make the joint.

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



5.4 132 kV Terminations (XLPE Cable into GIS)

Two types of cable connection into GIS switchgear are required:

Cable Connectors Complete –

The GIS cable termination shall be suitable for mounting into GIS in accordance with IEC 62271 Part 209 Clause 7.2 Note 2 to dimensions for fluid filled cable connections Fig 3 rated voltage 123 kV to 170 kV. The cable connector shall be complete.

Cable Connectors Plug-in Type -

The GIS cable termination shall be suitable for plugging into GIS with connector bushing already factory fitted. The connector shall exclude the bushing which will be provided and installed by the Switchgear Manufacturer.

The cable terminations for a maximum working voltage of 145 kV are required to be installed in SF6 gas insulated switchgear and are to be of the dry type for installation into switchgear manufacturer fitted bushings pre-fitted to the SF6 gas insulated switchgear.

The Tenderer shall supply details of the maximum working stress in kV/mm in all critical areas of the terminations. The working stress levels shall be included on sectional drawings of terminations.

Gland isolation shall be provided to insulate the sheath from earth at the termination position. The insulation level shall be 15kV DC.

The impulse insulation level of the termination shall be 650kVpk.

Preference will not be given to aluminium or aluminium alloy materials for any exposed metalwork associated with the termination and cable gland.

The O-rings for sealing the GIS housing to the termination insulator are to be supplied by the GIS manufacturer, as for spare O-rings.

All necessary jointing material, apart from the O-rings described above shall be supplied with each termination.

The Tenderer shall provide details of shelf life and storage conditions of jointing materials where required in Attachment "2".

5.5 66kV and 132kV Outdoor Terminations (Sealing Ends)

The Tenderer shall submit full details of outdoor cable terminations complying with IEC 60840 Ed. 2.0 b and the performance requirements of Clauses 10.1.1 and shall be suitable for application to Energex's and Ergon Energy's 66kV and 132 kV cables as described in Table 5.1 of this specification.

The outdoor cable terminations shall be suitable for mounting on low mount substation structures as well as being suitable for pole mounting.

The Tenderer shall submit offers for both Polymeric insulator housing types, and Porcelain insulator housing types.

The maximum working stress levels in kV/mm shall be stated in Attachment 2 and on sectional drawings of the terminations.

The polymeric and porcelain insulator housing and sheds shall withstand the electrical stress associated with continuous operation at 72kV or 145 kV as applicable, under the environmental conditions described in Clauses 4.1 and 4.2 above.

All necessary jointing material, including base support insulators, shall be supplied with each termination.

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5.6 Link Boxes and Associated Equipment

Proposed earth bonding arrangements for a typical cable installation, utilising sectionalised cross bonding, are shown in Electricity Association Engineering Recommendation C.55/4.

The Tenderer shall provide details of the following items as described in Appendix 3:

Cross-bonding link box, suitable for use at joints with 240 mm² copper XLPE insulated concentric bonding lead connections, and complete with three sheath voltage limiters.

Sheath-break link box, suitable for use at joints with 240 mm² copper XLPE insulated concentric bonding lead connections, and complete with six sheath voltage limiters.

Solid earthing link box suitable for use at joints with 240 mm² copper XLPE insulated concentric bonding lead connections.

Non-linear resistor for limiting transient voltages between the metal clad gas insulated switchgear and 132 kV cable terminations

Any Tenderer submitting alternative designs to the above shall provide full details and quantities of special bonding accessories in their offer.

The link boxes shall be manufactured of 316 or 316L grade stainless steel and shall be suitable for use with 240mm² copper conductor concentric bonding leads.

Link boxes provided for positions along the cable route shall be suitable for horizontal mounting in a below ground concrete pit where link boxes may be immersed in water for long periods and they shall be waterproof in this environment.

In addition to the terminals for bonding link connection, terminals for connection of temporary or working earths shall be provided.

All terminals and lid bolts shall be not less than M12 size.

The links, lugs and connectors shall be made of copper or copper chromium alloy and shall be electro-tinned in accordance with AS-K141. The thickness of the plating shall be at least 8 micrometres. For ease of connection or removal, the links shall be provided with an open slot at both ends.

The boxes shall be designed so as to avoid incorrect link connections.

The boxes shall have a suitable seal to prevent moisture ingress after installation. The seal must be a re-useable type to allow repetitive access to the links.

Surge diverters, otherwise known as sheath voltage limiters (SVLs), shall be single phase, gapless zinc oxide units rated at 4.5kV rms, 20 kA for 8/20 us, 20 kJ energy absorption on 2 shots before cooling and encapsulated in silicone rubber of at least 8mm thickness.

Earth bonding leads shall be comprised of a 240mm² copper conductor core, concentric XLPE insulated cable in accordance with EA Engineering Recommendation C.55/4 and as detailed in Appendix 4 of this specification.

The Tenderer shall supply technical details describing earth bonding equipment offered, including drawings with the tender documents.

6. Special Tools

Energex and Ergon Energy have a wide range of general equipment and special tools available to complete installation of the cable and accessories.

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To enable the Tenderer to assess the suitability of existing Energex and Ergon Energy equipment and special tools for the installation of cable accessories being offered, the Tenderer are invited to contact Energex and Ergon Energy to obtain necessary details.

The Tenderer shall submit separate details, including price, of any special tools that are identified as being necessary for their installation procedures. Prices for recommended compression heads, guide blocks and all dies required shall be provided. Full dimensions and details of the dies tendered, including die holder dimensions, shall also be provided with the tender so that dies and compression heads held by Energex and Ergon Energy can be evaluated. The Tenderer shall also provide details of the dimensions of the connector compression tool.

Tools that are available from normal commercial outlets should not be included.

7. Ancillary Equipment

All items necessary to this contract and not included in the items previously specified shall be termed "ancillary equipment".

The Tenderer shall list such items. A quantity and price shall be shown for each individual item to allow a review of requirements at the time of ordering.

8. Accessory Testing

8.1 Cable Joints and Terminations

The terminations, joints and other accessories will be deemed to have been tested if they pass satisfactorily the tests to which they will be subjected as a part of the test assembly for the cable tests.

Accessories not included in the cable test assembly shall have been tested separately and type test certificates shall be supplied. Any Tenderer offering accessories tested separately shall provide sufficient documentation to establish that the tests are relevant to the fitting of accessories to a cable of equivalent or higher dielectric stress design.

Each pre-fabricated joint body shall be subjected to a routine test comprising an ac voltage withstand and partial discharge test.

8.2 Link Boxes

The link boxes and their internal equipment shall comply with the following requirements:

DESCRIPTION	REQUIREMENT
Short circuit current withstand on links	40kA _{r.m.s.} for 1 sec
Electrical contact resistance (maximum) for main current path between links, studs and pillars	5μΩ
Pressure type test (internal explosion pressure)	200kPa
Pressure routine test	40kPa for 15 min
Water immersion test	3m of water for 7 days
Impulse Voltage Withstand:	60kV _{pk} , 1.2/50 μsec

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(a) Between links and between SVL connections	waveshape
(b) From links and SVL connections to earth	35kV _{pk} , 1.2/50 μsec waveshape
DC Voltage Test between links and from links to earth	25kV DC for 5 min
Insulation resistance	100MΩ at 1000V DC

9. Test Certificates

Test Certificates in duplicate shall be supplied for all tests undertaken by the manufacturer of the accessories under this specification.

Such test certificates shall be signed by a properly authorised person and forwarded to the Contract Supervising Officer with a covering letter setting out the Contract and Order numbers.

Energex or Ergon Energy may appoint a representative to be present for inspection and witnessing of tests at any time during the manufacture of the accessories.

By means of the specified Progress Reports, the Supplier shall keep the Contract Supervising Officer fully informed with regard to his intentions to: -

- (a) Commence manufacture of cable accessories
- (b) Carry out specified tests

10. Performance and Testing

10.1 Joint, Termination and Link Box Performance Requirements (electrical)

The Tenderer shall supply joints, terminations and link boxes that meet the test requirements of the relevant Standards, including IEC 60840 Ed. 2.0 b, IEC 62271-209, EA Engineering Recommendation C.55/4 and C66/1 and AS/NZS 4325.1 and shall complete Attachments 1 to 5 inclusive.

The joints and terminations shall withstand the electrical stress associated with continuous operation at highest system voltage under the environmental conditions described in Clauses 4 of this specification.

11. Quality Assurance

It is expected that suppliers will have a quality system certified to ISO 9002 in operation.

Documentary evidence shall be provided concerning the level of Quality System Certification associated with the Tenderer and/or Manufacturer. This documentation shall include the Capability Statement associated with the Quality System Certification.

12. Risk Assessment

12.1 Legislation

The Tenderer must comply with the requirements of the Queensland Workplace Health and Safety Act 2011, Queensland Electrical Safety Act 2002 and associated regulations, codes of practice and compliance/advisory standards

12.2 Documentation

Tendered items shall be subjected to a formal risk assessment. The Plant Code of Practice 2005 requires the Tenderer to perform a risk assessment and provide the resultant documentation to the Purchaser with their tender in accordance with the 'Risk Assessment' schedule (Attachment 4) included with this specification. Where required by some questions, full details to support answers must be furnished.

If the complete risk assessment documentation is not provided with the tender, or does not meet the required standard, the tender may either be rejected, or may have their price loaded with the estimated costs associated with the Purchaser conducting the assessments.

Any documented risk assessment that accompanies the tender must meet the requirements of the Risk Management Advisory Standard 2000 as a minimum standard and address the five main steps of the risk management process. It is preferred that the risk assessment methodology uses an energy model to identify hazards.

The risk assessment/s must identify hazards to the Corporation's personnel, public and property associated with:

- the installation of the equipment
- the operation and maintenance of the equipment during life expectancy
- dismantling/disposal of equipment at end of life.
- The 'Risk Assessment' schedule, Attachment 4 included with this specification is to be completed by the Tenderer. Note that the schedule contains a generic set of questions designed to cover all of the Purchaser's plant and materials and the Tenderer is only required to complete those items applicable to the product offered. Where required by some questions, full details to support answers must be furnished.

13. Environmental Considerations

The Tenderer is 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 of used or unused materials supplied in the jointing and terminating kits.

14. Reliability

The Tenderer is required to comment on the reliability of the equipment and the performance of the materials offered for a service life of 60 years under the specified system and environmental conditions.

Where the specified guaranteed service life is less than 60 years Suppliers are required to provide comment and submit evidence in support of the reliability and performance claimed including information on Failure Mode and Effect Analysis.

15. Traceability

The Suppliers shall determine which sub-components in their plant require traceability and shall indicate these and the method of batch identification in the Tender response.

The criteria for traceability shall be based on previously identified failure modes which may necessitate the recall of plant from service for rework or replacement should they occur either in the field or are discovered during manufacture or testing at works.

The Purchaser will give due recognition to the number of sub-components incorporating traceability and the method of batch identification when assessing conformance of the Suppliers' Quality Assurance System to the specified requirements.

16. Field Trials and Phasing in of New Material

If required by Energex and /or Ergon Energy all material not previously supplied to or approved by Energex or Ergon Energy for use in the network shall be trialled at the Tenderer's cost and includes:

- provision of adequate samples;
- a comprehensive and successful field trial to be undertaken by the successful Tenderer prior to the commencement of production/implementation;
- training for the appropriate staff of Energex and /or Ergon Energy as well as service contractors;
- Any modifications to the items offered in order to meet the reasonable requirements of this specification;
- provision of documented works procedures to be followed during installation of the material; and
- provision of associated tools and equipment not listed in Clause 21.

Phasing-in of new material will not take place until the successful Tenderer has demonstrated the ability to supply full production models at full production capacity and has in their store, a minimum of two (2) months requirements for Energex and Ergon Energy. Phase-in will then take place over an agreed period.

For major 66kV and 132 kV projects the Tenderer is to provide a guaranteed Production and Delivery Schedule.

17. Training for Installations of 132kV Joints and Terminations

Energex personnel have completed several installations of 110kV and 132kV XLPE cables involving outdoor terminations, joints (pre-moulded) and SF6 immersed terminations. Energex's experience with 110kV and 132kV XLPE cable commenced in 1985, and subsequently Energex staff received training in cable accessories installation in the U.K. (two manufacturers, the U.S.A. (two manufacturers) and Sweden (one manufacturer).

To enable Tenderers to assess the current level of skills and training needs of Energex staff in relation to the cable accessories being offered, Tenderers are invited to contact the Energex Contract Supervising Officer to obtain necessary details.

Should training and certification for Energex staff be necessary, the Tenderer shall provide detailed proposals for the options involving training at the Manufacturer's works or training in

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Brisbane by providing suitably qualified personnel for field supervision and inspection of the first accessories of each type during installation. Tenderers are to note that the training and field supervision activity may not be sequential.

The costs for training and supervision options shall be detailed by the Tenderer.

Tender prices for the option involving training at the Contractor's Works shall include the cost of supply of all consumable training materials, but shall not include travel and accommodation expenses for Energex personnel.

Tender prices for the option involving training in Brisbane shall include all costs and import duties for the supply and delivery of consumable training material to Brisbane and travel and accommodation expenses for the Contractors qualified Training Officer(s). Tender prices for the option involving field supervision shall include all costs and travel and accommodation expenses for the Contractor's qualified Training Officer(s).

Should any test facilities be required in association with any training-in-Brisbane proposal, then the test facilities required shall be identified in the tender documents.

The Tenderer shall submit a training plan for each option in sufficient detail to allow evaluation of each option by Energex.

The Tenderer shall be responsible for all costs in relation to any extension to the training program resulting from the non-availability of training materials and special tools to be supplied under the contract.

For the Training in Brisbane option, all training materials should be supplied in the one crate, if possible, which shall be clearly marked.

18. Samples

When requested, production samples of each item offered shall be submitted to assist in the evaluation of the offer.

Each sample shall be delivered freight free, suitably packaged and labelled with the following information:

Name of Tenderer and this Contract No. #
Contract Item Numbers
Any supporting data on features or characteristics

Energex or Ergon Energy may, at its discretion, either purchase the items at the tender price or return the samples to the respective Tenderer after the contract has been awarded.

19. Packaging and Marking

Supplier's attention is specifically drawn to the requirements of Section 4, Appendix 9 of the Instruction to Tenderers with regard to the packaging and delivery of palletised goods.

All items are to be supplied in packaged lots in accordance with the quantities detailed in Section 4, Appendix 9 of the Instruction to Tenderers.

Each container shall include the manufacturer's recommended installation procedure document.

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Each packaged lot and each kit within the packaged lot be marked with the following information:

Marking Required on Each Kit	Marking Required on Each Packaged Lot
Names of Supplier/Manufacturer	Names of Supplier/Manufacturer
Product Code	Product Code
Item Description	Item Description
Energex /Ergon Energy Stock Code	Energex / Ergon Energy Stock Code
Quantity : I kit	Pack Size: No. of Kits
Date of Manufacture	Date of Manufacturer

All items shall be packaged so that the materials can be transported and delivered in an undamaged condition. Damaged goods will not be accepted.

Materials shall be protectively enclosed in sealed polythene bags.

20. Service Performance

The Tenderer shall, for the items offered, state: -

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

Suppliers shall complete Schedule 4, Section 4 of the Instruction to Tenderers.

21. Information to be provided

The specific technical requirements for the items offered shall be as stated in Attachments "1" to "3" of this specification. The supplier shall provide all details requested by Attachments "1" to "3" and shall guarantee such data.

Attachment "5" details a checklist of supporting technical documentation which is required to be submitted with the offer.

The Tenderer shall supply one copy of a general jointing instruction with the tender documents together with drawings of not less than 1/4 scale fully describing the joints offered.

The general jointing instruction shall state the shelf life of the joint kit.

The successful Tenderer shall provide one copy of specific jointing instructions included with each joint kit. Such specific jointing instructions shall be approved and signed by Energex, Ergon Energy and the Manufacturer's/Supplier's representative.

The Tenderer shall supply one copy of a general terminating instruction including drawings of not less than 1/4 full size fully describing the cable terminations with the tender documents. This information shall be of sufficient detail to identify what existing components can be re-used or whether modifications to or new components are required.

The general terminating instruction shall state the shelf life of components of the termination kit.

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The successful Tenderer shall provide one copy of specific terminating instructions included with each terminating kit. Such specific terminating instructions shall be approved and signed by Energex, Ergon Energy and the Manufacturer's/Supplier's representative.

The Tenderer shall provide an estimate of labour hours to complete each joint and termination after cutting of cable(s), in a workshop situation, using experienced jointers.

These estimates are to be provided in Attachments 1-2 inclusive.

The Tenderer shall advise on the assembly environment required for making off their accessories

The Tenderer shall provide a copy of the Material Safety Data Sheets (MSDS) for any chemicals used in the joints and terminations, in particular:

- Resins as fillers for outer box around joints
- Oils used in outdoor and GIS terminations

22. Tools and Equipment

The following is a list of tools that are currently fitted on crew trucks, or that trades persons carry:

Switchboard Rescue Kit	Pole-top Rescue Kit	First Aid Box
Body Belts	Fire Extinguisher	Face Shield
Ladders (electrical)	Heating Equipment	Leather Gloves
Linesman's Platform	Gas Detector	Rubber Mats
Linesman's Tool Bags	Ladles	Insulating Tester
Polarity Tester	Compound Buckets	Phasing Box & Diodes
LV Insulating Gloves	Metal Pots	Insulated Torque Wrench
HV Operating Gloves	Oil Baths	Hydraulic Crimpers
Hauling Line & Block	Safety Glasses	Tarpaulins
Pole Leakage Tester	Thermometer Metal	Thermometer Fluid
Heatshrink Gas Torches	Pit Rescue Kit	Insulated Tools

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23. Attachment 1A - Technical Details – 66kv Joints

NOTES: A separate schedule is to be provided for each item offered except for details common to all items which only need to be provided once.

	Specified Requirements	Guaranteed Value
Item No.		
Manufacturer's Name and Address		
Country of Manufacture		
Manufacturer's Catalogue No.		
Type Test Certificate No.		
Rated Voltage		
AC Withstand (72 kV)	30 Minutes	
Impulse (peak) (350 kV)	No Flashover	
DC Withstand (kV)	Minutes	
Partial Discharge (57 kV)	< 5pc	
Voltage withstand across screen break (kVp)	35kVp	
Short Circuit current withstand on links	25kA rms for 1s	
Impact Resistance (Wedge dropped 2m)	No damage	
Maximum working stress level (kV/mm)		
Type of Connector (Mechanical /Compression)		
Cold Applied Insulating components (yes/no)		
Fully Metallic Screened (yes/no)		
Joint sleeve material	Tinned Copper	
Covering over joint sleeve	Resin Filled Outer Box	
Re-enterable (yes/no)		
Overall Length/Required Pit Length mm		/
Detailed Instructions to suit cable type and voltage included in kits (yes/no)		
Pack Size		
Pack Weight (kg)		
Shelf Life (years)		
Labour Estimate to complete Joint (hours)		

NAME OF TENDERER: _____

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24. Attachment 1B - Technical Details – 132kV Joints

NOTES: A separate schedule is to be provided for each item offered except for details common to all items which only need to be provided once.

	Specified Requirements	Guaranteed Value
Item No.		
Manufacturer's Name and Address		
Country of Manufacture		
Manufacturer's Catalogue No.		
Type Test Certificate No.		
Rated Voltage		
AC Withstand (190 kV)	30 Minutes	
Impulse (peak) (650 kV)	No Flashover	
DC Withstand (kV)	Minutes	
Partial Discharge (114 kV)	< 5pc	
Voltage withstand across screen break (kVp)	45kVp	
Short Circuit current withstand on links	40kA rms for 1s	
Impact Resistance (Wedge dropped 2m)	No damage	
Maximum working stress level (kV/mm)		
Type of Connector (Mechanical /Compression)		
Cold Applied Insulating components (yes/no)		
Fully Metallic Screened (yes/no)		
Joint sleeve material	Tinned Copper	
Covering over joint sleeve	Resin Filled Outer Box	
Re-enterable (yes/no)		
Overall Length/Required Pit Length mm		/
Detailed Instructions to suit cable type and voltage included in kits (yes/no)		
Pack Size		
Pack Weight (kg)		
Shelf Life (years)		
Labour Estimate to complete Joint (hours)		

NAME OF TENDERER: _____

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25. Attachment 2A - Technical Details - 66kV Terminations (Outdoor)

NOTES: A separate schedule is to be provided for each item offered except for details common to all items which only need to be provided once.

	Specified Requirements	Guaranteed Value
Item No.		
Manufacturer's Name and Address		
Country of Manufacture		
Manufacturer's Catalogue No.		
Type Test Certificate No.		
Rated Voltage		
AC Withstand (72 kV)	30 Minutes	
Impulse (peak) (350 kV)	No Flashover	
DC Withstand (kV)	Minutes	
Partial Discharge (57 kV)	<5 pc	
Maximum working stress level (kV/mm)		
Total creepage distance over insulator body and sheds		
Protected creepage distance under insulator sheds		
Type of Connector (Mechanical /Compression)		
Cold Applied Insulating components (yes/no)		
Detailed Instructions to suit cable type and voltage included in kits (yes/no)		
Pack Size		
Pack Weight (kg)		
Shelf Life (years)		
Labour Estimate to Complete termination (hrs)		

NAME OF TENDERER:

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26. Attachment 2B - Technical Details - 132kV Terminations (To GIS & Outdoor)

NOTES: A separate schedule is to be provided for each item offered except for details common to all items which only need to be provided once.

	Specified Requirements	Guaranteed Value
Item No.		
Manufacturer's Name and Address		
Country of Manufacture		
Manufacturer's Catalogue No.		
Type Test Certificate No.		
Rated Voltage		
AC Withstand (190 kV)	30 Minutes	
Impulse (peak) (650 kV)	No Flashover	
DC Withstand (kV)	Minutes	
Partial Discharge (114 kV)	<5 pc	
Maximum working stress level (kV/mm)		
Total creepage distance over insulator body and sheds		
Protected creepage distance under insulator sheds		
Type of Connector (Mechanical /Compression)		
Cold Applied Insulating components (yes/no)		
Detailed Instructions to suit cable type and voltage included in kits (yes/no)		
Pack Size		
Pack Weight (kg)		
Shelf Life (years)		
Labour Estimate to Complete termination (hrs)		

NAME OF TENDERER:

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27. Attachment 3 - Technical Details – Link Boxes

DESCRIPTION	REQUIREMENT	GUARANTEED VALUE
Short circuit current withstand on links	40kA _{r.m.s.} for 1 sec	
Electrical contact resistance (maximum) for main current path between links, studs and pillars	5 μΩ	
Pressure type test (internal explosion pressure)	200kPa	
Pressure routine test	40kPa for 15 min	
Water immersion test	3m of water for 7 days	
Impulse Voltage Withstand:	60kV _{pk} , 1.2/50 μsec waveshape	
(a) Between links and between SVL connections		
(b) From links and SVL connections to earth	35kV _{pk} , 1.2/50 μsec waveshape	
DC Voltage Test between links and from links to earth	25kV DC for 5 min	
Insulation resistance	100MΩ at 1000V DC	
Sheath Voltage Limiters (SVL's) for Cross Bonding Link Boxes:		
SVL Type	TZS 4.5	
Rated Voltage	4.5 kV rms	
Maximum continuous operating voltage	3.8 kV rms	
Rated 8/20 μ second current	20 kA	
20 kA 8/20 20 shot duty cycle with power frequency voltage applied 1s/shot	5.4 kV rms	
High current 4/10 μ second withstand	100 kA	

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28. Attachment 4 - Risk Assessment

The Tenderer shall complete the relevant items (as applicable):

REF.	PARTICULARS	RESPONSE
1.	Have Risk Assessments been carried out on equipment tendered which meet the requirements of AS/NZS 4360 (Yes/No)	
2.	Have copies of such risk assessments been included with the tender (Yes/No)	
3.	What is the weight of the components to be moved (for example - cable box covers/drawout circuit breaker trucks)?	
4.	How often do the components have to be moved?	
5.	Are space restrictions associated with:	
5.1	Manual/materials handling tasks	
5.2	Installation/maintenance	
5.3	Operating procedures?	
6.	Is there provision for the use of mechanical lifting devices?	
7.	Is the load stable?	
8.	What is the level of coupling? (poor/fair/good) (e.g. are operating handles fitted with grips)	
9.	What are the push/pull/rotational forces required to operate the equipment:	
9.1	When new?	
9.2	During life expectancy?	
10.	Do "above ground" work surfaces have adequate fall protection (e.g. slip resistant surface, hand rails)?	
11.	Do the work positions require undesirable postures such as:	
11.1	Bending	
11.2	Stretching	
11.3	Twisting	
12.	What postures are required to be sustained over what period of time?	
13.	What movements are repetitive and for what duration?	
14.	What are the sound pressure levels (expressed in dB(A))?	

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29. Attachment 4 - Risk Assessment (Cont'd)

Ref.	PARTICULARS	RESPONSE
15.	What hazardous substances are used/produced (including after failure) such as:	
15.1	Dust	
15.2	Gas	
15.3	Fume	
15.4	Emissions	
15.5	Mist	
15.6	Liquid	
15.7	Solids	
16.	Are the hazardous substances controls compatible with normal operational requirements?	
17.	Is a Material Safety Data Sheet for all hazardous substances provided?	
18.	What are the expected hazardous changes/by-products associated with the deterioration of a substance?	
19.	Is there any possible contact with energised components?	
20.	What are the levels of radiation emitted?	
21.	When in service, are any normally accessible areas hot/cold enough to be a hazard?	
22.	Are there any biological hazards?	
23.	Are there any mechanical hazards (e.g. nip in points, exposed moving components)?	
24.	Are mechanical hazards appropriately controlled (e.g. guarding, lock-outs)?	
25.	Are load limits established and clearly identified?	
26.	Are gauges clearly visible and easily interpreted?	
27.	Are control movements consistent with established Australian conventions (e.g. switch "UP" position is "OFF")?	
28.	What is the degree of whole body or hand/arm vibration? (Hz)	
29.	Are projectiles generated?	
30.	Are special tools required/identified/supplied?	
31.	What are the hazards associated with equipment failure?	

NAME OF TENDERER _____

Technical Specification for Underground Power Cables and Accessories for Nominal System Voltages of 66kV and 132 kV



30. Attachment 5 - Technical Documentation Checklist

Ref.	PARTICULARS	UNITS
Have full and comprehensive details been submitted WITH the tender documents associated with each of the following items?		
5.2, 5.3 & 5.4	Maximum working stress in kV/mm	
5.3	Shrink-back force containment	Yes/No
5.6	Details of link boxes	Yes/No
7	Ancillary equipment list	Yes/No
9, 10	Type Test Certificates for all items offered	Yes/No
11	Quality Assurance systems of BOTH the SUPPLIER and the MANUFACTURER	Yes/No
12	Risk Assessments	Yes/No
13	Environmental considerations	Yes/No
14	Reliability	Yes/No
15	Traceability	
16	Field trials	Yes/No
16	Production & Delivery Schedule for Major 66kV & 132kV projects	Yes/No
17	Training, Training Plan & Training Materials	Yes/No
18	Samples	Yes/No
21	Information to be provided	Yes/No

SIGNATURE OF TENDERER
