DEVELOPMENT AND TESTING OF THE 110 KV SUPERLINK SYSTEM

Dag **WILLEN;** NKT Group A/S (NKT), (DK), dag.willen@nkt.com
Werner **PRUSSEIT;** Theva Gmbh (Theva), (DE), prusseit@theva.com
Robert **PRINZ;** Stadtwerke München Gmbh (SWM), (DE), prinz.robert@swm.de
Robert **BACH;** Fachhochschule Südwestfalen, Soest (FH-SWF), (DE), bach.robert@fh-swf.de
Alexander **ALEKSEEV;** Linde AG (Linde), (DE), alexander.alekseev@linde.com

ABSTRACT

A new transmission technology using 2G HTS wires with high engineering current density is developed in the SuperLink project. The goal of the project is a versatile and easy-to-install 110 kV power-link developed specifically for city areas such as Munich, Germany. Transporting 500 MW over 10-20 km lengths in such a power link require high performance in the AC loss of the HTS conductors, strong and compact cryogenic dielectrics and energy-efficient thermal insulation. This article presents some first experimental results and implications of these test results on the use of 2G HTS conductors in compact HTS power systems.

KEYWORDS

High-temperature superconductor, HTS, energy cable, energy system, Superlink.

INTRODUCTION

Practical High-Temperature Superconducting (HTS) cable systems can replace multiple circuits of conventional copper and aluminium cables in high-density population centers. This has the potential of drastically reducing the cost of excavation and installation works, for example by replacing a large tunnel by a narrow trench or under-boring (HDD). The planning and permission process can be simplified since only a single optimal route needs to be found as compared to multiple routes for conventional cable technology.

In terms of Green Technology, the energy balance can tip in favour of HTS systems in situations of high loads provided that the cryogenic cooling losses are small and that the AC losses of the HTS system are low. An energy-efficient system has the added benefit of enabling long distances between cooling stations. This is a requirement in densely populated areas where space for locating cooling stations can be hard to find.

In the SuperLink project, it is the ambition to demonstrate a full-scale HTS cable system with these attributes in a utility environment. We present here the status of the development and testing of the components for this system.

SYSTEM ARCHITECTURE

Different system architectures have been demonstrated for three-phase AC systems. Some variations are single-phase in single cryostats, three phases in a single cryostat and triple coaxial cables ("Triax"), Fig. 1. Liquid nitrogen (LN_2) is used as impregnation for the electrical insulation and as circulating coolant to maintain the cryogenic temperatures required for the superconducting material. Cooling configurations include counterflow cooling within one cryostat and separate return cryostats linking the two ends of the cable system. After careful study in the initial phases of this project, including considerations of pressure drop, temperature margins for fault-events, and the optimal distance between cooling stations, the configuration shown in Fig 2 was developed. The advantage of this configuration is that a low temperature and high pressure of the liquid nitrogen can be maintained in the main cryostat with the three HTS cable cores. The separate return cryostats (RL) are connected to the main cryostat and brings out the LN_2 near a point with the highest temperature and lowest pressure that the HTS cable can tolerate under normal operation. The temperature and pressure of the nitrogen in the return cryostat are not constrained by the requirements of the HTS cable cores. This increases the serviceable length between each cooling station compare to other solutions.

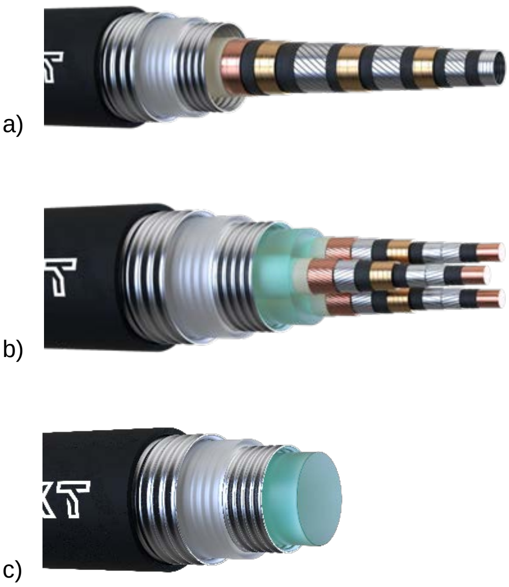

Fig. 1: HTS cable architectures a) Tripple coaxial for MV distribution; b) 110 kV HTS "SuperLink" for HV subtransmission; c) separate return cryostat for return transport of LN_2 coolant and impregnation medium.

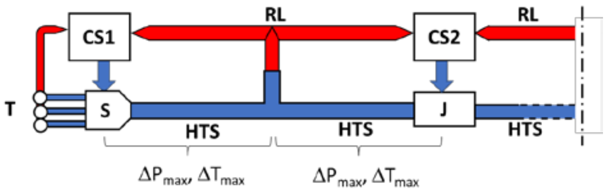

Fig. 2: Cooling architecture for long-length HTS cable system. Terminations (T), splitterbox (S), HTS cable (HTS) with Joints (J), return line (RL) and cooling systems (CS1 and CS2).