

**Quality Assurance lessons learnt**

Most high voltage underground cable components are not impacted by weather effects, such as buried cables, joints installed in its dedicated chambers, indoor terminations and GIS terminations. However, outdoor terminations are subjected to weather constraints: wind, rain, UV, various pollution... All those constraints can impact the outdoor termination performances by making it a weak point of the high voltage cable system.

Based on the French TSO's 2019-2020 service experience data, terminations are the main origin of internal faults on the whole cable system (59%, cf. Figure 1). Internal faults occur during the operation of the cable system due to material imperfections (production defects), wrong product installation or material aging problems (oil leakage). The type of defects and the termination technology are detailed in the following chart (cf. Figure 2).

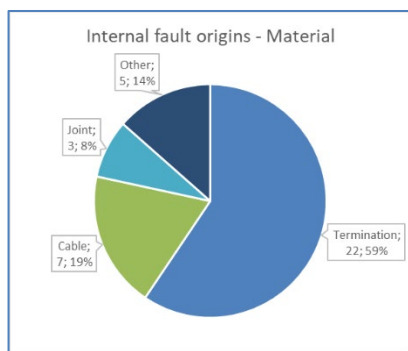


Figure 1 : Internal fault origins - Material

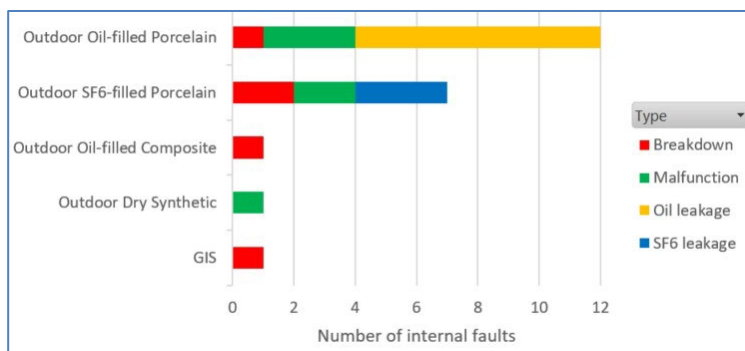


Figure 2 : Internal fault origins - Type and Technology

In case of a failure, the restoration of the cable system may be long and the exploitation system must adapt in the meantime. The duration of the restoration depends on various parameters: fault localisation, fault root cause analysis, material and reparation staff availability... Then, to prevent any disruption of the transmission network, TSO must plan a quality assurance of the whole cable system. Such quality assurance involves:

- Cable system quality management at every step: qualification, manufacturing, testing and installation;
- Preventive maintenance: visual inspection of accessories (joints, terminations and auxiliaries), technical visits of underground connections...
- Curative maintenance: the restoration time optimization through material availability, staff training, staff availability...

The French TSO has introduced a new pollution class (SPS<sup>1</sup>) named “e-Very Heavy” in its Technical specification. This new pollution class is defined for high equivalent salinity (SES<sup>2</sup> ≥ 112 kg/m<sup>3</sup>) and longer creepage distance (USCD<sup>3</sup> = 53.7 mm/kV). Its application is for outdoor terminations installed along the coast which have shown a decreased lifetime. For instance, those installed along the Channel coast have experienced a lifetime of about 25 years. Such shortened lifetime can be linked to corrosion, involving watertight joints and chemical compatibility issues on various elements.

The TSO deploys 3 in-house jointer teams for curative maintenance dedicated to the restoration in case of any underground cable failure. Those 3 teams are sufficient at national level because of the high reliability of the infrastructure: material with expected long lifetime (more than 40 years), low failure probability and integrated maintenance management. Moreover, the restoration time is decreased by the national reserve which stores all the necessary material used for repairing underground cable system: cables, joints, terminations and others.

<sup>1</sup> SPS = Site Pollution Severity (according to IEC 60815-1)

<sup>2</sup> SES = Site Equivalent Salinity for type B pollution sites (according to IEC 60815-1)

<sup>3</sup> USCD = Unified Specific Creepage Distance (according to IEC 60815-1)

This is the insulator creepage distance divided by the RMS value of the maximum rated voltage Um.