Noble Denton Marine Services

Assessment and operation of Wind Turbine Installation Vessels.
Risk reduction through implementation of good practice recommendations

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Opening comments

**Safety**: Jack-ups are often large and complex vessels that can operate in extreme environmental conditions. Failure to ensure the correct selection and operation of these vessels could have serious safety implications including loss of life.

**Knowledge**: Some participants in this growth sector may be less familiar with the ... industry practices for Jack-up operations

Introduction

- Development & early rounds – some context
- Initial lessons learned
- Going further offshore
- Good practice recommendations
Development & Early Rounds

- First commercial wind farm “Vindeby” (1991!)

Statistics:
- 11x 0.45MW turbines
- 5m waterdepth
- Installed with floating crane

Result: **Success** – despite sheltered location reportedly 20% more power than size similar turbines on land so paved the way forward
‘Round One’ Wind Farms

Government & Crown Estate granted 17 ‘Round One’ wind farms off UK, Europe similar for up to 30x turbines

Turbine size ~2MW+.

Waterdepth Depth & Distance from shore
- <20m waterdepth
- <12 nautical miles

Equipment used: Crane vessels
- Jackups
- Coastal barges

e.g. KS Titan II at North Hoyle 2003
[Now ‘Bull Ray’ – Hercules offshore]
‘Round Two’ and Industry Reflection

Waterdepth & distance from shore
- <30m waterdepth
- <30 nautical miles

Larger windfarms with 75-160 wind turbines (typically 3-5MW) = larger capacity

Reality:
- More components
- Heavier components
- Longer transit times
- Less sheltered
- Increased waiting on weather & downtime
Early Reflections

- Most installations went very well
- BUT some areas beginning to be questioned:
  - Following marine & coastal construction ‘best practice’ – appropriate?
  - Opportunities for improvements on downtime & waiting on weather?
  - Incidents investigated (resulting UKHSE recommendations)
  - Unit suitability for ‘Round Three’?

- Renewable UK, pulled together a committee of operators, industry advisors and safety representatives and published:

Industry Guidance

Safety: Jack-ups are often large and complex vessels that can operate in extreme environmental conditions. Failure to ensure the correct selection and operation of these vessels could have serious safety implications including loss of life.

Knowledge: Some participants in this growth sector may be less familiar with the key Health and Safety issues, legal standards and industry practices for Jack-up operations.

NEWS

Windfarm cranes sink in Atlantic

Construction of a windfarm off the Donegal coast could be delayed after a barge carrying giant cranes sank in the Atlantic.

The barge, K.C. Titan 1, was travelling from the United States to Liverpool when it was lost at sea. There were no injuries.

Its cranes were due to install turbines at the Renvyle Flats windfarm.

Titan 1 lost during initial transit - 2008

Lisa A’ at Robin Rigg - 2007

‘Sea Worker’ capsize after evacuation – Feb 2016
Key Considerations – Selection & Operation

Foundation conditions:
Site-investigation; ‘enough’ to understand ground conditions:

- Some locations layered (complex) soils
- Position of core / sample ~ Lateral variability?
- Seabed hazards – surface & sub-surface

If location has complex soils, more information reduces uncertainty (multiple samples / seismic profiling)
Key Considerations – Selection & Operation

**Weather limits** for remaining on location (‘storm’ capability)

Seastate limits afloat / transit

Forecast #1 shows window suitable to move
**Key Considerations – Selection & Operation**

**Weather limits** for remaining on location ('storm' capability)

Seastate limits afloat / transit

**BUT**

Forecast #2 (later or another provider) shows window between days 4 & 5 is now lost

Move / operations limited to Day 1
Assessing Unit Capability

Operations Targeting:
- High payload capability
- Maximised waterdepth for operations
- Fast transit speeds

Review of capability, or Independent assessment to understand:
- Expected Foundation Response during installation
- Global Stability – Overturning and leg sliding
- Structural Strength – Leg and holding system
- Foundation Capacity – Footing load vs load applied during installation.

www.seajacks.com
Understand Unit Capability

<table>
<thead>
<tr>
<th>“Design rated” Capability</th>
<th>Site Specific Assessment</th>
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<tbody>
<tr>
<td>Assumed Foundation Conditions:</td>
<td>On-site conditions:</td>
</tr>
<tr>
<td>- Indicative Penetration</td>
<td>- Penetration range on-site</td>
</tr>
<tr>
<td>- Footing Assumptions - Pinned (conservative?)</td>
<td>- Consideration of fixity based on geotechnical review</td>
</tr>
<tr>
<td>- Fixity (ambitious?)</td>
<td></td>
</tr>
<tr>
<td>Representative Environment:</td>
<td>Client Met report for area:</td>
</tr>
<tr>
<td>- Waterdepth (often single waterdepth)</td>
<td>- Range of waterdepths across site</td>
</tr>
<tr>
<td>- Windspeed</td>
<td>- Windspeed (storm &amp; crane ops)</td>
</tr>
<tr>
<td>- Wave-height (&amp; periods)</td>
<td>- Site-specific wave data</td>
</tr>
<tr>
<td>- Current speed</td>
<td>- Site-specific current</td>
</tr>
<tr>
<td>Assumed Airgap</td>
<td>Operational Airgap</td>
</tr>
<tr>
<td>Design Loading Condition</td>
<td>Turbine specific loading arrangement &amp; windage</td>
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<tr>
<td>Considers general operational capability</td>
<td>Targeting specific operations at a specific location</td>
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Design vs. Operations

“Design” Windage – understood?

Unconservative

Better... but is 1 too low? Or 2 too high?

Vs. Target operations
Potential Efficiencies from Assessment

Intention for wind farm installation work is to be swift & efficient

- MUST understand actual soil conditions
- Potential for any ‘problematic’ locations e.g. deeper penetration, with reduced payload and preload (e.g. schedule this to be location 4 of 4 in that outing).
- Consideration of a ‘safe jacking location’ within the windfarm complex to which to move to rather than retreating to port.

IF a unit is having difficulty satisfying assessment or warranty requirements:

- Use of seasonal extremes to reduce loading condition sufficient to satisfy assessment requirements
- **Optimising orientation** with use of directional extremes where possible.
- Consideration of lowering to survival airgap to sit out weather extremes
Concluding Comments

- Offshore wind is an area of growth with ambitious targets
- Lessons learned through transition from ‘near-shore’ to ‘offshore’ operations
- Recommended Practices
- Understand ground conditions at proposed site
- ‘Design’ conditions / Site-Specific Assessment – understand unit capability and work within this.
- Potential to reduce risk further & unlock operational efficiencies

Nordsee Ost Wind Farm
Questions

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