

Test confirmation on the given range
of performed electrical tests on

**HEAT SHRINKABLE TERMINATION AND JOINT ACCESSORIES FOR
THREE-CORE POWER CABLES**

ELCOTERM TIS 1282

Series: ELCOTERM TES 1284

ELCOTERM GLS 1275

Applicant:

ELCON MEGARAD SpA

Via Nazionale 110, Zona Industriale

83030 Arcella (AV) - ITALY

Inspection Body: TÜV Thüringen - Industrial Services

Inspection date: 18-11-2016	Previous inspection date: 03 up to 05.10.2016
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Inspector: Dipl.-Ing. Justo Moreno

Assessment location/ inspection location:

High Voltage Laboratory – ELCON MEGARAD Headquarter

The test results are exclusively related to the test samples. This report must not be copied in an abridged version without the written permission of the test institute.



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1. REFERENCES – CODES AND STANDARDS

- [1] CENELEC HD 629.1 S2:2006 + A1:2008
Test requirements on accessories for use on power cables of rated voltage from 3,6/6 (7,2) kV up to 20,8/36 (42) kV. Part 1: Cables with extruded insulation
- [2] Standard CEI EN 61442:2005
Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 36 kV (Um = 42 kV)

2. REVIEW RELATED DOCUMENTS

[A]	ELCON MEGARAD Test Report No.:	472_16
[B]	Drawings	
	ELCOTERM TIS 1282	844
	ELCOTERM TES 1284	846
	ELCOTERM GLS 1275	834

3. PURCHASE REFERENCE

4. MANUFACTURER

ELCON MEGARAD S.p.A.
Via Nazionale 110, Zona Industriale
83030 Arcella (AV) – ITALY

5. ASSESSMENT PURPOSE	REFERENCE TO THE STANDARD REQUIREMENTS
<input checked="" type="checkbox"/> Pre-inspection meeting in order to plan the arrangement of type test reports as required in tender specification	Identification and stamping of test samples acc. to tender specification. Start of cycling tests acc. to Clauses of the standard EN 61442
<input checked="" type="checkbox"/> Visual examination, checks	Compliance will be obtained by testing acc. to test sequence in Table 3
<input checked="" type="checkbox"/> Witnessing tests	Tests performed in the sequence given in Table 3: Clauses: 4, 6, 7 and 9 (in air)
<input type="checkbox"/> Manufacturing progress status	Not applicable due to this is a pre-shipment qualification
<input checked="" type="checkbox"/> Final inspection. Examination	Review and approval of load cycling test results (Clause 5). Clause 13
<input checked="" type="checkbox"/> Components check, Marking and labelling	Compliance of components and installation instructions. Clause 13

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6. DESCRIPTION AND INSPECTION NOTE

6.1 – INSPECTION PURPOSE

Inspection purpose is to validate and approve the arrangement and carrying out of type tests on accessories for 3-core 6,35/11kV XLPE armored insulated power cables as specified in the standard CENELEC HD 629.1 S2 and in the standard EN 61442.

The HV Laboratory of ELCON MEGARAD commissioned us to assist and to witness the performing of each test contained in Table 3 of the standard and provide the attestation that the requirements were met.

The test station structure used for the tests is the High Voltage Laboratory of ELCON MEGARAD at Arcella – Headquarter, which are equipped with state of art instruments to perform the required tests and operates under the dispositions of the Manual related to the certified Quality Assurance System implement by the Group.

Instruments and test appliances used are subjected to control and calibration procedures as established in the Manual. (See also point 6.5).

6.2 – GENERAL PROGRESS OF THE SUPPLY

Not applicable due to the fact that this is a qualification.

6.3 – EMPLOYED DOCUMENTS

- Elcon Megarad Test Report No. 472_16
- Elcon Megarad Instructions for assembling with description of examination objects, as detailed on Section 2.

6.4 – INSPECTION TASKS, TEST AND RESULTS

In order to produce written reports on type tests proving compliance with the above mentioned specifications for joints, indoor and outdoor terminations had been performed following assessment sequence:

- 04 up to 05 April 2016 – Kick-off Meeting with identification and stamping of test samples. Assembling of samples in the manner specified in the manufacturer's instructions.
Five loops: 11 kV-1, 2, 3; 11 kV-4 and 11 kV-5.
- From 01 August up to 03 August 2016 – Carrying out of impulse test, D.C. / A.C. voltage dry withstand; partial discharge at ambient temperature and impulse voltage at elevated temperature.
- From 04 August up to 05 August 2016 – Heating cycling tests on the samples being subjected to the above listed main tests. The arrangements for these tests are shown in the test sequence table of test report 472_16.
- From 02 to up 26 September 2016 – Heating cycling tests in water only for joints. Immersion test only for outdoor terminations.
- From 03 up to 05 October 2016 – AC partial discharge test and impulse voltage test at ambient temperature. Partial discharge test at elevated temperature. Heat cycling test in water on indoor terminations closed.
- From 07 to up 08 November 2016 – Thermal short circuit tests (screen and conductor) by SVEPPI-SIEMENS Laboratory.
- From 17 to up 18 November 2016 – Salt fog test closed. Impulse voltage at ambient temperature and A.C. voltage dry withstand tests on short circuit tested sample. Test results final examination.

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Visual examination on the tested samples to ascertain whether any damage (cracking of filling media, moisture paths, corrosion effects, leakages) has taken place. Documentation review.

TEST RESULTS

The sampling at 04-04-2016 has been carried out according with the Elcon Megarad internal procedure. The dimensions of the tested samples were found in compliance with those indicated in the installation instructions supplied by the manufacturer (Section 6.3 of this report)

For the general test sequence were installed five samples

- Joint ELCOTERM GLS-1275; terminations ELCOTERM TIS-1282 and TES-1284:
3 test loops acc. to schemas 11 kV-1, 11 kV-2, 11 kV-3
- Termination ELCOTERM TIS-1282 and termination ELCOTERM TES-1284:
2 test loops acc. to schemas 11 kV-4, 11 kV-5

On page 3 of the test report 472_16 is further described the into the loops assembled cable type: XLPE 6,35/11 kV in Cu, with cross-section 3 x 300mm²

Standard Clause – Test				Test result							
5 DC voltage dry withstand 15 min. at 38 kV				W	No breakdowns occurred on the three test loops						
4 AC voltage dry withstand 5 min. at 28,5 kV				W	No breakdowns occurred on the three test loops						
4 AC voltage wet withstand (outdoor terminations) 1 min. at 25,5 kV				W	No breakdowns occurred on the two test loops						
7 Partial discharge at 23°C, 13kV 11kV-1 11kV-2				W	Loop 11kV-1			Loop 11kV-2			
Phase 1 Phase 2 Phase 3					2 pC	2 pC	2 pC	2 pC	2 pC	2 pC	
					Measurement device calibrated to 10 pC. Measured rates, for each loop and each phase, always less than the max. required						
14 Impact test on the joint at 23°C. Three impacts on area of connector: first in the middle and once in the both sealing areas				W	Insulation resistance measurement between conductor and metallic screen. Insulation resistance in air before impact >51 GΩ. After impacts measurement on joint immersed in H ₂ O Phase 1 >51 GΩ Phase 2 >51 GΩ Phase 3 >51 GΩ						
6 Impulse voltage withstand at 95°C 10 impulses of each polarity at 95 kV				W	No flashovers or breakdowns occurred on the two test loops 11 kV-1 and 11 kV-2						
6 Impulse voltage at ambient temperature 10 impulses of each polarity at 95 kV				W	No flashovers or breakdowns occurred on the two test loops 11 kV-1 and 11 kV-2						
9 Heating cycle test in water – only for joint 63 cycles at 16 kV				R	No breakdowns occurred on the two test loops						
9 Heating cycle test in air 63 cycles for the joint 126 cycles for terminations at 16 kV				R	No breakdowns occurred on the two test loops						
9.4 Immersion test for outdoor terminations 10 8h-cycles: 5h heating ON at 108A; 3h heating OFF with natural cooling at 23°C.				R	During the cooling period, the conductor keeps a value of temperature 5-10K above the ambient temperature 23°C.						
7 Partial discharge at 95°C (T _{conductor}) Two loops → 11 kV Two loops → 13 kV				W	Loops 1 and 2 at 1,73U ₀			Loops 1 and 2 at 2U ₀			
Phase 1 Phase 2 Phase 3					2 pC	2 pC	2 pC	2 pC	2 pC	2 pC	
					Measurement device calibrated to 10 pC. Measured rates, for each loop and each phase, always less than the max. required						
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Standard Clause – Test			Test result							
7 Partial discharge at ambient temperature			W	Loops 11 kV-1			Loop 11 kV-2			
Two loops → 1,73U ₀		Two loops → 2U ₀		2 pC	2 pC	2 pC	2 pC	2 pC	2 pC	
Phase 1	Phase 2	Phase 3		Measurement device calibrated to 10 pC. Measured rates, for each loop and each phase, always less than the max. required						
10 Thermal short circuit test at 25kA 2 short-circuits of 1s duration, applied to the screen. Performed by SVEPPI			R	No visible damage on the test loop 11 kV-3						
11 Thermal short circuit test at 36kA two short-circuits of 2,44s duration, applied to the conductor. Performed by SVEPPI-SIEMENS			R	No visible damage on the test loop 11 kV-3						
6 Impulse voltage withstand at 23°C 10 pulses of each polarity at 95 kV			W	No flashovers or breakdowns occurred on the test loop 11 kV-3						
4 AC voltage dry withstand 15 min. at 16 kV			W	No breakdowns occurred on the test loop 11 kV-3						
4 AC voltage dry withstand 15 min. at 16 kV			W	No breakdowns occurred on the two test loops 11 kV-1 and 11 kV-2						
13 Humidity test for indoor terminations 300h at 8 kV			W	<ul style="list-style-type: none">• No flashovers or breakdowns occurred.• No damages that might compromise the functionality of the terminations was observed.• No evidence of dielectric property loss due tracking was detected.• No other anomalies (splitting or puncture of the material) were observed on the test loop 11 kV-4						
13 Salt fog test for outdoor terminations 1000h at 8,073 kV; water conductivity 1560mS/m, water pressure 5bar. Test box volume: 25,2 m ³			W	<ul style="list-style-type: none">• No flashovers or breakdowns occurred.• No damages that might compromise the functionality of the termination under test was observed.• No evidence of dielectric property loss due tracking was detected.• Light erosion effects on the no-tracking tube (less than 2mm) was detected.• No other anomalies (splitting or puncture of the material) were observed on the test loop 11 kV-5						

R = Review / W = Witness

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Standard Clause – Test		Test result
Examination	W	Test loops: 11 kV-1 and 11 kV-2 11 kV-4 Joint and terminations passed the test. No cracking in the filling media and/or tape or tube components. No moisture path bridging a primary seal. No corrosion and/or tracking and/or erosion. No leakage of any insulation material.
Examination	W	Test loops: 11 kV-3 and 11 kV-5 Joint and terminations passed the test. No cracking in the filling media and/or tape or tube components. No moisture path bridging a primary seal. Light erosion effects on the no-tracking tube (less than 2mm) on test loop DEWA 11 kV-5 was detected. No leakage of any insulation material.

R = Review / W = Witness

6.5 – EMPLOYED TEST INSTRUMENTS AND CALIBRATION

Measuring instruments used					
INSTRUMENT	MATR.	CALIBRATION DATE	next calibration date	FREQUENCY	SUPPLIER CODE
Monitor control Unit	AT 238	30 March 2015	30/03/2020	5 years	Reg.No.:2335
Monitor Impulse generator	AT 230	30 March 2015	30/03/2020		Reg.No.:2335
Partial discharge Measuring System MPD500	AT 218	23 Sept. 2013	23/09/2019		DL097B
DC Phenix dielectric test set	AT 240	01 sept. 2014	09/2019		14-8928
DC Phenix power supply unit	AT 241	01 sept. 2014	09/2019		14-8918
Ohmmeter AVO Scale 51 GΩ	AT 141				MEGGER BM.11D
Power supply n°3 for dielectric test	AT 213	01 Sept. 2014	01/03/2020		2333
AC power supply n°4 for impulse generator test	AT 225				2336/1

Completed list of instruments is attached on APPENDIX 1 (page 14) of Test Report 472_16



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6.6 – ATTACHMENTS

1. Laboratory Test Report No.: 472_16
2. Instructions for assembling No. 844, 846 and 834

7. CONCLUSIONS AND REQUIRED ACTIONS

Having assessed the reported results related the cable accessories

- ELCOTERM TIS 1282
- ELCOTERM TES 1284
- ELCOTERM GLS 1275

we declare that these are compliant with the standard requirements and demonstrate satisfactory performance characteristics to meet the customer specifications.

Location: Milan

Date: 2016-11-21



[Signature]
Dipl.-Ing. Justo Moreno
TÜV THÜRINGEN INSPECTOR

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TYPE TEST REPORT


N° 472_16


The test results can be applied only to the tested objects.


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Prepared by: Eng. Generoso De Simone



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Report n°	472_16	Date:	18/11/2016
Customer	ELCON MEGARAD S.p.A.		
Place	ELCON MEGARAD S.r.l. - H.V. Laboratory – Arcella (AV) ITALY		
Testing date	01/08/2016 to 18/11/2016		
	Type	Drawing	
OBJECTS	ELCOTERM TIS-1282	844	
	ELCOTERM TES-1284	846	
	ELCOTERM GLS-1275	834	
DESCRIPTION	HEAT SHRINKABLE TERMINATIONS & JOINT ACCESSORIES FOR 3-CORE 11kV CABLE		
VOLTAGE	U ₀ /U 6.35/11 U _{max} 12 kV		
CABLE	3-core 6.35/11 kV XLPE Armoured Insulated Cable.		
SECTION	3 x 300mm ² Cu		
REFERENCE STANDARD	CENELEC HD 629.1 S2. 2006 –		
TEST METHODS	EN 61442		
RESULTS	The tested objects comply with the reference Standard.		
ELCON MEGARAD H.V. Lab. Manager:	Eng. G. De Simone		
Test Operators:	Mr. F. Lombardo Mr. C Del Vecchio		
TUV Inspector:	Eng. J. Moreno		
This report consist of	14 pages		
Attachments	---		

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COMPONENTS CONTROL ACCESSORIES ASSEMBLING CONTROL

- THE COMPONENTS CONTAINED IN THE PACKAGING, AND MENTIONED IN THE BILL OF MATERIAL OF THE DRAWING HAVE BEEN IDENTIFIED AND IN GOOD STATE
- Nº 5 CABLE LINES HAS BEEN ASSEMBLED BY ELCON-MEGARAD OPERATOR ACCORDING TO THE INSTALLATION INSTRUCTION AS FOLLOWING

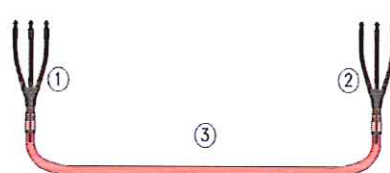
COMPOSITION OF THE CABLE LINES

Date:
4 to 5/04/2016;

Loop	Cable ③	Section	Termination ①	Joint ④	Termination ②
11 kV-1	XLPE 6.35/11 kV	3x300 mm ² Cu	ELCOTERM TIS- 1282	ELCOTERM GLS- 1275	ELCOTERM TES- 1284
11 kV-2	XLPE 6.35/11 kV	3x300 mm ² Cu	ELCOTERM TIS- 1282	ELCOTERM GLS- 1275	ELCOTERM TES- 1284
11 kV-3	XLPE 6.35/11 kV	3x300 mm ² Cu	ELCOTERM TIS- 1282	ELCOTERM GLS- 1275	ELCOTERM TES- 1284
11 kV-4	XLPE 6.35/11 kV	3x300 mm ² Cu	ELCOTERM TIS- 1282	//	ELCOTERM TIS- 1282
11 kV-5	XLPE 6.35/11 kV	3x300 mm ² Cu	ELCOTERM TES- 1284	//	ELCOTERM TES- 1284



11 kV-1, 2, 3



11 kV-4



11 kV-5

indicative scheme of the 3-core cable loops

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TEST SEQUENCE A1, A2, A3 (Table 3 & 4); IB1, IIB1, I-IIB2 (Table 5)
CENELEC HD 629.1 S2:2006 + A1:2008 - CENELEC EN 61442: 2005 - 04

No.	TEST	Test object	Loops	Test requirement
1	DC Voltage dry	All	1, 2, 3	15 min. at 38 kV
2	AC voltage Dry	All	1, 2, 3	5 min. at 28,5 kV
3	AC Voltage wet	Only outdoor Termination	1, 2	1 min at 25,5 kV
4	Partial Discharge at ambient temperature	All	1, 2	Max 10 pC at 11 kV
5	Impact at ambient temperature	Only Joint	1, 2	Insulation resistance 1GΩ min.
6	Impulse at elevated temperature	All	1, 2	10 impulse each polarity at 95 kV
7	Heating cycle voltage in air	Indoor and outdoor Terminations	1, 2	126 cycle at 16 kV
8	Heating cycle voltage in air	Only Joint	1, 2	63 cycle at 16 kV
9	Heating cycle voltage in water	Only Joint	1, 2	63 cycle at 16 kV
10	Immersion	Only outdoor termination	1, 2	10 cycles
11	Partial Discharge at elevated and ambient temperature	All	1, 2	Max 10 pC at 11 kV
12	Thermal short circuit (screen)	All	3	25 kA per 1 sec
13	Thermal short circuit (conductor)	All	3	According IEC 61442
14	Impulse voltage at ambient temperature	All	1, 2, 3	10 impulse each polarity at 95 kV
15	AC voltage dry	All	1, 2, 3	15 min. at 16 kV
16	Humidity	Only indoor termination	4	300 h at 8 kV
17	Salt fog	Only outdoor termination	5	1000h at 8 kV
18	Examination	All	1, 2, 3, 4, 5	

Results: the items under test successfully passed all the tests

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TEST SEQUENCE

CENELEC HD 629.1 S2 2006
CENELEC EN 61442: 2005 - 04

TEST 01	D.C. voltage dry withstand 15 minutes at $6U_0$ (clause 5 of EN 61442)			
OK	LOOP:	11kV-1	11kV-2	11kV-3
	Applied Voltage:	38 kV		
	Testing time:	15 min		
	RESULT:	No flashovers or breakdowns		
	Note: The test has been performed, on all phases together, of the cable loops at ambient temperature (26°C).		Date: 01/08/2016	

TEST 02	A.C. voltage dry withstand 5 minutes at $4,5U_0$ (clause 4 of EN 61442)			
OK	LOOP:	11kV-1	11kV-2	11kV-3
	Applied Voltage:	28,5 kV		
	Testing time:	5 min		
	RESULT:	No flashovers or breakdowns		
	Note: The test has been performed, on all phases together, of the cable loops at ambient temperature (26°C).		Date: 01/08/2016	

TEST 03	A.C. voltage wet withstand 1 minute at 4 U ₀ (clause 4 of EN 61442)		
OK	LOOP:	11kV-1	11kV-2
	Applied Voltage:	25,5 kV	
	Testing time:	1 min	
	Rain Parameters	Precipitation condition Vertical: 2 mm/min Horizontal: 2 mm/min	Resistivity of the water : 100 Ω m Temperature of the water: 23°C
	RESULT:	No flashovers or breakdowns	
	Note: The test has been performed, on all phases together, of the cable loops at ambient temperature (26°C).		Date: 01/08/2016

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TEST 04	Partial discharge at ambient temperature Max 10pC at 1,73U ₀ (clause 7 of EN 61442)						
OK	LOOP:	11kV-1			11kV-2		
	Voltage Applied [kV]	11			11		
	Phase	1	2	3	1	2	3
	Partial discharge level [pC]	2	2	2	2	2	2
	Voltage Applied [kV]	13 *			13*		
	Phase	1	2	3	1	2	3
	Partial discharge level [pC]	2	2	2	2	2	2
	RESULT:	Partial discharge measurement, referring to 2 steps above mentioned is always less than the maximum required.					
	Note: The PD measurement has been performed, on each phase, of the cable loops at ambient temperature (23°C) . The PD measurement device has been calibrated, to 10pC at the starting of the test. * = measurement at 2U ₀ .				Date: 01 and 03/08/2016		

TEST 05	Impact at ambient temperature (clause 14 of EN 61442) and insulation resistance measurement between conductor and metallic screen						
OK	LOOP:	11kV-1			11kV-2		
	Phase	1	2	3	1	2	3
	Measurement of Insulation resistance in air	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ
	IMPACT	The Test has been performed applying, with a 4kg mass from an height of 1 m, n° 3 impacts on the joints, the first in the middle of connector area, the second in the right sealing and the third in the left sealing.					
	IMMERSION	After the impact test the joints were immersed in water at ambient temperature with a height of water of 1,00 m over the top surface of the joint for 3 hours					
	Phase	1	2	3	1	2	3
	Measurement of Insulation resistance in water	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ	>51 GΩ
	RESULT:	The joints passed the test					
	Note:				Date: 01 and 02/08/2016		

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TEST 06		Impulse voltage at elevated temperature 10 impulses for each polarity (clause 6 of EN 61442)																				
OK	Applied voltage		95 kV																			
			Positive Polarity – 10 shots										Negative Polarity – 10 shots									
	LOOP: 11 kV-1	Phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	LOOP: 11 kV-2	Phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	RESULT:		No flashovers or breakdowns										No flashovers or breakdowns									
	Note:		- Tamb = 26°C, Tconductor = 95°C ; P = 890mbar, Relative Humidity = 67% - The test has been performed, on each phase of the cable loops															Date: 03/08/2016				

TEST 07, 08		Electrical heat cycling in air 126 cycles at 2,5U ₀ (clause 9 of EN 61442)	
OK	LOOP:	11 kV-1	11 kV-2
	Applied Voltage:	16 kV	
	Number of cycles:	126 for the terminations and 63 for the joint	
	Temperature calibration:	According to the method 3 of the annex A of the IEC 61442, a control cable was used for the temperature calibration, when 95°C were measured on the conductor 70°C were measured on the over sheath	
	RESULT:	No flashovers or breakdowns	
	Note: Each heating cycle is of 8 hours duration with 5 hours of heating with injection of the loading current and 3 hours of natural cooling to within 10 K of ambient temperature. During the heating time, the cable conductor temperature is maintained at 5-10K above the maximum cable conductor temperature with 2 hours as steady temperature.		Date for terminations: 05/08/2016 to 26/09/2016
			Date for Joints 05/08/2016 to 02/09/2016

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TEST 09	Electrical heat cycling in water 63 cycles at 2,5U ₀ (clause 9 of EN 61442)		
OK	LOOP:	11 kV-1- Joint only	11 kV-2- Joint only
	Applied Voltage:	16 kV	
	Number of cycles:	63	
	Temperature calibration:	According to the method 3 of the annex A of the IEC 61442, a control cable was used for the temperature calibration, when 95°C were measured on the conductor 70°C were measured on the over sheath	
	RESULT:	No flashovers or breakdowns	
	Note: Each heating cycle is of 8 hours duration with 5 hours of heating with injection of the loading current and 3 hours of natural cooling to within 10 K of ambient temperature. During the heating time, the cable conductor temperature is maintained at 5-10K above the maximum cable conductor temperature with 2 hours as steady temperature.		Date: 02/09/2016 to 26/09/2016

TEST 10	Immersion 10 cycles (clause 9.4 of EN 61442)		
OK	LOOP:	11 kV-1- Outdoor termination only	11 kV-2- Outdoor termination only
	Number of cycles:	10	
	RESULT:	No visible damage	
	Note: Each heating cycle is of 8 hours duration with 5 hours of heating with injection of the loading current and 3 hours of natural cooling to within 10 K of ambient temperature. During the heating time, the cable conductor temperature is maintained at 5-10K above the maximum cable conductor temperature with 2 hours as steady temperature..		Date: 26/09/2016 to 30/09/2016

TEST 11a		Partial discharge at elevated temperature Max 10pC at 1,73U ₀ (clause 7 of EN 61442)											
OK	LINE:	11 kV-1						11 kV-2					
	Voltage Applied [kV]	11			13*			11			13*		
	Phase	1	2	3	1	2	3	1	2	3	1	2	3
	Partial discharge level [pC]	2	2	2	2	2	2	2	2	2	2	2	2
	RESULT:	Partial discharge measurement, referring to 2 steps above mentioned is always less than the maximum required.											
	Note: The PD measurement has been performed, on each phase, of the cable loops at elevated temperature (T _{conductor} = 95°C) . The PD measurement device, has been calibrated, to 10pC at the starting of the test. * = measurement at 2U ₀ .									Date: 03/10/2016			

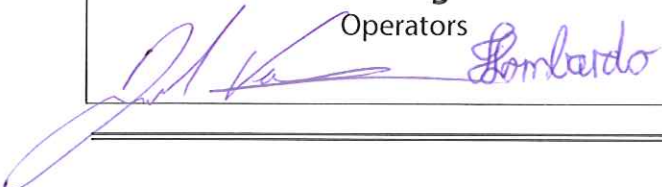

Elcon Megarad Operators <i>[Signature]</i>	Elcon Megarad H.V. Lab. Responsible <i>[Signature]</i>
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TEST 11b	Partial discharge at ambient temperature Max 10pC at 1,73U ₀ (clause 7 of EN 61442)												
OK	LOOP:	11 kV-1						11 kV-2					
	Voltage Applied [kV]	11			13*			11			13*		
	Phase	1	2	3	1	2	3	1	2	3	1	2	3
	Partial discharge level [pC]	2	2	2	2	2	2	2	2	2	2	2	2
	RESULT:	Partial discharge measurement, referring to 2 steps above mentioned is always less than the maximum required.											
	Note: The PD measurement has been performed, on each phase, of the cable loops at ambient temperature (23°C) . The PD measurement device has been calibrated, to 10pC at the starting of the test. * = measurement at 2U ₀							Date: 03/10/2016					

TEST 12	Thermal short circuit (Screen and Armour) (clause10 of EN 61442)	
OK	LOOP:	11 kV-3
	Test Current (kA):	25
	Duration (s)	1
	Number of short circuit:	2
	Heating Temperature:	The calibration temperature determined during the thermal cycles test (test N° 7) was used as reference for the heating of the cable conductor
	RESULT:	No visible damage
	Note: The test was performed in SVEPPI - SIEMENS Laboratory, details of the test are in report SVEPPI 16/193 of the 09/11/2016	
Date: 07/11/2016 to 08/11/2016		

TEST 13	Thermal short circuit (Conductor) (clause 11 of EN 61442)	
OK	LOOP:	11 kV-3
	Test Current (kA):	36 (Calculated with initial temperature of 10°C and short circuit temperature of cable 250°C)
	Duration (s)	2.44 s
	Number of short circuit:	2
	RESULT:	No visible damage
	Note: The test was performed in SVEPPI - SIEMENS Laboratory, details of the test are in report SVEPPI 16/193 of the 09/11/2016	
Date: 07/11/2016 to 08/11/2016		

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TEST 14a		Impulse voltage at ambient temperature 10 impulses for each polarity (clause 6 of EN 61442)																				
OK	Applied voltage		95 kV																			
			Positive Polarity – 10 shots										Negative Polarity – 10 shots									
	LOOP 11 kV-1	Phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	LOOP 11 kV-2	Phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Phase 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	RESULT:		No flashovers or breakdowns										No flashovers or breakdowns									
	Note:		<div>- Tamb= 22°C, P = 925mbar, Relative Humidity = 74%</div> <div>- The test has been performed, on each phase of the cable loops</div>																		Date: 03/10/2016	

TEST 14b		Impulse voltage at ambient temperature 10 impulses for each polarity (clause 6 of EN 61442)																				
OK	Applied voltage		95 kV																			
			Positive Polarity – 10 shots										Negative Polarity – 10 shots									
	11 kV-3	Phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
		Phase 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
		Phase 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	RESULT:		No flashovers or breakdowns										No flashovers or breakdowns									
Note: - Tamb= 19°C, P = 1038mbar, Relative Humidity = 67% - The test has been performed, on each phase of the cable loop												Date: 17/11/2016										

TEST 15a		A.C. voltage dry withstand 15 minutes at 2,5U ₀ (clause 4 of EN 61442)	
OK	LOOP:	11kV-1	11kV-2
	Applied Voltage:	16 kV	
	Testing time:	15 min	
	RESULT:	No flashovers or breakdowns	
	Note: The test has been performed, on all phases together, of the cable loops ambient temperature (22°C).		Date: 03/10/2016

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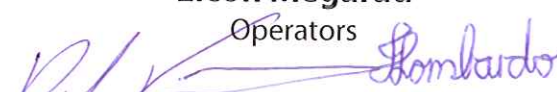

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TEST 15b		A.C. voltage dry withstand 15 minutes at 2,5U ₀ (clause 4 of EN 61442)	
OK	LOOP:	11kV-3	
	Applied Voltage:	16 kV	
	Testing time:	15 min	
	RESULT:	No flashovers or breakdowns	
	Note: The test has been performed, on all phases together, of the cable loop ambient temperature (19°C).		Date: 17/11/2016

TEST 16		Humidity test 300h at 1,25U ₀ (clause 13 of EN 61442)			
OK	LOOP:	11kV-4			
	Applied Voltage:	8 kV			
	Testing time:	300 h			
	TEST SPECIFICATION				
	Water pressure:	4,5 bar	Air pressure:	5,1 bar	
	Average diameter water drops atomized	10 µm	Conductivity	70 ±10 mS/m	
	Water flow rate	10,1 ±2,5 l/h	Air flow rate	34 l/m	
	Test Room Volume	25,2 m3			
	RESULT:	<ul style="list-style-type: none">• No breakdowns, no flashovers happened.• No damages that might compromise the functionality of the terminations were observed.• No evidence of dielectric quality loss due to tracking was detected.• No other anomalies (splitting or puncture of the material) were observed.• The sample passes the test			
	Note: -		Date: 21/09/2016 to 04/10/2016		

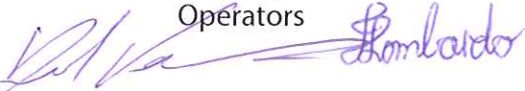

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TEST 17	SALT FOG test 1000h at 1,25U0 (clause 13 of EN 61442)			
OK	LOOP:	11kV-5		
	Applied Voltage:	8 kV		
	Testing time:	1000 h		
	TEST SPECIFICATION			
	Water pressure:	4,5 bar	Air pressure:	5,1 bar
	Average diameter water drops atomized	10 µm	Conductivity	1600 ±200 mS/m
	Water flow rate	10,1 ±2,5 l/h	Air flow rate	34 l/m
	Test Room Volume	25,2 m³		
	RESULT:	<ul style="list-style-type: none">• No breakdowns, no flashovers happened.• No damages that might compromise the functionality of the terminations were observed.• No evidence of dielectric quality loss due to tracking was detected.• No other anomalies (splitting or puncture of the material) were observed.• The sample passes the test		
	Note: - -		Date: 05/10/2016 to 17/11/2016	





TEST 18a	Examination		
OK	LOOP:	11kV-1, 11kV-2 & 11kV-4	
	RESULT	Terminations ELCOTERM TIS-1282 & ELCOTERM TES-1284 Joints: ELCOTERM GLS-1275	
		No cracking in the filling media and/or tape or tube components	
		No moisture path bridging a primary seal	
		No corrosion and/or tracking and/or erosion	
		No leakage of any insulating material	
	Note: ---		Date: 05/08/2016


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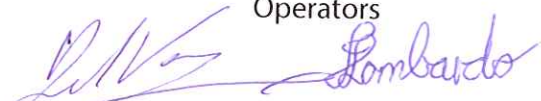

TEST 18b	Examination	
OK	LOOP:	11kV-3& 11kV-5
	RESULT	Terminations ELCOTERM TIS-1282 & ELCOTERM TES-1284 Joints: ELCOTERM GLS-1275
		No cracking in the filling media and/or tape or tube components No moisture path bridging a primary seal No corrosion and/or tracking and/or erosion No leakage of any insulating material
	Note: -	Date: 18/11/2016

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APPENDIX 1 : MEASURING INSTRUMENTS

Device Description	Supplier Code	Frequency	Calibrated on	Next Calibration Date	Elcon ID
Monitor Control Room	n.a.	n.a.	n.a.	n.a.	AT 238
Monitor Impulse Generator	n.a.	n.a.	n.a.	n.a.	AT 230
DC Phenix Dielectric Test Set	Registration number 14-8928	5 years	01/09/2014	09/2019	AT 240
DC Phenix Power Supply Unit	Registration number 14-8928	5 years	01/09/2014	09/2019	AT 241
Power Supply Area n° 3 for Dielectric Test	Registration number 2333	5 years	30/03/2015	03/2020	AT 213
Coupling Impedance: CPL542	Registration number GE459D	5 years	22/09/2014	09/2019	AT 216
Measurement Coupling Unit: MCU 502	Registration Number JE373B	5 years	02/05/2014	05/2019	AT 224
PD Calibrator Unit: CAL542	Registration Number HH462D	5 years	05/09/2014	09/2019	AT 219
Partial Discharge Measuring System: MPD500	Registration Number DL097B	5 years	23/09/2014	09/2019	AT 218
Measurement Power Pack: MPP600	Registration Number FA665U	5 years	23/09/2014	09/2019	AT 221
Portable PC for PD	Registration Number 2761261526	n.a.	n.a.	n.a.	AT 223
Power Supply Area n° 4 for Impulse Generator Test	Registration number 2336/1	5 years	30/03/2015	03/2020	AT 225
Four Stadiums Impulse Generator 400 kV – 10 kJ	Registration Number 2336	5 years	30/03/2015	03/2020	AT 227
Impulse Voltage Test Technique – Dr. Strauss Digital Recorder	Registration Number TR-AS 100-12	2 years	13/11/2014	11/2016	AT 226
Ohmic capacitive divider HAEFELY	Registration Number 99100314.1	2 years	13/11/2014	11/2016	AT 169
Hybrid Recorder YOKOGAWA μ R1000	Registration Number 362RS422A	n.a.	n.a.	n.a.	AT 127
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 184
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 185
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 186
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 187
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 188
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 189
Termocouple "T" Type	n.a.	1 year	28/04/2016	04/2017	AT 197
Fluke Digital Multimeter	355	6 months	07/05/2016	11/2016	AT 176

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