How to manage risks for future offshore wind farms
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Abstract
The offshore wind industry is constantly seeking towards larger scales, both in terms of wind farm size and wind turbine capacity. MHI Vestas has already launched a wind turbine with a rating of 9.5MW and it is not unlikely that we will see turbines with a rating up to 15MW during the next 10 years. The increased size introduces new risks for the projects that needs to be identified and managed to achieve successful project development.

A well-defined risk management processes gives a competitive advantage in an increasingly cost-competitive industry where bid price is no longer the only determining factor for being selected. It is therefore important for the developers and contractors to demonstrate that they can be best in class in managing risks.

DNV GL links the risk management process to the prediction of Levelized Cost of Energy (LCoE). This is contradictory to normal industry practice where risks are mapped towards the impact on CAPEX, OPEX and production separately. Aggregating the risk to LCoE allows project management to identify the overall most important risks on the projects.

Objectives
- Demonstrate best practice risk management for future wind farms
- Understand risk impact on LCoE
- Identify main risks related to offshore wind farms

Method

Establish the context
Generic offshore wind risk register to identify key risks in the industry.

Risk Identification
Based on assessment criteria such as phases, technology, risk owner, category (TECOP)

Planning Design Fabrication Transportation Construction Operation Decommissioning

Technology
- Turbine
- Foundation
- Infra cables
- Offshore substation
- Offshore export cables
- Oshore export cables
- System (electrical system)
- General including risks related to areas such as project management, regulation, organization etc.

Risk Analysis
Analyze the identified risks based on the following criterias:

<table>
<thead>
<tr>
<th>Risk Criterias</th>
<th>Financial</th>
<th>Schedule</th>
<th>Technical</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Safety</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3. Supply</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4. Quality</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Risk Evaluation
Define mitigation actions to reduce probability and consequence

Evaluation example of risk:

<table>
<thead>
<tr>
<th>Mitigation Actions</th>
<th>Probability</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Improve design</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2. Increase capacity</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Results
The identified risks gives the following risk “heat maps” for risks pre-mitigations (to the left) and post-mitigations (to the right). Before mitigation it is noted that six risks are identified to have an extreme impact on the LCoE.

The risks identified are relevant for the seven phases, and it can be observed that around 60% of the risks identified may impact the construction phase. It is however noted that most critical risks with regards to impact on LCoE occurs at the design phase, and shows the importance of addressing the risks at an early phase.

Conclusions
The following graph shows the potential LCoE impact on the different technologies. The highest impact on LCoE is observed for the foundation risks, the general project risks and the turbine risks. This shows how important it is for contractors and developers to have appropriate risk management processes with contract structures that cover potential risks and reduces the LCoE impacts. The graph further shows the impact of having appropriate mitigations which reduces the impact on LCoE significantly.

References
1. DNV GL, technical due diligence work
2. ISO 31000:2009, Risk management – Principles and guidelines

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