Submarine power cables account for a small portion of the total investment in developing offshore wind farms. However, it is a critical component of the total infrastructure and cable failures are often the highest risk in developing and operating offshore wind farms. Therefore DNV GL, ECN, Deltares and other partners invite you to participate in the Joint Industry Project (JIP) with the aim to prevent future cable failures.

Background
In recent years there has been a significant increase of offshore cable installations due to growth in the offshore wind farm developments and interconnectors. Approximately 80% of insurance claims within the offshore wind industry are related to cable failures. Subsea cable faults contributed to the financial losses of global offshore wind projects and led to insurance claims accounting for more than EUR 60 million annually, which is only a small part of the actual total loss. Cable failures pose one of the highest risks in offshore wind as it could easily black out a section or even an entire wind farm. Cable inspections and repairs require expensive marine operations. Project repair operations can be delayed for several months due to vessel availability, weather windows and material acquisition. This leads to serious loss of revenue and technical degradation issues for power dependent equipment.

Objective
The main objective of the project is to reduce the levelized cost of energy (LCoE) and increase the reliability of supply of renewable energy from offshore wind by preventing a significant number of cable failures caused by damage during manufacturing, installation and operation. To achieve this, there is a need for a better understanding of the root causes of cable failures. Based on previous analyses (by a.o. DNV GL), this is partly due to errors introduced during the design, manufacturing and installation of the cable. Additionally, morphodynamic processes during the operational phase can expose submarine cables, leaving them vulnerable with an increased risk of external impact on the cable’s integrity. Furthermore, it is our understanding that continuous monitoring of the cable’s state of health during each project phase should be a crucial aspect of this proposed JIP. A lifetime monitoring system using fiber optics will therefore be designed, tested and developed during this project.
Approach
The proposed work will be based on our expertise in advanced technical solutions for offshore wind and interconnectors. The project is divided in five work packages (WP) to ensure a clear project structure with well-defined goals and tasks.

<table>
<thead>
<tr>
<th>Work Package</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP1 Identification of critical factors</td>
<td>Identify critical factors and impacts on failures Data base on failures and root causes Definition for improving current practice and mitigating measures</td>
</tr>
<tr>
<td>WP2 Design phase of submarine cable projects</td>
<td>Improving design and cable project development guidelines for integration Analysis and design of the integration of fiber optics for an unambiguous and accurate sensor response Cable route design optimization</td>
</tr>
<tr>
<td>WP3 Installation phase of submarine cable projects</td>
<td>Definition of areas for installation improvements following WP1 Develop fiber optic measurement techniques as an installation monitoring and early warning system Improving installation guidelines quality of measurement of impact on cables by adding tests Transport and installation modeling and optimizations</td>
</tr>
<tr>
<td>WP4 Operational phase of submarine cable projects</td>
<td>Develop further understanding on local morphodynamics, including sand waves Monitoring burial depth and early warning system Further understanding of impacts of mechanical and electrical stress during operational phase of cable projects Cable integrity monitoring system – development and validation in laboratory environment for operational phase of cable projects</td>
</tr>
<tr>
<td>WP5 Recommendations</td>
<td>Recommendations for selection and application of continuous monitoring and early warning systems Recommendations for cable layout and burial depth, cable system design, transport, installation methods and O&amp;M Recommendations for the application and testing of fiber optics into cables to monitor mechanical loads during installation and operation</td>
</tr>
</tbody>
</table>

Results
This project will result in defining a cable system with reduced likelihood of failure and increased intelligence. Specifically:

a. Recommendations will be formulated for such a cable system
b. A proof of principle will be performed to illustrate the results are achievable
c. The financial value of the reduced failure rate will be quantified

In general the impact of the project is a reduced failure risk; thereby reducing non-delivered energy, repair/failure related costs and increasing wind farm operation time. All in all, this project will lead towards a reduced levelized cost of energy, a lower carbon footprint of the offshore industry and lower insurance costs. It is stressed that results from several work packages can be applied to existing and future wind farms, which increases the relevance of the research and the potential cost savings.

Who may join?
The JIP is open to all parties with an interest in improving the quality of submarine power cables, including:
- Offshore wind farm developers
- Grid asset owners, TSOs and DSOs
- Energy utilities
- Energy project investors
- Insurance companies
- Cable manufacturers
- Cable installers

Taking part
The total project duration will be 2 years, aiming to start mid-2018. For this project a significant contribution from the Dutch government will be requested in order to result in a total budget scope exceeding EUR 1.5million. The remaining required budget will be obtained from participation fees.

Fee for larger companies (utilities, insurance companies, designers, engineering firms, cable manufactures, etc.):
- €35k / 2 year project

Fee for smaller companies (SME’s):
- €15k / 2 year project

Interested to learn more about this project or willing to participate? Please contact the project coordinator: Jan-Joost Schouten
janjoost.schouten@deltares.nl
T +31 (0) 646911168