

Prediction of progressive wear in Cable Protection Systems

Publieke samenvatting / Public summary

The wind energy industry is facing challenges with cable protection systems (CPS). Now – well before reaching the end of the design life time of the wind farms – operators and windfarm owners are confronted with a significant state of wear of cable protections systems, which is far beyond expected at this stage and can lead to significant costs. It is our understanding that many in the industry have encountered the problem and the causes for excessive wear are now a frequent discussion in the industry as it does not appear to be limited to a single CPS design or particular wind farm location. The unanticipated wear of these systems means that the present design strategy does not appear conservative and that measures the need to be taken to stabilise and protect the subsea power cables.

CPS can be further stabilized by putting a cover on top of it. For example, by placing a rock berm on top of (part of) the exposed part of the cable. This reduces the distance over which the CPS is fully exposed and is intended to limit movement of the entire system. Covering the CPS was common in early offshore wind farms, but in recent years the cover was typically omitted. Damage to CPS systems is typically observed in windfarms that did not have such cover hinting towards their beneficial impact on overall performance of the CPS.

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In engineering, the evaluation of loads on a structure and the strength of the structure is typically performed separately and one after the other. This approach is also applied for cable protection systems, which are exposed to a complex loading environment. For these types of systems an integrated approach appears to be more appropriate. Cable protection systems are applied to stabilise and protect subsea a power cable as it exits an offshore structure (wind turbine or high voltage station). Here the power cable is exposed as it has a short free-spanning section and generally also a section on top of the scour protection after which it is buried into the seabed. The cable protection system is used to stabilise this section of the subsea power cable. These systems operate in a complex hydrodynamic environment where the strength/stiffness of the system influences the load, which is why an integrated approach is needed.

This proposal's objective is to investigate the dynamic loading of cable protection systems and deliver a modular framework for the analysis of such systems for the fatigue limit state (FLS) specifically. The framework is a set of computations, or a computational procedure, that is required to translate environmental loading to fatigue damage or wear damage over the life time of the structure. Although the focus is on the FLS, the ultimate load state (ULS) will also be included within the framework. It is independent of specific software. At each step of the framework, output is generated, to be used as input for the next step. The output and input formats are generic, so that all can use their own software to perform the computational steps. Everything that Deltares develops to fill in the procedure will be shared within the consortium. The analysis framework will make no a priori assumptions and will be used, upon completion, to identify the main drivers for damage to and wear of cable protection systems used to protect the inter-array and export cables near bases of support structures throughout the offshore industry. The analysis framework will be applicable for multiple types of CPS and different types of foundations,

ranging from monopiles for wind turbines to jackets
for Offshore High Voltage Stations (OHVS).

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in
samenwerking met de Topsector Energie ontsloten.

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