Design and Implementation of SF6 Gas Insulated Medium Voltage Instrument Transformer

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Abstract

In this paper, SF6 gas insulated voltage instrument transformer (VIT) is designed and implemented and also tested electrostatically. A complex model consisting of air bubbles inside the epoxy cast resin is used for computer tests. The standard lightning over voltages is applied according to IEC 66076-3 and IEC 61869-3-2011. Computer tests show that SF6 gas insulated VIT is cost effective, lighter than that of epoxy cast resin, and environmentally friendly.

Some of the few important concepts that must be observed are the protection of the environment from the design and manufacturing process to the installation stages of the voltage and current instrument transformers, ensuring operational safety, minimizing maintenance requirements and minimizing fire risks. This plays an even more important role, especially in medium voltage (MV) and low voltage (LV) instrument transformers because it is one of the most important components of distribution systems. [1-2].

SF6 gas is used as insulating material inside the VIT due to its properties such as high dielectric strength, chemical stability and non-toxicity. Critical points between the high voltage winding and core material are defined and the associated electric field and breakdown voltages are calculated by simulation. Analytically, Equation (1) is then used to obtain the breakdown voltage of SF6.

$$V_{sf6}=1321pd^{0.915}kV \quad (1)$$

In Eq. (1), p is pressure and d is distance between the selected (critical) points.
is calculated analytically using Eq. (1) and COMSOL Multiphysics® simulations. Since the electric field is nonuniform, the multiplication of SF6 pressure and distance between the selected points is calculated within a range of for the simulations. The standard lightening impulse voltage is defined in Eq. (2) [3].

$$V_L=175000(\exp(-14600t)-\exp(2469135t)) \quad (2)$$

SF6 gas will easily reach all the coils as it is pressed into the housing under pressure in the pressurized environment (after drying for the body, after necessary pretreatments such as gas pressure under negative pressure). On the other hand, compared with the traditional model, the weight will be reduced to a great extent and will occupy less space in the panel due to its small size. The following figures shows the model and computer simulations of SF6 gas insulated VIT.
Verification tests results are given in Table 1 and Table 2.

Figures used in the abstract

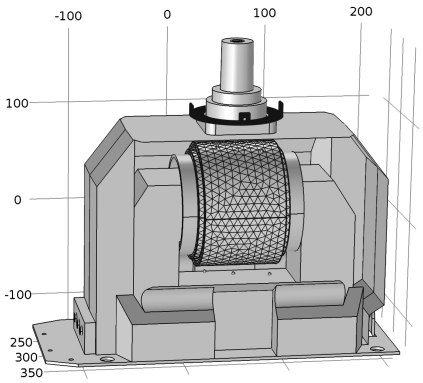

Figure 1: Inner parts of SF6 gas insulated VIT with air bubbles.