

## Retrofit of outdoor terminations using dry type solutions: development, testing, installation and operating experience

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### ABSTRACT

*This paper deals with the refurbishing of high voltage cable systems, in particular the retrofit of terminations for XLPE cables. A new approach is presented, considering existing challenges and providing insights of the development process including simulations, adaptations and verifications by laboratory tests. The design of specific solutions and installation are also covered in this paper. Finally, some examples of refurbishing projects already performed show the field experience gained until now.*

### KEYWORDS

Retrofit, refurbishing, high voltage cable systems, outdoor termination, dry type, XLPE cable, EPR cable, cable accessories, life time extension, leakage, damage, repair, development, design, testing, FEM simulation, compatibility testing, system safety, environment friendly

### INTRODUCTION

Since the 1970's XLPE insulated cables are used for transmission and distribution of electric energy. In the 1980's the voltage range covered by XLPE insulated cables increased from medium voltage up to 245 kV. The use of cable accessories for XLPE insulated cables grew in the same manner as the XLPE insulated cable use. The resulting increasing number of cable systems consisting of XLPE cables, joints and terminations, and their years of operation combined with the growing interest in ecological but also economical solutions to secure a functional power grid are leading suppliers to provide products prolonging the life of existing cable systems instead of replacing them. The target of retrofitting is to ensure secure operation and extend the lifetime of the cable system by replacing only aged or damaged components. In addition to considering economic aspects, the aim is also to achieve technical and environmental improvements. In this paper, the focus is on outdoor terminations whether installed in a substation or on an overhead line tower. Compared to other cable accessories, outdoor terminations need to withstand wind, rain, solar radiation, pollution, in some cases big ambient temperature variations, which may accelerate their ageing behaviour. For the retrofit of an outdoor termination, there are various approaches, which depend on the technical feasibility and imply different amount of work and costs. This paper is dealing with a solution where the refurbishing is performed without or with very few changes to the existing cable system and support structures. The old termination is disassembled and replaced on the spot by a new one, using part of the same but re-prepared cable section on which the old termination was installed. This retrofit solution is modular and adaptable to the on-site situation. The paper provides insights of the road to market of this approach describing research and development work as well as verification by laboratory testing. Finally, some examples of retrofit projects installed show the field experience already gained.

### APPROACH

#### Existing approach

Retrofitting of outdoor terminations can be necessary due to a damage such as leakage, corrosion of metal parts, water ingress, damages by external influences or reduce the risk of failure in aged cable systems. Existing approaches are:

1. Replacement of the complete termination and a part of the cable with a new cable, a joint to connect the cables and a new outdoor termination.
2. Cutting the termination and pulling the remaining cable to have enough cable length to install a new termination
3. Cutting the termination and install a new one on an adapted support.

The type of termination used (conventional fluid filled or pluggable) can have a major impact on the costs.

All approaches are technically suitable, but practically not feasible in all cases. Following restrictions of each approach can make them unattractive.

1. The costs are very high due to the civil works and material needed.
2. Only possible if enough additional cable length is available.
3. Only if enough space for the new support is available.

#### New approach

The new approach has been developed based on the existing dry type termination family, following the principle seeking to avoid any additional costs caused by civil works on the cable system, installing additional accessories, installing a new cable or changing the support structure of the termination being replaced. One of the main advantages of using termination based on dry flexible technology is that this technology gives freedom of choice to the customer through its variants, such as dry flexible termination, with integrated post insulators or surge arrester for increased system safety [1].

#### Challenges

Specific information are a requirement to configure a retrofit termination to be installed on an existing cable and support structure. A check sheet is used to get the required information:

1. Cable data sheet
2. Termination data sheet (at least Um and creepage distance)
3. Termination drawing