



# WETS D'15 Workshop

*Organization: Jicable and Prospective 2100*

*Palais des Congrès de Versailles, France*

*Thursday, 25 June 2015*

## Part 2 - Technologies

# THE 4 TOPICS OF WETS D'15

Prepared by : Roger TAMBRUN ERDF and Philippe BARATON R&D

## 1. General data of the network

Roger TAMBRUN + Guillaume PELTON : **ERDF** & Yves BRUMENT : **EDF R&D**

## 2. Technologies

Roger TAMBRUN : **ERDF** & Yves BRUMENT + Christophe TOURCHER : **EDF R&D**

2.1 – Cables

2.2 – Accessories

## 3. Diagnosis of ageing and estimation of the residual life

Roger TAMBRUN : **ERDF** & Hervé DIGARD + Thierry ESPILIT : **EDF R&D**

## 4. Renewal of the distribution networks

Gauthier BEAUZEMONT : **ERDF** & Emanuela BUCCAFURRI + Adrien RESMOND : **EDF R&D**

## 2-1- 1 MV Technologies cables

What kind of cables for a long lasting life (for ex: French model)

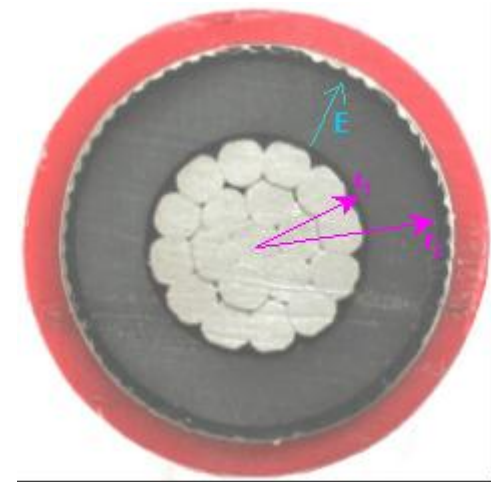
### MV Cables with synthetic insulation



On the left NF C33-226 150mm<sup>2</sup> **E = 4,5mm**

On the right NF C 33-223 150 mm<sup>2</sup> **E = 5,5mm**

These sections allow to be aware of the thickness decrease of the insulation and of the sheath

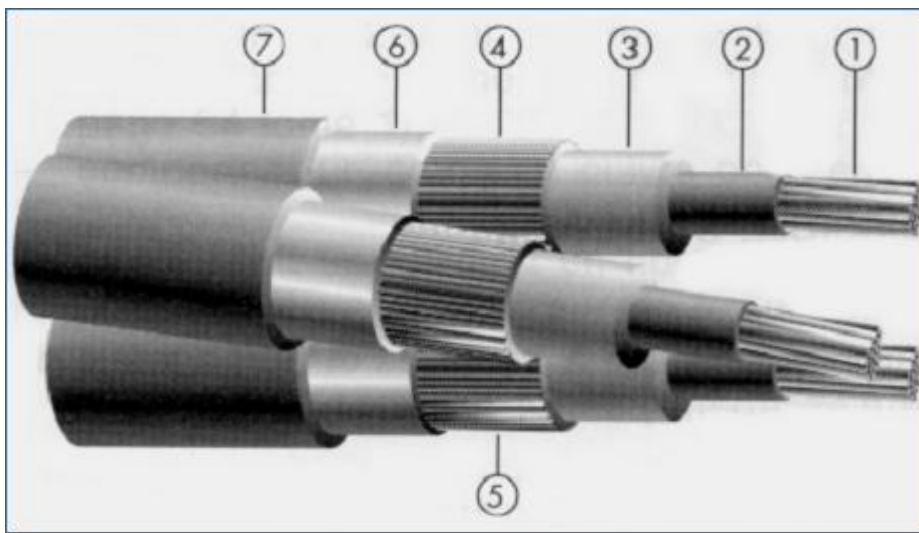


### NFC 33-226 150-mm<sup>2</sup> cable

- Core diameter = 14,2 mm
- Semiconductor thickness = 0,5 mm
- Insulation thickness = 4,5 mm
- Sheath = 2;2

## 2-1- 2 MV Technologies cables : Cables with synthetic insulation

What kind of cables for a long lasting life (for ex: French model)



### NF C 33-226

- 1 - 50, 95, 150 and 240 cabled core (630 and 1200mm<sup>2</sup> for the primary substations)
- 2 –extruded semi-conductor with variable thickness
- 3 – PR insulation
- 4 – extruded, fluted or flat semi-conductor, peelable, of variable thickness
- 5 – hygroscopic powder or swelling ribbon
- 6 – stuck back screen (Aluminium possibly Copper)
- 7 –PVC or PE sheath

### NF C 33-223 / 2000 cable

- A descriptive approach
- Fixed description
- A unique model
- Functions guaranteed and checked through design

### NF C 33-226

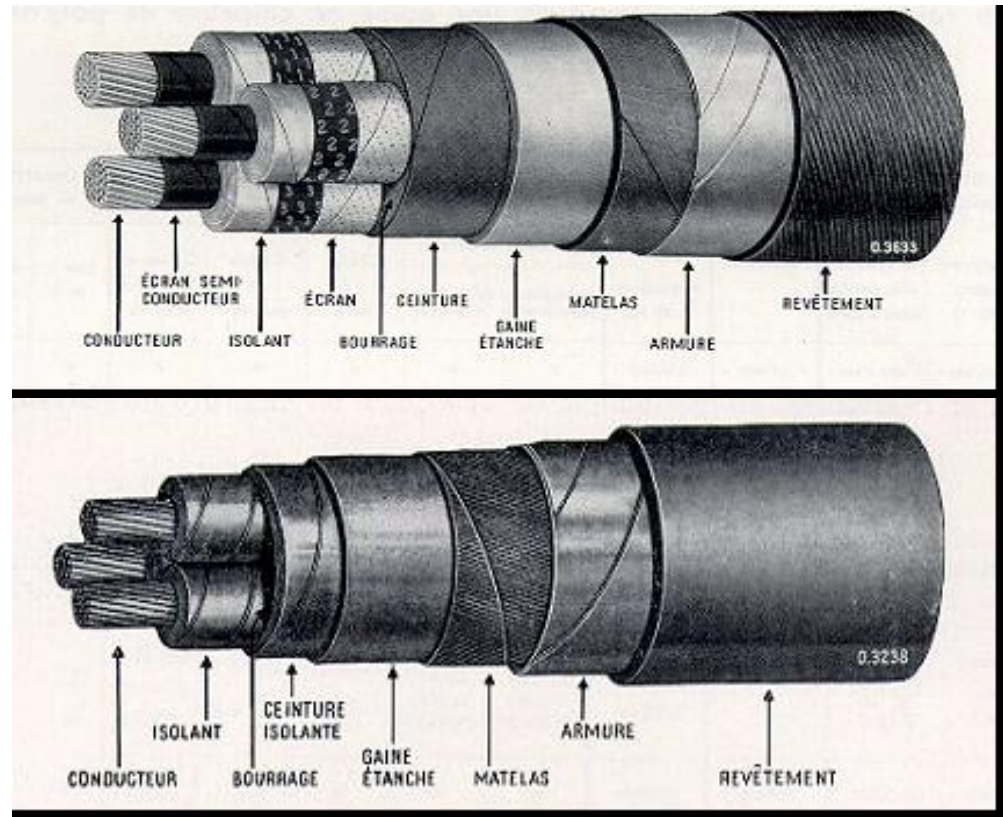
- A more functional approach
- More innovations
- Different models
- More complex validation



Model 2008... is C2 (grey or black sheath with grey band), TR (termite resistant), with extended setting-up temperature:  $-10/+50^{\circ}\text{C}$ , with possible EDR option

## 2-1- 3 MV Technologies cables : Cables with paper insulation Hold good cables for a long lasting life (for ex: French model)

### Tri-metal cable



### Belt cable

Other cables:

- impregnated paper unipolar
- Tri-lead

**ISULATION:** viscous mineral oils (very fluid) in the unipolar cables or stabilised (greasy) in the tri-metal cables



## 2-1- 4 MV Technologies cables

Submarines cables construction HN 33 S 26



# 2-1- 5 MV Technologies cables

submarines cables construction

Old cable



New cable with optical fiber



# 2-1- 6 MV Technologies cables

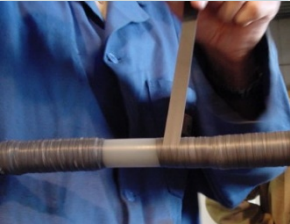

Study under consideration

## Ageing of MV Cables



- |||| Better knowledge of mechanisms which lead to cable faults
  
- |||| Determination of weak technologies
  - |||| Studies finished for PILC cables
    - |||| Belted cables is a weak technology to replace quite quickly
    - |||| Others technologies : long life before failure without mechanical stress
  
  - |||| Studies still in progress for polymeric cables
  
- |||| The most difficult for these studies: take back from the field cables to perform tests and carry out expertises



## 2-2- 1 MV Accessories - Technologies

	Historic	Advantage	Disadvantage	Background
<p>Tape</p> 	<p>Older technology</p> <p>1980 : Rubber Tapes</p> <p>2000 : paper tapes forbidden</p> <p>Used only for transition joint</p>	<p><b>Cost</b></p> <p><b>Adaptability</b></p> <p>Size (urban area)</p>	<p><b>Quality of realisation (wrapping)</b></p> <p>Quantity of components</p> <p>Time (wrapping and resinous injection)</p> <p>Resinous (european safety requirements)</p>	<p>Old paper tapes Transitions</p> <p>Branch : Old D1200</p>
<p>Heat Shrink</p> 	<p>Used since 75-80'</p> <p>Years 95' : reduction of use ' (safety reason)</p> <p>Since 2006 : relaunch (transition, branch)</p>	<p><b>Cost</b></p>	<p><b>Quality of realisation</b></p> <p><b>Flame</b></p>	<p>Termination of substation (630 &amp; 1200 mm<sup>2</sup>)</p>

## 2-2- 2 MV Accessories - Technologies

	Historic	Advantage	Disadvantage	Background
<p>Cold Shrink</p> 	<p>First joint in 1985</p> <p>Younger but predominant techno</p> <p>2014 : Compact joint</p>	<p><b>Time</b></p> <p>Easy installation</p>	<p>Size of excavation (before 2014)</p> <p>Easy installation (qualification of jointer)</p> <p>Blind installation</p> <p>Size of cold shrink transitions</p>	<p>Transitions (1 model + improvement for 2 other models)</p> <p>Few cases of quality of components</p>
<p>Slidding</p> 	<p>Connectors</p> <p>Joint (before 1985)</p>	<p>Easy installation</p>	<p>?</p>	<p>?</p>

## 2-2- 3 MV Accessories - Types

- All accessories are supplied for 3 phases (1 accessory or 1 kit = 3 phases)
- Joint for polymeric cable
  - 50 up to 240 mm<sup>2</sup> (Al & Cu)
  - Cold Shrink
  - Mechanical connectors (Since 2002)
  - 45 000 / year
- Transition-joint (paper - polymeric cables)
  - 50 up to 240 & 25 up to 95 (Al & Cu)
  - Cold shrink (50%), tape (35%), heat shrink (15%)
  - Mechanical connectors (Since 2002)
  - 17 000 / year
  - New : Hybrid (CS body + tape & resin protection)
- Special accessories
  - “Quick” repair transition-joint
  - Repair kit (2 accessories with a length of cable )
  - 1 000 / year



## 2-2- 4 MV Accessories - Types

- **Branch**
  - 50 up to 240 mm<sup>2</sup> (Al & Cu)
  - Polymeric cable only : Cold and heat shrink
  - Paper & polymeric cables : Tape & resin
  - 7 000 /year
- **Termination**
  - Only for polymeric cable
  - 50 up to 240 mm<sup>2</sup> (Al & Cu)
  - Cold shrink
  - External models : Normal & Polluted
  - Internal models : Short for compact cells
  - 18 000 / year



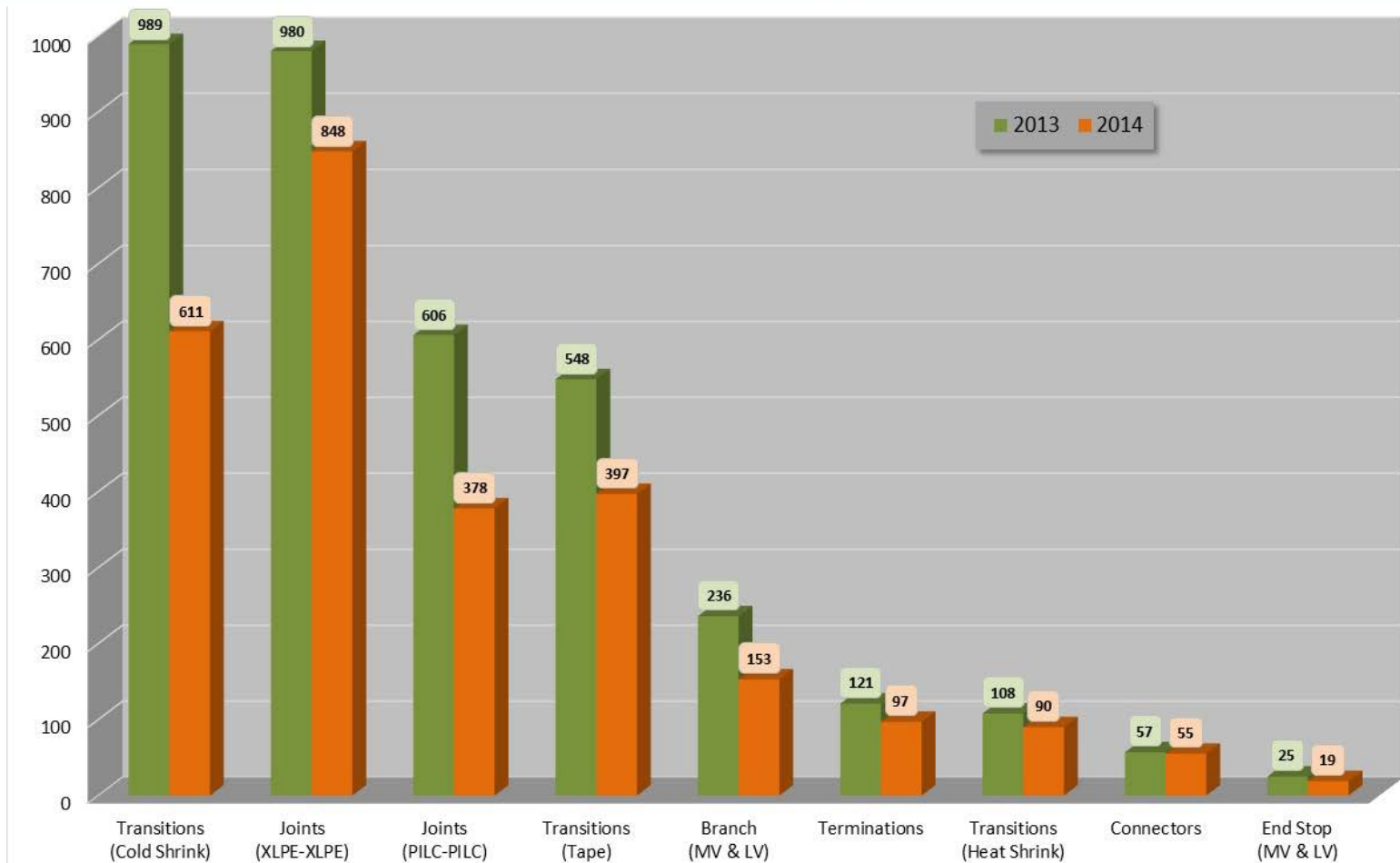


## 2-2- 5 MV Accessories - Types

- **Separable connector**
  - Only for polymeric cable
  - 50 up to 240 mm<sup>2</sup> (Al & Cu)
  - CSD 250 A, CSE 250 A, CSE 400 B, CSD 400 B (Sliding contact)
  - Future : 630 Amps, 800 Amps for producers (Bolted contact)
  - 30 000 / year
- **Stop-end**
  - 50 up to 240 (Al & Cu)
  - Polymeric cable : Cold shrink
  - Paper cable : Tape & resinous
  - 1 500 / year
  - Special model with short-circuit phases and earthing connection (for cable not connected)



## 2-2- 6 MV Accessories – Fault Statistics



# 2-2- 7 MV Accessories - Studies

- Cold Shrink Joints

- Instructions installation

- Quality of pictures and explications
    - Understanding

- Marges of installation

- Impact of position of electrical component

- Moisture vs cold shrink components (Thesis)

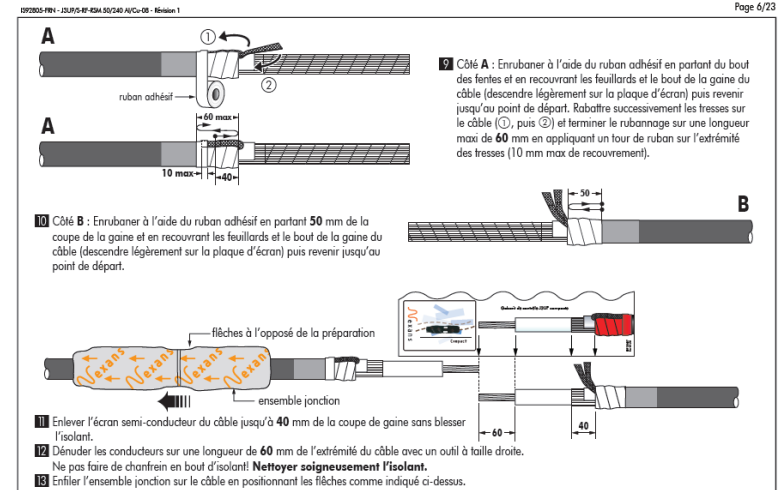
- Silicone / EPDM

- Pressure (Thesis)

- Silicone / EPDM

- Ageing of network accessories (Joints & Transition All technologies)

- Accessories of the network (in service or after failure)
  - Electrical tests, examination
  - Evaluation of lifetime



## 2-2- 8 MV Accessories - Studies

- Improvement of aluminium screen connection
  - Longitudinal Aluminium screen cable
  - Needs
    - 240 mm<sup>2</sup> Cu → 25 A
    - 630 A mm<sup>2</sup> Alu → 35 A

