DEVELOPMENT OF A 270 kV XLPE CABLE SYSTEM FOR HVDC APPLICATION

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ABSTRACT

A type test qualification has been performed on a full cable system, including a 1000 mm² aluminium conductor cable with 17 mm insulation thickness and accessories (moulded field joint and terminations). The joint used during the test campaign took advantage from the LDPE experience gained on the EHV 225 kV AC networks.

The test was carried out on a 270 kV system according LCC converter type protocol of CIGRE recommendations TB 219. The cable system passed successfully and allows to a qualification for both technologies VSC and LCC.

The authors will present the main characteristics of the system in test, and details the results obtained

KEYWORDS

Space charge, XLPE, PEA, VSC, LCC.

INTRODUCTION

Today, DC seems more suitable than AC for long length high voltage power transmission. Indeed, multiple losses such as capacitive loss encountered in AC can be drastically reduced by working in DC [1]. Using polymers as insulation for HVDC cable is a challenge for a number of researchers and manufacturers due to the multiple advantages brought over current oil-filled paper insulation.

There are, however two main reasons why the traditional paper type cable has been used for transmission of energy for DC application.

The first one is a fairly restricted market dominated by paper insulation that fit in satisfactorily with the need. Thus the profitability of the investments required to developed synthetic insulation HVDC cable was not proved. The second one is related to the only technical point of view due to the insufficient knowledge of the extruded synthetic material's behaviour under DC stress. Space charges formation under DC stress is certainly the major concern for such a material. The space charges build up may modify the electric field distribution inside the insulation and leads to local overstresses unsuitable to long-run ability. In addition the introduction of VSC technology where the power flow reversal occurs without changing polarity of the cable encourages the use of synthetic insulated cables.

During last years many progress for semi-conductive and insulation polymeric materials were done and insulation technology was significantly improved as well.

Sileccable started the study to develop materials and technology for extruded insulation cables in years'90s [2]. Measurement techniques are now available and the spatial distribution of space charge was deeply investigated, applying PEA technology (Pulsed Electro-acoustic Analysis).

The intention of the present study is to explore the possibility to use plaques and model cable for characterisation of the dc electrical properties. The focus of the paper is to asses the reliability of XLPE insulation cable system subjected to high dc electric stress with polarity reversal. This paper describes the development process of 270 DC XLPE Cable systems with the results of the type tests qualification according Cigre recommendations TB 219.

EXPERIMENTAL

PEA system for plaque samples

Space charge measurements have been performed using the Pulsed Electro-Acoustic (PEA) method. The method consists in detecting and analyzing the acoustic waves generated by the interaction between the space charge in the material and an applied electric pulse. Further information about the technique is given in [3, 4]. The test bench set up is given in fig. 1

Fig.1: PEA Test bench for plaque specimen up to 30 kV

The samples were submitted to dc poling voltages in the range 5 to 20 kV, corresponding approximately to applied fields 10 to 40 kV/mm. A polarity reversal is performed after the step of 40 kV/mm.

Voltage ramp-up and ramp-down were 1 kV/mm/s. Data