IMPROVEMENTS ON DRY TYPE DESIGN FOR GIS AND TRANSFORMER TERMINATION UP TO 300 KV, BY MEANS OF ADJUSTABLE COMPRESSION FORCE

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ABSTRACT

Experiences from identical in house technology up to 170 kV at Brugg Kabel AG and existing finite element simulation allowed developing a new GIS/transformer termination for 300 kV XLPE-Cable with cross section up to 2500 mm^2. Such product has specific peculiarities like wide application range and optional plug-in characteristics.

Developed design has a wide application range for each stress cone. Such application range allows compensating to a quite large extent the manufacturing tolerances of the cable insolation diameter. As further improvement, adjustable pre-load of the compression springs further allow an extended installation temperature range of 0 ÷ 40 °C, granting optimal interface contact pressure at the cable-stress cone and stress cone-epoxy insulator interfaces at any operating temperature. In addition, depending on the chosen application, it is possible to either install the plug-in or the locked-in dry-type termination.

Development activity has been finalized with type tests at three different voltage levels: 170, 245 and 300 kV and having been documented and certified by an independent third party authority.

KEYWORD

GIS/Transformer termination, stress cone, silicone material, *FEM simulation, springs adjustment*

INTRODUCTION

Prefabricated termination are widely used in 145kV - 300kV EHV cable due to its advantages of easy and short assembling time, requirement of less skill, that have a rubber stress relief cone pressurized by springs on an epoxy unit. A construction of type termination is shown in Figure 1, which has two insulation interfaces of "silicone stress cone-epoxy insulator" and XLPE cable insulation-silicone stress cone", and the silicone stress cone is pressurized by springs for secure the two interfaces' mechanical contact. Therefore, long-term electrical and mechanical performance evaluation is required.

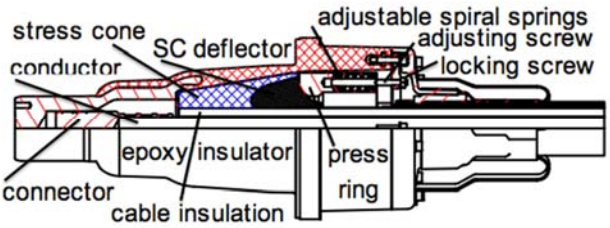

Fig.1 Compressed springs to supply the contact pressure

Meanwhile, the shrinkage of XLPE cable insulation beneath the silicone stress relief cone is observed under the long-term pressurization. The shrinkage is unavoidable and is one of an issue on long-term insulation interface performance. The shrinkage due to XLPE insulation creep is affected by pressure, time and especially by temperature. Therefore, the shrinkage under various conditions is to evaluate. Furthermore, its long-term performance was evaluated by electrical break down strength test with shrunk cables.

DEVELOPMENT OF SILICONE STRESS CONE AND THE SELECTION OF SILICONE RUBBER MATERIAL

In the development of the GIS/Transformer termination type plug-in and dry, criteria must be defined for the pressure force of the stress-cone to cable insulation and to the epoxy insulator at low operating temperature of -15°C.

Contrariwise the pressure force shall not exceed 5bar at maximum conductor temperature of 90°C or emergency operation up to 105°C and ambient temperature up to 60°C to avoid a deformation of the cable insulation.

From experience, the minimum pressure force of the stress-cone onto the insulation is defined at 1bar and at highest temperature at 5bar. To archive this operation pressure range, one further precondition is the right choice of the insulation material as well as of the semiconductor material for the stress-cone. Both must have the same or similar mechanical characteristics.

In addition, a linear characteristic of the compression springs must be respected. For the use of sealing ends at permanent high temperature, it is advantageous to adjust the compression spring so that the pressure force of the stress-cone can be reduced. Are all prerequisites fulfilled, it is possible to use stress-cones for a cable insulation diameter with a larger tolerances.