



**TECHNICAL SPECIFICATION FOR
PREFERRED SUPPLIER FOR SUPPLY OF
HIGH VOLTAGE AERIAL
BUNDLED XLPE INSULATED CABLES**

ENERGY FIJI LIMITED

Revision History & Document Control

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1.0 Introduction

Energy Fiji Limited [EFL] is responsible for generation, transmission and distribution of electricity in Viti Levu, Vanua Levu, Ovalau and Tavuni in Fiji. By the end of 2017, EFL had 182,439 customers. This includes residential, commercial and institutional customers.

The Energy Fiji Limited (EFL) is requesting proposal for the Preferred Supplier for supply of item listed below for EFL's consumption to carryout repair, maintenance and Construction of Power line Network in Fiji.

The preferred Supplier arrangement will be for a period of 3 (three) years from the date of signing of the contract. The award of this Tender may be split and awarded to more than one successful bidder.

This document outlines the technical requirements for high voltage aerial bundled conductor (HV ABC) for use in EFL's distribution network.

The items covered under this specification are tabulated below.

No.	Stock Code	Item Description	Cable Length/ Drum
1	New Item	6.35/ 11 (12) kV XLPE ABC - 50mm ²	500m
2	New Item	6.35/ 11 (12) kV XLPE ABC - 95mm ²	500m

Table 1.1: Items Covered Under this Specification

This Specification covers the general requirements of design, manufacture, testing, supply and delivery of XLPE insulated, 6.35/11 (12) kV, non-metallic screened (without further protection) three core aerial bundled cables for use on overhead distribution systems in a totally exposed environment.

2.0 References

2.1 Applicable Standards

The item shall be designed, manufactured and tested in accordance with the latest edition of the Standards specified below and all amendments issued prior to the date of closing of tenders except where varied by this specification.

AS/NZS 3599.2	Electric cables - Aerial bundled - Polymeric insulated - Voltages 6.35/11(12) kV and 12.7/22(24) kV Non-metallic screened
AS/NZS 1125	Conductors in insulated electric cables and flexible cords
AS/NZS 1660	Test methods for electric cables, cords and conductors
AS/NZS 1531	Conductors - Bare overhead - Aluminum and aluminum alloy
IEC 60502	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) Part 2: Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV)
IEC 60811-605	Electric and optical fibre cables - Test method for non-metallic materials - Part 605: Physical tests - Measurement of carbon black and/or mineral filler in polyethylene compounds
IEC 60811-607	Electric and optical fibre cables - Test method for non-metallic materials - Part 607: Physical tests - Tests for the assessment of carbon black dispersion in polyethylene and polypropylene
AS/NZS 2857	Timber drums for insulated electric cables and bare conductors
ISO 31000	Risk Management
AS/NZS ISO 9001	Quality management systems -Requirements

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

3.0 System Conditions

3.1 Environmental Conditions

The HVABC shall be suitable for installation outdoors and shall be designed to withstand the following service conditions.

Description		Conditions
Atmosphere	:	Saliferous, corrosive and dusty
Ambient Temperature	:	Peak: 40°C 24 Hour Average: 30°C Annual Average: 22°C Minimum: 10°C
Relative Humidity (Average)	:	85%
Rainfall	:	Annual Average: 1900mm
Isokeraunic (Thunder day) level	:	60 thunder days per year
Seismic	:	To a maximum of 7 on the open-ended Richter Scale

Note: Fiji is situated in a region where cyclones are experienced frequently. All plant and equipment shall be designed and constructed to withstand these extreme conditions.

3.2 System Conditions

Nominal Voltage	11kV
System Highest Voltage	12kV
System Frequency	50Hz
Number of Phases	3
System Earthing	Effectively Earthed
Impulse Withstand Voltage (peak)	28kV
Power Frequency Withstand Voltage	95kV (peak)

4.0 Design and Construction

Equipment offered that is found on inspection not to conform to this Specification shall be replaced by the vendor at no cost to Energy Fiji Limited.

4.1 Phase Cable Conductors

The power cables to be manufactured based on the following requirements of relevant clauses of Section 1 and with the particular requirements of section 2 of AS/NZS 3599.2 and the reference documents, therein.

The cable shall consist of three single core conductors made of stranded circular compacted Aluminum, made up from wires in the H68 condition, and shall comply with the requirements of AS 1125.

Conductor shall be clean & reasonably uniform in size and shape and its surface shall be free from sharp edges.

4.2 Conductor Screen

4.2.1 Material

All cables shall have an extruded, cross-linked, semi-conductive conductor screen. A semi-conductive tape may be used as part of the conductor screen and shall be applied directly on the conductor prior to the extrusion of the semi-conductive conductor screen.

4.2.2 Conductor Screen Thickness

The minimum thickness at any point of the extruded layer of conductor screen shall be not less than 0.3 mm. Refer to AS 1660 for the specified methodology for measurement of insulation thickness.

4.3 Insulation

4.3.1 Material

Insulation shall be of cross-linked polyethylene (XLPE). The grade of insulation shall be X-90.

All cable insulation shall be black in color.

The pigmentation shall be chosen so as to afford long term stability under ultra-violet radiation and shall include a minimum content of 2% by weight of carbon black evenly distributed throughout the insulation and shall not be detrimental to the insulation levels.

The XLPE conductor shall be suitable for use under the environmental and systems conditions as per Clause 3 of this specification.

4.3.2 Insulation Thickness

The average thickness of insulation, determined by the method specified in AS 1660, shall be not less than 3.4 mm; and the minimum thickness at any point shall not fall below 0.35 of the specified thickness.

4.4 Insulation Screen Material and Thickness

The screen shall consist of a layer of extruded, cross-linked, semi-conductive compound, applied directly over the insulation. The average thickness shall be not less than 1.2 mm and the thickness shall be not less than 80%, and not more than 130%, of the specified thickness.

4.5 Phase Cable Marking

The phase cables shall be identified by the numerals '1 ONE', '2 TWO' and '3 THREE', printed as figures and words on the surface of the extruded insulation screen. In addition, one of the phase cables shall include the manufacturer's name or registered trade name or mark, and year of manufacture, together with the following information:

<i>Cable Voltage Designation</i>	<i>Information to be marked</i>
6.35/11 (12) kV	11 kV

Another phase cable shall be printed with sequential numbers to indicate the length/ meter marks. The marking shall not degrade the insulation level.

4.6 Details of Messenger/ Catenary Wire (Neutral Conductor)

Bare Messenger Conductor shall consist of aluminum alloy wires. Aluminum Alloy Wires shall be tested with relevant Australian Standards or equivalent international standards.

Messenger Conductor shall be Stranded non-compacted Circular & shall have smooth round surface to avoid damage to the outer insulating sheath of single core phase cables twisted around the messenger.

There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wires before finally drawing.

The messenger wire shall have a tensile strength of 300N/mm² or more.

The technical characteristics of the messenger wire shall be as follows:

Nominal Cross Sectional Area of Phase Conductor (sq. mm)	Nominal Area of Aluminum Alloy in Messenger Wire (sq. mm)	No. of Strand of Aluminum Alloy	Strand Diameter of Aluminum Alloy (mm)	Maximum DC Resistance at 20°C (ohm/km)
50	70	7	3.57	0.48
95	70	7	3.57	0.48

4.7 Conductor Electrical Data

The standard size and technical characteristics for single core power cable is given below:

Nominal Cross Sectional Area of Al Conductor (sq. mm)	Maximum DC Resistance at 20°C (ohm/km)	Minimum no. of strands	Nominal Thickness of Insulation (mm)	Maximum Short Circuit Current for 1 sec (kA)
50	0.641	6	3.6	4.72
95	0.32	15	3.6	8.96

5.0 Technical Compliance Requirements

5.1 Electrical Resistance of Conductor Cores

The resistance per core for a unit meter cable should be kept to minimal and the values on the manufactured item shall be quoted in a table of Technical Detail Table in Appendix and submitted with the bids.

5.2 Electrical Impedance Characteristics of Cable

The per-unit reactive characteristics of the cable are to be maintained to the standard requirements and variations on such parameters will not be accepted.

5.3 Bending Radius of Cable

Adequate bending radius of the power cables shall be maintained and specified in the Technical Details Table in Appendix.

5.4 Insulation Coordination Test

All insulation requirements and the respective tests and compliance shall be aligned to details stipulated by relevant Australian Standards or equivalent international standards.

6.0 Quality Assurance

The manufacture shall submit evidence that the design and manufacture of the HV ABC is in accordance with AS/NZS ISO 9001 and shall include the Capability Statement associated with the Quality System Certification.

7.0 Performance and Testing

7.1 General

Test certificates referred to shall be from an accredited independent testing laboratory acceptable to the purchaser. Proof of accreditation by a national/ international authority shall be forwarded with the offer. Test reports shall be complete including all the pages as issued by the testing authority. Parts of test reports shall not be acceptable.

The cables shall also be tested as per IEC 60811-605 and IEC 60811-607. The test certificates shall be provided with the bid.

7.2 Type Test

The following Type tests shall be carried out on the cables as per Relevant Australian Standards & Type tests certificates shall be provided with the bid.

List of Type Tests:

1. Resistance test on conductor
2. Test for thickness of insulation
3. **Physical tests for insulation**
 - a. Tensile strength and elongation at break
 - b. Ageing in air oven
 - c. Hot set test
 - d. Shrinkage test
 - e. Water absorption (Gravimetric)
4. **Physical test for outer sheath (As per IEC 60502-2)**
 - a. Tensile strength and elongation at break
 - b. Ageing in an oven
 - c. Shrinkage test
 - d. Hot deformation
 - e. Loss of mass in air oven, heat shock and thermal stability test
5. Partial discharge test
6. Bending test
7. Dielectric power factor test
 - a. As a function of voltage
 - b. As a function of temperature
8. Insulation resistance (volume resistivity) test
9. Heat cycle test
10. Impulse withstand test
11. High voltage test
12. Flammability test
13. Cold impact test
14. **Type test for messenger wire:**
 - a. Ultimate tensile strength (breaking load) test on finished wire
 - b. Resistance test
 - c. Elongation test

7.3 Routine Test

The following tests shall be carried out as routine tests on all sizes of all drums of unarmored cables by the supplier in presence of the purchaser's representative

- a) Conductor resistance test
- b) Partial discharge test
- c) High Voltage Test.

7.4 Acceptance Tests

The EFL may carry out acceptance tests on an item to prove it conforms to the requirements of this Specification.

The following tests shall be carried out as acceptance tests:

- 1. Conductor resistance test for both messenger and phase conductor
- 2. Test for thickness of insulation and sheath of phase conductor
- 3. Partial discharge test
- 4. High voltage test
- 5. Hot set test for insulation
- 6. Tensile strength and elongation at break test for insulation and sheath
- 7. Insulation resistance (volume resistivity) test
- 8. Breaking load test on finished wire for messenger wire
- 9. Resistance test for messenger wire

7.5 Witnessing of Test

The EFL reserves the right to witness all testing. The Supplier shall give the EFL reasonable notice of when testing will be carried out and two (2) EFL engineers to be invited to witness the testing.

Note to bidders: Any other tests not covered by specification but required as per relevant International Standards shall also to be carried out and reports submitted with the bid.

8.0 Packaging and Marking

8.1 Drums

The cable shall be of one length on each drum and shall be supplied on timber drums complying with the requirements of AS/NZS 2857.

8.2 Cable Length per Drum

The following are the required length of cables that needs to be placed in a drum:

HVABC Description	Cable Length Per Drum
6.35/ 11 (12) kV XLPE ABC - 50mm ²	500m
6.35/ 11 (12) kV XLPE ABC - 95mm ²	500m

8.3 Drum Marking

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

- Manufactures name and details
- The rated operating voltage
- The number of cores and size of the conductors and the conductor material
- Wording to identify the insulation and sheath
- Year of Manufacture
- 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 3599.2, with which the cable complies
- Length of the cable wound onto the drum
- EFL stock number (if applicable)

8.4 Storage

The equipment shall be capable of being stored without deterioration within the temperature range of 10°C to 40°C for no less than 24 months.

9.0 Technical Information to be supplied

The following information shall be supplied with the offer:

- a) Sectional view, showing the General constructional feature with conductor / conductor screen / insulation / insulation screen and outer sheath etc.
- b) Complete dimensional drawing including AutoCAD drawings
- c) Quality assurance certificate as per the applicable standards stated in Clause 6 of this specification
- d) Duly completed schedule of guaranteed technical particulars
- e) Manufacturing experience and list of purchasers
- f) Type test certificates
- g) Sample routine test certificates

Offers of vendors who fail to furnish above particulars shall be rejected.

10.0 Stock Availability

The bidder is required to show the size of his/her stock holding and the ability to meet the required estimate quantity per annum. The movement of the HVABC will depend on EFL's project works and for operation and maintenance purposes. An estimate movement of the item are outlined in the table below but it will not be purchase as a lump sum quantity at once. Hence, the successful bidder will be required to carry a consignment / safety stock at times to meet EFL's demand within the three year contract period.

No.	Stock Code	Item Description	Cable Length/ Drum	Approximate 3 Year Stock Movement
1	New Item	6.35/ 11 (12) kV XLPE ABC - 50mm ²	500m	3 drums
2	New Item	6.35/ 11 (12) kV XLPE ABC - 95mm ²	500m	3 drums

11.0 Environmental Considerations

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

12.0 Reliability

Suppliers are required to comment on the reliability of the equipment and the performance of the materials tendered for a service life of 35 years under the specified system and environmental conditions.

Suppliers are invited to submit any proposals which may increase the anticipated service life of poles.

13.0 Samples

13.1 Production Samples

Samples of items will be required during the tender assessment period.

13.2 Sample Delivery

When samples are required, production samples 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

The Purchaser may at its discretion either purchase the samples at the tendered price or return the samples to the respective tenderer after the contract has been awarded. Samples shall be supplied within 7 days of official request.

The lead time should be confirmed by the supplier from the time of EFL raising the order.

14.0 Training

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

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

- Handling

- Storage
- Application
- Installation
- Maintenance
- Environmental performance
- Electrical performance
- Mechanical performance
- Disposal

15.0 Appendix

15.1 Price Schedule

Bidders are required to complete the price schedule below and submit a copy with the offer.

HVABC Description	Cable Length Per Drum	Unit Price per meter	Price per drum
6.35/ 11 (12) kV XLPE ABC - 50mm ²	500m		
6.35/ 11 (12) kV XLPE ABC - 95mm ²	500m		

15.2 Technical Details - HVABC

All tenderers are required to complete and submit a copy of this form with their bid submissions.

Particulars	Response from Bidders	
Phase Conductor:	50mm ²	95mm ²
Material		
Number of cores		
Shape of conductor		
Nominal cross section area (mm ²)		
Number of strands in conductor		
Diameter of each strand (mm)		
Approximate diameter of conductor (mm)		
Maximum DC resistance at 20°C (Ω/Km)		
Conductor Screening:		
Material		
Minimum thickness (mm)		
Insulation:		
Material		
Nominal thickness (mm)		
Tolerance of thickness		
Insulation Screening:		
Material		
Thickness (mm)		
XLPE Sheath Over Core:		
Material		
Nominal thickness (mm)		
Sheath color		
Messenger Wire:		
Material & its applicable standard		
Shape of conductor		
Nominal cross section area (mm ²)		
Number of strands in conductor		
Diameter of each strand (mm)		
Approximate conductor diameter (mm)		
DC resistance at 20°C (Ω/Km)		
Breaking load (KN)		

Cables:		
Continuous current carrying capacity in still air at ambient temperature of 40°C (A)		
Continuous current carrying capacity in 1 m/s wind at ambient temperature of 40°C (A)		
Continuous current carrying capacity in 2 m/s wind at ambient temperature of 40°C (A)		
Rated RMS power frequency core-to-earth voltage		
Rated RMS power frequency core-to-core voltage		
AC conductor resistance at 75°C (Ω /Km)		
Equivalent star reactance		
Three phase voltage drop at 75°C (mV/Amp.m)		
AC test voltage		
Maximum short circuit current for 1 sec (kA)		
Identification of power core		
Approximate overall diameter of cable		
Cable weight per 100m		
Total mass of cable (Kg/Km)		
Standard length of cable in each drum (m)		
Gross weight of drum (kg)		
Maximum conductor temperature during short circuit		
Bending radius of cable		
Manufacturer identification mark		

Name of Tenderer: _____

Signature of Tenderer: _____

Date: _____

15.3 Submission Requirements

All tenderers are required to complete and submit a copy of the submission requirements with their bid submissions.

Requirements	Response from Bidders
Completed technical details (Clause 15.2), submission requirements (Clause 15.2) & price schedule (Clause 15.1). (Yes/No)	
Validity of bid (120 days required) (Yes/No)	
Training included as part of Bid. (Yes/No)	
Witnessing included as part of bid. (Yes/No)	
Payment conditions.	
Delivery Term. (CIF preferred)	
Price review period after award of tender. (months)	
Cables country of manufacture.	
Origin of materials for cable manufacturing.	
Bidders company profile outlining financial, technical and production capabilities.	
Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating.	
Quality management system used in the production of cables, attached certificate.	
Health, Safety and Environmental plans.	
Detailed receiving, handling and storage details.	
Minimum warranty period from time of acceptance of cables.	
Sample inspection and test plan.	
Typical installation manual for cables.	
Disposal method after service life.	
Complete dimensional drawing including AutoCAD drawing.	
List of Type test certificates provided. (As per Clause 7.2 & 7.3)	
Sample routine test certificates.	

Name of Tenderer: _____

Signature of Tenderer: _____

Date: _____