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Qualification of a highly electrically and mechanically stressed AC cable system

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Abstract: This paper describes a successful prequalification test according to IEC62067 for an HVAC cable system of which one part was subjected to simultaneous high electrical and mechanical stress. The focus in this paper lies on the design principles behind this kind of system and on the result of the performed tests.

Keywords: XLPE cable systems, HV/EHV power cables, mechanical stress

1 Introduction

HVAC cable systems based on XLPE have now reached a maturity level where installations at the 400kV level appear with regularity. At the same time novel requirements have been put on XLPE cable systems through innovations within the power sector pushing the limits for such systems to a new level.

One of these innovations is the Powerformer™ technology developed by ABB. Within this technology, the long service record and consistent reliability of XLPE cable systems are used to build a new type of electrical insulation system for power generators.

The base characteristics of XLPE cable systems fulfilled the needs for the development of a high voltage generator. However, to optimize the generator design additional requirements were introduced:

1. The cable system must have electric field levels in excess of those used at the 400kV level in order to minimize the size.
2. The cables should withstand higher mechanical stresses than standard XLPE cables.
3. The conductor has to have a low loss design in order to be adapted for the use in a high voltage generator.

The current paper gives an in-depth exploration of the first two points both from a design and a testing point-of-view. The basis for the development is described in Section 2, Section 3 contains the chosen design criteria, the test set-up is described in Section 4, the results from the prequalification and subsequent tests are detailed in Section 5 and some final comments regarding the qualified system are given in Section 6.

2 Basis for development

Behind ABB's development of an XLPE cable system designed for high electrical and mechanical stress lies a long and successful implementation of XLPE cable and accessory technology. The first XLPE cable system for voltages above 100kV was provided by ABB in 1973 and the first above 200kV in 1978. The first 400kV type and long term field tests were performed in 1986 and 1988, respectively. This was then followed by a successful prequalification test of a 400kV cable system in 1995.

The electric design stress for XLPE cables has gradually increased over the years. In this document,