Mitigation of piling noise during construction of offshore windfarms – special focus OWP DanTysk and Sandbank

Bremerhaven 14.10.2015 - RAVE Conference

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A key player in offshore wind

“I like the challenge on this type of project, especially offshore, as it is pretty much at the edge of what is technically possible.”

Benjamin Koss, Project Manager Civil Works
Vattenfall Sylt-Cluster

Vattenfall offshore wind farms in the German North Sea

Sandbank Cluster
- SB
- SBPlus
- SBE

DanTysk Cluster
- DT
- NP
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<th>Noise mitigation</th>
<th>Denmark</th>
<th>Germany</th>
<th>Netherlands</th>
<th>Sweden</th>
<th>UK/Wales/Scotland</th>
<th>Belgium</th>
<th>France</th>
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<td>Authority</td>
<td>Danish Energy Agency (DEA)</td>
<td>Federal Maritime and Hydrographic Agency (BSH)</td>
<td>Rijkswaterstaat (Waterwet (Ww), Water act)</td>
<td>Swedish Agency for Marine and Water Management (SwAM)</td>
<td>UK/Wales: “Marine Management Organisation”, The Planning Inspectorate</td>
<td>Flemish Government, the Department Leefmilieu, Natuur &amp; Energie</td>
<td>Ministère de l’Écologie, du Développement durable et de l’Énergie</td>
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<td>Soft start</td>
<td>Yes, but not standardised</td>
<td>Yes (9)</td>
<td>Under discussion, most likely yes.</td>
<td>Not at present</td>
<td>Yes, but no general rule.</td>
<td>No (3)</td>
<td>No – at developers discretion</td>
</tr>
<tr>
<td>Marine Mammal Observers (MMO)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes, but no general rule.</td>
<td>Yes, taken up in permit and not standardised (1)</td>
<td>No (3)</td>
<td>No – at developers discretion</td>
</tr>
<tr>
<td>Acoustic Deterrent Devices (ADD)</td>
<td>Yes, recommended but not standardised</td>
<td>Yes (9), Pinger and Seal soarer</td>
<td>Under discussion, most likely yes.</td>
<td>No</td>
<td>Occasionally, judged on case by case basis (9)</td>
<td>Yes, taken up in permit (1)</td>
<td>No – at developers discretion</td>
</tr>
<tr>
<td>Seasonal restrictions in piling (for marine mammals)</td>
<td>No</td>
<td>No (8) not in general</td>
<td>Yes, depending on season and turbine number</td>
<td>No</td>
<td>Not in general</td>
<td>Yes, but advice only: no piling between 1st January and 30th April (1)</td>
<td>No – at developers discretion</td>
</tr>
<tr>
<td>OWF development in protected areas</td>
<td>Not a priori forbidden</td>
<td>Not a priori forbidden</td>
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<td>Noise thresholds</td>
<td>Yes, cumulative SEL 183 dB re 1μPa (unweighted) on harbour porpoise (2)</td>
<td>Yes, 160 dB SEL and 190 dB SPL at 750 m from piling event (9)</td>
<td>Yes, depending on season and turbine number</td>
<td>No</td>
<td>No (1)</td>
<td>No (3)</td>
<td>No</td>
</tr>
<tr>
<td>Restriction on parallel piling</td>
<td>No</td>
<td>Cumulative calculation necessary. Depending on season, OWF location and impact on protected areas</td>
<td>Under discussion, most likely no more than one construction activity.</td>
<td>No</td>
<td>No (1)</td>
<td>No (3)</td>
<td>No – at developers discretion</td>
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The impact of noise from piling activities on marine mammals, particularly harbour porpoises (*Phocoena phocoena*), has become a crucial aspect in the process of approving offshore wind farm projects in Germany.

**Bundesnaturschutzgesetz – Federal law on nature protection**

- Forbidden to injure (§ 44 Abs. 1 BNatSchG) → Individual
- Forbidden to significantly disturb (§ 44 Abs. 1 BNatSchG) → Population

To meet these rules for harbor porpoise, threshold levels in Germany were set to 160dB SEL in 750m distance to the piling location.

Since 1. December 2013 a „Noise mitigation concept“ was introduced for new permits by the Federal Ministry for the Environment (BMU).

2015 - new piling regulation in practical implementation – max. 180min piling time (monopiles) including deterrence
Components of a noise mitigation concept:

- **Deterrence (Soft start, Pinger, Seal Scarer)**
  - displace animals from areas of high noise levels

- **Noise mitigation system (BBC, IHC, HSD...)**
  - decrease piling noise
  - Mitigation of noise generation – decreased piling energy, alternative foundation installation

- **Control of efficiency (Hydrophones, C-PODs)**
  - document efficiency of noise mitigation and effect on harbour porpoise abundance

- **Documentation**
Noise mitigation systems used in OWPs

Far-field mitigation

- Bubble curtain

Near-field mitigation

- Hydrosound damper
- IHC sleeve

Systems ready for full Offshore test
- AdBm system
- BEKA sleeve
- W3G system

Generic piling noise spectrum without mitigation

Combined possible

Modified after www.riffgat.de
Project Set-up and current status:

- Joint venture with SWM
- MP installation by ABJV
- Construction: Mar 2013 – Dec 13
- Commissioning: 2014/15
- Power 288 MW

Project Details:

- 70 km West of Sylt island
- Water depth 21 to 31 m
- Size 72 km²
- 80 WEA locations
- Monopiles Ø 6.00 m
DanTysk - Big Bubble Curtain (BBC) variations

- BBC
- DBBC
- DBBC + linear BC
- TBBC + linear BC
- DBBC - DFI + linear BC
- DBBC + BBC

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Sandbank Monopile installation – Noise mitigation: DBBC + HSD

Project Set-up and current status:
- Joint venture with SWM
- MP installation by Bilfinger
- Construction start: mid 2015
- Planned commissioning: 2017
- Power 288 MW

Project Details:
- 90 km West of Sylt island
- Water depth 25 to 34 m
- Size 59 km²
- 72 WEA locations (1. Phase) – Status 43 MPs installed
- Monopiles Ø 6.40-6.80m

Combination of two noise mitigation systems:
Hydrosound Damper + Double Big Bubble Curtain

Vattenfall offshore wind farms in the German North Sea

Layout Sandbank Cluster

NORTH SEA

Sandbank extension
Sandbank

in operation
under construction
construction preparation
in consent process/permitted
Transformer platform
Sea cable SylWin cluster with Transformer substation
Sandbank noise mitigation - Hydrosound Damper
Sandbank - Noise mitigation regulations and mitigations

Regulations – SB/DT
- Noise limit - DT/SB
- Maximum 180min piling time including deterrence - SB
- Maximum 5 days deployment of bubble curtain, maintenance checks of DBBC - SB
- Piling energy limit 1000-1500kJ - DT/SB
- Reference measurements and documentation – DT/SB
- Hydrosound documentation after 48h /each installation – 72 h after each installation cycle(4 MPs) – DT/SB
- C-POD documentation after each 8 MPs – DT/SB
- Daily progress report – DT/SB

Mitigation - SB
- Online hydrosound monitoring
- Hammer adjustments/checks (tests, software, maintenance, exchanges)
- Implementation of new inclination measurement tools
- Re-deployment of DBBC
- Adjustment of the piling protocol
- Piling analyses
- Deterrence analysis
HSD and BBC & combination of systems

Spectra of noise mitigation at OWP DanTysk

Spectra of noise mitigation at OWP Sandbank
Control of Efficiency vs deterrence

Measurements of C-PODs at DT and SB show close distance during piling and fast re-occurrence after piling to the piling site.

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Control of Efficiency vs deterrence

Change of deterrence protocol necessary/useful?
Summary

In DanTysk 160dB level and in Sandbank 180min max piling time was met after extensive optimization, but:

Each OWP has project specific parameters and all noise mitigation systems are still in “testing phase”:

- Soil parameters, installation technique, foundation design, noise mitigation system: all parameters are OWP specific and influence noise generation
- Still a challenge to meet 160dB in 750m distance – at least at construction start:
- Every project still needs an optimization phase
- Knowledge basis of the noise limit needs to be improved

180 min maximum piling time represents a new challenge (costs and HSE):

- Depending on project specific conditions this requirement cannot be met
- Knowledge basis of the piling time limit needs to be improved

Noise mitigation requirements need to be known early in the project

- Late implementation will increased costs and risk of permit breach
Research at DanTysk - DEPONS

Timeline: 2013 – 2017
Budget: 1.8 mill EUR

DanTysk Part:
November 2013 – Februar 2014
12 x C-PODs
12 x Hydrophones

www.depons.au.dk

Status report (Feb 2015)

DISTURBANCE EFFECTS ON
THE HARBOUR PORPOISE POPULATION
IN THE NORTH SEA
Thanks for your attention!