Recommendations for Testing DC Transition Joints for Power Transmission at a Rated Voltage up to 500 kV

CIGRE WG B1.42: Gunnar **EVENSET (Convener,NO)**, Bjorn **SONERUD (Secretary,NO)**, Marco **ALBERTINI (IT),** Jesus **CORREA (ES)**, Ivan **JOVANOVIC (US),** Tae-Ho **LEE (KR)**, Mohamed **MAMMERI (FR),** Hiroshi **NIINOBE (JP),** Peter **SUNNEGARDH (SE),** Roman **SVOMA (GB),** Minh Nguyen **TUAN (FR),** Volker **WERLE (DE),** Zheng-Zheng **CHEN (CN) ,** Bruno **BRIJS (BE),** Anders **JENSEN (DK),** Pascal **STREIT (CH), Pierre ARGAUT (pierre.argaut@sileccable.com) (FR)**

ABSTRACT

This paper introduces the coming final report of SC WG B1.42 of CIGRE. giving recommendations for Testing DC Transitions Joints for Power transmission. The purpose of these new recommendations is to give general guidance for tests on DC transition joints for power transmission. These recommendations are valid for transition joints between paper-insulated oil filled/mass impregnated cables, including PPL, and extruded insulation cables with rated voltage up to 500 kV.

KEYWORDS

HVDC. Transition joint ; Testing; Extruded; SCFF; PPL/MI

1 Introduction

Background

Mass Impregnated Paper Cables (MI) has been used predominantly in HVDC applications since the 1950s. Gas filled (GF) as well as Self Contained Fluid Filled (SCFF) HVDC cables were also used, however the widespread use of XLPE in AC transmission and distribution networks and further research and development in polymeric insulation has resulted in the use of XLPE also for HVDC applications. In the 1990s, interest in Polypropylene Laminate Paper (PPL) for use in SCFF cables resulted in the application of this technology not only for EHV AC, but also in HVDC. Mass impregnated PPL has also been developed specifically for HVDC applications.

Gradually over the last decade the voltage of the HVDC XLPE projects has increased and it is probable that interconnection between XLPE, MI and PPL/MI will be necessary as the networks are reconfigured in the future, to form diversions or as part of a repair. New projects may use combinations of technologies depending on markets, voltage levels, manufacturing technologies and project risk profiles. The connection between the different cable systems is likely to be a complex prospect as some of the specified cable operating temperatures are different at this moment in time (50º-55ºC for MI, 70ºC-90ºC for XLPE and 85ºC-90ºC for PPL/MI and fluid-filled). The cable systems may be type tested and qualified to operate for different HVDC converter technologies (VSC or LCC).

Terms of Reference

CIGRE set up WG B1.42 to review this subject and issue a brochure to include:

- A review of the existing recommendations and standards and the extent to which they cover the testing of transition joints.
- Installation considerations and how the testing and specification impact project applications
- Definition of test regimes for transition joints for routine, sample, type, prequalification and after installation tests.

Purpose of this paper

This paper introduces the CIGRE Technical Brochure prepared by B1.42.giving recommendations for Testing DC Transmission joints for Power Transmission. This paper takes some parts of the Technical Brochure but does not include the details of the Scope of Approval of Type Tests and Prequalification Tests.

The tests in these recommendations from B1.42 are mainly based on recommendations in TB 496 [1], TB 415 [2] and Electra No. 189 [3].

The purpose of these new recommendations is to give general guidance for tests on DC transition joints for power transmission. These recommendations are valid for transition joints between paper-insulated oil filled/mass impregnated cables, including PPL, and extruded insulation cables with rated voltage up to 500 kV. Pipe type and gas pressurized cables are not considered. Concentric cables with low voltage return insulation are considered, but not bi-pole concentric cables. Transition joints for single core and multi core cables (i.e. cables with individual metallic screen, but common armour) are covered. Both land and submarine transition joints are covered.

Different types of transition joints can be used to connect oil-filled/mass impregnated to extruded insulated HVDC cables, for example a back-to-back transition joint (TB 89 & TB 177). Each manufacturer may have different solutions. Y branched joints are not considered within these guidelines. Tests on joints between cables with similar type of insulation are not considered in this document (covered by TB 496), even if they are used between cables with different conductors or different screens [1].

Although the application of high voltage transition joints for interconnection of different cable systems is likely to increase for example in projects of upgrading existing lines , the quantity of transition joints compared to the quantity of standard accessories required will be low. There will also be a large variety of cable constructions which have to be connected using transition joints.

The number of type tests that can be performed may be limited due to the availability of suitable paper insulated cables, thus guidance is given in **6.1 General**.

Comments on the need for a prequalification test are also made. Three appendixes complete the recommendations. Appendix 3 covers Temperature Distribution in Transition Joints with dissimilar cable insulation.