HVDC Power Cables: potential of superconducting and resistive designs

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ABSTRACT

The goal to reduce the carbon footprint of the human activity has resulted to a larger use of electric power as compared to fossil fuel power.

There are new generators types and new power generation facility locations.

On the other hand, in crowded areas, a larger amount of electric power has to be provided.

New types of high power transmission cables that are fitted to match these different needs are being designed.

The authors will address the case of High Voltage Direct Current cables:

- Choice of conductor : resistive, superconductive
- Choice of insulation system, lapped, extruded – different types of extruded insulation systems will be addressed,
- Challenges regarding the cable system design, and specially accessories
- Prototypes evaluation and performance assessment.

A special focus will be given to superconductive HVDC transmission.

KEYWORDS

HVDC, Superconducting cables

INTRODUCTION

Distributed generation (wind mills, solar cells, offshore generators) implies an in depth modification of the transmission network to bring the electric power from the production sites which are generally remote from the consumption areas.

Interconnection, management of reactive power has given to HVDC transmission a revival.

Now there are many designs of HVDC generators:

- line commutated converters,
- voltage source converters,
- multilevel voltage source converters,

They can be associated with a large choice of transmission cables:

Resistive conductor:

- lapped oil filled
- lapped mass impregnated
- extruded

Superconductive conductor:

- lapped liquid nitrogen filled.

This gives a wide range of technical solutions to the transmission engineer.

Superconducting HVDC cables are currently receiving significant attention due to their potential for transmitting large amounts of power. We will focus specifically on their last developments.

CAPABILITIES OF RESISTIVE HVDC POWER CALE SYSTEMS

LAPPED CABLES :

The traditional HVDC MI and oil filled cables with a lapped/impregnated dielectric are applicable to both LCC and VSC converters. Polarity reversals do not represent any problem.

Fig 1: Oil Filled Cable of the Gibraltar strait

Fig 2: Mass Impregnated Cable of the Norned connection

In the present situation these cables can transmit 900MW under 550kV, i.e. 1800MW for a bipole + and - 550kV.