

Modern Pipe-type Cable System

**New High Voltage XLPE Cable
and associated Accessories
including Transition Joints**

Application up to $U_{max} = 170$ kV

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Objective:

- Cable design of modern XLPE pipe-type cables for retrofitting of gas-pressure cable systems in Germany and Europe
- Accessories for XLPE pipe-type cables
- Qualification - type test
- Commercial installations - references
- Concept and qualification of transition joints

Design Pipe-type Cable

- Cable type : 2X(FL)2YFG 3x1x 300 RM/50 64/ 110 kV



Design Pipe-type Cable

- Cable type: **2X(FL)2YFG 3x1x ... RM/ 50**

Construction			64/110 kV			76/132 kV	87/150 kV
conductor size	mm ²		240	300	400	630	630
	Ø conductor	mm	18,6	20,6	23,8	30,6	30,6
conductor screen	mm		0,5	0,5	0,5	0,9	0,9
insulation	mm		10,6	10,6	10,6	11,0	12,6
	Ø insulation	mm	40,8	42,8	46,0	54,4	58,1
insulation screen	mm		0,45	0,45	0,45	0,8	0,8
	Ø core	mm	41,7	43,7	46,9	56,0	59,7
copper wire screen	mm ²		50	50	50	50	50
aluminium foil	mm		0,2	0,2	0,2	0,2	0,2
PE-sheath	mm		2	2	2	2	2
	Ø sheath	mm	49,6	51,6	54,8	63,9	67,7
armouring	mm		6x1,2	6x1,2	6x1,2	6x1,2	6x1,2
	number		46	48	51	59	61
	Ø cable	mm	110,2	114,5	125	140	148
weight	kg/ m		16,2	18,2	21,2	31,8	32,8

Design Pipe-type Cable

- Cable type: **2X(FL)2YFG 3x1x ... RM/ 50**

Electrical data		64/110 kV			76/132 kV	87/150 kV
conductor size	mm ²	240	300	400	630	630
field strength at conductor at U _o	kV/ mm	8,9	8,7	8,4	9,0	9,3
field strength over insulation at U _o	kV/ mm	4,3	4,4	4,5	5,4	5,3
ampacity *)	A	464	512	576	652	760
*) utility-load, laying depth 1,20 m, earthing at both sides						

Application		64/110 kV			76/132 kV	87/150 kV
conductor size	mm ²	240	300	400	630	630
smallest steel tube	mm	133x4,0	139,7x4,0	139,7x4,0	168,3x4,5	168,3x4,5
permissible pulling strength	kN	82	86	91	106	110
max. production length	m	750	750	750	550	500

Accessories Pipe-type Cable



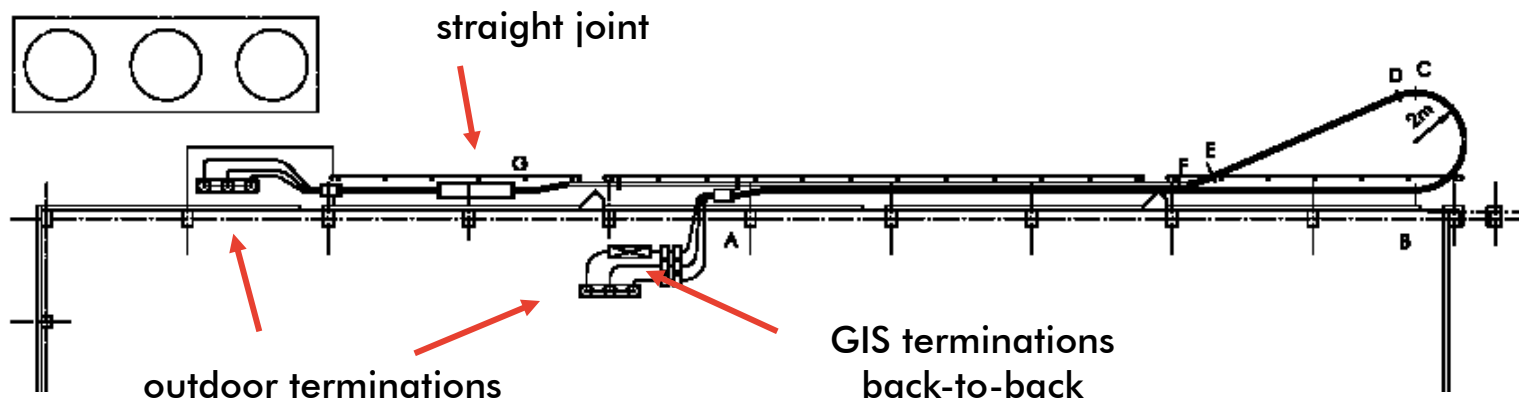
Accessories Pipe-type Cable



Qualification test passed in 2006

=> adapted to IEC 62067, German national customers specification

1 year at 2Uo with load cycles



Available type tests:

- 123 kV voltage level (300 mm² copper)
=> acc. to IEC 60840, German national customers specification
- 145 kV voltage level (630 mm² copper)
=> acc. to BS 7912, IEC 60840
- 170 kV voltage level (630 mm² copper)
=> acc. to NEN 3630, IEC 60840

Commercial installations – References



Commercial installations – References

<i>Year</i>	<i>Order-No.</i>	<i>Client</i>	<i>Project</i>	<i>Country</i>	<i>Voltage</i>	<i>Conductor</i>	<i>Length</i>	<i>OD Term.</i>	<i>GIS Term.</i>	<i>Joints *)</i>
<i>Jahr</i>	<i>Auftrag-Nr.</i>	<i>Kunde</i>	<i>Projekt</i>	<i>Land</i>	<i>Spannung</i>	<i>Leiter</i>	<i>Länge</i>	<i>Freiluft-EV</i>	<i>GIS EV</i>	<i>Muffen</i>
			Niederausse							
2005	685846	RWE Power	m	Germany	123 kV	300 mm ²	520	6		
2006	730922	RWE Systems	Handbach	Germany	123 kV	300 mm ²	452	6		
2006	730967	RWE Systems	Hilden	Germany	123 kV	300 mm ²	978	6		2
2007	799729	RWE Systems	Bottrop	Germany	123 kV	300 mm ²	3970	3	3	7
2007	799742	RWE Systems	Bochum	Germany	123 kV	300 mm ²	3182	3	3	6
2008	857724	RWE Systems	Dortmund	Germany	123 kV	300 mm ²	3660	3	3	7
2008	864208	RWE Systems	Bonn	Germany	123 kV	240 mm ²	3710	3	3	5
2009	908869	EDF-UK	Laleham	UK	145 kV	630 mm ² Al	26500	12		52
2009	910377	RWE Systems	Ruttenscheid	Germany	123 kV	300 mm ²	2715	3	3	5
2009	910378	RWE Systems	Altenessen	Germany	123 kV	300 mm ²	1692	6		2
2009	910647	RWE Systems	Löhne	Germany	123 kV	300 mm ²	2184	6		4
2010	920480	EnBW	Bludenzerstr.	Germany	123 kV	300 mm ²	1445	3	3	2
Total							51223	60	18	92

*) 3-core joints / 3-adrige Muffen

New achievements – transition joints:

- Step-up technology to connect pipe-type XLPE cables with other types of cable:
 - ⇒ XLPE-cable with standard insulation thickness for direct burying
 - ⇒>> **Step-up straight joint**
 - ⇒ Paper-insulated pipe-type cable, gas-compression cable
 - ⇒>> **Step-up transition joint**

New concept:

- Use of premoulded EPDM joint body
- Boring of each side adapted to the individual cable diameter
- Transfer of inner diameter inside the shielding electrode

→ ***“ Step-up joint ”***

Step-up Straight Joint

- Straight connection between two XLPE insulated cables with different insulation diameter
- Connecting XLPE pipe-type cables to standard XLPE cables for direct burrying
- Using premoulded EPDM joint body

Step-up Straight Joint



Premoulded EPDM-body with step-up:



Step-up Straight Joint



Step-up Straight Joint



Type test on 110 kV cables 300 mm² copper:

- Cable 1 : insulation thickness = 18 mm
=> 123PMJ-3
- Cable 2 : insulation thickness = 10.6 mm
=> 123PMJ-0
- Step-up joint : 123PMJ-0/3
- Type test acc. to IEC 60840 for 123 and 145 kV voltage level:
=> ***passed in 2007***

Step-up Transition Joint

- Transition between XLPE insulated cable and paper insulated cable
- Connecting XLPE pipe-type cable and paper-insulated gas-pressure cable
- Using premoulded EPDM joint body

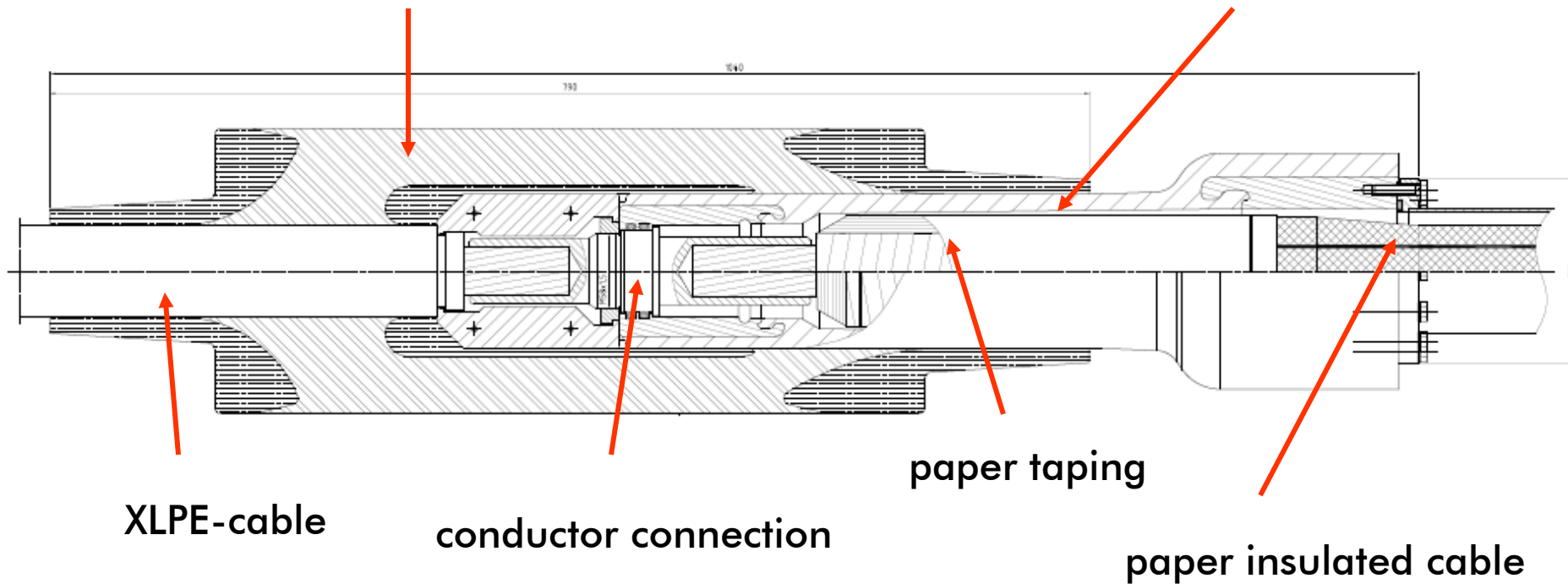
Application to:

- Low-pressure oil-filled cables up to 1200 mm² Cu
- Gas-pressure cables up to 900 mm² Cu and Al
- Pipe-type XLPE-cable up to 630 mm² Cu and Al
 - 110 kV voltage level : 10.6 mm insulation thickness
 - 132 kV voltage level : 11.0 mm insulation thickness
 - 150 kV voltage level : 12.6 mm insulation thickness

Concept of transition joint:

EPDM-joint body („step-up joint“)

barrier insulator



Step-up Transition Joint

Stress-cone on paper cable side



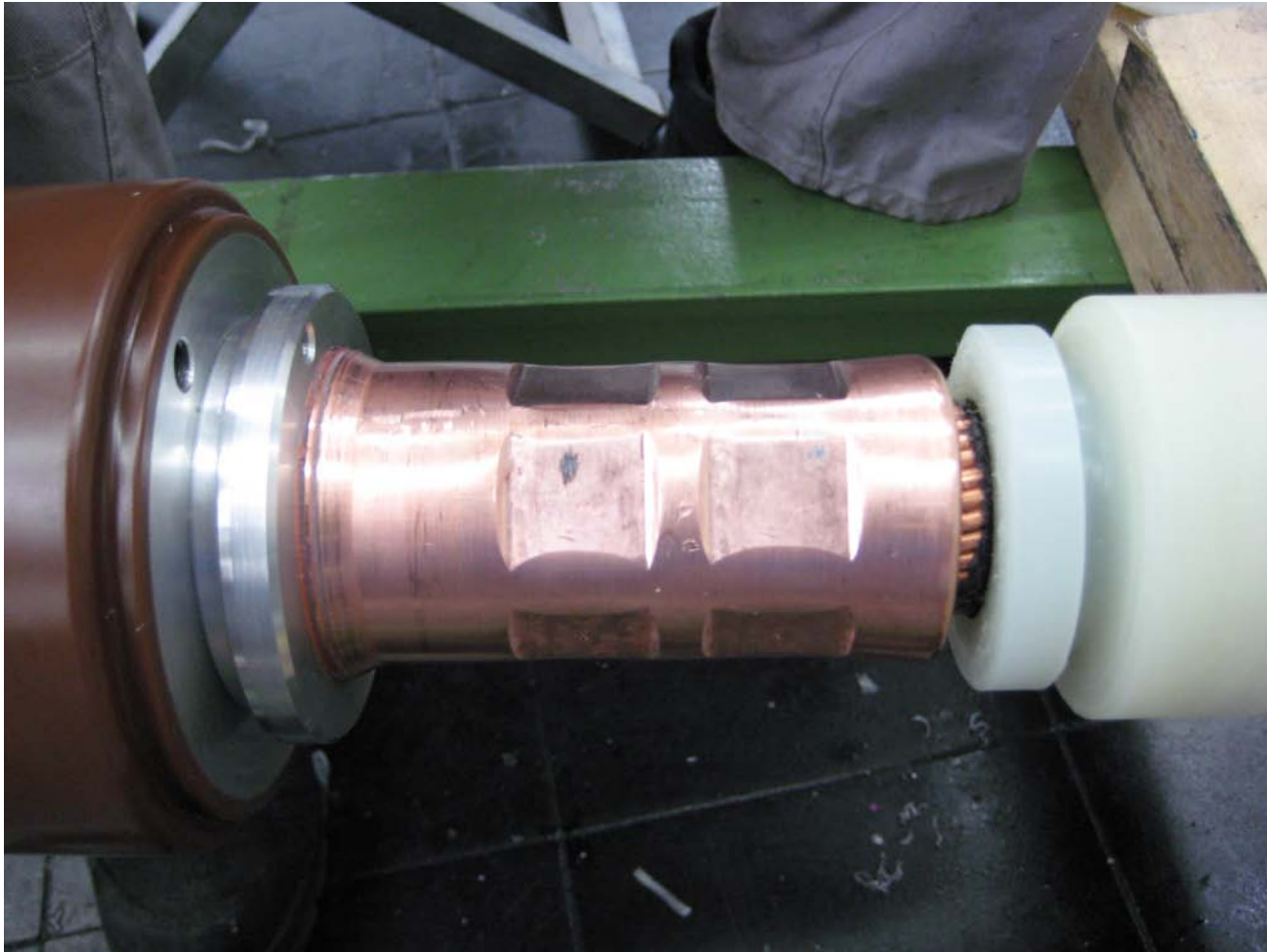
Step-up Transition Joint

Epoxy insulator on paper cable side



Step-up Transition Joint

Conductor connection



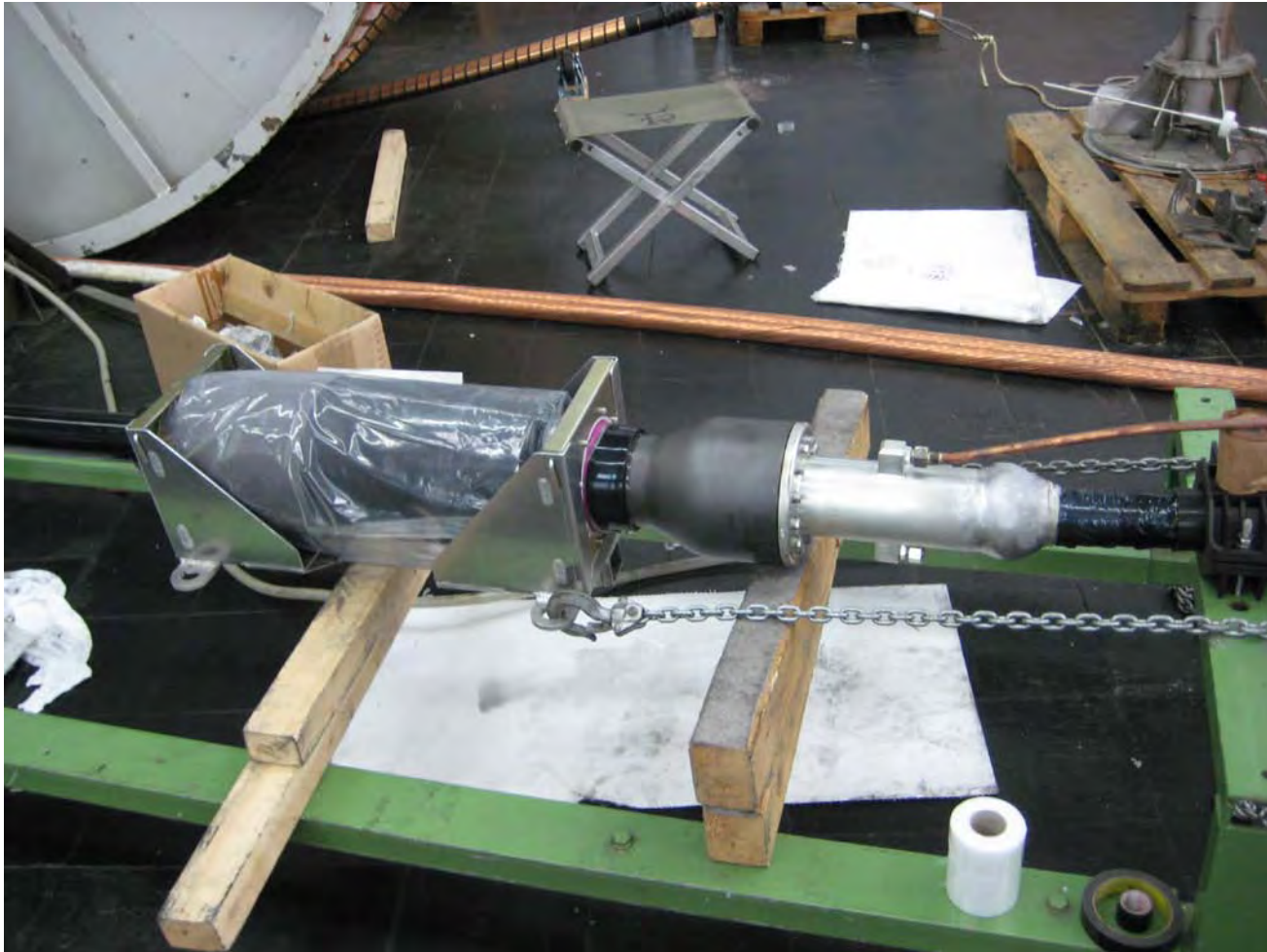
Step-up Transition Joint

Finished connection



Step-up Transition Joint

Joint body after positioning



Step-up Transition Joint

Two joints ready for testing



Step-up Transition Joint

Test loop at HV lab of Nexans Superconductor-Hannover



Conclusion:

- Modern XLPE pipe-type cable system has been established in several commercial projects up to 145 kV since 2005
- Qualification for 170 kV voltage level finished, commercial application under preparation
- Qualification of step-up straight joint for the connection to standard XLPE-cables completed
- Qualification of step-up transition joint for the connection to low-pressure oil-filled cables completed
- Qualification of step-up transition joint for the connection to gas-pressure cables completed

Future Aspects:

- **Extention of Pipe-type Cable System to 245 kV Voltage Level**
- **Replacement of high-pressure pipe-type oil-filled cables by pipe-type XLPE-cables, using step-up transition joints for looping-in and/or repair works**

Nexans Modern Pipe-type Cable System

Thank you for
your
kind attention

