WETS D’15 Workshop

Organization: Jicable and Prospective 21OO
Palais des Congrès de Versailles, France
Thursday, 25 June 2015

Part 4 - Renewal of the distribution networks

ERDF DT – Pôle réseau et EDF R&D - LME

ÉLECTRICITÉ RÉSEAU DISTRIBUTION FRANCE

THE 4 TOPICS OF WETS D'15

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➢ General data of the network

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

➢ Technologies

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

1 – Câbles

2 – Accessories

➢ Diagnosis of ageing and estimation of the residual life

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

➢ Renewal of the distribution networks

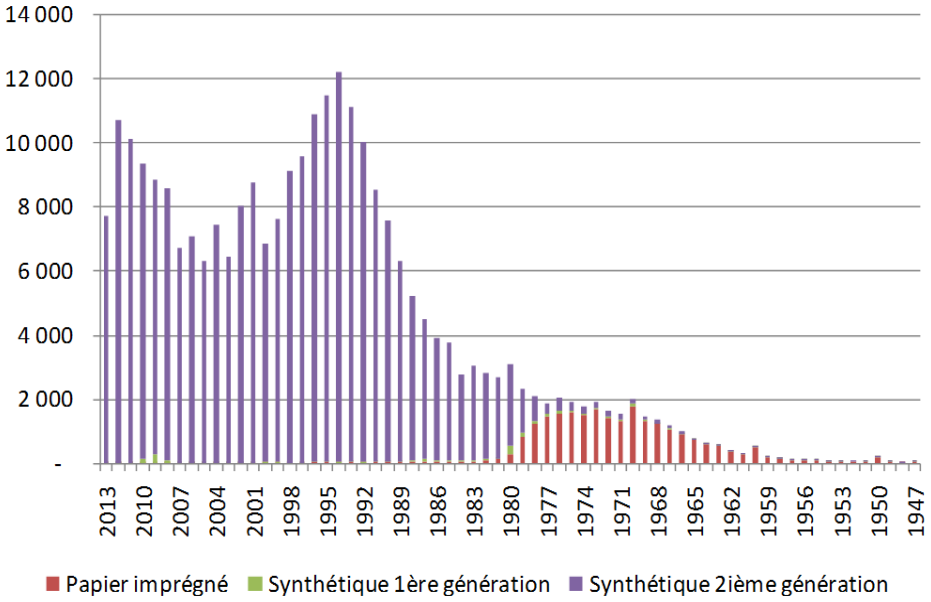
Roger TAMBRUN : **ERDF &** Emanuela BUCCAFURRI + Adrien RESMOND : **R&D**

4-1-1 Renewal of the distribution networks

Methodology to optimize technically and economically the renewal : R TAMBRUN

Patrimonial diagnosis of MV underground cables

- PILC paper impregnated and synthetic1st-generation MV underground cables have a failure rate (excluding backhoe loader aggression) significantly higher than recent synthetic technologies
- The breakdowns mainly related connecting boxes but also the cables themselves
- They are mainly located in urban areas and represent 10% of the 280 000 km of MV underground links operated by ERDF
- These technologies represent a risk in terms of quality and costs incurred intervention
- The risk increases with time and synthetic technologies are aging …



4-1-2 Renewal of the distribution networks

Methodology to optimize technically and economically the renewal : By R TAMBRUN

Towards a new ambition

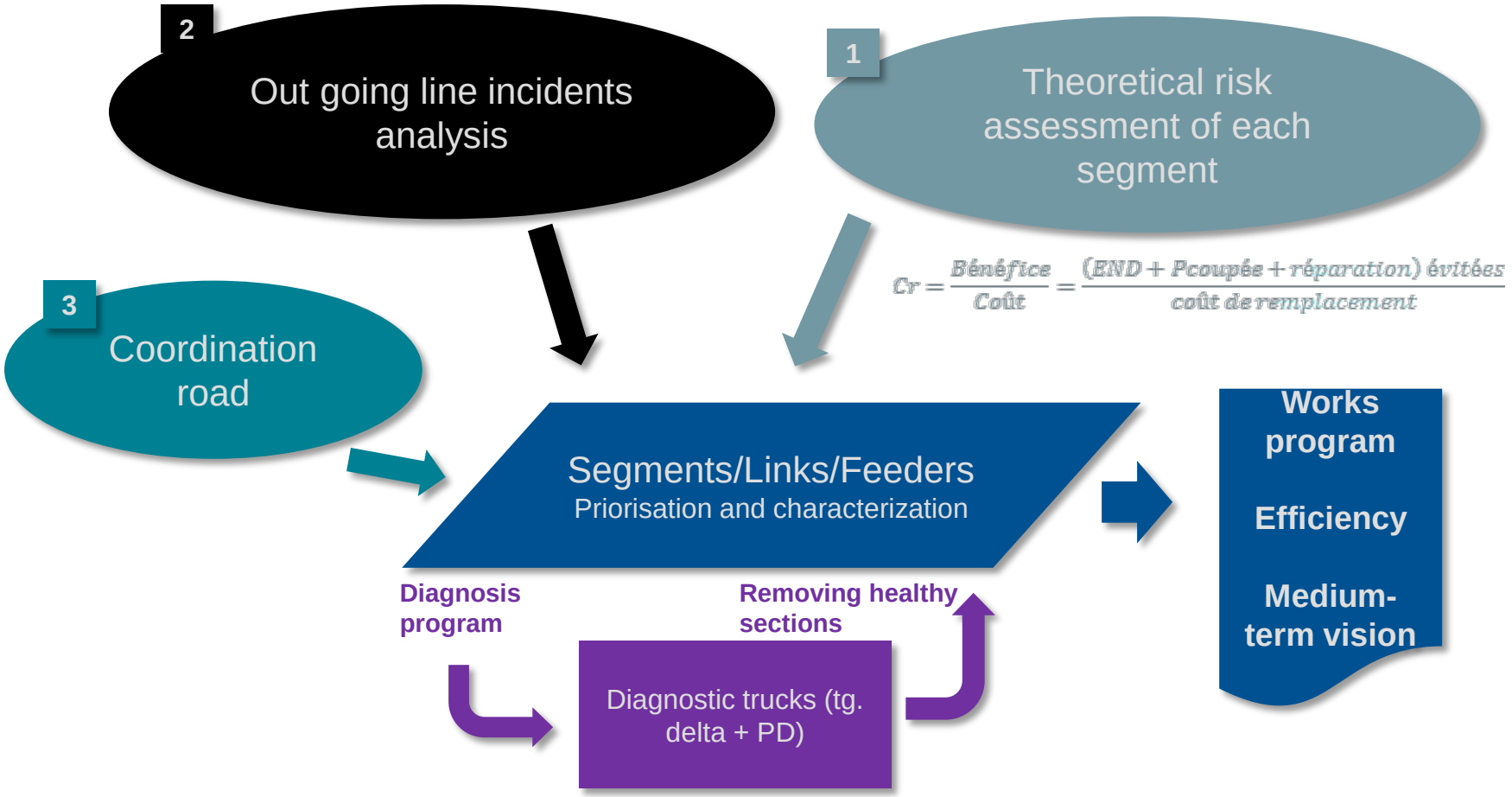
- ERDF aims to reduce the intrinsic failure rates (all technologies) for 4 to 3 breakdowns / 100 km / year in 4 years thanks to a risky sections replacement riddled policy

Policy

- Characterize the risk segments by relying on
  - probabilistic estimation of the impact of failures (quality, power cut, cost of intervention)
  - the targeted use of diagnostic trucks (tg delta + partial discharges) on longer cable links (between 2 distribution substations)
- Continue the replacement of 1,000 km / year of highest risk segments

4-2-1 Renewal of the distribution networks

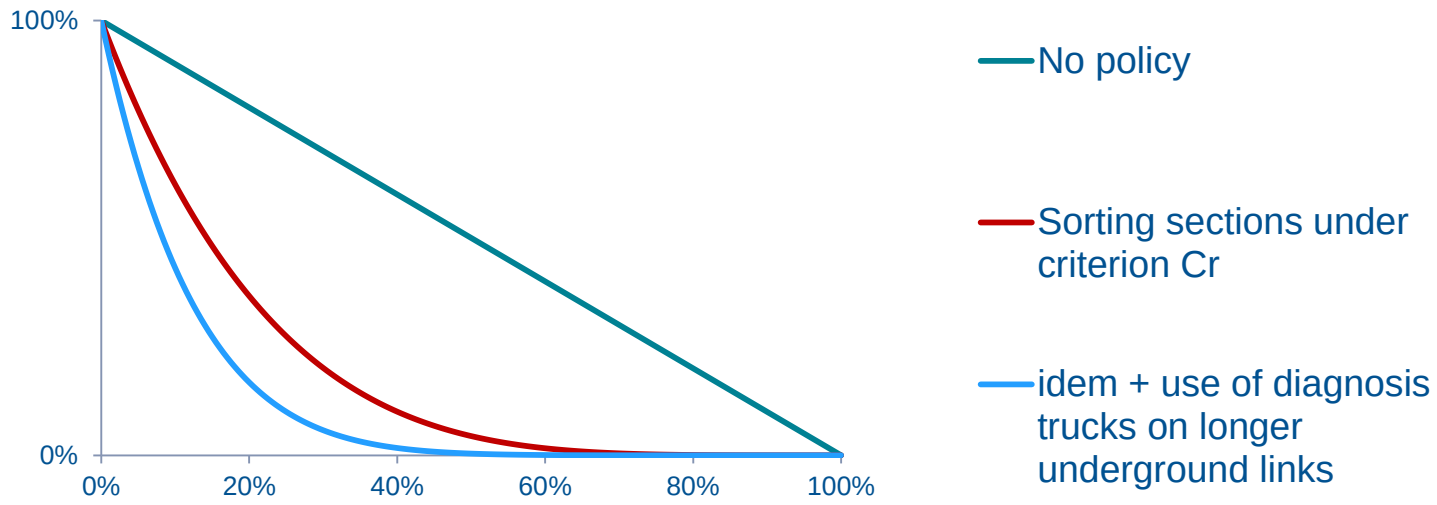
what best strategy to replace accessories and cables : By R TAMBRUN,



4-2-2 Renewal of the distribution networks

what best strategy to replace accessories and cables : By R TAMBRUN

Theoretical evolution of the number of breakdowns on risky technologies depending on the progress of removal

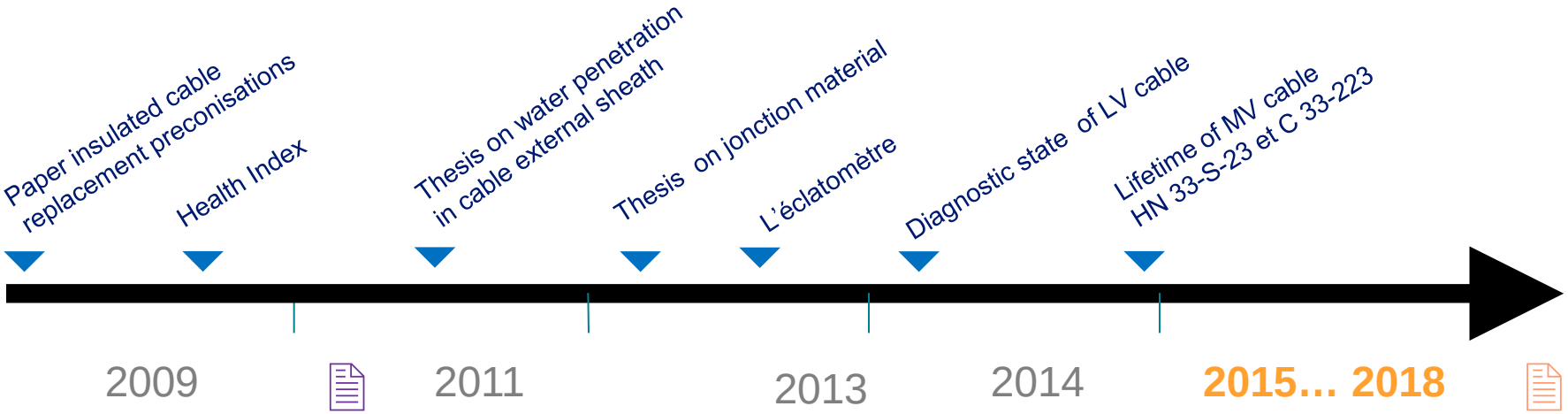


- The use of diagnostic trucks (tg delta + partial discharges) isolates healthy portions and avoid their replacement

- Given the cost of use, diagnostic trucks must be used on the longer risky connections (>300m)

4-3 Renewal of the distribution networks

Ageing of the network : by A.RESMOND



… To follow

New use of the network impact on lifetime materials
Lifetime of jonctions
Feedback on MV cable from 2000
Thesis:
Water penetration in jonction
XLPE ageing model of MV cables

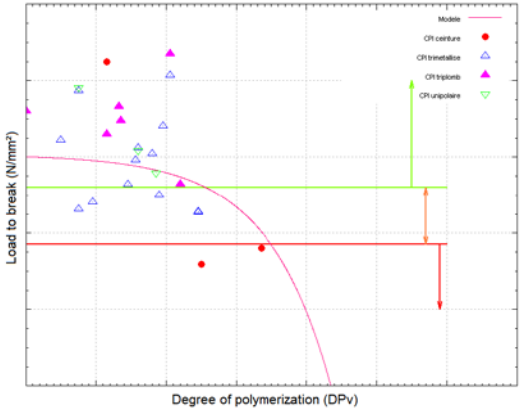
4-3-1 Renewal of the distribution networks

low and Medium voltage PI cable : by A.RESMOND

NF C33-100

Cable sampling

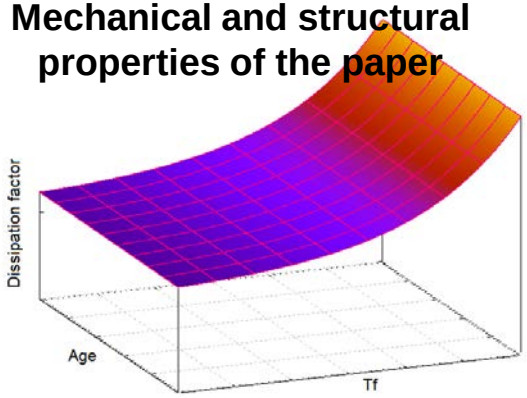
Electrical properties with exploitation conditions



Eclatomètre

Prepar and test the paper

Mechanical and structural properties of the paper

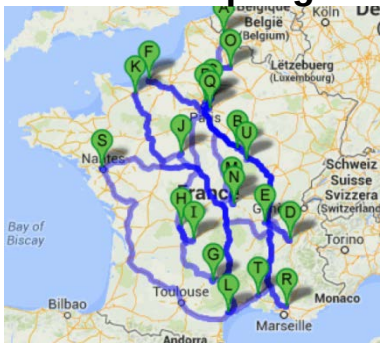


4-3-2 Renewal of the distribution networks

Low voltage SI cable, state of the network and ageing modelisation : by A.RESMOND

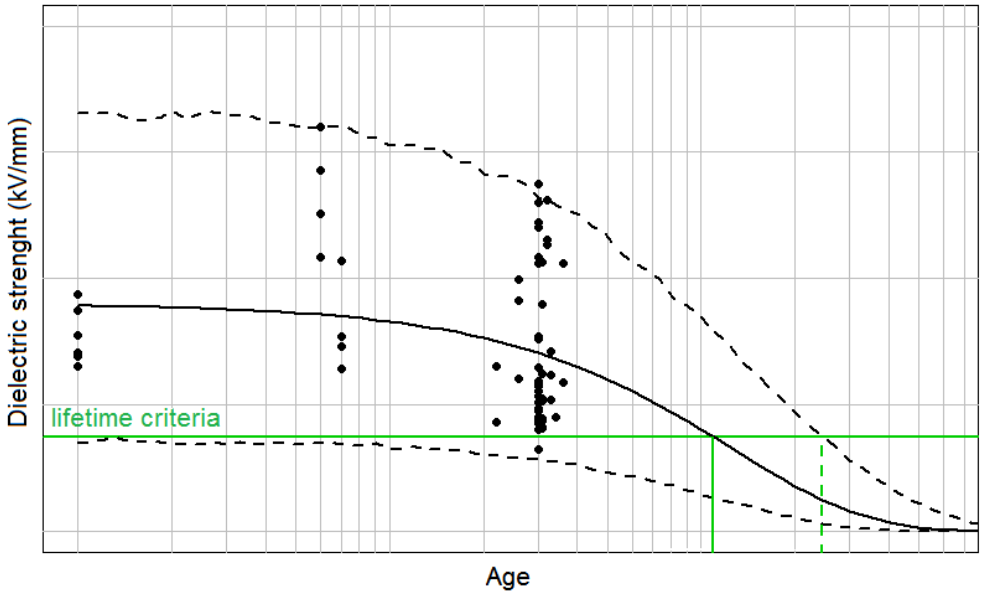
NF C 33-S-33

Cable sampling



Shield corrosion

Dielectric properties of insulation LV cables



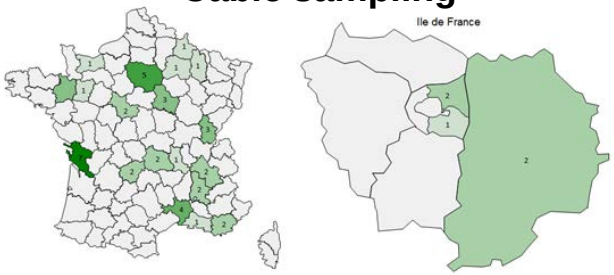
- **Mechanical properties of insulation and external sheath**
- **Quality of the conductor**
- **…**

4-3-3 Renewal of the distribution networks

Medium voltage SI cable : by A.RESMOND

NF C33-S-23 and C33-223

Cable sampling



Shield oxydation

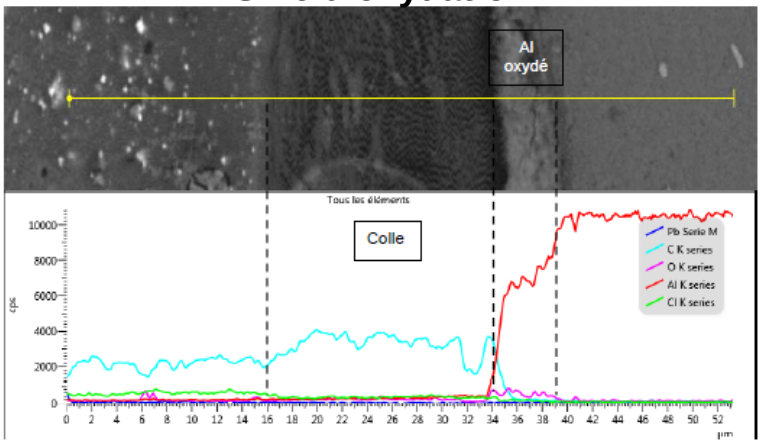
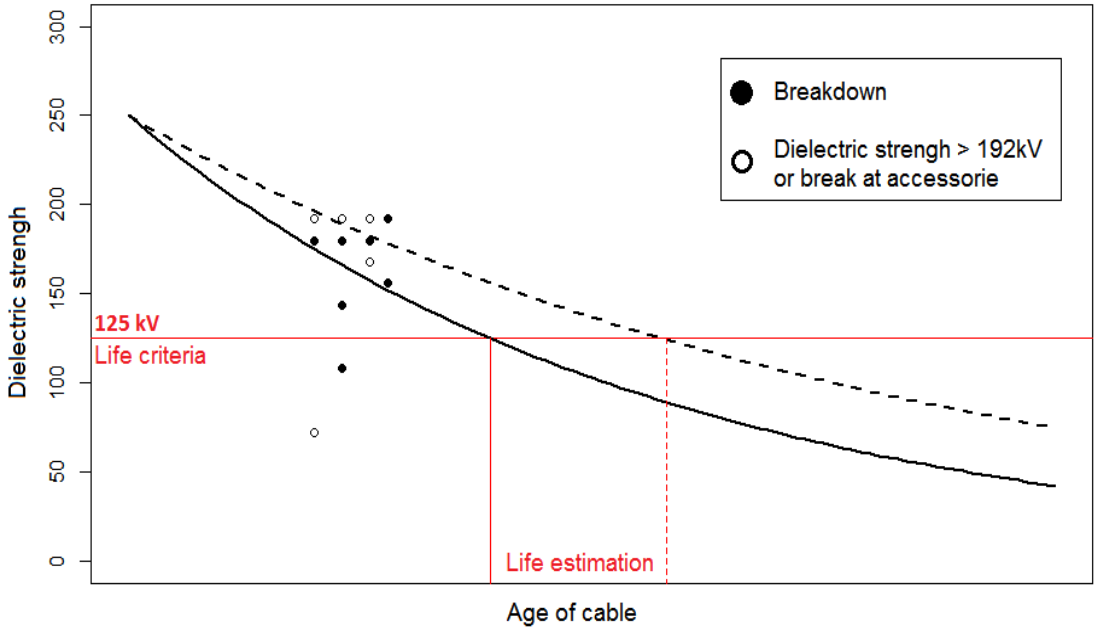


Figure 11 – Analyse EDS sur une ligne à l'interface écran/gaine polymère de l'échantillon A14a

Dielectric breakdown test results and lifetime modelisation

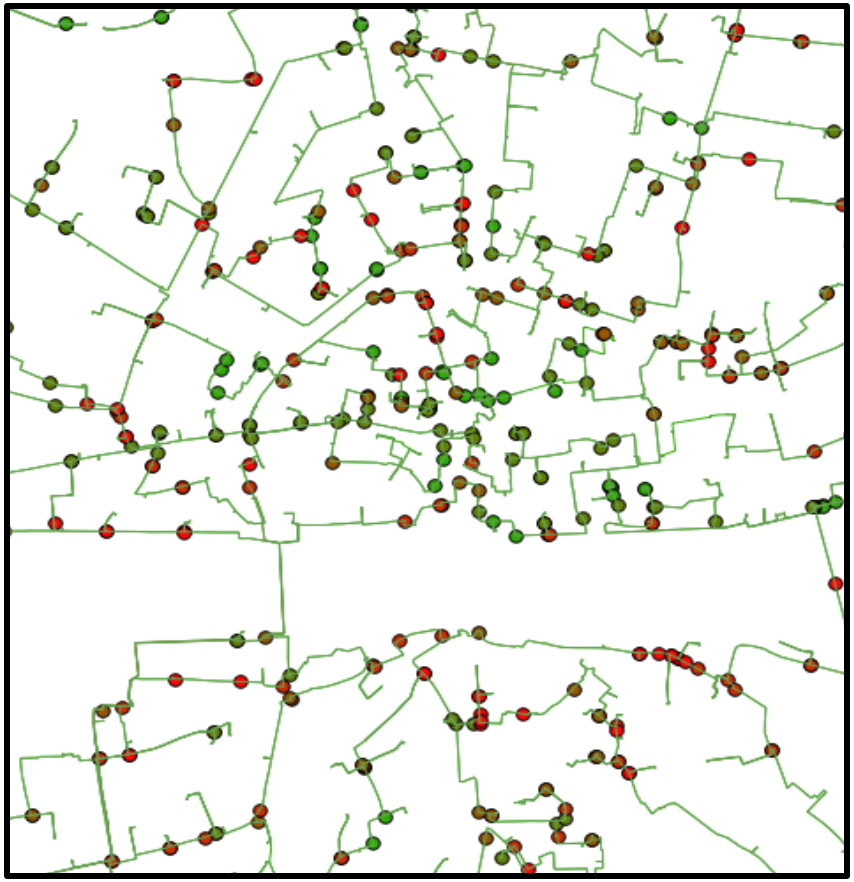


- **Water penetration**
- **Electric properties**
- **Quality of the overlapping of the shield**
- **…**

4-3-4 Renewal of the distribution networks

Health Index, target the *a priori* risky material to test them with off-line diagnosis : by A.RESMOND

- **Ranking links, cables and accessories**
- **Give an estimation of the fault probability which can be used for economic or strategic plan**
- **Target risky links for diagnostic off-line**



4-3-5 Renewal of the distribution networks

Health Index, a tool between asset management and material expertise : by A.RESMOND

	Cables	Accessories
Electrical risk	➢ Technology (insulation) ➢ Laying type ➢ Exploitation voltage ➢ Length	➢ Type (paper/paper, synth/synth, transition) ➢ Difference of sections ➢ Laying type ➢ Exploitation voltage
Thermical risk	➢ Technology (insulation) ➢ Laying environement ➢ Load and variation	➢ Technology (insulation) ➢ Laying environement ➢ Load and variation
Thermo-mecanical and environnement risk	➢ slope (paper insulation) ➢ Excessive curve	➢ slope (adjacent to a paper insulation cable)

4-3-6 Renewal of the distribution networks

Health Index, some results of experiments : by A.RESMOND

High risk of breakdown	14	20	0	2
Risky cable	42	27	1	0
Medium risk	24	16	0	0
Low risk	10	2	0	0
Health Index DP	**Measure at 10 years**	**Measure at 5 years**	**Risky cable**	**Breakdown to forecast**

Partial discharges located on cable	Discordances corrected by re-parametrization
Partial discharges located on accessories	Lack of field data difficult to obtain : montage quality surely has a big influence
Dissipation factor mesure of links	Discordances due to accessories
Cable and accesories fault historic on the area	Good concordance with re-parametrization Fault historic not large enough to make a robust statistical study