POTENTIAL OF MULTILAYER COATING FOR GAS INSULATED CABLE DIELECTRIC WITHSTAND IMPROVEMENT

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ABSTRACT

Gas Insulated Lines (GIL) are widely used for linking gas insulated substations (GIS) to overhead lines or to power transformers.
The possibility of improving the GIL dielectric withstand by applying a multi-layers coating on the conductors surface, in order to reduce the GIL size, is investigated. Tests are thus done with SF_6 gas, as it is widely used in GIL, and a silicone based multi-layers coating. N_2 gas is also investigated since it is considered as one of the possible SF_6 substitutes in a greenhouse effect viewpoint.
A dielectric withstand improvement is noted under negative Lightning Impulse voltage in accordance with the literature. Advanced tests may be carried out on the gas/coating interface, the voltage wave form, presence of particles, moisture, etc.

KEYWORDS

Dielectric withstand, SF_6 substitutes, N_2, coated electrode.

INTRODUCTION

Gas insulated lines (GIL) are widely used for linking gas insulated substations (GIS) to overhead lines or to power transformers. Because they are versatile by design, they can easily be installed in different configurations (horizontally, vertically or at inclined positions, in overhead and ground level). They can also be installed in underground tunnels eliminating thus the need for unsightly overhead lines for both short and long distances. When installed on the outskirts of towns, cities or large industrial sites such as factories, power stations, airports, etc., the environmental horizon is preserved while the effective delivery of high voltage power up to 800 kV to users can be provided [1-3].
But a major drawback of this technology is that in case of failure, repairing operation can be difficult and long. Therefore, important work is conduct in the technical community to improve the reliability of GIL, and especially the dielectric behaviour which is one of the major cause of failure [8, 9].
Actually GIL often use sulphur hexafluoride gas (SF_6) as insulating gas, but, since SF_6 is identified in the Kyoto protocol as one of the potential greenhouse gases, many works have been launched to find possible alternatives. One of the best candidates from a Global Warming Potential (GWP) viewpoint is the nitrogen gas (N_2).
Unfortunately, this gas has a low dielectric withstand compared to SF_6, so mixtures of 90 to 95% of N_2 with 5 to 10% SF_6 can also be found in that technology.
In the following, we focus on the possibility of improving the dielectric withstand of a GIL by applying a multi-layers coating on the conductors. Indeed, it is now well known that the dielectric withstand of a gas insulated system is reduced by field-emitted electrons at the conductors [4-7].

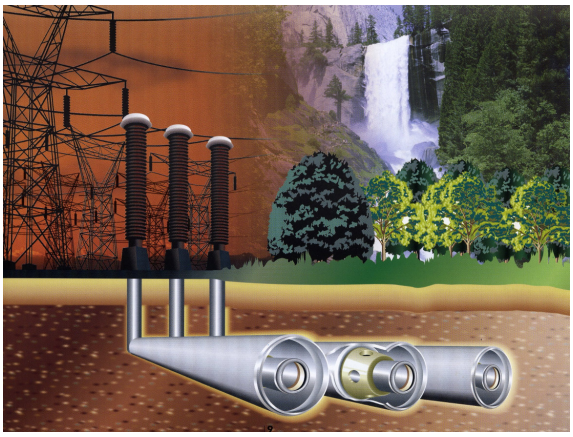

Figure 1: Example of underground GIL.

This dielectric withstand improvement would then allow to improve the reliability and/or will allow to reduce the GIL dimensions, especially in the case of N_2.

For that purpose, the investigation is carried out on a GIL-based system, with SF_6 and N_2 gases.
The first part of the study is dedicated to a comparison of the SF_6 and N_2 dielectric withstand without coating under negative Lightning Impulse (LI) voltage. Then, the influence of a silicone based multilayer coating on the dielectric withstand of a GIL-like system insulated by the two gases is investigated.