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Pirelli-EDF DEVELOPMENT on superconducting cables

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Abstract

The superconducting cable appears to be a promising application of high temperature superconducting materials. Thus, an industrial feasibility study of high power « cold dielectric » cable was initiated in cooperation between Pirelli and EDF. The development of this cable system faces many challenges, both technical and economical. The initial results presented in the paper, both experimental and economical are encouraging.

Résumé

Le câble supraconducteur apparaît comme une application prometteuse des matériaux supraconducteurs haute température. C'est pourquoi l'étude de faisabilité indutrielle d'un câble de forte puissance à « diélectrique froid » a été lancée en collaboration entre Pirelli et EDF. Le développement de ce système de câble est un enjeu à la fois technique et économique. Les premiers résultats techniques et les perspectives économiques, qui font l'objet de cette publication, sont encourageantes.

Background

The discovery, in 1987, of high temperature superconducting materials able to work in liquid nitrogen revitalised the interest of the electrical industry in the development and the possible introduction of superconducting equipment in the electrical network. Among these equipment, the superconducting cable appears to be a very promising application.

One of the first deployments of HTS cable technology can be foreseen in situations where cable installation costs have a high impact on the total cost of the cable system. This situation could emerge in future around large urban areas, for example, if environmental constraints dictate the need to underground cable networks in areas of restricted installation corridors, or when existing networks with conventional underground cables become saturated.

Considering this background, PIRELLI and EDF launched a collaboration for:

- Studying the technical and industrial feasibility of a high power superconducting link;
- Developing a system prototype using the " cold-dielectric " cable design concept ;
- Estimating the investment, operating and maintenance costs of a superconducting link;
- Evaluating the economic attractiveness of HTS links in a variety of network configurations.

The study addresses only a.c. applications at the present time.

Preliminary Design Activity

The initial design phase was driven by the following system parameters:

Total nominal power (MVA)	3000	
Nominal voltage (kV)	90	225
No. of circuits	6	4
Power per (n-1) circuit (MVA)	600	1000
Circuit length (km)	10	10
BIL (kV)	450	1050
Short circuit current (kA)	10.3	31.5
Short circuit duration (s)	1.7	0.5

Two preliminary designs for cold dielectric cables and accessories were defined for the two voltage ratings. The main features are the two-layer design for the conductor, the use of Polypropylene Paper Laminate (PPL) as dielectric material and the capability to withstand the short circuit conditions indicated in the above table.

Experimental Activity

An experimental programme was initiated to characterise all the key elements of the