

New generation of dry type high voltage termination

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ABSTRACT

In the power transmission market, a strong trend towards dry high voltage cable accessories is visible. Historically, the first terminations were oil filled due to the usage of oil impregnated high voltage cables. Today, with the use of XLPE cables, all cable accessories should also be without any liquid to avoid any leakage. This paper shows the development of such kind of a termination based on the new method of using a gel as a filling media.

KEYWORDS

Outdoor termination, leakage free, gel filled, dry type, hollow core insulator, self-supporting.

INTRODUCTION

Conventional oil-immersed terminations have been in use for many decades and voltage classes up to 550 kV in the power transmission market. At this, there is already a trend visible from porcelain to composite outdoor terminations but they still rely on an insulating liquid as a filling material. Based on this, these oil immersed terminations still require a lot of attention during installation, especially the sealing system, so that no leakage will occur and a standard failure free operation time of 40 years is given.

Consequently, there is a market need for dry type terminations which do not use any kind of insulating liquid and thereby allows an easier installation and maintenance. This paper will start with the current situation of dry type terminations. In this respect different requirements on the terminations are highlighted and compared because there are different dry type termination designs existing in the power transmission market. Further on the future developments and market trends in the field of high voltage, dry type terminations will be explained as well as new technologies and a new developed solution of a dry type termination is presented.

This novel solution is based on a new insulation material which behaves like a gel and is specifically developed for high-voltage cable accessories. The development, design and performance are explained in detail and the paper concludes with the summary about the already conducted type tests and the relevant operation experience.

EXISTING FLUID FILLED TERMINATIONS

In the past, the power cables were insulated by means of oil impregnated papers. This cable technology also requires fluid filled terminations due to the paper coil which is used inside of the termination for electrical stress control.

But since the implementation of XLPE and their high voltage cable accessories, there were significant steps made towards dry technologies. Today all existing high voltage cable accessories up to 170 kV are typically dry and without an insulating liquid except outdoor terminations.

The majority of this product group are still liquid filled terminations with a filling of insulating material such as silicone oil, ester oil or Polyisobutylene (PIB) (see figure 1).

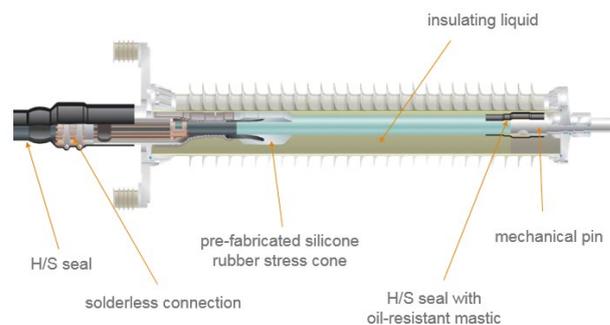


Fig. 1: Design of typical liquid filled type termination

This type of liquid terminations are in operation for more than 50 years but one critical item of these terminations is the sealing system. On the one hand the installation skills in the field are decreasing and an increasing number of improperly installed sealing can be seen in the market. This leads to a leakage which is damaging the environment and also very often results in an electrical breakdown of the termination if not noticed in time. On the other hand, today's outdoor terminations achieve a lifetime of more than 35 years and specifically the sealing systems achieve end of life time. This results also in leaking terminations in the field.

Therefore some different types of dry type outdoor terminations were developed [1]:

- Dry flexible outdoor terminations
- Dry resin plug-in outdoor terminations
- Gas-filled outdoor terminations
- Dry pre-assembled outdoor terminations

But each of the concepts did not become the standard termination due to technical limitations. The dry flexible termination is normally non-self-supporting and cannot take up any mechanical forces at the contact point. There are self-supporting versions existing, but these ones do not achieve the seismic performance compared to radial symmetric terminations. Dry resin plug-in outdoor terminations are technically the best solution normally but are significantly more expensive compared to liquid filled terminations due to the involved materials. Gas filled terminations are dry but face the same challenge for the sealing system as liquid filled systems. Dry pre-assembled terminations are using pre-moulded silicone arrangements which limits the flexibility regarding application and usage. In order to overcome the individual limitations of different dry type concepts, a new dry type termination based on an insulating gel was developed.

DESIGN OF DRY TYPE TERMINATION

The new dry outdoor termination with a silicone pre-molded and factory tested stress cone is available for a wide range