After Installation Testing of Inter-array Cables at Offshore Wind Farms using Damped AC Voltages

Rogier **JONGEN**, Edward **GULSKI;** onsite hv solutions ag, Lucerne, (Switzerland), r.jongen@onsitehv.com, e.gulski@onsitehv.com
Aleksandra **RAKOWSKA**, Krzysztof **SIODLA**; Poznan University of Technology, Poznan, (Poland), aleksandra.rakowska@put.poznan.pl, krzysztof.siodla@put.poznan.pl
Hans **GAAL**, Visser & Smit Hanab BV, Papendrecht, (the Netherlands), h.gaal@vshanab.nl

ABSTRACT

The voltage level of 33 kV for offshore inter-array cables has been the standard to date, but due to growing power demand slowly the voltage level of 66 kV will be used as the standard.

Considering the present problematic with failures in the operation of 33 kV cables and enhanced risks by using 66 kV cable systems, advanced quality control is becoming very important.

As the current state of the international standards is based on onshore experiences there is still a problematic to cover the actual serious problems experienced with failures on 33 kV inter-array cables. Internationally, the testing after-installation protocol is still under consideration.

In this contribution based on testing experiences of inter-array cables at offshore wind farms test procedures will be presented.

The application partial discharge monitored damped AC voltage testing in this concern is specially discussed in combination with actual testing examples that show the findings on inter-array cables at offshore wind farms.

INTRODUCTION

The continuous increase in renewable energy has worldwide contributed in the rapid growth in the number of offshore wind farms, as shown in fig. 1.

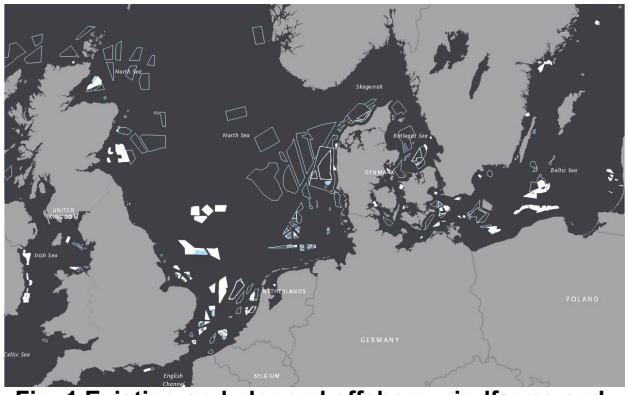

Fig. 1 Existing and planned offshore windfarms and allocated regions in Northern Europe [15]

Submarine or subsea cables play a vital role in bringing the generated power from the wind turbine to the offshore substation and eventually to shore. But repairing any damages to such critical infrastructure can be challenging and costly. Subsea cable damage most often arises from two areas [1]:

- External faults e.g. caused in the open sea by anchor strikes, dragging fishing nets, and erosion by jointer error or poor workmanship.
- Poor planning and building at the start of the project, coupled with inadequate risk identification, sub-standard design, and deficiencies in how procedures are applied.

The offshore wind sector on average declares at least 10 subsea cable failures to insurers each year. The incidents may not be very frequent, but their financial severity continues to grow to the effect of accounting for 77% of the total global cost of offshore wind farm losses [2]. It has found that two-thirds of cable faults recorded in its claims database can be attributed to contractor errors during installation, even if they do not become evident until the wind farms starts operations or is operational for a certain time.

NEW DEVELOPMENTS TOWARDS 66 KV

As the physical dimensions and generating capacity of offshore wind turbines increase, it is necessary to increase the voltage of an array cable network, which results in a decreased current for a given power level. As the current is reduced, so are the losses and more power can be transmitted through a cable with an equal cross-section of the cable core. This means that the future inter-array cables of offshore wind farms will operate on a voltage level of 66 kV, instead of the current 33 kV. However this increase is not just doubling the voltage level in respect to the technical point of view. Both voltage classes have their own technical challenges. High voltage testing is among the challenges facing this relatively new part of the offshore wind farm industry.

Advanced quality control is becoming very important. The main challenge is the need for specialized teams for cable installation and testing activities. The systematic testing and diagnosis during manufacturing, transportation, installation and operation can exclude or at least reduce possible risks of a failure during operation. However the testing after-installation protocol for offshore wind farms is still under consideration. The current state of the international standards is not based on long term experiences as obtained in offshore sector but more or less a copy of existing onshore standards and recommendations. As a result the provided solutions do not cover the actual problems experienced on inter-array cables.

Considering the risks, the offshore industry needs to setup own reliable specifications for submarine cable testing and diagnosis. This is done for instance in the new published Cigré Technical Brochure 722 and the upcoming IEC 63026, however regarding offshore after