Bankability of floating wind projects
Haugesund 24 June 2020
About DNV GL
DNV GL has built an extensive global footprint in offshore wind – and serve as an *honest broker* for the industry today

<table>
<thead>
<tr>
<th>&gt;97%</th>
<th>&gt;20 GW</th>
<th>&gt;50 GW</th>
<th>Global reach – local application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Played a role in the majority of the world’s offshore wind projects</td>
<td>Offshore wind measurements and energy resource assessment studies</td>
<td>DNV GL has provided Owner’s Engineer and Due Diligence services</td>
<td>DNV GL has local knowledge through our global footprint supported by European experience</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2,400</th>
<th>&gt;90%</th>
<th>Offshore standards and recommended practices</th>
<th>&gt;30 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy experts, who combine industry expertise, multi-disciplinary skills and innovation to solve complex technical issues in challenging environments</td>
<td>Of offshore wind farms are certified by DNV GL</td>
<td>Widely accepted in the renewable energy industry</td>
<td>Experience in supporting the development of offshore wind</td>
</tr>
</tbody>
</table>
From floating wind pioneer to a leading advisor

1st JIP:

2nd JIP:

Projects:
- Hywind demo (2008)
- Pelastar FEED (2013)
- WindFloat Atlantic (2015-2018)
- VolturnUS – concept (2014)
- aerodyn SCD nezzy – concept (2014)
- Nautilus – concept – SoF (2017)
- WindFloat Atlantic (2015-2018)
- EolMed-Gruissan Floating Windfarm (ongoing)
- Hywind Tampen (ongoing)
- Groix & Belle-Ile wind farm (ongoing)
- Nautilus – concept – SoF (2017)
- EolMed-Gruissan Floating Windfarm (ongoing)
- Hywind Tampen (ongoing)
- Groix & Belle-Ile wind farm (ongoing)
- DNV Guideline (2009)
We have been technical advisor to seven floating wind transactions and over 10GW of bottom fixed transactions

Lenders’ technical advisor to the 1.2 GW Hornsea Project One offshore wind farm

Successful Due Diligence enabled financing package of more than GBP 3.5 billion

Published: 27 September 2018  Author: Mona Ghobadi  Keywords: Wind energy

Contact: Simon Cox, Head of Section, Offshore Projects

BRISTOL, United Kingdom - 27 September 2018 - DNV GL, the world’s largest independent energy advisory and certification body, has successfully completed a lenders’ technical due diligence on Ørsted’s Hornsea Project One, the world’s largest offshore wind farm with a total capacity of 1.2 GW.

DNV GL supports Windplus as Lenders’ technical advisor to the 25 MW WindFloat Atlantic project

Technical Due Diligence helped secure EUR 60 million from the European Investment Bank to become world’s first project-financed floating wind farm

Published: 07 November 2018  Author: Mona Ghobadi  Keywords: Wind energy

OSLO, Norway - 7 November 2018 - DNV GL, the world’s largest independent energy advisory and certification body, has successfully completed a lenders’ technical due diligence on the 25 MW Windfloat Atlantic project, the biggest floating wind farm in the Iberian Peninsula.
Why floating wind?
Offshore wind to be more than 12% of global electricity generation in 2050

World electricity generation by power station type

Units: PWh/yr

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Most of the relevant offshore wind areas are in deep waters

Offshore wind Outlook 2019, IEA
Most of the relevant offshore wind areas are in deep waters

Offshore wind Outlook 2019, IEA
Floating wind to increase to more than 19GW in 2040
DNV GL projects a cost reduction of about 70% for floating wind until 2040.

Reference: DNV GL 2020
Floating wind risk picture
Floating wind = Off-the-shelf bottom fixed turbines + well known oil and gas technology?
Floating wind can leverage experience from bottom fixed wind and oil & gas, but differences need to be assessed

### Relevant experience

#### Design and fabrication
- WTG (RNA)
- Tower
- Substructure
- Mooring and anchoring
- Dynamic cable (array cable)
- Floating offshore substation
- Dynamic high voltage cable (>66kV)
- Export cable

#### Installation
- Mooring and anchoring
- Turbine installation/mating
- Towing and hook-up
- Floating offshore substation
- Dynamic cables
- Export cables

#### Operation
- Normal WTG maintenance
- Heavy WTG maintenance
- Substructure maintenance

**Legend**
- High experience
- Medium experience
- Low experience

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1 Experience from O&G, bottom fixed and floating wind considering volume and similarities
How do you reduce and manage risk?
Continue to follow best practice in project development

- Assure the relevant experience in developers organisation and team
- Proper site investigation and measurement campaign
- Choose “proven” floater technology and “proven” turbines
- Design according to respected floating wind standards
- Certify /verify the design (and construction)
- Choose experienced contractors
- Monitor, inspect and maintain

Utilize lessons learnt
Fabrication: Thoroughly assess the foundation fabrication process

1) Large part of CAPEX

![Pie chart showing percentages of CAPEX components]

- Other: 100%
- Development: 90%
- Installation: 80%
- Turbine: 70%
- Floater: 60%
- Mooring: 50%
- Electrical: 40%
- 20%

2) Takes time and on the critical path

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabrication (Nr 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbine assembly (Nr 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towing and hookup (Nr 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbine commissioning (Nr 1)</td>
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3) Some differences from existing experience

- More complex than jacket, monopiles and towers
- More units and has to be less costly than ships and oil & gas structures

4) Local supply chain requirements in a global market
Operation: Thoroughly plan for events in the operational phase

- **Major component failure**: 1-2 events per turbine per lifetime
- **Cable failure**: A total of 43 cable failures have been reported between 2007-2018
  
  1 Offshore Wind Subsea Power Cables Installation, Operation and Market Trends September 2018

- **Mooring line failure**: ~0.2 events per turbine per lifetime with oil & gas experience
  
  2 E. Fontaine, 2014 (OTC 25273)
Contracts: Thoroughly assess and ideally minimize the contract interfaces

Floating wind

- Turbine RNA
- Tower
- Mooring structure
- Anchors
- + installation
- + onshore crane

Bottom fixed

- Turbine
- Foundation
Thank you

Magnus Ebbesen
Business Lead - Floating Wind Advisory
Magnus.Ebbesen@dnvgl.com

The future is floating