KEMA

HIGH-VOLTAGE LABORATORY

Certificate

KEMA

TEST REPORT

Report no.	40070251.000-HVL 01-1114
Client	Arab Cables Co. "El Sewedy" 14, Baghdad St., El Korba, Heliopolis, Cairo Egypt
Reference	-
Concerning	test
Date	30 March until 10 June 2001
Place	KEMA High Voltage Laboratory, Arnhem The Netherlands
Object	single phase XLPE insulated power cable
Type	230 kV/Cu/XLPE/lead sheath/LLDPE 1x 1000 mm^2
Manufacturer	Egytech Cables Co., Cairo, Egypt

REQUIREMENTS
The requirements as specified in the draft standard IEC 62067 (2000) (20/442/CDV).

TEST PROGRAMME
For the programme we refer to page 2.

SUMMARY AND CONCLUSION
The results obtained relate only to the work ordered and to the material tested.
The tests were passed.

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KEMA High-Voltage Laboratory

Arnhem, 3 July 2001

This B-report consists of:
28 pages
1 appendix

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MATERIAL DATA

Manufacturer	Egytech Cables Co., Cairo, Egypt
Type	230 kV/Cu/XLPE/lead sheath/LLDPE 1x 1000 mm^2
Year of manufacture	2000
Quantity submitted	one length of approximately 50 m
No. of phases	1
Insulation	XLPE
Conductor material	Copper
Conductor cross-section	1000 mm^2
Screening material	Lead
Sheath material	LLDPE (ST3)
Sheath color	Black
Rated voltage	230 kV
Rated frequency	50 Hz
Water penetration design	- a barrier is included which prevents longitudinal water penetration along the gap between the outer surface of the insulation screen and the water impermeable barrier - a barrier is included which prevents longitudinal water penetration along the conductor

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the data sheets as shown in appendix A of this report.
KEMA has verified that this data sheets adequately represent the material tested.

SUBCONTRACTING

The following tests, as mentioned in the Test Programme, were subcontracted to KEMA Registered Quality:

1.7 resistivity of semi-conducting screens in accordance with IEC 62067, clause 12.4.11
2 non-electrical type test in accordance with IEC 62067, clause 12.5
3 verification of cable construction in accordance with IEC 62067.

PERSONS ATTENDING THE TEST

Neither the manufacturer nor the purchaser were represented during the test.

THE TEST WAS CARRIED OUT BY

Mr H.E. Keizer	KEMA Nederland B.V.
Mr A.B.G.M ten Have	KEMA Nederland B.V.
Mr J. Maassen	KEMA Nederland B.V.

PURPOSE OF THE TEST

Purpose of the test was to verify whether the material complies with the specified requirements.

DESCRIPTION AND RESULTS OF THE TEST

MEASUREMENT UNCERTAINTY

The last page of this report contains a table with measurement uncertainties. Unless otherwise indicated in the report, the measurement uncertainties of the results presented are as indicated in this table.

1 ELECTRICAL TYPE TESTS

1.1 Check on insulation thickness before electrical type tests

Prior to the electrical type tests the insulation thickness was measured in accordance with clause 12.4.1 of IEC 62067 (1999). The results are represented in appendix 1 page 1.
The average thickness of the insulation did exceed the specified value by more than 5%.
Therefore the test voltages were increased.
The rated voltage used for all tests amounted to: U_0 = 134,7 kV.

1.2 Bending test

The test object was subjected to a bending test in accordance with clause 12.4.4 of IEC 62067 (2000).
The test object was bent around a test cylinder. The diameter of the cylinder was 3,32 m. The test consisted of three cycles of wind, unwind, reverse winding direction, wind and unwind.
During the test the temperature of the test object was approximately 10 °C.
The results are represented in appendix 1 page 2.
The test was carried out successfully.

1.3 Partial discharge test

The test object was subjected to a partial discharge test in accordance with clause 12.4.5 of IEC 62067 (2000).
On completion of the bending test, the test sample was subjected to a partial discharge measurement. The partial discharges were measured between the conductor and core screen. The measurement was carried out in a direct circuit. For this purpose a partial discharge-free coupling capacitor was used. Special precautions were taken in order to avoid external discharges of the test object. The partial discharges were detected by means of a wide-band amplifier, a high pass filter and an oscilloscope.

The measuring circuit was calibrated by means of an impulse generator giving a repeating pulse of a known pC-value. The noise level amounted to 2 pC. The voltage was raised up to 235 kV, 50 Hz and maintained at this level for 10 seconds. Subsequently the voltage was lowered down to 202 kV, 50 Hz. At this level the partial discharge level was determined.
The results are represented in appendix 1 page 3.
The test was passed.

1.4 Tan δ measurement

The test object was subjected to a tan δ measurement in accordance with clause 12.4.6 of IEC 62067 (2000).
The measurement of the dielectric loss factor was carried out by using a Schering bridge and a loss-free standard capacitor. The measurement was carried out at U_0. The loss-factor of the insulation between the conductor and core screen was measured.
During the measurement the temperature of the test object was 96 °C.
The results are represented in appendix 1 page 4.
The test was passed.

1.5 Heating cycle voltage test

1.5.1 HEATING CYCLE VOLTAGE TEST

The test object was subjected to a heating cycle voltage test in accordance with clauses 12.4.7 of IEC 62067 (2000).
The cable was mounted in the test set-up in a U-bend having a diameter of 4 m. One heat cycle consists of applying heating current for at least 8 hours followed by at least 16 hours of natural air cooling. The test object was heated up to a conductor temperature of 96 °C within the first 6 hours of the heating period and was kept steady at 96 °C for 2 hours. This temperature was achieved by inducing current in the cable. In total 20 such heating cycles were carried out.
During the whole of the test period, a voltage of $2U_0$ was applied to the test object.
The results are represented in appendix 1 page 5.
The test was passed.

1.5.2 PARTIAL DISCHARGE TEST

After cooling down to ambient temperature, after the last heat cycle, the test object was subjected to a partial discharge test in accordance with clause 12.4.5 of IEC 62067 (2000).
The measurements were carried out as mentioned above under item 1.3. The measurement was carried out in a direct circuit. The noise level amounted to 1 pC.
After the partial discharge measurement at ambient temperature the test object was heated up to a conductor temperature of 96 °C. In order to achieve this temperature, current was induced in the cable.

Two hours after thermal equilibrium was established the partial discharge test was performed. The measurement was carried out as mentioned above under item 1.3. The measurement was carried out in a balanced circuit. The noise level amounted to 2 pC.
The results are represented in appendix 1 page 6.
The test was passed.

1.6 Impulse voltage test (followed by a.c. voltage test)

1.6.1 IMPULSE VOLTAGE TEST

The test object was subjected to a lightning impulse voltage withstand test in accordance with clauses 12.4.9 of IEC 62067 (2000).
The waveform of the impulse voltage was determined at approximately 50 percent of the specified test value. The recorded front duration and time to half value amounted to 1,9 µs and 47 µs respectively. The waveform complied with the specified requirements. The test consisted of 10 positive and 10 negative impulses with crest values of 1050 kV. The voltage was applied between the conductor and core screen. The voltage measurement was carried out by means of an RC-voltage divider and a digitizer. During the test the temperature of the test object was 96 °C. In order to achieve this temperature, current was induced in the cable. Two hours after thermal equilibrium was established the impulse voltage withstand test was performed. During the test the atmospheric conditions were not taken into account.
The results are represented in appendix 1 pages 7 up to and including 9.
The test was passed.

1.6.2 A.C. VOLTAGE TEST

The test object was subjected to an a.c. voltage test in accordance with clause 12.4.8 of IEC 62067 (2000).
Upon completion of the impulse voltage withstand test, and cooling down to ambient temperature, the test object was subjected to an a.c. voltage test of 270 kV, 50 Hz for 15 minutes.
The results are represented in appendix 1 page 7.
The test was passed.

1.7 Resistivity of semi-conducting layers

The measurement of the resistivity of the semi-conducting layers was carried out in accordance with clause 12.4.11 of IEC 62067 (2000).
The results are represented in appendix 1 page 10.
The test was passed.

2 NON-ELECTRICAL TYPE TESTS

2.1 Check of cable construction

The examination of the conductor and measurements of insulation and sheath thickness were carried out in accordance with clause 12.5.1 of IEC 62067 (2000).
The results are represented in appendix 2 page 1.
The test was passed.

2.2 Tests for determining the mechanical properties of insulation before and after ageing

The mechanical properties of insulation before and after ageing were determined in accordance with clause 12.5.2 of IEC 62067 (2000).
The results are represented in appendix 2 page 2.
The test was passed.

2.3 Tests for determining the mechanical properties of non-metallic sheaths before and after ageing

The mechanical properties of the outer sheath before and after ageing were determined in accordance with clause 12.5.3 of IEC 62067 (2000).
The results are represented in appendix 2 page 3.
The test was passed.

2.4 Ageing tests on pieces of completed cable to check compatibility of materials

Ageing tests on pieces of completed cable were carried out in accordance with clause 12.5.4 of IEC 62067 (2000).
The results are represented in appendix 2 page 4.
The test was passed.

2.5 Hot set test for XLPE insulation

A hot set test for the XLPE insulation was carried out in accordance with clause 12.5.10 of IEC 62067 (2000).
The results are represented in appendix 2 page 5.
The test was passed.

2.6 Carbon black content of PE sheath

The carbon black content of the outer sheath was measured in accordance with clause 12.5.12 of IEC 62067 (2000).
The results are represented in appendix 2 page 6.
The test was passed.

2.7 Water penetration test

The water penetration test was carried out in accordance with clause 12.5.14 of IEC 62067 (2000). In total 8m cable was used for this test.
The cable was tested for longitudinal water tightness both along the gap between the outer surface of the insulation screen and the water impermeable barrier and along the conductor.
After completion of the 10 heating cycles no water emerged from the ends of the cable.
The results are represented in appendix 2 page 7.
The test was passed.

3 CONSTRUCTION

3.1 Check of cable construction and dimensions

The construction of the cable was checked against the manufacturer's specification.
The results obtained are represented in appendix 3 page 1.
No deviations were observed.

Appendix 1 page 1

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.1
Test date	3 April 2001

1.1 RESULTS OF THE CHECK ON INSULATION THICKNESS OF CABLE BEFORE ELECTRICAL TYPE TESTS

average thickness (mm)	specified thickness (mm)	maximum allowed thickness (mm)	result
26,86	25,5	(25,5+5%=) 26,78	the average thickness of the insulation did exceed the specified value by more than 5%.

Remark
The test voltages were adjusted to an electrical stress at the conductor screen equal to that applying when the average thickness of the insulation is equal to the nominal value.
The adjusted test voltage U_0 is 134,7 kV.

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.4
Test dates	30 March 2001

1.2 RESULTS OF THE BENDING TEST

Atmospheric conditions
Ambient temperature 10 °C

Test object
Temperature 10 °C

outer diameter of cable D (mm)	diameter of conductor d (mm)	requirement bending diameter 25(D+d) + 5% (mm)	hub diameter of drum (mm)	observations
118	40	4148 max.	3320	3 cycles (wind/unwind and wind/unwind in opposite direction)

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.5
Test dates	5 April 2001

1.3 RESULTS OF THE PARTIAL DISCHARGE TEST

Atmospheric conditions

Ambient temperature	22	°C	Ambient air pressure	1008	hPa
Humidity	11	$g(H_2O)/m^3$			

Test object

Temperature	22	°C	Rated voltage (U_0)	134,7	kV

Circuit parameters

Power frequency	50	Hz	Calibration	5	pC
Bandwidth	40-400	kHz	Noise level	2	pC
Coupling capacitor	2600	pF	Circuit	direct	

voltage	duration	partial discharge level	max. allowable pd-level	inception		extinction		result
(kV)	(s)	(pC)	(pC)	(kV)	(pC)	(kV)	(pC)	
235	10	-	-					
202		≤ 2	5	-	-	-	-	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.6
Test date	6 April 2001

1.4 RESULTS OF THE TAN δ MEASUREMENT

Atmospheric conditions

Ambient temperature	22	°C	Ambient air pressure	1021	hPa
Humidity	10	$g(H_2O)/m^3$			

Test object

Length (approx.)	11,5	m	Temperature	96	°C
Rated voltage (U_o)	134,7	kV			

Circuit parameters

Power frequency	50	Hz
Standard capacitor	57,36	pF

applied voltage (kV)	C (nF/m)	tan δ (x 10^{-4})	max. allowable value for tan δ (x 10^{-4})	result
134,7	0,165	3,3	10	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.7
Test dates	9 until 29 April 2001

1.5 RESULTS OF THE HEATING CYCLE VOLTAGE TEST

1.5.1 Heating cycle voltage test

Atmospheric conditions

Ambient temperature (min/max)	22-27	°C

Test object

Temperature	ambient/96	°C

no. of heat-cycles	required conductor temperature	applied heating current	heating		cooling	Ac Voltage applied continuously	result
			total heating time	duration of conductor at 96 °C	cooling time		
	(°C)	(A)	(h)	(h)	(h)	(kV, 50 Hz)	
20	95 ≤ t ≤ 100	2100-2400	8	2	16	269	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.7
Test dates	9 until 29 April 2001

1.5 RESULTS OF THE HEATING CYCLE VOLTAGE TEST (continued)

1.5.2 Partial discharge test (at ambient)

Atmospheric conditions

Ambient temperature	23	°C	Ambient air pressure	1012	hPa
Humidity	10	$g(H_2O)/m^3$			

Test object

Temperature	23	°C	Rated voltage (U_o)	134,7	kV

Circuit parameters

Power frequency	50	Hz	Calibration	5	pC
Bandwidth	40-400	kHz	Noise level	1	pC
Coupling capacitor	2600	pF	Circuit	direct	

voltage	duration	partial discharge level	max. allowable pd-level	inception		extinction		result
(kV)	(s)	(pC)	(pC)	(kV)	(pC)	(kV)	(pC)	
235 202	10	2	- 5	130	2	115	≤1	passed

1.5.2 Partial discharge test (at high temperature)

Atmospheric conditions

Ambient temperature	21	°C	Ambient air pressure	1021	hPa
Humidity	7	$g(H_2O)/m^3$			

Test object

Temperature	96	°C	Rated voltage (U_o)	134,7	kV

Circuit parameters

Power frequency	50	Hz	Calibration	5	pC
Bandwidth	40-400	kHz	Noise level	2	pC
Coupling capacitor	2600	pF	Circuit	balanced	

voltage	duration	partial discharge level	max. allowable pd-level	inception		extinction		result
(kV)	(s)	(pC)	(pC)	(kV)	(pC)	(kV)	(pC)	
235 202	10	≤ 2	- 5	-	-	-	-	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.9
Test dates	4 May 2001

1.6 RESULTS OF THE IMPULSE VOLTAGE TEST (followed by a.c. voltage test)

1.6.1 Impulse voltage test

Atmospheric conditions

Ambient temperature 22 °C Ambient air pressure 1011 hPa
Humidity 7 $g(H_2O)/m^3$

Test object

Temperature 96 °C

voltage and polarity (kV)	description	oscillogram appendix 1 page	oscillogram fig. no.	result
+ 525	waveshape: 1,91/47,96 µs at 50% of the test voltage	8	1	
+ 682	1 impulse at 65% of the test voltage		2	
+ 840	1 impulse at 80% of the test voltage		2	
+ 1050	5 impulses at 100% of the test voltage		3	
+ 1050	5 impulses at 100% of the test voltage		4	passed
- 525	waveshape: 1,90/48,18 µs at 50% of the test voltage	9	5	
- 682	1 impulse at 65% of the test voltage		6	
- 840	1 impulse at 80% of the test voltage		6	
- 1050	5 impulses at 100% of the test voltage		7	
- 1050	5 impulses at 100% of the test voltage		8	passed

1.6.2 A.c. voltage test

Atmospheric conditions

Ambient temperature 20 °C Ambient air pressure 1011 hPa
Humidity 7 $g(H_2O)/m^3$

Test object

Temperature 30 °C

applied voltage (kV)	frequency (Hz)	duration (min)	observations	result
270	50	15	no breakdown	passed

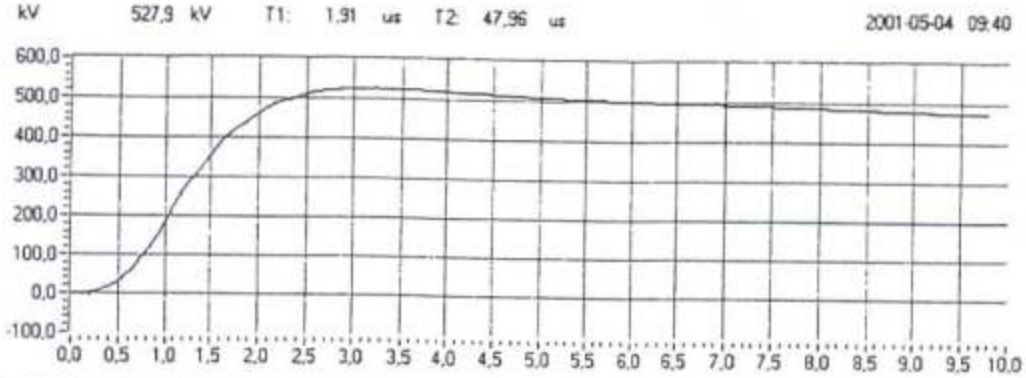


Fig. 1: Waveshape 50% of test voltage

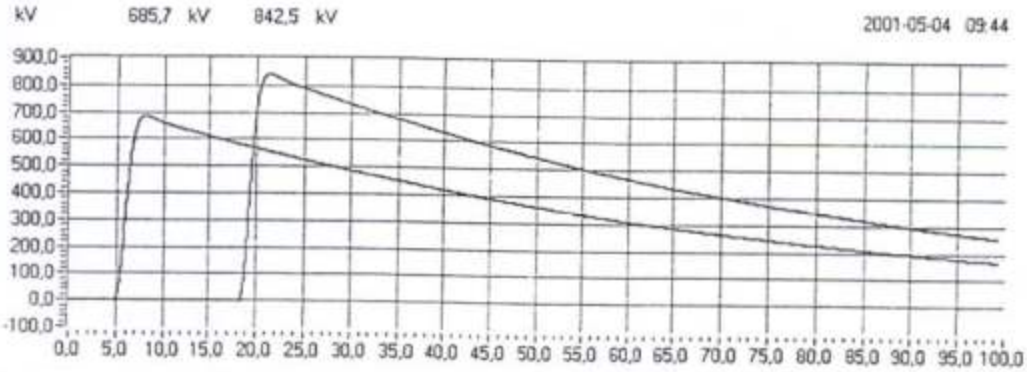


Fig. 2: 65% and 80% of test voltage

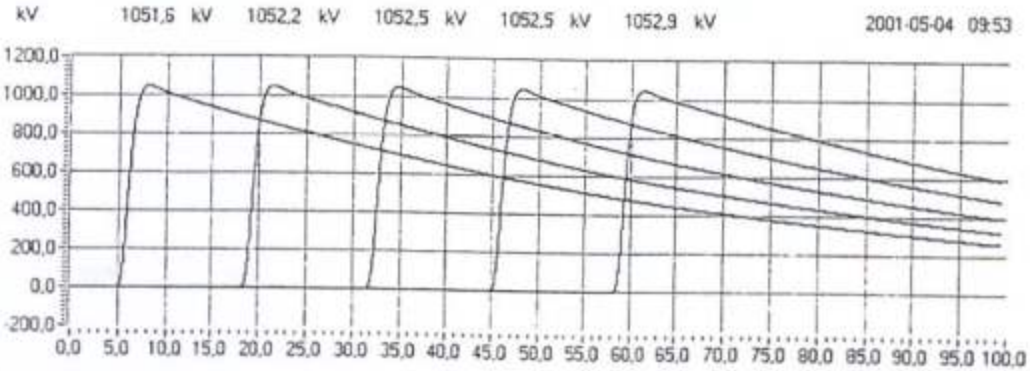


Fig. 3: 100% of test voltage

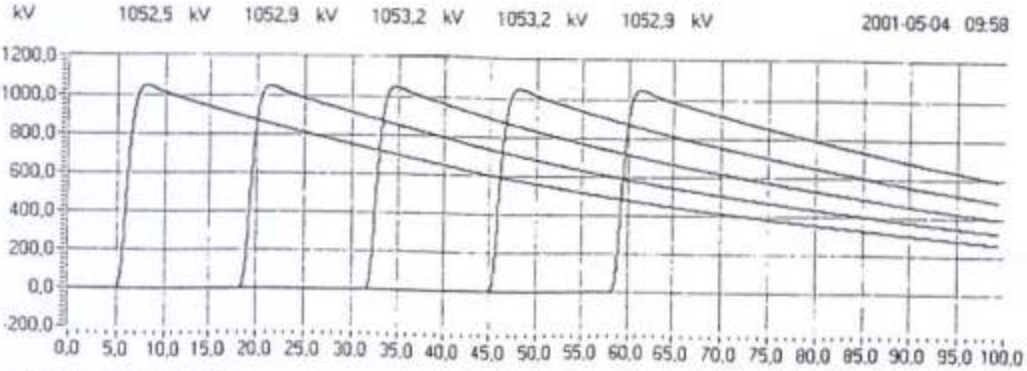


Fig. 4: 100% of test voltage

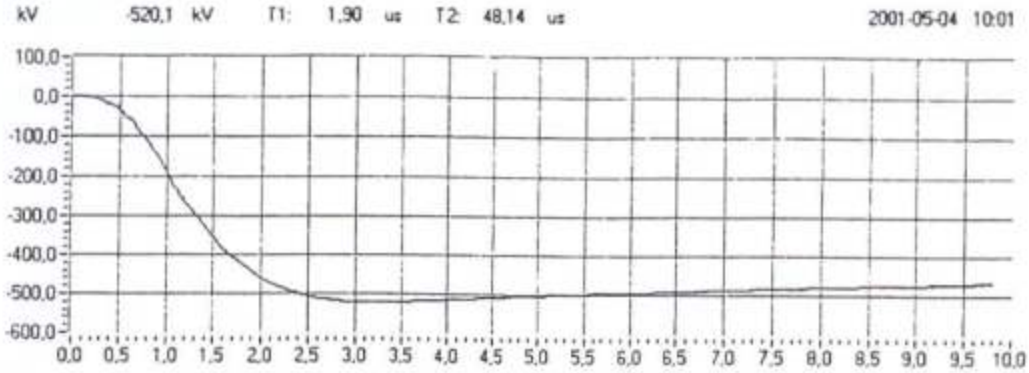


Fig. 5: Waveshape 50% of test voltage

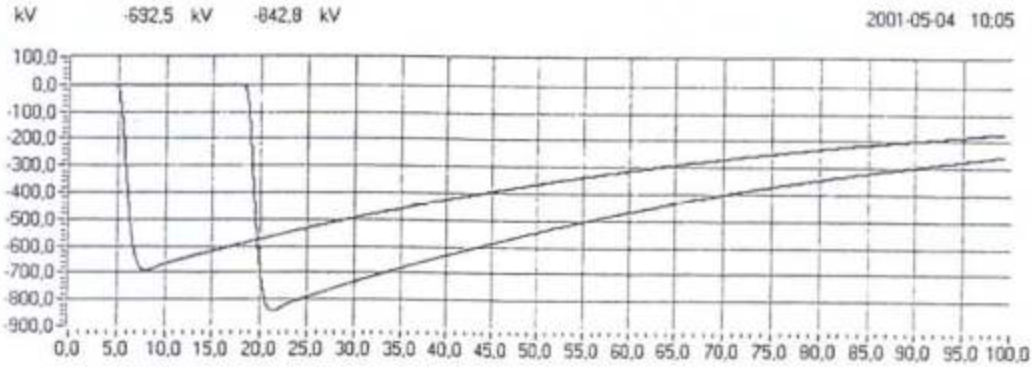


Fig. 6: 65% and 80% of test voltage

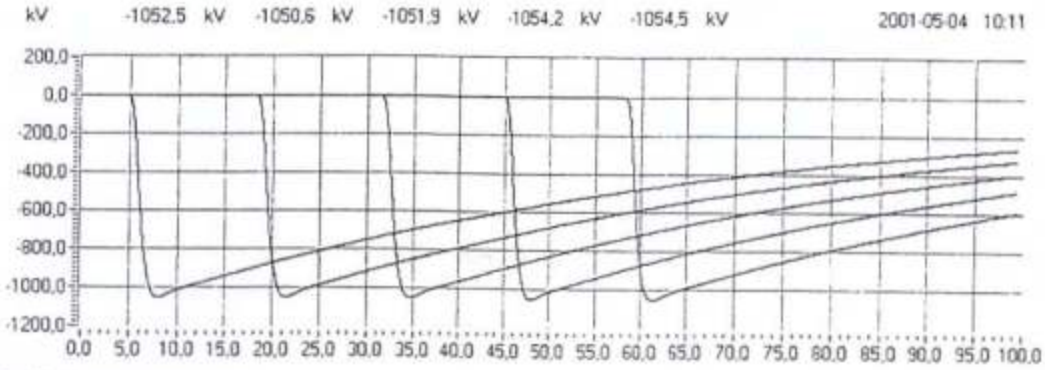
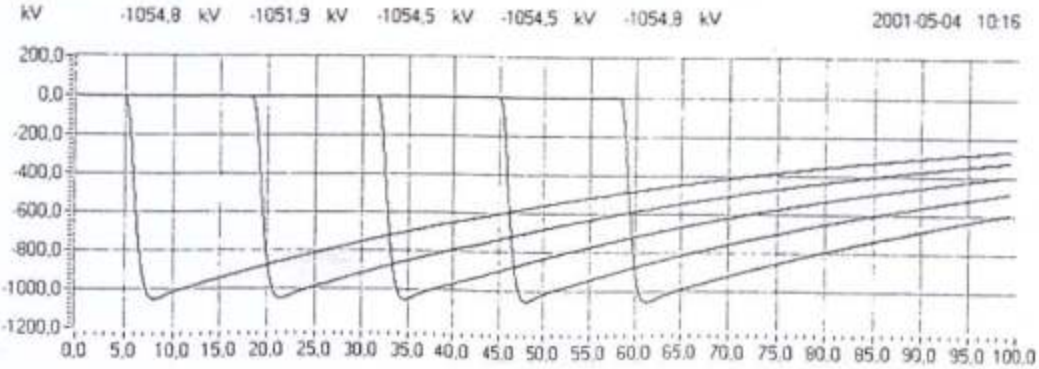


Fig. 7: 100% of test voltage



Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.4.11
Test dates	25 April 2001

1.7 RESULTS OF THE MEASUREMENT OF THE RESISTIVITY OF SEMI-CONDUCTING LAYERS

item	unit	requirement	measured/determined	result
conductor screen				
- without ageing	Ωm	≤ 1000	1,5	passed
- after ageing	Ωm	≤ 1000	4,4	passed
core screen				
- without ageing	Ωm	≤ 500	34,5	passed
- after ageing	Ωm	≤ 500	35,9	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.5.1
Test date	25 April 2001

2.1 RESULTS OF THE CHECK OF CABLE CONSTRUCTION

item	unit	requirement	measured/determined	result
conductor (IEC 60228, Class 2)				
- resistance at 20 °C	Ω/km	≤ 0,0176	0,0174	passed
- no. of wires		≥ 91	5 x 61	passed

item	unit	requirement	measured/determined	result
thickness insulation				
- specified	mm	25,5		
- minimum	mm	≥ 22,95	25,3	passed
- $(t_{max} - t_{min}) / t_{max}$	-	≤ 0,10	0,10	passed
thickness non-metallic sheath				
- specified	mm	4,0		
- average	mm	≥ 4,0	4,3	passed
- minimum	mm	≥ 3,3	3,7	passed

item	unit	requirement	measured/determined	result
thickness lead alloy sheath				
- specified	mm	3,0		
- minimum	mm	≥ 2,75	2,75	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm²
Requirements	IEC 62067 (2000), clause 12.5.2
Test date	25 April 2001

2.2 RESULTS OF THE TESTS FOR DETERMINING THE MECHANICAL PROPERTIES OF INSULATION

item	unit	requirement	measured/determined	result
without ageing				
- tensile strength	N/mm²	≥ 12,5	29,9	passed
- elongation	%	≥ 200	564	passed
after ageing				
- tensile strength	N/mm²	NA	30,2	
variation with samples without ageing	%	± 25 max	+1	passed
- elongation	%	NA	627	
variation with samples without ageing	%	± 25 max	+11	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.5.3
Test date	25 April 2001

2.3 RESULTS OF THE TESTS FOR DETERMINING THE MECHANICAL PROPERTIES OF NON-METALLIC SHEATHS

item	unit	requirement	measured/determined	result
without ageing				
- tensile strength	N/mm²	≥ 10,0	24,0	passed
- elongation	%	≥ 300	873	passed
after ageing				
- tensile strength	N/mm²	NA	20,5	
variation with samples without ageing	%	-	-	
- elongation	%	≥ 300	717	passed
variation with samples without ageing	%	-	-	

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm²
Requirements	IEC 62067 (2000), clause 12.5.4
Test date	25 April 2001

2.4 RESULTS OF THE AGEING TESTS ON PIECES OF COMPLETE CABLE TO CHECK COMPATIBILITY OF MATERIALS

item	unit	requirement	measured/determined	result
Insulation				
- tensile strength	N/mm²	NA	26,4	
variation with samples without ageing	%	± 25 max	- 12	passed
- elongation	%	-	-	
variation with samples without ageing	%	± 25 max	+ 2	passed
Sheath				
- tensile strength	N/mm²	NA	21,2	
variation with samples without ageing	%	-	-	
- elongation	%	≥ 300	847	passed
variation with samples without ageing	%	-	-	

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.5.10
Test date	25 April 2001

2.5 RESULTS OF THE HOT SET TEST FOR XLPE INSULATION

item	unit	requirement	measured	result
- elongation under load	%	≤ 175	55	passed
- permanent elongation	%	≤ 15	5	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.5.12
Test date	25 April 2001

2.6 RESULTS OF THE MEASUREMENT OF THE CARBON BLACK CONTENT OF PE SHEATH

item	unit	requirement	measured	result
- carbon black content	%	2,5 ± 0,5	2,2	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000), clause 12.5.14
Test dates	30 May until 10 June 2001

2.7 RESULTS OF THE WATER PENETRATION TEST

Atmospheric conditions

Ambient temperature (min/max)	19/22 °C
Temperature of test object	amb/96 °C

no. of heating-cycles	required conductor temperature (°C)	applied heating current (A)	heating		cooling	result
			total heating time (h)	duration of conductor at 95-100 °C (h)	cooling time (h)	
10	95-100	2340	8	2	16	passed

Client	El Sewedy Group
Test object	230 kV/Cu/XLPE/lead sheath/LLDPE 1 x 1000 mm^2
Requirements	IEC 62067 (2000)

3 VERIFICATION OF CABLE CONSTRUCTION

See also manufacturer's data sheets in appendix A.

	determinations	remarks
marking of the cable	Egytech Cables ELSEWEDY 1x1000mm^2 230 kV CU/XLPE/LEAD/HDPE 2000	The outer sheath was made of LLDPE instead of HDPE as indicated in the marking
colour of the core	black	
colour of the outer sheath	black	
construction	- 5 segments of 61 copper wires each - semi conducting tape - semi conducting conductor screen - XLPE insulation - semi conducting insulation screen - semi conducting swelling tape - lead sheath - LLDPE ST3 oversheath	
outer diameter of the cable (mm)	121,4 average	
outer diameter of the core (mm)	103,6 average	

- The marking and construction of the outer sheath do not comply with each other. The marking is HDPE, the outer sheath was made of LLDPE (ST3).

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

measurement	measurement uncertainty
dielectric tests and impulse current tests	peak value: ≤ 3% time parameters: ≤ 10%
capacitance measurement tan δ measurement	0,3% ± 0,5% ± 5×10^{-5}
partial discharge measurement	< 10 pC : 2 pC 10 - 100 pC : 5 pC > 100 pC : 20 %
measurement of impedance ac-resistance measurement	≤ 1%
measurement of losses	≤ 1%
measurement of insulation resistance	≤ 10%
measurement of dc resistance	1 μΩ - 5 μΩ : 1% 5 μΩ - 10 μΩ : 0,5% 10 μΩ - 200 μΩ : 0,2%
radio interference test	2 dB
calibration of current transformers	2,2 x 10^{-4} Ii/Iu and 290 μrad
calibration of voltage transformers	1,6 x 10^{-4} Ui/Uu en 510 μrad
measurement of conductivity	5%
measurement of temperature	-50 °C - -40 °C : 3 K -40 °C - 125 °C : 2 K 125 °C - 150 °C : 3 K
tensile test	1%
sound level measurement	type 1 meter as per IEC 651 and ANSI S1.4.1971
measurement of voltage ratio	0,1%

Data sheets of cable construction

of

Egytech Cables Co El Sewedy

(3 pages)

130/230 kV Cable
Cable Construction
Sample No. 1

1. Conductor

Material		Plain, Annealed Copper
Size	mm^2	1000
No. of Segments		5
No. of wires for each segment		61
Conductor Diameter	mm	40
Conductor Type		Segmental Milliken Conductor Including non-conducting water blocking tapes inside each segment and separate each segment from each other.

2. SC Tapes

Material		First tape Water blocking Semi-Conducting tape
Material		Second tape Semi-conducting tape
Diameter	mm	41

3. Conductor Screen

Material		Extruded Extra Clean super smooth semi-conducting
Thickness	mm	1.5 (nominal)
	mm	1.3 (minimum)
Diameter	mm	45 (Approx.)

4. Insulation

Material		Super Clean XLPE
Thickness	mm	25.5 (nominal)
	mm	22.95 (minimum)
Diameter	mm	96 (Approx.)

5. Insulation Screen

Material		Extruded Extra Clean super smooth semi-conducting
Thickness	mm	1.5 (nominal)
	mm	1.3 (minimum)
Diameter	mm	99 (Approx.)

6. SC Swelling Tape

130/230 kV Cable
Cable Construction
Sample No. 1

Material		Water Blocking Semi-Conducting tape
Diameter	mm	103 (Approx.)

7. Lead Alloy

Material		Alloy
Thickness	mm	3.0 (nominal)
Type		E
Diameter	mm	109 (Approx.)

8. Sheath

Material		LLDPE
Thickness	mm	4.0 (nominal)
	mm	3.3 (minimum)

9. Graphite Coating

Material		Graphite coating.
Outer Diameter	mm	118 (Approx.)