DRY TERMINATIONS FOR HIGH VOLTAGE CABLE SYSTEM

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ABSTRACT

Comparison between dry and fluid filled terminations in term of their designs, drawbacks and benefits will be presented. Overview of available dry type terminations will be given as well as the actual status of extra high voltage dry self-supported outdoor termination development..

INTRODUCTION

Terminations for extruded high voltage cable are traditionally made with a supporting insulator (porcelain or composite), a rubber stress-cone slip on the prepared cable and a fluid (oil or SF6) filling the empty space between the cable and the insulator. This design has a very long and good experience but has also some drawbacks. The sealing of the system has to be perfectly made to avoid any leakage and ensure a good performance along the entire product life time. In the case of internal arc, such fluid filled terminations, especially oil filled, can produce severe damages to the surrounding equipments and human beings.
The use of fluid free or dry termination can eliminate the risk of leak and strongly reduce the risks associated with an explosion in case of internal arc. Dry sealing ends are now used since many years for GIS terminations up to the extra high voltage level (550 kV). Such design is now commonly accepted and tends to be more and more the standard for such application. Dry outdoor termination are also being used with success since many years but their voltage application has been limited up to now to the lower end of high voltage class. Actual developments of outdoor termination are oriented towards dry type terminations for extra high voltage that will increase the use of such products in the near future as figure of merit will also gives them clear advantages over traditional fluid filled designs.

TRADITIONAL FLUID FILLED TERMINATION

Traditional fluid filled terminations are composed of one supporting insulator filled with oil or SF6 as presented in figure 1. For GIS and transformer terminations the insulator is made of an epoxy based material. Insulators used for outdoor terminations are of porcelain or composite type. The electrical stress control is usually made with a rubber cone slip on the prepared extruded cable. The volume between the cable with its stress-cone and the supporting insulator is filled with some dielectric fluid such as silicon oil or SF6. This termination design is being used since many years and has very long and good experience but has also some drawbacks.
This simple design can be adapted to various cable constructions and dimensions without problems. The volume between the stress-cone and supporting insulator being filled with fluid material the variation in cable dimension is easily adapted without any special care.
One disadvantage of this design is that the presence of a fluid needs a very careful sealing of the termination to avoid any leak that could lead to an electrical breakdown.
Tight sealing between metal parts is presenting usually no problem. The most critical point where sealing has to be achieved perfectly is the interface between the cable and the termination base plate. As cable dimensions are not always identical, the sealing system has to fit onto the various cable dimensions. Some examples of sealing systems are schematically presented in figure 2. This potential risk of leak that is present in all fluid filled installations request a periodical inspection to check oil level or gas pressure. To reduce the risk associated with leak some termination, especially in extra high voltage, are equipped with a monitoring system to detect any fluid seepage before it give rise to major problem.
A second drawback of fluid filled terminations, especially the oil filled ones, is that the power released in case of breakdown is very high. The total power involved during the fault corresponds to the electrical power during the internal arc and additional power due to the combustion of the oil initiated by the arc. With oil filled termination the ratio of combustion energy to electrical energy can easily reach a factor 10 depending on the oil volume. This high power released during fault can cause severe damage to the surrounding equipment although that oil filled termination can in some case be equipped with anti explosion device which limit the impact of such failure.

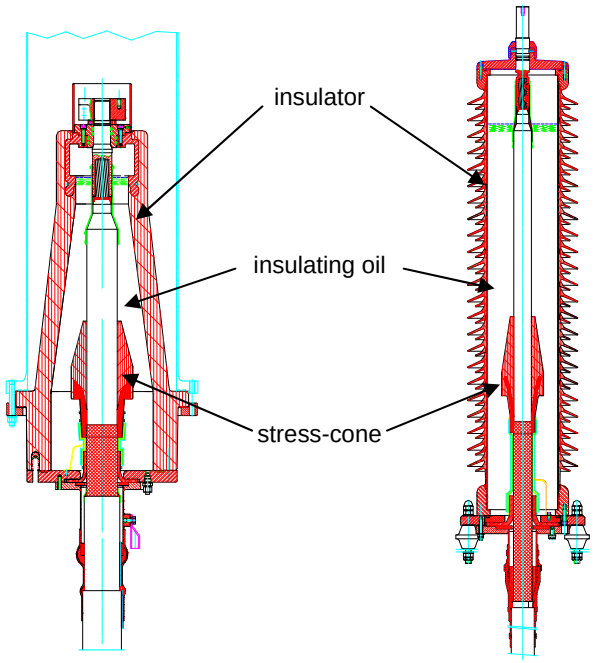

Fig. 1: typical design of fluid filled terminations