Close and Return

Increased voltage for the HVDC Light® product range – a complete solution

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ABSTRACT

A new voltage level – 320 kV – has been introduced for HVDC Light® cable systems. The design principles of this system are the same as for the previous 80 and 150 kV levels. A total power window of several tens of MW to at least 1000 MW is now covered. The 320 kV cable system has been type tested according to the applicable CIGRÉ Recommendation. The diameter and weight of polymer HVDC submarine cables is about half the weight of three-phase HVAC submarine cables. Longer lengths of polymer HVDC land cable can be wound on a drum due to the lower weight and dimensions. This results in fewer joints per circuit length and less transportation costs.

KEYWORDS

HVDC, polymer, cable, system, installation

INTRODUCTION

The electricity networks of today increasingly need control and stability at high levels of loading. Increasing the stability through adding more lines is not always an option due to restrictions in right-of-way or limits to acceptable short circuit currents. Here, HVDC transmission solutions using undergrounding through extruded cables systems offer unique advantages.

Other reasons for introducing HVDC Light® cable systems in the network are the bulk transport of power both at land and sea, the interconnection of different parts of network for stability or control reasons and the connection of remote loads as for example oil-platforms.

Both underground and submarine projects have been realised using the HVDC Light® converter and the HVDC Light® polymer cable technology [1, 2]. The installed systems, so far, work on voltages of 80 and 150 kV. The installed powers have increased from the first project (Gotland) at 50 MW to the latest installed (Estlink) at 350 MW. At the moment of writing a total of 1566 km of HVDC Light® cables has been installed.

A gradual increase in both power and voltage is foreseen. For the larger powers, that is more than ca. 400 MW, it is more suitable to use a higher transmission voltage. The next DC voltage that complies with AC system levels through the use of HVDC Light® converters we see is 320 kV. For that reason the gradual cable system development has focused on this voltage. This new voltage level opens a window of power transmission between roughly 400 and 1000 MW – see Figure 1 [3].

HVDC connections need cable systems and converter stations. The development of the cable systems has so far focused on the Voltage Source Converter type. In order to keep down delivery time of stations these are more and more standardised around fixed voltages and power blocks. The standardized voltages are 80, 150 and 320 kV.

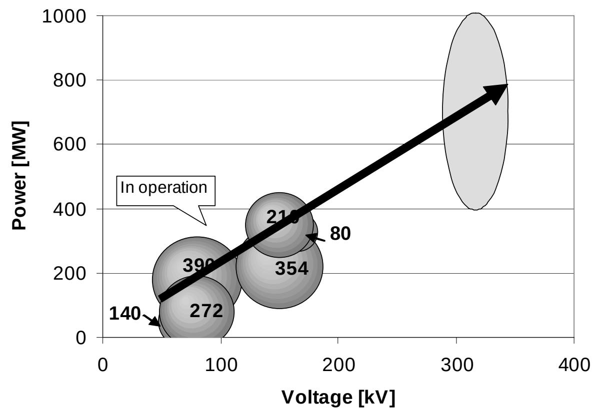

Figure 1. Foreseen increase in power and voltage for polymer HVDC. Every bubble represents an existing commercial project. The size of the bubble refers to the amount of cable delivered. The numbers denote the number of cable kilometers of the projects.

DEVELOPMENT OF 320 KV SYSTEM

The development of the 320 kV polymer cable system started from the earlier experience of the 80 and 150 kV experience. Virtually the same design concept was used for the development of the 320 kV system. This ensured a safe and solid basis for the development and future operation of this next voltage level.

Differences and similarities

A difference with the lower voltage classes is introduced though. The insulation thickness was chosen such that the mean electrical field strength was increased. The reason for this is the same as for the increasing field strengths of HVAC cables. That is, the outer diameters of cables become unrealistically large for higher voltages if the design field stresses are kept too low. The insulation thickness d of 150 kV HVDC Light®™ cables is standardized to 12 mm whereas the insulation thickness of the first 320 kV cables were set to 18 mm. This means an increase of the mean electrical field strength $E_m = U/d$ of 42%.

The electrical design of the termination is such that the heart of the termination is still based on the 80 and 150 kV designs. That is, a combination of non-linear field controlling adapters and a stress cone.