as, 240 500

FXCTV 3x500mm² FXCTV 3x240mm² FXCTV 3x95mm²



Tender Elsam Our ref 05-1059 Page 4 of 14 Rev. 050929-4 2005-09-29

Diameter

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

4.7. Fiber optic cable

The fiber optic cable is the same type (copper tube and PE sheath) as we have used in the wind farms at "Utgrunden", "Yttre Stengrund", "Samsø", "Nysted", and other projects.
The fiber optic cable is of ribbon type.

Typical fiber optic cable design & properties

CABLE PROPERTIES

Bending radius, permanently and during installation minimum 0,75 m

Crush resistance 100 kN/m Impact resistance 50 J

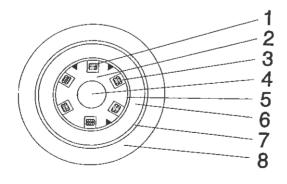
Tensile strength, 1 kN

Cable net weight 0,4 kg/m

Factory length, without splice 24 km

CONSTRUCTION

1 Acrylate coated ribbon 1.1x0.4 mm 2 Slotted core: Polyethylene 8.5 mm 3 Filling compound: Thixotropic gel 4 Strength member: Fibre Reinforced Plastic 3.5 mm 5 Wrapping: Polyester tape 6 Sheath: Polyethylene, black 13 mm 7 Copper sheath 14 mm 8 Sheath: Polyethylene, black 18 mm





Tender Elsam Our ref 05-1059 Page 5 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

4.7.1. Typical geometrical and mechanical data for the fibres

Proof test tension Proof test extention	50 ² N 8,6 N	N
		l N
Proof test time	1 %	%
Extention at maximum cable tention	18	S
Impact of manifering at 11 to 11	<0,3 %	%
Continuous outontion offer and a service of the ser	<216 N/mm²	N/mm²
Continuous extention after maximum cable tention	<0,05%	1 %
Continuous impact after maximum cable tention	< 36 N/mm ²	N/mm²
Fibre lifetime at continuous impact/extention as indicated above	> 40 year	vear
	25 000 m	m

^{1; 60} mm and 100 turns gives a maximum of 0.05 dB at 1550 nm.

Optical data for the fibres:

Attenuation in fibres at 1310 nm (mean value)		
Attornation in fibre at 1010 lim (mean value)	≤ 0.35 dB/km	dB/km
Attenuation in fibres at 1310 nm (maximum value)	< 0.39 dB/km	dB/km
Attenuation in fibres at 1550 nm (mean value)	< 0.200 dB/km	dB/km
Attenuation in fibres at 1550 nm (maximum value)	≤ 0.210 dB/km	
Total dispersion at 1310 nm		dB/km
Total dispersion at 1550 nm	≤ 2,8 ps/km x nm	ps/km x nm
Cut-off wave length after cabling	≤ 18 ps/km x nm	ps/km x nm
out on wave length after capling	< 1260nm	nm

4.8. Cable core binder

A woven polymeric tape will keep the three cable-cores, polymeric profiles and fiber optic cable together.

4.9. Bedding

Bitumen impregnated tape.

4.10. Armour

Galvanized steel wires covered by a layer of bitumen (\varnothing 4mm) will protect the cable during laying and against anchors, fishing-gear etc.

4.11. Outer serving

The outer protective cover consist of bitumen and two layers of polypropylene yarn, where the outer layer will be black with different numbers of orange lines in order to simplify identification between the different cross sections.

^{2;} Typical value for testing 0.5 m lengths.



Tender Elsam Our ref 05-1059 Page 6 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

4. MECHANICAL DATA FOR FXCTV 3x500mm² CABLE

Bending radius complete cabl	e:		
at installation:		2,0	m
at laying with tensior):	2,5	m
when installed:		1,4	m
Bending radius each phase):			
at installation:		0,9	m
when installed:		0,6	m
Coil:			
circular: (diameter)	(alt.1)	8,0	m
oval : (size)	(alt.2)	5 x 14	m
,	(alt.3)	6 x 12	m
	(alt.4)	7 x 10	m
min. drop height alt.1	(1)	8,0	m
min. drop height alt.2		10,0	m
min. drop height alt.3		10,0	m
min. drop height alt.4		9,0	
a. op 7.oigin uit.4		3,0	m
Maximum tension at laying:		160	kN
< 100 m from conductor	or joint:	110	kN

5. MECHANICAL DATA FOR FXCTV 3x240mm² CABLE

Bending radius complete cable: at installation: at laying with tension: when installed:	2,1 2,5 1,2	m m m
Bending radius each phase: at installation: when installed:	0,8 0,6	m m
Maximum tension at laying	75	kN

FXCTV 3x500mm² FXCTV 3x240mm² FXCTV 3x95mm²



Tender Elsam Our ref 05-1059 Page 7 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

6. MECHANICAL DATA FOR FXCTV 3x95mm² CABLE

Bending radius complete cable: at installation: at laying with tension: when installed:	2,1 2,5 1,1	m m m
Bending radius each phase: at installation: when installed:	0,7 0,5	m m
Maximum tension at laying:	31	kN

7. TESTING OF FXCTV CABLES

Each completed cable length including possible factory joints will be tested according to Inspection and Test Plan (ITP), please see appendix.



Tender Elsam Our ref 05-1059 Page 8 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

8. CALCULATED RESULTS FXCTV 3x500mm² (According to IEC 60287)

क्षितिताम्बर्धास्त्रम् । । । । । । । । । । । । । । । । । । ।	់ ដែរ មាស់ទទួល	2005:09:29
a.c resistance at max. temperature, R _{ac}	0,0499 Ω/km	At I _{max}
Loss factor for sheath and screen:		
λ_1	0,0681	
λ_2	0,2688	
Thermal resistance of insulation, T ₁	0,3405 K.m/W	
Thermal resistance of bedding, T ₂	0,1336 K.m/W	
Thermal resistance of outer covering, T ₃	0,0573 K.m/W	
Thermal resistance of surrounding, T ₄	0,2378 K.m/W	
Max continuous conductor current, I _{max} Non-adiabatic short circuit current, I Non-adiabatic short circuit current, I	640,5 A 101,9 kA/0,5 sec. 4,0 kA/0,5 sec.	37,7 MVA at 34 kV Conductor Copper screen (per phase)
Conductor losses per phase	20,49 W/m	At I _{max}
Screen losses per phase	1,39 W/m	At I _{max}
Armour losses per phase	5,51 W/m	At I _{max}
Dielectric losses per phase, W _d	0,007 W/m	At 34 kV
Total losses per phase	27,40 W/m	
Gapavitance, per phase	0,309 μF/km	
Capacitive charging current, per phase	1,906 A/km	At 34 kV
Inductance between conductors, per phase	0,334 mH/km	
Inductive reactance, (star reactance)	0,105 Ω/km	
Electric stress at conductor screen	3,28 kV/mm	At 36 kV
Electric stress at insulation screen	2,09 kV/mm	At 36 kV
	2,00 87771111	Ur an Va
Positive sequence impedance per phase, Z.	0,0668 0,1050	(1+j) Ω/km
Negative sequence impedance per phase, Z	0,0668 0,1050	(1+j) Ω/km
		(.)/ =5/1///

^{*} Max continuous conductor current, $I_{\rm max}$ is based on 50°C air temperature.



Tender Elsam Our ref 05-1059 Page 9 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

9. CALCULATED RESULTS FXCTV 3x240mm² (According to IEC 60287)

િટાબિટાસિયાસકાણકાણકા સ્ટાહિક 	FACTIV BARRONING SERV."	2005±09-79
a.c resistance at max. temperature, R _{ac}	$0,0975~\Omega/km$	At I _{max}
Loss factor for sheath and screen:		
λ_1	0,0341	
λ_2	0,1331	
Thermal resistance of insulation, T ₁	0,4476 K.m/W	
Thermal resistance of bedding, T ₂	0,1405 K.m/W	
Thermal resistance of outer covering, T ₃	0,0545 K.m/W	
Thermal resistance of surrounding, T ₄	0,2702 K.m/W	
Max continuous conductor current, I _{max} Non-adiabatic short circuit current, I Non-adiabatic short circuit current, I	* 450,6 A 49,0 kA/0,5 sec. 3,3 kA/0,5 sec.	26,5 MVA at 34 kV Conductor Copper screen (per phase)
Conductor losses per phase	19,79 W/m	At I _{max}
Screen losses per phase	0,67 W/m	At I _{max}
Armour losses per phase	2,63 W/m	At I _{max}
Dielectric losses per phase, W _d	0,0052 W/m	At 34 kV
Total losses per phase	23,11 W/m	
Capacitance, per phase	0,217 μF/km	
Capacitive charging current, per phase	1,336 A/km	At 34 kV
Inductance between conductors, per phase	0,386 mH/km	
Inductive reactance, (star reactance)	0,121 Ω/km	
Electric stress at conductor screen	3,54 kV/mm	At 36 kV
Electric stress at insulation screen	1,96 kV/mm	At 36 kV
	-1	, noon y
Positive sequence impedance per phase, Z,	0,1138 0,1212	(1+j) Ω/km
Negative sequence impedance per phase, Z	0,1138 0,1212	
,	0,1100 0,1212	(1+j) Ω/km

^{*} Max continuous conductor current, I_{max} is based on 50°C air temperature.



Tender Elsam Our ref 05-1059 Page 10 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

10. CALCULATED RESULTS FXCTV 3x95mm² (According to IEC 60287)

Calculated results, three core earlies	15. CuV 33. 95 mm ² 8/18/	Solution of the
A CONTRACTOR OF THE CONTRACTOR		
a.c resistance at max. temperature, R _{ac}	$0,2465~\Omega/km$	At I _{max}
Loss factor for sheath and screen:		
λ_1	0,0124	
λ_2	0,0481	
Thermal resistance of insulation, T₁	0,6134 K.m/W	
Thermal resistance of bedding, T ₂	0,1572 K.m/W	
Thermal resistance of outer covering, T ₃	0,0625 K.m/W	
Thermal resistance of surrounding, T ₄	0,3101 K.m/W	
Max continuous conductor current, I _{max} Non-adiabatic short circuit current, I Non-adiabatic short circuit current, I	* 267,0 A 19,5 kA/0,5 sec. 2,8 kA/0,5 sec.	15,7 MVA at 34 kV Conductor Copper screen (per phase)
Conductor losses per phase	17,57 W/m	At I _{max}
Screen losses per phase	0,22 W/m	At I _{max}
Armour losses per phase	0,84 W/m	At I _{max}
Dielectric losses per phase, W _d	0,0039 W/m	At 34 kV
Total losses per phase	18,64 W/m	
Capacitance, per phase	0,159 µF/km	
Capacitive charging current, per phase	0,982 A/km	At 34 kV
Inductance between conductors, per phase	0,452 mH/km	
Inductive reactance, (star reactance)	0,142 Ω/km	
Electric stress at conductor screen	3,99 kV/mm	At 36 kV
Electric stress at insulation screen	1,79 kV/mm	At 36 kV
	.,,	ALOURY
Positive sequence impedance per phase, Z ₊	0.2615 0.1420	(1+j) Ω/km
Negative sequence impedance per phase, Z.	0,2615 0,1420	(1+j) Ω/km
	7,22.2 0,1.20	(1.1) 22/11

^{*} Max continuous conductor current, I_{max} is based on 50°C air temperature.



Tender Elsam Our ref 05-1059 Page 11 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

11. CALCULATED LOSSES IN GRID LAYOUT:

The loss calculations are based on:

Continuous load on each turbine.

Number of turbines (Wtg)

• Seabed temperature at 3,0 m depth.

Thermal resistivity of seabed

R at 30 MW (500mm²)
 R at 30 MW (240mm²)

R at 30 MW (95mm²)

3,6 MVA

25

15°C

0,7 K.m/W

0,0524

0,1084

0,2479

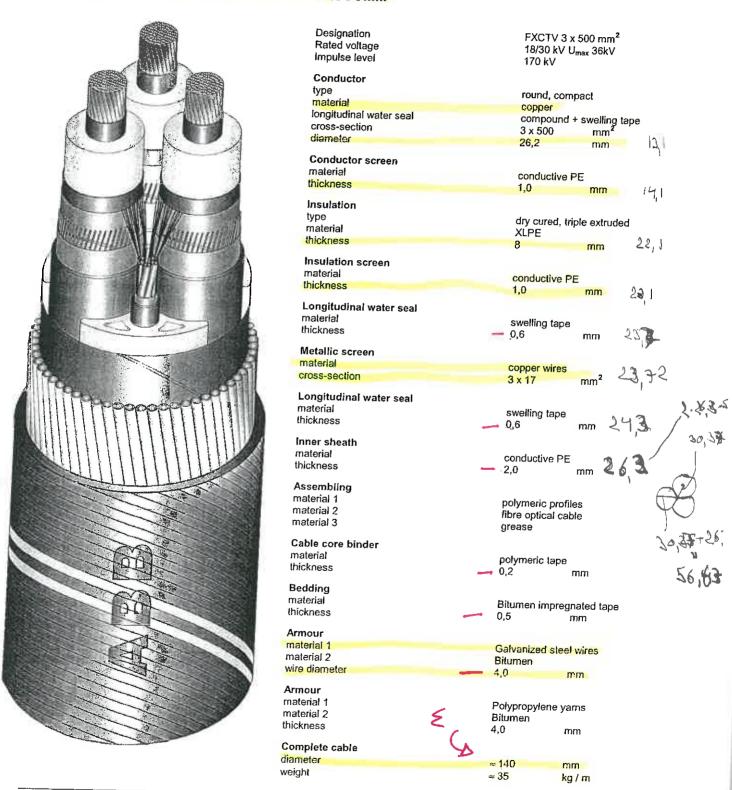
From	То	Load	Current	Cable	Ler	ngth	10	ss / unit	171
Wtg	Wtg		at 34 kV	size	Wtg - Wtg		Load	Dielectric	Loss tota
		MW	Α	mm²	m .	m	W/m		Load
						•••	44/11)	W/m	kW
Shore	A2	32,4	550,18	3 x 500 🔗	470 8450	4020	56,94	0,0210	400.45
A2	A3	28,8	489,05	3 x 500 💪	560	2040	44,99	0,0210	483,40
A3	A4	25,2	427,92	3 x 240 6	560	-80 4 o	60,65	0,0210	28,79
A4	A5	21,6	366,79	3 x 240 📥	560	20 40	44,56	0,0210	38,81
A5	A6	18	305,66	3 x 240	560	89-40	30,94		28,52
A6	Α7	14,4	244,52	3 X 95 🚕	560	80-40	43,68	0,0156	19,80
A7	A8	10,8	183,39	3 x 95	560	2040	24,57	0,0156	27,95
A8	B8	7,2	122,26	3 x 95	750	20 40	10,92	0,0156	15,72
B8	B9	3,6	61,13	3 x 95 💪	560	2040	2,73	0,0156	9,06
						200 . 2	2,13	0,0156	1,75
hore	B2	28,8	489,05	3 x 500 8 4	8 28460	1020	44,99	0.0040	
B2	B3	25,2	427,92	3 x 240 🎸	560	20 40	60,65	0,0210	382,40
B3	B4	21,6	366,79	3 x 240 🖊	560	80-40	44.56	0,0210	38,81
B4	B5	18	305,66	3 x 240 🕜	560	28 40	30,94	0,0210	28,52
B5	B6	14,4	244,52	3 x 95 🥢	560	28-40	43,68	0,0156	19,80
B6	B7	10,8	183,39	3 x 95 🕜	560	20 40	43,08 24,57	0,0156	27,95
B7	C7	7,2	122,26	3 x 95 74		80	10,92	0,0156	15,72
C7	C8	3,6	61,13	3 x 95		80-40	2,73	0,0156	9,06
						you was	2,13	0,0156	1,75
	C1	28,8	489,05	3 x 500 85	2 8490	40 20	44,99	0.0040	
	C2	18	305,66	3 x 240 🗽		80-40	30,94	0,0210	383,75
	C3	14,4	244,52	3 x 95 4/	560	280-470	43,68	0,0156	19,80
	C4	10,8	183,39	3 x 95 😘	560	89- (1-	-	0,0156	27,95
	C5	7,2	122,26	3 x 95 //	560	88-40	24,57	0,0156	15,72
	C6	3,6	61,13	3 x 95 //	560	80 40	10,92	0,0156	6,99
	D1	7,2	122,26	3 x 95 340	750	30 40	2,73	0,0156	1,75
1 [02	3,6	61,13	3 x 95		88 40	10,92	0,0156	9,06
			•	= -1 -0	- 500	y0 7 6	2,73	0,0156	1,75



Tender Elsam Our ref 05-1059 Page 12 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

12. CABLE DESIGN FXCTV 3x500mm²

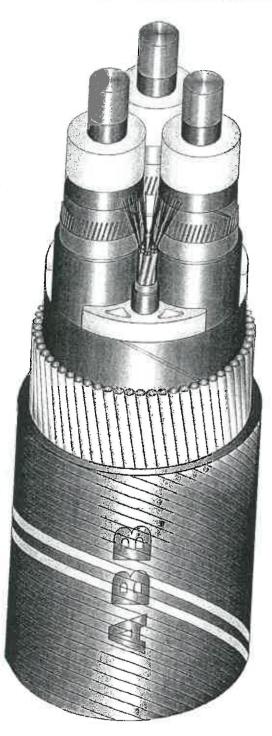




Tender Elsam Our ref 05-1059 Page 13 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

13. CABLE DESIGN FXCTV 3×240mm²



Designation Rated voltage Impulse level

Conductor type material cross-section

Conductor screen material thickness

Insulation type material thickness

Insulation screen material thickness

Longitudinal water seal material thickness

Metallic screen material cross-section

Longitudinal water seal material thickness

Inner sheath material thickness

Assembling material 1 material 2 material 3

Cable core binder material thickness

Bedding material thickness

Armour material 1 material 2 wire diameter

Armour material 1 material 2 thickness

Complete cable diameter weight

FXCTV 3 x 240 mm² 18/30 kV U_{max} 36kV 170 kV

round, solid (or compacted) copper 3 x 240 mm²

conductive PE 1,0 mm

dry cured, triple extruded XLPE 8 mm

conductive PE 1,0 mm

swelling tape 0,6 mm

copper wires 3 x 14 mm²

swelling tape 0,6 mm

PE 3,0 mm

polymeric profiles fibre optical cable grease

polymeric tape 0,2 mm

Bitumen impregnated tape 0,5 mm

Galvanized steel wires Bitumen 4,0 mm

Polypropylene yarns Bitumen 4,0 mm

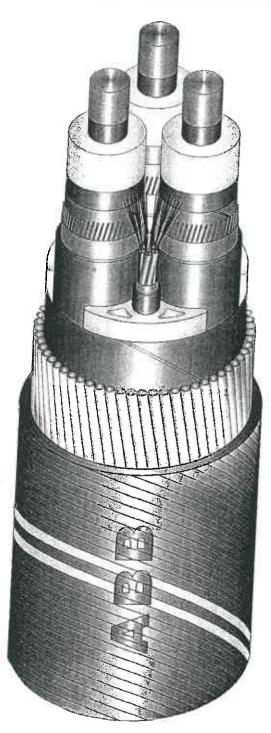
≈ 120 mm ≈ 22 kg/m



Tender Elsam Our ref 05-1059 Page 14 of 14 Rev. 050929-4 2005-09-29

Burbo Offshore Windfarm ABB Power Technologies AB High Voltage Cables

14. CABLE DESIGN FXCTV 3x95mm²



Designation Rated voltage Impulse level

Conductor type material cross-section

rial -section

Conductor screen thickness

Insulation type material thickness diameter

Insulation screen thickness

Longitudinal water seal 1 material thickness

Metallic screen material cross-section

Longitudinal water seal 2 material thickness

Inner sheath material thickness

Fillers material material material

Cable core binder material thickness

Bedding material

Armour type material thickness

Outer cover material thickness

Complete cable diameter weight

FXCTV 3 x 95 mm² 20/34 kV U_{max} 36kV 170 kV

round, solid copper 3 x 95 mm²

0,8 mm

dry cured, triple extruded XLPE 8,0 mm 31 mm

1,0 mm

conductive swelling tape

mm

copper wires mm
3 x 12 mm²

0,6

conductive swelling tape

PE 3,0 mm

polymeric profiles grease fiber optic cable

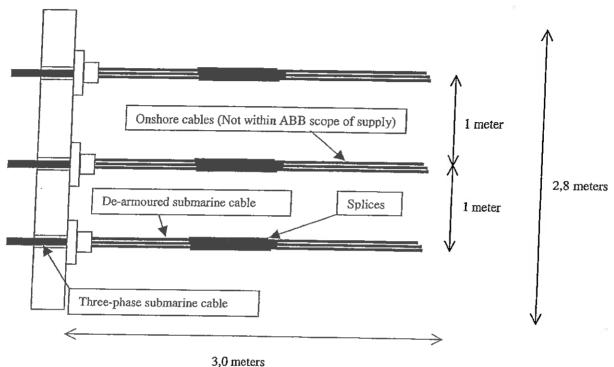
nylon 0,15 mm

bitumen impregnated tape

wires, single layer galv. steel wires 4 mm

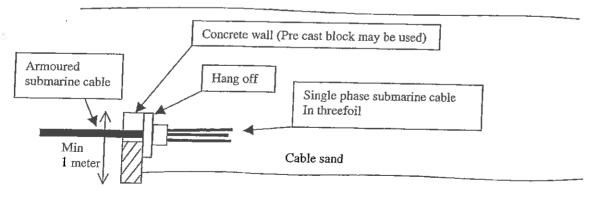
polypropylene yarn 4 mm

≈ 106 mm ≈ 16 kg/m Sketch of onshore jointing chamber. (CIF)
 This is based on the assumption that the jointing chamber is an open design with only a concrete wall where the hang-off is fitted.



Where the armoured submarine cable enters the CIF, there shall be a concrete wall with open slots for the cableto attach the hang-off. These hang off devices will be of the same type as those being installed on the wind turbines.

Splicing will be done in an open dug jointbay in a temporary jointing facility. After splicing the splices shall be buried in cable sand and the following layers backfilled and compacted.



Natural soil

Page 1 of 1

Standby rate. Example.

The master time schedule states at what date we should have access to the different WT:s. When our personell are on site, and these dates are not met by another contractor such as foundation contractor, WT contractor or Cable laying contractor, the standby rate would be applicable, unless we are given access to other WT:s where we could continue with our work.

Example:

WT installation on foundations are delayed outside the time schedule for any technical reasons. This would be situation where the standby rate would be applicable.

All situations with standby time would have to be considered as separate items. We will ofcource try our best to work together with all contractors to minimize standby time, for instance work in parallel with other contractors on WT:s whenever possible technically and concidering safety for personnel. Standby time would only be applicable for delays compared to the master time schedule. If we would work faster then our given time in the schedule, standby time would not be applicable for the time to the next planned operation. Our offer is based on that we can work in one continous operation.

							_		
		OBJ	ECT: FXCTV 3x5	500/17 36	5 kV				
	$U = 34 \text{ kV} \text{ I}$ $U_m \approx 36 \text{ kV} \text{ I}$ $U_0 = 18 \text{ kV} \text{ V}$ $d = 26,2 \text{ mm}$ $t_n = 8,0 \text{ mm}$ $t_n = 2,0 \text{ mm}$ $d_n = 4,0 \text{ mm}$ $D = 140 \text{ mm}$ $C_n = 0,33 \mu\text{F/k}$ $R_n = 0,0366 \text{ ohm}$	tages and Cable I Rated voltage Highest voltage for Value of U ₀ for dete Nominal diameter Nominal thickness Nominal diameter Nominal diameter Mominal diameter Mominal capacit Vkm Conductor res	equipment (between the conductor of conductor of insulation of cable overshead armour wires of cable coresistance DC 20 °C	oltages oth	uctors)	Rout Sam Com	tents tine Test ple Test missioning r optical te	-	pag 1 2 3 4
No.	Name of dam.		Specifying documen	ts ; Clause	Requirements	_		Code	
1	Characteristics, method or type	of inspection			3			1, 2, 3	
1.	Routine test Routine test shall be		n manufactured ler	ngth of c	able				
1.1	Measurement of elect of conductor	rical resistance	IEC 60502-2	16.2	20°CR _{DC} ≤	0,0366	ohm/km	A-0	
1.2	Measurement of electron of screen	rical resistance	IEC 60502-2 1	6.2	20°CR _{DC} ≤ 1	1,2	ohm/km	A-C	;
1.3	* Partial Discharge Te:	st	IEC 60502-2 1	6.3 T€	est voltage raised to held 10 s. ≤ 10 pC at U =	36 31	kV kV	A-C	
1.4	Voltage Test		IEC 60502-2 1	5.4	5 minutes at U=	63	kV	A-C	
1.5	Test on fiber optical cal	ble			Please see page 4	in this	document		
at manuf at manuf at a subc at erection other, spe	facturer outside ABB zontractor of the manufacturer an site ecified under "Remarks"	Code 2.Inspector B customer/owner represer C customer/owner represer N representative of respons O representative of the man P reor, of the manufact, cue C representative of the man C representative of the man Y other, specified under "Re withnessing not specified	ntative sible ABB company sufacturers design function sility function, mandatory bo sufacturers quality function		Code 3. Distribution of report C customer/owner and manuf N responsible ABB company of the manufacturers design a Q the manufacturers cuality for J journal is kept, no reporting. Z other, specified under "Rem - reporting not specified"	and the m nd quality inction for each o	anufacturers qu functions	uality funci	tion
marks, n order to	avoid inaccuracy (due to temp	erature variations) all res	sistance measurement	will be perf	ormed prior to assembling				
.3 is for	information only, A PD-test wil	be performed on samp	les taken from beginnir	ig and end	from each extrusion serie (R	efering t	o Electra 189	2.2.2	
								_	
. înd.	<u> </u>	Specification of revision					Approved Da		
ponsible	department			(Customer.	Plant, Order, etc.)		Approved Da	1.6	
ared by	cal Department	 ·			ppe Energy UK (BUF	RBO)			
oved by	Flemming Krogh			Title					
over de	Kenneth Johannesson			ITP xxx	xx				Language E No of sh.
T, TN	И, Q, CC				3x500/17 36 kV				4
	wer Technologies H	igh Voltage Cab	les	Document No	Draft	Dat	2005-10	-04	Sheet 1

- 1									
	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	OE oltages and Cable Dime of Rated voltage of Highest voltage for equ of Value of Uo for determing on Nominal diameter of co on Nominal thickness of in on Nominal diameter of an on Nominal diameter of an on Nominal diameter of ca of Nominal diameter of	ipment (between nation of test volta onductor nsulation oner PE-sheath mour wires able of cable core nce DC 20 °C	conducto		Roi Sar Cor	ntents utine Test nple Test nmissionir er optical t	-	ρ
No.	Name of item.		Specifying docum	nonts - Claus		lo	2000		
1	Characteristics, method or typ	e of inspection	land and	Norwa _ Lautan		Heques	menta	1, 2, 3	
2.1	Conductor examinati	I- 2.4 will be performed owill be performed on san on on on oness of insulation and	on samples taken nples taken from I IEC 60502-2	beginning	ginning and end from ea g and end from each co ≥	ach ext emplete 53	rusion ser ed cable le wires	ie ngth A-	c
	non-metallic sheath								
2.2.1	Measurement of insul		IEC 60502-2		$t_{min} \ge t_{max} - t_{min} / t_{max} <$	0,15	mm mm	A-0	С
			IEC 60502-2	17.5.3	t _{min} ≥	1,40	mm	A-0	
2.3	Partial Discharge Test	t	IEC 60502-2	16.3	Fest voltage raised to held 10 s. \leq 10 pC at U =	36 31	kV kV	A-C	;
2.4	Hot Set Test for XLPE	-Insulation	IEC 60502-2 1	17.5.10	IEC60502-2 Table	22 XLI	PE	A-C	
	Measurement of diame	ter of armour wires	IEC 60502-2 1	17.7.7	$d_{min} \ge$	3,8	mm	A-C	
t manufa t manufa t a subco l erection	ified under "Remarks"	Code 2.inspector B customer/owner representative, C customer/owner representative N representative of responsible AB D representative of the manufactur P repr. of the manufact, quality fund c representative of the manufactur Y other, specified under "Remarks" - witnessing not specified	B company ers design function	ıl	Code 3. Distribution of repond C customer/owner and manu N responsible ABB company D the manufacturers design a Q the manufacturers quality J iournal is kept, no reporting Z other, specified under "Ren - reporting not specified	ufacturers of and the named and quality function	nanufacturers o r functions	uality function	
					<u> </u>				
								-	
ind,		Specification of revision					Approved	Date	
hnica red by	epartment Department			1	, Plant, Order, etc.) ape Energy UK (BUF	RBO)			
ved by	emming Krogh			Title					I ancurar:
ver deba , TM,	enneth Johannesson riments Q, CC			ITP xx	xxx ' 3x500/17 36 kV				Language E No of sh.
Pow	ver Technologies Hi	igh Voltage Cables		Document N	lo	Da			Sheet
		an voltage caples			Draft		2005-1	0-04	2

OBJE	ECT: FXCTV 3x500/1	7 36 kV			
Rated voltage Highest voltage for equi Falue of U ₀ for determing Nominal diameter of control Nominal thickness of instance of the Nominal diameter of and Nominal diameter of cantrol Nominal diameter of cantrol Nominal capacitance Why Conductor resistance	ipment (between con nation of test voltages onductor nsulation oner PE-sheath mour wires able e of cable core nce DC 20 °C		Sample Test Commissioni	ing test	pag 1 2 3 4
	Specifying documents ; CI	ause	Requirements	Code	
Code 2.Inspector B customer/owner representative C customer/owner representative N representative of the manufact. P repr. of the manufact, quality fur C grerresentative of the manufact.	IEC 60502-2 20) F , mandatory hold point BB company wers design function notion, mandatory hold point wers well function retres quality function	Code 3. Distribution of report C customer/owner and manu N responsible ABB company D the manufacturers design i Q the manufacturers design i J lournal is kept, no reporting Z other, specified under "Ren	facturers quality funct and the manufacturer and quality functions	s quality function	
- Willessind Hot specified					
Providentian of					
pecinication of revision	1/2	omer Plest Onder and	Approved	Date	
		, ,	RBO)		1
			/		
		xxxxx		Ĭ.	Language E
	FXC	CTV 3x500/17 36 kV		ļ	No of sh.
gh Voltage Cables		nent No,	Date 2005		Sheet 3
	Rated voltage Highest voltage for equ Value of Uo for determin Nominal diameter of co Nominal thickness of in Nominal thickness of in Nominal diameter of an Nominal diameter of an Nominal diameter of ca m Nominal diameter of ca m Nominal capacitance n/km Conductor resistan n/km Screen/sheath res of inspection sts after installation fon test shall be carried poptical cable Code 2.Inspector B customer/owner representative of the manufact, quality fur Q representative of responsible A D representative of the manufact y other, specified under "Remarks - wilnessing not specified Specification of revision	Rated voltage Highest voltage for equipment (between convalue of Uo for determination of test voltages) Nominal diameter of conductor Nominal thickness of insulation Nominal thickness of insulation Nominal diameter of armour wires Nominal diameter of cable m Nominal diameter of cable m Nominal capacitance of cable core n/km Conductor resistance DC 20 °C n/km Screen/sheath resistance DC 20 °C n/km Screen/sheath resistance DC 20 °C Specifying documents : Cl of inspection IEC 60502-2 20) Optical cable Code 2.Inspector B customer/owner representative, mandatory hold point C customer/owner representative N representative of the manufact, quality function, mandatory hold point C customer/owner representative N representative of the manufact, quality function, mandatory hold point C representative of the manufact, quality function, mandatory hold point C representative of the manufact, quality function, mandatory hold point C representative of the manufacturers quality function Y other, specified under "Remarks" - wilnessing not specified Specification of revision (Cust Sea	Rated voltage Highest voltage for equipment (between conductors) Value of U _o for determination of test voltages Nominal diameter of conductor Nominal thickness of insulation Nominal thickness of insulation Nominal diameter of armour wires Nominal diameter of cable m Nominal capacitance of cable m Nominal capacitance of cable core n/km Conductor resistance DC 20 °C n/km Screen/sheath resistance DC 20 °C n/km Screen/sheath resistance DC 20 °C n/km Screen/sheath resistance DC 20 °C Specifying documents ; Clause Specifying documents	Rated voltage Highest voltage for equipment (between conductors) Value of U _o for determination of test voltages Nominal diameter of conductor Nominal thickness of insulation Nominal diameter of around wises Nominal diameter of cable m Nominal diameter of cable of inspection Specifying documents : Clause Specifying documents : Clause Specifying documents	Rated voltage Ridghest voltage for equipment (between conductors) Rated voltage Ridghest voltage for equipment (between conductors) Avalue of U ₂ for determination of test voltages Rominal diameter of conductor Rominal thickness of insulation Rominal thickness of insulation Rominal diameter of cable Requirements Re

		OBJE	CT: FXCTV 3x	500/17 36	kV				
		Voltages and Cable Dime	nsions			Cont	ents		pag
		(V Rated voltage		veen conductors)			Routine Test Sample Test		
ł		V highest voltage for equi	pment (betwee						
U ₀ = 18 kV Value of U ₀ for determination of te d = 26,2 mm Nominal diameter of conductor				voltages			Commissioning test		
t _n = 8,0 mm Nominal thickness of insulation						Fiber	optical tes	sts	4
		nm Nominal thickness of ca		.					
		nm Nominal diameter of cal		•					
		F/km Nominal capacitance							
		hm/km Conductor resistan							
	R _s = 1,2 c	hm/km Screen/sheath resi	stance DC 20 °	°C					
No.	Name of item.		Specifying docume	ents ; Clause		Requirem	ents	Code	
1	Characteristics, method or	type of inspection				'		1, 2, 3	
l	_								
ĺ		fiber optical cable	IEC 60793-1						
1		ving tests will be perform							
l	3.1 OTDR	Test on all fibres (Measure	ments must be	performed	I from both ends)				
ĺ		n at 1310 nm. n at 1550 nm.				≤ 0.35		M-	·C
1		n at 1625 nm.				≤ 0.25 (M-	_
		umber of approved fibres				≤ 0.25 (M-4	_
	Williaman	umber of approved fibres				16	pcs	M-0	С
	The follow	ing tests will be performe	ed as a part of	f the routii	ne test				
	The test wil	I be repeated after loading							
		on all fibres (Measuremen	ts must be per	formed fro	m both ends)				
		at 1310 nm.			 ,	≤ 0.35 d	B/km	A-C	,
	Attenuation	at 1550 nm.				≤ 0.25 d		A-C	
	Attenuation	at 1625 nm.				≤ 0.25 d		A-C	
	Minimum nu	mber of approved fibres					pcs	A-C	
							F	,,,	
	The following	ng tests will be performe	d as a part of	the comm	issioning test.				- 1
	3.2 OTDR Test	on all fibres (Measurement	s must be perfe	ormed fron	n both ends)				- 1
	Attenuation :					$\leq 0.35 \text{ dB}$	3/km	E-C	
	Attenuation a					≤ 0.25 dE	3/km	E-C	i
	Attenuation a					≤ 0.25 dE	3/km	E-C	ſ
	Minimum nui	mber of approved fibres				12 p	ocs	E-C	- 1
nde 1. Pla	ace of inspection	Code 2.Inspector	_ 						
	acturer (ABB company)	B customer/owner representative, m	andstory hold point		Code 3. Distribution of rep				- 1
	acturer outside ABB ontractor of the manufacturer	C customer/owner representative N representative of responsible ABB			C customer/owner and man N responsible ABB compar	av and the ma	nufacturers mus	ality function	
al erection	n site cified under "Remarks"	D representative of the manufacturer P repr. of the manufact, ouality funct	rs design function	oin!	Q the manufacturers design	n and quality to v function	unctions		
		Y other, specified under "Remarks"	s quality function		J journal is kept, no reporting other, specified under "Re-reporting not specified"	ng for each de emarks"	livery order		- 1
marks. no	otes	- witnessing not specified			102011101				
									- 1
					-		· J		
				 -					
. ind.		Specification of revision		 -					
	department			<u> </u>			Approved	Date	[
	al Department			(Customer, Pla	,	IDDO)			[
ared by				oeascap	e Energy UK (BL	ikro)			1
F oved by	lemming Krogh								
	enneth Johannesse	on –		ITP xxxxx	<u> </u>				Language
over dep	artments			TIE XXXXX					No of sh.
1, TM	I, Q, CC				x500/17 36 kV				4
		High Voltage Cables	ľ	Document No.	Draft	Date	2005-10		Sheet 4
						3		1	

		OBJ	ECT: FXCTV 3x95	5/12 36 k	V				
	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Voltages and Cable I kV Rated voltage kV Highest voitage for kV Value of U ₀ for dete mm Nominal diameter mm Nominal thickness mm Nominal diameter a mm Nominal diameter mm Nominal diameter a mm Nominal diameter a fr/km Nominal capacit bhm/km Conductor res ohm/km Screen/sheath	equipment (between the conductor of insulation of cable armour wires of cable core sistance DC 20 °C	oltages h	ctors)	Rou San Con	ntents utine Test nple Test nmissionir er optical t		pag 1 2 3 4
No.	Name of item		Specifying document	s ; Clause	Regultements			Code	
	Characteristics, method or	type of inspection	Former Minimum and the		Procedure to Month			1, 2, 3	
1. 1.1		be carried out on each	n manufactured len	_		0.40	2 obwylew		
1.1	of conductor	nectrical resistance	IEC 00302-2 1	0.2	20°CR _{oc} ≤	0,19	3 onm/km	ı A-(į
1.2	Measurement of e of screen	lectrical resistance	IEC 60502-2 10	3.2	20°CR _{DC} ≤ 1	1,5	ohm/km	A-C	;
1.3	Partial Discharge 1	Test Test	IEC 60502-2 16	3.3 Te	st voltage raised to held 10 s. ≤ 10 pC at U =	36 31	kV kV	A-C	;
1.4	Voltage Test		IEC 60502-2 16	.4	5 minutes at U=	63	kV	A-C	
1.5	Test on fiber optica	l cable			Please see page 4	in this	s docume	nt	
at manut at manut at a subc at erection other, so	ecified under "Remarks"	C customer/owner represent N representative of response D representative of the mare	nufacturers design function ality function, mandatory hole nufacturers quality function		Code 3. Distribution of report C customer/owner and manuf N responsible ABB company of the manufacturers desion a Q the manufacturers quality fu J journal is kept, no reporting 2 other, specified under "Rem - reporting not specified	and the nd quali nction for each	manufacturers ty functions	ouality func	tion
marks, n order to		temperature variations) all re	esistance measurement v	vill be perfo	rmed prior to assembling				
						_			
ind,		Specification of revision			······································		Approved	Date	
chnic	department cal Department				Plant, Order, etc.) pe Energy UK (BUF	RBO)			
oved by	Flemming Krogh			Title	. _				Language
over de	Kenneth Johannes Deartments M, Q, CC	son		TP xxx	xx 3x95/12 36 kV				E No of sh.
facturer		s High Voltage Cab		ocument No		ID	ate 2005-1	n-04	4 Sheet 1
		g ronage oar	,,,,,,		Diun.		2000-1	υ-υ 4	_ '

	Voltages and Cable Dim U = 34 kV Rated voltage	nipment (between conducto nation of test voltages conductor nsulation nner PE-sheath rmour wires able e of cable core nce DC 20 °C		Contents Routine Test Sample Test Commissioning t Fiber optical test	
No. 2.	Name of item. Characteristics, method or type of inspection Sample test The sample tests 2.1- 2.4 will be performed The sample test 2.5 will be performed on a s	Specifying documents; Clause on samples taken from beg	i inning and end from eac	Requirements	Code 1, 2, 3
2.1	Conductor examination Measurement of thickness of insulation and non-metallic sheath	IEC 60502-2 17.4	iast completed cable len	gtn. Solid conductor	A-C
2.2.1 2.2.2		IEC 60502-2 17.5.2	$t_{min} \ge t_{min} \le t_{max} - t_{min}/t_{max} < t_{min} \ge t_{min} \ge t_{min}$	7,1 mm 0,15 mm 2,20 mm	A-C A-C
2.3	Hot Set Test for XLPE-Insulation	IEC 60502-2 17.5.10	IEC60502-2 Table 2		A-C
2.4	Measurement of diameter of armour wires	IEC 60502-2 17.7.7	d _{min} ≥	3,8 mm	A-C
it manufac it manufac t a subcon t erection	prepr. of the manufact, quality fur Q representative of the manufact Y other, specified under "Remarks" y other, specified under "Remarks" witnessing not specified.	BB company urers design function notion, mandatory hold point urers quality function	Code 3. Distribution of report C customer/owner and manufa N responsible ABB company at D the manufacturers desion an Q the manufacturers qualify fur J iournal is kept, no reporting to Z other, specified under "Rema reporting not specified	nd the manufacturers quali d quality functions action or each delivery order	ity function
ind.	Specification of revision			Approved D	ate
chnica ered by	epartment al Department lemming Krogh	Seasc	r, Plant, Order, etc.) ape Energy UK (BUR		
over depa T, TM,	enneth Johannesson	ITP xx	xxx / 3x95/12 36 kV		Language E No of sh.
acturer 3 Power Technologies High Voltage Cables			Draft	Date 2005-10-	9 4 Sheet 2

OBJE	CT: FXCTV 3x95/12 36 k	٧		
Voltages and Cable Dime U = 34 kV Rated voltage U _m = 36 kV Highest voltage for equi U ₀ = 18 kV Value of U ₀ for determin d = 26,2 mm Nominal diameter of co t _n = 8,0 mm Nominal thickness of in t _n = 2,0 mm Nominal thickness of in d _n = 4,0 mm Nominal diameter of am D = 140 mm Nominal diameter of cal C _n = 0,33 μF/km Nominal capacitance R _s = 0,0366 ohm/km Conductor resistant R _s = 1,2 ohm/km Screen/sheath resi	pment (between conductor ation of test voltages inductor sulation ner PE-sheath mour wires ble of cable core ce DC 20 °C	Ro Sa Co	ontents putine Test imple Test immissioning test iver optical tests	pag 1 2 3 4
Manue of them Characteristics, method or type of inspection	Specifying documents : Clause	Requi	rements Code	
3.1 AC or DC test 3.1 Test on fiber optical cable 3.2 Test on fiber optical cable Code 1. Place of inspection At manufacturer (ABB company) At at manufacturer outside ABB at a subcontractor of the manufacturer at erection site other, specified under "Remarks" Code 2. Inspector B customer/owner representative, N representative of responsible AB D representative of responsible AB D representative of the manufacturer of the responsible AB D representative of the manufacturer of the responsible AB D representative of the manufacturer of the responsible AB D representative of the manufacturer of the responsible AB D representative of the manufacturer of the manufacturer of the manufacturer of the responsible AB D representative of the manufacturer of the ma	IEC 60502-2 20) Please mandatory hold point iiii company ars design function ction, mandatory hold point ers qualify function	Code 3. Distribution of report C customer/owner and manufactures N responsible ABB company and th D the manufacturers quality function J lournal is keet, no reporting for early a company and the company and	rs quality function e manufacturers quality function slity functions	ec
ev. ind. Specification of revision esponsible department echnical Department		lant, Order, etc.) De Energy UK (BURBO	Approved Date	
enared by K Flemming Krogh Droved by K Kenneth Johannesson	Title			Language
ke over departments VT, TM, Q, CC nufacturer	Document No.	3x95/12 36 kV	Date	E No of sh. 4 Sheet
BB Power Technologies High Voltage Cables		Draft	2005-10-04	3

OBJECT: FXCTV 3:	x95/12 36 kV			
Voltages and Cable Dimensions U = 34 kV Rated voltage U _m = 36 kV Highest voltage for equipment (between two decays) and two decays are supported by the support of the	oltages th	Contents Routine Test Sample Test Commissioning Fiber optical tes		pa; 1 2 3 4
No. Name of item. Specifying documents Characteristics, method or type of inspection	pents ; Chiune	Requirements	1, 2, 3	
3.1 OTDR Test on all fibres (Measurements must be Attenuation at 1310 nm. Attenuation at 1550 nm. Attenuation at 1625 nm. Minimum number of approved fibres The following tests will be performed as a part of The test will be repeated after loading 3.2 OTDR Test on all fibres (Measurements must be performed at 1310 nm. Attenuation at 1550 nm. Attenuation at 1625 nm. Minimum number of approved fibres The following tests will be performed as a part of The follow	e performed from both ends) of the routine test. rformed from both ends) <a href<="" th=""><th>≤ 0.35 dB/km ≤ 0.25 dB/km ≤ 0.25 dB/km 16 pcs € 0.35 dB/km € 0.25 dB/km 12 pcs 0.35 dB/km 0.25 dB/km 0.25 dB/km</th><th>M-C M-C M-C M-C A-C A-C A-C A-C E-C E-C</th><th></th>	≤ 0.35 dB/km ≤ 0.25 dB/km ≤ 0.25 dB/km 16 pcs € 0.35 dB/km € 0.25 dB/km 12 pcs 0.35 dB/km 0.25 dB/km 0.25 dB/km	M-C M-C M-C M-C A-C A-C A-C A-C E-C E-C	
Minimum number of approved fibres de 1. Place of inspection It manufacturer (ABB company) Interpretation and the manufacturer (ABB company) It is subconfractor of the manufacturer teretion site It is their specified under "Remarks" Code 2.inspector B customer/owner representative, mandatory hold point Coustomer/owner representative N representative of the manufacturers design function P reprint of the manufacturers quality function and to their, specified under "Remarks" Code 2.inspector B customer/owner representative, mandatory hold point Octoor of the manufacturers design function P reprint of the manufacturer and the manufacturers are substituted in the manufacturer and the manufacturers are substituted in the manufacturer and the manufacturer an	Code 3. Distribution of report C customer/owner and manufi N responsible ABB company of the manufacturers design at Q the manufacturers quality furboint J iournal is kept, no reporting of Z other, specified under "Termi	and the manufacturers ou nd quality functions inction for each delivery order	E-C	
arks, notes - witnessing not specified				
ind. Specification of revision		Assessed		
onsible department chnical Department red by Flemming Krogh	(Customer, Plant, Order, etc.) Seascape Energy UK (BUR	Approved	Date	1
Kenneth Johannesson	Title		1.	uage
over departments F, TM, Q, CC acturer	ITP xxxxx FXCTV 3x95/12 36 kV		No of	sh.
B Power Technologies High Voltage Cables	Draft	Date 2005-10	0-04 Shee	