INFLUENCE OF SUBSEA CONDITIONS ON THE LONG TERM PERFORMANCE OF AC XLPE CABLES

Kenneth JOHANSSON, Anna DAVIDSSON, Draka Kabel Sverige AB, Nässjö, (Sweden), kenneth.johansson@draka.com, anna.davidsson@draka.com

Martin JAKOBSSON, Ulf H NILSSON, Jan-Ove BOSTRÖM, Borealis AB, Stenungsund, (Sweden), martin.jakobsson@borealisgroup.com, ulf.nilsson@borealisgroup.com, jan-ove.bostrom@borealisgroup.com

Hallvard FAREMO, Odd LILLEVIK, SINTEF Energy Research, Trondheim, (Norway), Hallvard.Faremo@sintef.no, Odd.Lillevik@sintef.no

ABSTRACT

Medium voltage XLPE cables are becoming a major component for subsea systems, especially for connection of inter-array cabling for offshore wind farms. Cables in subsea installations are subjected to significantly different conditions compared to corresponding underground systems. In particular the combined influence of salt water and hydrostatic pressure is important to study in the case of wet and semi dry design cables.

In this study an accelerated ageing test has been made to simulate subsea conditions. Results from the testing of 20kV cables are reported and compared to data for cables with corresponding material systems tested according to methods prescribed in Cenelec HD 605.

KEYWORDS

Subsea cables, XLPE; wet ageing, Cenelec HD 605

INTRODUCTION

Infrastructure investments off shore have shown a rapid increase during the last 10 years. Generation of power from off shore wind parks and research and development of techniques to generate power from tidal currents and waves will put even more attention on subsea transmission and distribution of electricity. Even though the locations of the present installations today mostly are in shallow waters new possibilities to locate wind generators on floating platforms located at even deeper waters are being explored.

The power generated from wind generators are transferred via cables to transformers for transmission of collected power via HVAC or HVDC transmission links to major land based grids.

As valid for any system for supply of electricity high reliability is paramount. In subsea installations cables are subjected to conditions different to those prevailing for land cables and the obvious differences are the high hydrostatic pressure in combination with salt water.

For cables with wet or semi dry constructions or in case of water ingress due to possible damages to the cables, the risk for water treeing and thereby reduced cable life is one concern [1,2].

For land cables standards are well established where the water treeing degradation phenomenon is addressed via accelerated wet ageing tests. This type of tests and the performance requirements are described in standards such as Cenelec HD 620 / 605 [3,4] and ICEA S-94-649 [5].

As these standards do not address possible accelerated degradation conditions from hydrostatic pressure in combination with salt water, this study has been made to gain increased understanding of the influence of these conditions prevailing for subsea installed XLPE cables.

SUBSEA CABLE APPLICATIONS

The demand for subsea MV cables is continuously increasing as the demand for offshore wind farms increases as part of the global wind power development (Figure1).

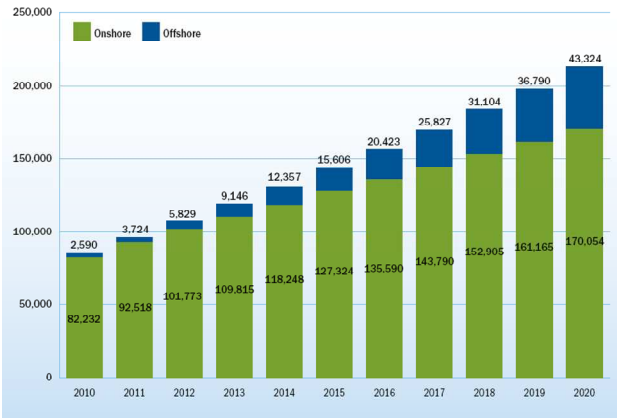

Figure 1: Forecasted cumulative wind power installation in the EU (MW) [6].

The application of subsea power cables for offshore wind farms is still a relatively new product area. To a large extent the technology so far has been based on traditional cable technologies for subsea power cables within offshore oil & gas applications and electrical utility applications. However, there are several differences between these application areas and offshore wind, and therefore traditional solutions may not necessarily be optimum.

There is a rapid development of offshore wind technology ongoing. For instance, the typical amount of wind turbines in future wind farms is expected to increase considerably compared to wind farms established so far. Also, future wind turbines will generate more electrical power than until now, and a requirement for general higher current carrying capacity of the cables can be expected.

Furthermore, due to the costs associated with establishing future offshore wind farms combined with the fact that the income from production of electric energy cannot be expected to be comparable with the income from the oil and gas industry, there will be a larger focus on cost effective solutions than in these areas. Consequently,