A.3.4.

Development project on HTS Cables

COEVOET M., EDF R&D, France
LADIE P., Pirelli Cavi e Systemi Energia, Italy

Abstract

High Temperature Superconducting (HTS) cable systems, characterized by high power carrying capacity coupled with reduced dimensions and environmental friendliness, may have the potential to give an answer to increasing constraints in transmission siting.
This paper presents the latest results achieved during the collaboration between Pirelli and EDF aimed at evaluating the technical feasibility of a high power superconducting link.

Résumé

Les systèmes à câbles supraconducteurs à haute température, caractérisés par des capacités de transport élevées tout en restant de dimension réduite et respectueux de l'environnement encombrement réduite , sont potentiellement capables de donner une solution aux contraintes croissantes liés aux implantations des systèmes de transport
Cet article présente les derniers résultats obtenus dans le cadre de la collaboration entre Pirelli et EDFdestinée à évaluer la faisabilité technqiue d'une liaison supraconductrice de forte puissance.

Preliminary Design Activity

Several years ago PIRELLI and EDF launched a collaboration aimed at studying the technical and industrial feasibility of high power superconducting links using the "cold-dielectric" coaxial cable design concept.
This collaboration was aimed at evaluating the possible deployment of HTS cable technology in situations where environmental constraints dictate the adoption of underground cable networks in restricted installation corridors or where existing conventional underground cables networks are approaching saturation. The design phase was driven by the following system parameters:

Total nominal power (MVA)	3000
Nominal voltage (kV)	225
No. of circuits	4
Power per (n-1) circuit (MVA)	1000
Circuit length (km)	10
BIL (kV)	1050
Short circuit current (kA)	31.5
Short circuit duration (s)	0.5

Experimental Activity

An experimental programme was implemented to characterise all the key elements of the superconducting coaxial cable system.

1. Dielectric

Dielectric materials were characterised in liquid nitrogen (LN2) at 77 K and 1 atmosphere as flat or cylindrical models; furthermore the evaluation of the performances of the most interesting materials in pressurised LN2 was performed: Paper Polypropylene Laminate (PPL), which showed the best dielectric performance, was selected. Cylindrical models showed impulse breakdown above 130 kV/mm and a.c. breakdown above 60 kV/mm.

2. Conductors

Experimental tests were carried out on prototype conductors of various designs, focusing on minimization of AC transport losses. See Fig. 1 in the next page.

The selected phase HTS conductor design is characterised by a two-layer structure, each layer consisting of 24 HTS tapes, applied in opposite directions.
The same two-layer structure was used for the concentric conductor.

Furthermore, a special composite support was developed in order to minimize the axial pull due to the thermal contraction.