THE OSLO FJORD PROJECT – THE FIRST PROJECT WITH LONG LENGTH OF 420 KV XLPE INSULATED SUBMARINE CABLES

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ABSTRACT

Statnett, the Norwegian Transmission System Operator (TSO), is replacing the submarine power transmission link across the Outer Oslo Fjord. Based on the experiences from the Ormen Lange Project (also 420 kV) and further development of submarine cable systems for 420 kV, the transmission link will partly be built with 3 cables with an insulation system of Crosslinked Polyethylene Insulation (XLPE).

The total length of the cable link is 13 km which make it necessary to include a factory made joint on the XLPE cables, the factory joint being the new accessory completing a cable system for 420 kV.

This paper addresses the prequalification of 420 kV factory joints needed to realize this project.

KEYWORDS

Long 420 kV submarine cable link, factory made crosslinked XLPE joints. Insulation expansion, Water penetration and Lead sheath fatigue evaluation.

INTRODUCTION/BACKGROUND

Today there are 3 different submarine cable links crossing the Oslo Fjord. These cable links are important for the power supply to the eastern part of Norway, and for power exchange with Sweden. In 1981, a cable connection in the Outer Oslo Fjord comprising 2 power loops with 6 paper insulated oil filled cables (SCFF), were installed and commissioned. This cable link has been a great success and a vital connection for the power transmission between the two contries after the free power marked opened in 1991. The cable link has been in operation continuously for 27 years without fault. In 2008 a cable fault made it necassary to reduce the maximum allowable transmission capacity to 65 % of the original 1800 MW.

Given the importance of the link it was necessary to increase the transmission capacity as well as improve the reliability of the cable link.

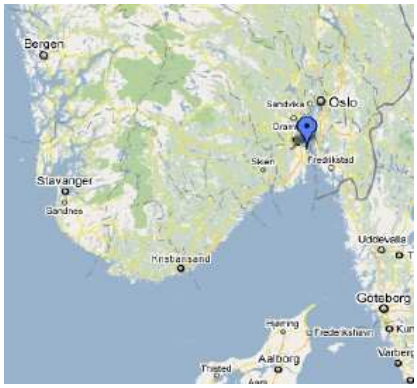

Figure 1 Location of cable link, marker on Horten

AMBIENT CONDITIONS AND GENERAL REQUIREMENTS

The maximum current requirement for the cables is 1350 A. Based on a maximum service voltage level of 420 kV, this constitutes a total transmission capacity above 2500 MW when all 9 cables are in service.

The cable link is located in fairly cold water, where the maximum sea temperature is 17 °C at the sea depth where the cable enters the cable conduits at land falls. The average sea temperature in the seabed in deep waters is 7 °C.

Ambient data and cable configurations used for the calculations are listed in the Table 1 below.

Number of cables	9
Distance between cables is in general	20 m
Min distance between cables at landfall	1 m
Maximum water depth	210 m
Max sea temp. at deep waters	7 °C
Max sea temp. at shallow waters	17 °C
Maximum burial depth	1 m
Thermal resistivity of sea bed	1.0 K.m/W

Table 1 Ambient data and cable configurations used for calculations

SELECTION OF CABLE ROUTE

Several cable routes options were evaluated, but the favourable option was to build a new submarine cable link close to the existing cables. Existing overhead lines, existing submarine cable termination compound and cable conduits can partly be reused.

The existing cables will not be removed before installation of the new cables, and because of the transition station located on the Island of Bastoy, the new cable route had to be south of existing cable routing to avoid crossing of these cables. Safety distance to anchoring zones, munitions area, varnishing shipwrecks and big submarine cliffs were elements forcing the cable corridor further to the south mid-fjord. In addition the cable corridor is crossing where the maximum water depth is 210 m, which is the shallowest part that could be chosen. From the ship