UNITED ARAB EMIRATES

FEDERAL ELECTRICITY & WATER AUTHORITY

FEWA SPECIFICATION NO. CBL-3.3 FOR 33KV SINGLE/THREE CORE STANDARD COPPER CONDUCTOR XLPE INSULATED CABLES

SPECIFICATION NO. CBL- 3.3
(Revised in April 2004)

33 KV, SINGLE/THREE CORE STRANDED COPPER CONDUCTOR XLPE INSULATED CABLES

1. Standard Specifications:

The cables shall conform and comply with the latest editions of the appropriate IEC standards (IEC 60502, IEC 60811 & IEC 60229 and any other relevant IEC standards) or any other equivalent international standard with all its latest addendum and amendments and shall be subject to the approval of FEWA.

2. Site conditions and Fault level:

The cables shall be suitable for continuous duty under specified system condition and under short time fault conditions of system fault level of 1500 MVA in the hot, humid and salty climate prevailing in the area. The maximum values of humidity and temperature experienced in this country are 100% and 50 deg.C. respectively.

3. Scope and nature of work:

The specification provides for the design, manufacture, test at manufacturers works in the presence of two FEWA inspectors, suitable packing, transportation and off loading at site of works or FEWA stores in satisfactory conditions and proper stacking as directed by FEWA.

4. Construction:

The cable shall be of single/three core construction, made up of highly compacted, round, stranded conductor of high grade Electrolytic Copper, XLPE insulated, suitable for use in system with nominal system voltage of 33 kV and highest system voltage of 36 kV.

5. Conductor screening:

Conductor screening shall be non-metallic and shall consist of a layer of extruded semi conducting compound which shall be firmly bonded to the inner surface of the insulation. The contact of the semi conducting shields with the cable insulation must be perfect without void creation at the inner surfaces. The interfaces must be smooth in a regular geometric shape and the semi conducting compound must have homogeneous structure particularly at the inter faces. The semi conducting shields must be mechanically stable under load cycling of the power cable.

An additional semi conducting tape in between conducting compound and the conductor shall be used.

6. Insulation:

Electrical grade cross linked polyethylene (XLPE) shall be extruded in simultaneous extrusion of conductor screening layer and insulation screening layer and shall be suitably cured.

The nominal thickness of the insulation shall be 8 mm and shall be guaranteed by the manufacturer to withstand the specified system voltages. The average thickness of insulation shall be not less than the specified nominal value. The minimum thickness at any place shall be as per IEC 60502.

7. Insulation Screening:

The insulation screening shall be non-metallic and shall consist of a layer of extruded semi conducting compound provided over the insulation simultaneously with the extrusion of the insulation. Semi conducting tape with suitable overlap over the extruded semi-conducting layer of compound shall be applied.

Conductor screen, insulation and insulation screen shall be vulcanized by triple extrusion method.

8. Metallic screening:

Concentric layers of copper wires with copper counter spiral shall be applied over the insulation screening. The total cross section of copper wire screen shall be not less than 25 mm2 for conductor of sizes upto 240 mm2 and shall be not less than 35 mm2 for conductor sizes above 240 mm2 upto 500 mm2.

In addition to above condition, manufacturer should make sure that minimum earth fault current capability of each of the three individual core metallic screens for 1 sec. shall be 2.5KA (i.e. 7.5KA for 1 sec. when all of the 3 metallic screens are combined together) without combining armour.

9. Water Sealing:

Cables shall be provided with water sealing of conductor and longitudinal and radial water sealing along the metallic screen as described below:

The conductor water sealing shall consist of a swelling material provided between conductor strands which turns into a jelly when comes in contact with water.

The longitudinal water sealing along the metallic screen shall be provided by a swelling layer applied over the metallic screen or by a swelling material provided between metallic screen wires as applicable.

The radial water sealing shall be provided by a corrosion resistant metal or metal-polyethylene laminate applied over the longitudinal water sealing. Special care in preventing galvanic corrosion is required in the design. It is essential that water sealing is efficient to reduce the lengths of cable to be cut, in case of any ingress of water due to mechanical cable damage.

10. Over sheath:

The over sheath shall be an extruded layer of polyethylene type ST7. An outer conducting coating shall be applied to the covering to serve as an electrode for the voltage test on the over sheath.

The outer sheath shall be of fire and termite resistant PE material. Anti corrosion protection shall consist of a coating of waterproof compound/foil/plastic tape over the metallic screening followed by continuous extrusion of PE sheath.

11. Identification:

The following identification marks shall be permanently embossed along two lines diametrically opposite to each other on the cable at suitable intervals.

33000 volts;.....mm2 single/three core copper cable; XLPE insulated - property of FEWA - UAE - Year of manufacture - manufacturer's name.

Length of cable on one meter intervals shall be embossed on the outer jacket.

Marking on the over-sheath shall indicate cumulative length of the cable, wound on the drum such marking starting with “000” on the inner end and actual length on the drum.

12. Packing:

The cable shall be wound on a suitable non returnable strong drum to prevent damage during storage and transport. On the side of the drum, necessary description, such as order No. type, voltage. size, material of conductor, gross and net weight of the cable, length, direction of rolling and drum number etc. shall be clearly marked. Completed cable shall be sealed at both ends to avoid any ingress of moisture, foreign bodies etc. No drum shall contain more than one length of cable. The inner as well as outer end of cable shall be brought out on the drum flange and shall be clamped in such a manner to make the cable length marking easily visible.

The diameter of bore for the cable drum for inserting the shaft shall not be less than 120mm. The cable drums must be closed with wooden planks to prevent cable damage during storage and transportation.

13. Current rating and Temperature Rise:

The cable shall be capable of withstanding the maximum conductor temperature of 90 deg.C. in continuous operation and a temperature of 130 deg.C. for a limited period. Under fault conditions the cable shall be rated to withstand a final temperature of 250 deg.C.

Guaranteed current carrying capacity at 35 deg.C. soil temperatures shall be mentioned in the appropriate column of the schedule of guaranteed particulars.

Thermal resistivity of filling sand shall be considered as 1.5^0 m/w for erection at site and 2.0^0 m/w for design purpose.

14. Cable Drum Length:

The length of cable for drum shall be according to the following table. A variation of $\pm$ 5% of the cable drum length may be acceptable.

Cable size	Drum Length
1 x 500 sq.mm	500 Metres.
1 x 300 sq.mm	500 Metres.
3 x 300 sq.mm	250 Metres.
3 x 240 sq.mm	250 Metres.
1 x 240 sq.mm	1000 Metres.

All cable lengths cut and used for various tests shall be to contractor's account and shall not be included in cable length to be supplied to FEWA.

15. Test Certificate:

Certified copies of the following type test certificates shall be supplied along with the offer. Type Test certificates more than seven years old are not acceptable. If type test certificates which are acceptable to FEWA or not enclosed along with the offer, Authority reserves its right to ask the tenderer to conduct all or any of the following type test in presence of two FEWA inspectors at no additional cost to FEWA.

16. Type test, Electrical:

a) Partial discharge test.
b) Bending test plus partial discharge test.
c) Power factor (tan delta) measured as a function of voltage and capacitance measurement.
d) Power factor measurement as a function of temperature.
e) Heating cycle test plus partial discharge test.
f) Impulse withstand test followed by power frequency voltage test.
g) High voltage alternating current test for 4 hours.
h) Insulation resistance measurement.

The above type tests and all the Non-Electrical type tests shall be carried out as per relevant clauses of IEC 60502 & IEC 60811.

Routine Test

All the routine tests shall be carried out as per IEC at manufacturer's works on all lengths of ordered cable during manufacture and certificates of these tests shall be forwarded to FEWA.

17. Witnessing tests at manufacturer's works:

The following tests (routine and sample as mentioned in IEC 60502) will be carried out in presence of at least two FEWA inspectors at the manufacturer's works.

a) Electrical resistance measurement of conductor and metallic screen.

b) Partial discharge test : magnitude of discharge at 33kV should not exceed 10 PC.

c) High voltage test : 67kV AC between conductors and screen for 5 minutes.

d) Conductor examination.

e) Check of dimension.

f) Voltage test for 4 hours : 76kV AC between conductor and screen for 4 hours.

g) Hot set test for XLPE insulation.

h) Tests on sheath as per IEC 60229.

The supplier shall make provision in his offer to bear all costs that are incurred in carrying out these tests to the satisfaction of FEWA. However, costs towards travel, accommodation, etc. of FEWA representatives shall not be included in the quoted price.

The following additional requirements are applicable for 3 core cable.

18. Assembly:

The three insulated cores shall be laid up with necessary non-hygroscopic fillers and bound with non-vulcanisable tape/strip or wire to a compact circular assembly. Metallic layer over each individual core shall be in contact with each other.

19. Inner Sheath:

The inner sheath shall be made of extruded PE complying with relevant IEC standard.

20. Metallic Armour:

The metallic armour shall confirm to IEC 60502 or any equivalent international standard with latest addendums and amendments. The armouring for multicore cables shall consist of galvanized steel round wires applied over the inner sheath

The armouring for single core cables shall consist of non-magnetic material such as aluminium or aluminium alloy.

In case of galvanized steel armour wires, the mass of coating shall not be less than 275 g/m^2.

SCHEDULE 'A'

SUB-MANUFACTURERS

The Tenderer shall state below the names of the sub-manufacturers to the main manufacturer and details of the equipment proposed to be manufactured or supplied by them:

Name & Address of the Sub-Manufacturer	Description of Equipment

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'B'

PLACE OF MANUFACTURE, TESTING AND INSPECTION

The Tenderer to complete the following schedule for all materials he proposes to supply

Item No.	Description	Manufacturer	Place of manufacture	Place of testing and inspection

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'C'

DEVIATION FROM TENDER SPECIFICATION

The Tenderer to state in the following schedule the deviations from the tender specifications proposed in his offer. Deviations other than those specifically listed below will not be taken note of:

Item No.	Description	Precise Details of the Deviations

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
1.	Manufacturer and country of origin			
2.	Applicable Standards			
3.	Normal working voltage between phases	KV		
4.	Voltage grade of cable	U_o/Umax		
5.	Number of cores	Single/ Three		
6.	Type of cable (Manufacturer's designation)			
7.	Conductor detail			
a)	Material			
b)	Compacted	Yes/No		
c)	Number of wires in each conductor	No.		
d)	Diameter of wire in each conductor	mm		
e)	Area	Sq.mm		
f)	Diameter of conductor in stranded and compacted shape.	mm		
8.	Semi conductive tape over conductor			
i)	Material			
ii)	No. of layers	No.		
iii)	Nominal diameter after taping	mm		
9.	Conductor Screen			
i)	Material			
ii)	Nominal thickness	mm		
iii)	Minimum thickness	mm		
iv)	Total diameter after conductor screen	mm		
v)	Whether extruded	Yes/No.		
10.	Maximum dielectric stress at nominal voltage			
a)	At conductor screen (assumed smooth)	KV/mm		
b)	At core/insulation screen	KV/mm		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
11.	Insulation			
a)	Material			
b)	Nominal thickness of insulation	mm		
c)	Minimum thickness at any point	mm		
d)	Total diameter	mm		
e)	Details of vulcanization process			
	i) Extrusion Method			
	ii) Curing Method			
	iii) Cooling Method			
12.	Core/Insulation screen			
a)	Semi conducting screen (extruded)			
	i) Material			
	ii) Nominal thickness	mm		
	iii) Minimum thickness	mm		
	iv) Total diameter	mm		
b)	Semi conducting tape			
	i) Material			
	ii) Nominal thickness	mm		
	iii) Minimum thickness	mm		
	iv) Width	mm		
	v) Total diameter	mm		
c)	Metallic shield/Screen			
	i) Material			
	ii) Electrical cross section	mm^2		
	iii) Min. cross section of each wire	mm^2		
	iv) Number of wires	Pcs		
	v) Total diameter	mm		
	vi) Fault current rating for 1.0 sec kA	KA		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
d)	Spiral equalizing tape			
	i) Material			
	ii) Width and thickness	mm		
	iii) Lay length	mm		
13.	Water Sealing			
a)	Conductor longitudinal water blocking provided ?	Yes/No.		
	i) Material	--		
	ii) Location	--		
b)	Longitudinal water blocking for metallic screen provided ?	Yes/No.		
	i) Material	--		
	ii) Location	--		
c)	Radial seal provided ?	Yes/No.		
	i) Material			
	ii) Location			
d)	Testing proposal enclosed for	Yes/No.		
	i) For longitudinal sealing			
	ii) For radial sealing			
14.	Inner Sheath (if required):			
a)	Material			
b)	Type as per IEC			
c)	Nominal thickness	Mm		
d)	Minimum thickness at any point	Mm		
15.	Armour (if required)			
a)	Material		--	
b)	Diameter of each wire	mm	--	
c)	Number of wires	Nos.	--	
d)	Total diameter	mm	--	
e)	D.C. Resistance	Ohm/km	--	

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
f)	Tensile Strength	N/sq.mm	--	
g)	Galvanizing Thickness	microns	--	
16.	Outer covering : (Outer sheath)			
a)	Material			
b)	Colour			
c)	Nominal thickness	mm		
d)	Minimum thickness at any point	mm		
e)	Termite resistant	Yes/No.		
f)	i) Conductive coating	Yes/No.		
	ii) Base material for conductive coating			
16.	Nominal overall diameter of completed cable	mm		
17.	Minimum weight of copper (conductor)	Kg/m		
18.	Minimum weight of copper (metallic sheath)	Kg/m		
19.	Minimum weight of completed cable	Kg/m		
20.	Allowable minimum radius of bend around which cable can be laid :			
	a) Buried directly or in air	M		
	b) In ducts	M		
	c) For sealing ends	M		
21.	a) Maximum DC resistance of conductor at 20^0 C	Ohm/km		
	b) Maximum DC resistance of metallic screen	Ohm/km		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
22.	Maximum AC resistance of conductor at 90^0 C	Ohm/km		
23.	Equivalent star reactance of three phase circuit at 50^0 C	Ohm/km		
24.	Maximum charging current per conductor at nominal voltage	MA/km		
25.	Maximum dielectric loss of three phase circuit when operating at normal voltage and frequency at maximum conductor temperature of 90^0 C	W/km		
26.	Maximum continuous current carrying capacity per conductor when laid direct in the ground to a depth of 1,000 mm, with ground temperature of 35^0 C and assumed g=1.5^0 m/w, 600mm circuit centers and conductor temperature of 90^0 C			
a)	One three-phase circuit per trench laid			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
b)	Two three-phase circuits, each in			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
c)	Three three-phase circuits, each in			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
27.	Maximum continuous current carrying capacity per conductor when drawn into ducts at a ground temperature of 35^0 C and assumed g=1.5^0 m/w 200mm circuit centers and conductor temperature of 90^0C			
a)	One three-phase circuit	A		
b)	Two three-phase circuits	A		
c)	Three three-phase circuits	A		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
28.	Maximum continuous current carrying capacity per conductor when installed in air at an ambient temperature of 50^0 C and conductor temperature of 90^0 C and circuit centers 300mm.			
a)	One three-phase circuit per trench laid			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
b)	Two three-phase circuits, each in			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
c)	Three three-phase circuits, each in			
	i) Trefoil formation	A		
	ii) Flat formation (200mm spacing)	A		
29.	Metallic core screen losses in a cable of three-phase circuit at nominal voltage, 50 Hz frequency and at current rating given in item 28 (a), (b) & (c).			
30.	Metallic sheath/armour losses in a cable of three-phase circuit at nominal voltage, 50Hz frequency and at current rating given in item 28 (a), (b) & (c).	W/m		
31.	Conductor short-circuit current permissible when short-circuit occurs at conductor temperature as stated in item 28 (a), (b) & (c) for period of :-			
	a) 1.0 Second	kA		
	b) 3.0 Second	kA		
32.	Earth fault short-circuit current carrying capacity for 1 second, cable loaded as in item 28 (a), (b) & (c) before short-circuit and final limiting temperature of copper screen armour or sheath.	kA		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
33.	Maximum dielectric loss angle of charging VA of cable at normal voltage and frequency at a conductor temperature of :-			
	a) 20^0 C			
	b) 90^0 C			
34.	Maximum dielectric loss angle of charging VA of cable at normal frequency at a conductor temperature of 20^0 C			
	a) At 0.5 Uo			
	b) At 2 Uo			
35.	Impulse withstand voltage (90^0 C) :-			
	a) Positive 1/50 wave	kVp		
	b) Negative 1/50 wave	KVp		
36.	Positive sequence :-			
	a) Resistance	Ohms/km		
	b) Reactance	Ohms/km		
	c) Capacitance	pF/km		
37.	Negative sequence :-			
	a) Resistance	Ohms/km		
	b) Reactance	Ohms/km		
	c) Capacitance	pF/km		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-1'
GUARANTEED TECHNICAL PARTICULARS
33KV XLPE CABLES

S.No.	Description	Unit	1Cx500 sq.mm	1Cx240 sq.mm
38.	Zero sequence :-			
	a) Resistance	Ohms/km		
	b) Reactance	Ohms/km		
	c) Capacitance	pF/km		
39.	Maximum conductor temperature			
	a) Continuous	^{0}C		
	b) Short time	^{0}C		
40.	Total power loss (three phase system)	kw/km		
41.	Maximum permissible pulling force at total cable in drums	kN		
42.	Cable drum details :-			
a)	Nominal delivery length per drum	M		
b)	Maximum delivery length per drum	M		
c)	Maximum gross weight of full drum	Kg		
d)	Steel or wooden drum			
e)	Weight of empty drum	Kg		
f)	Drum dimensions			
	i) Flange diameter	mm		
	ii) Bore diameter	mm		
	iii) Width	mm		

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-2'

PARTICULARS & GUARANTEES TO THE CROSS-LINKED POLYETHYLENE INSULATING MATERIAL

S.No.	Description	Unit	Guaranteed Particulars
1.	Minimum tensile strength at 23^0 C	N/sq.mm	
2.	Minimum elongation at break at 23^0 C	%	
3.	Ageing test (168 Hrs. at 135 $\pm$ 3^0 C		
a)	Tensile strength Maximum variation	%	
b)	Elongation at break Maximum variation in elongation at break		
4.	Water absorption test (at 85 $\pm$ 2^0 C,336 Hrs. Maximum variation of mass	Mg/cm	
5.	Minimum volume resistivity at 90^0 C	Ohm-cm	
6.	Hot set test (at 200^0 C, 15 minutes, 20N/cm2)		
	a) Elongation	% max	
	b) Set	% max	
7.	Shrinkage test @ 1 Hr. 130 $\pm$ 3^0 C Maximum shrinkage	% max	
8.	Insulation resistance constant at 90^0 C	Mohm-km	
9.	Dielectric power factor as a function of voltage at ambient temperature :		
	a) Maximum tan delta at Uo	x 10-4	
	b) Maximum increment at tan delta between 0.5 Uo and 2 Uo	x 10-4	
10.	Dielectric power factor as a function of temperature at 2 KV :		
	a) Maximum tan delta at Uo	x 10-4	
	b) Maximum increment at tan delta between 0.5 Uo and 2 Uo	x 10-4	
11.	Maximum partial discharge at 1.73 Uo	PC	

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'D-3'

PARTICULARS & GUARANTEES RELATING TO PE OUTER COVERING

S.No.	Description	Unit	Guaranteed Particulars
1.	Tensile test and elongation at break without ageing.		
a)	Minimum tensile strength	N/m^2	
b)	Minimum elongation at break	%	
2.	After accelerated ageing for 14 days @ 110 $\pm$ 2^0 C		
a)	Tensile Strength:		
	i) Value (Minimum)	N/m^2	
	ii) Variation (Maximum)	%	
b)	Elongation at break:		
	i) Value (Minimum)	%	
	ii) Variation (Maximum)	%	
c)	Minimum elongation at break	%	
3.	Pressure test @ 115 $\pm$ 2^0 C Maximum indentation		
4.	Insulation resistance constant K at 20^0 (Min)	MΩ-Km	
5.	Flame retardance test		
6.	Carbon black content	%	
7.	Water penetration test		
8.	Sheath test voltage		
9.	Shrinkage test as per IEC 60811:		
	Maximum shrinkage	%	

Name of Tenderer :_____

Designation :_____

Signature :_____

Date :_____

SCHEDULE 'E'

DETAILS OF PAST EXPERIENCE OF MANUFACTURER

Name and address	Quantity supplied	Year of supply	Remarks

Signature :_____

Designation :_____

Name of Tenderer ;_____

Date :_____