

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

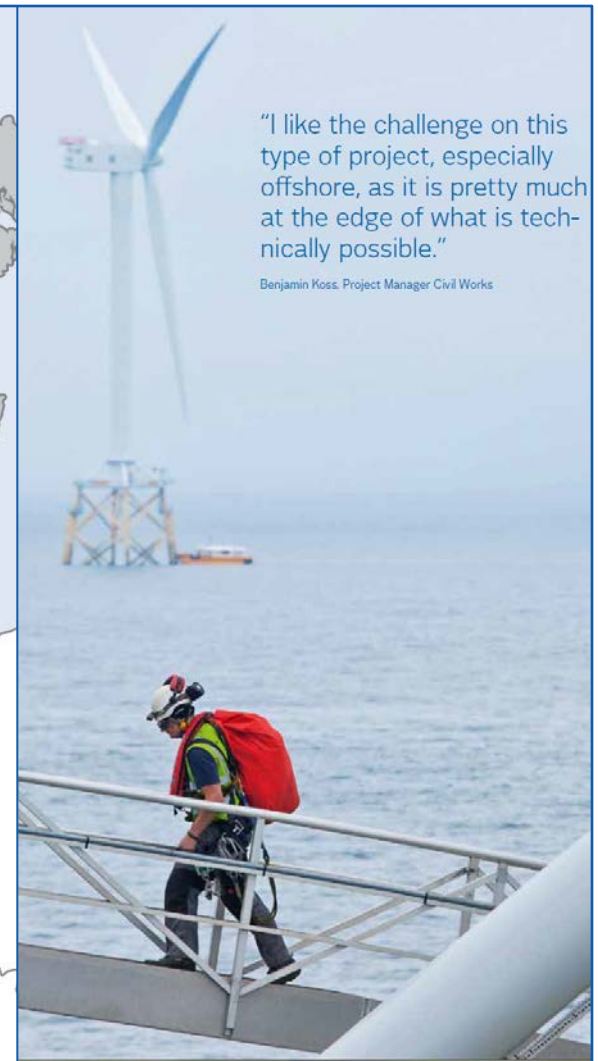
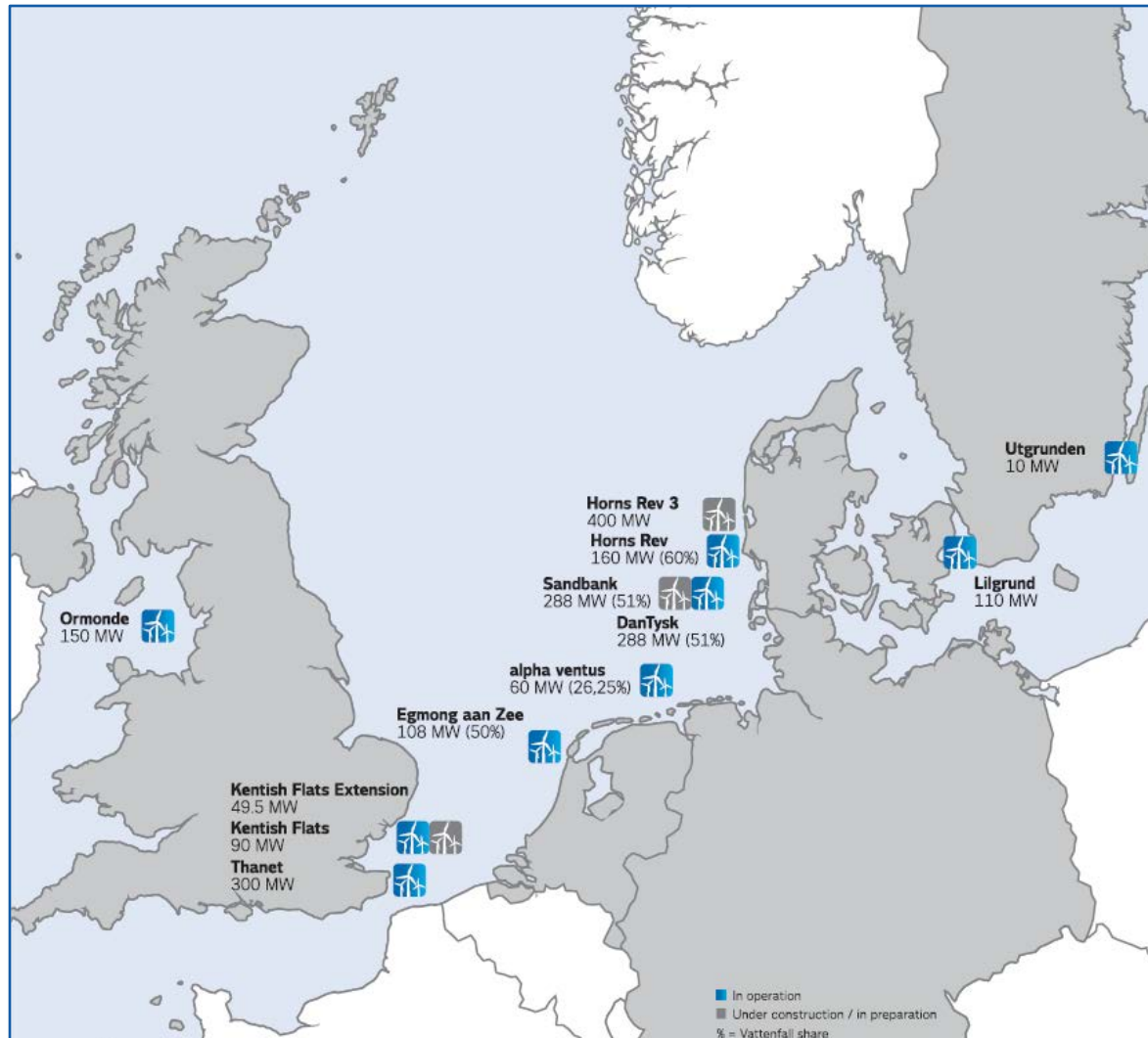
Bremerhaven 14.10.2015 - RAVE Conference

Dr. Eva Philipp
Vattenfall Europe Windkraft
Überseering 12
22297 Hamburg

Agenda

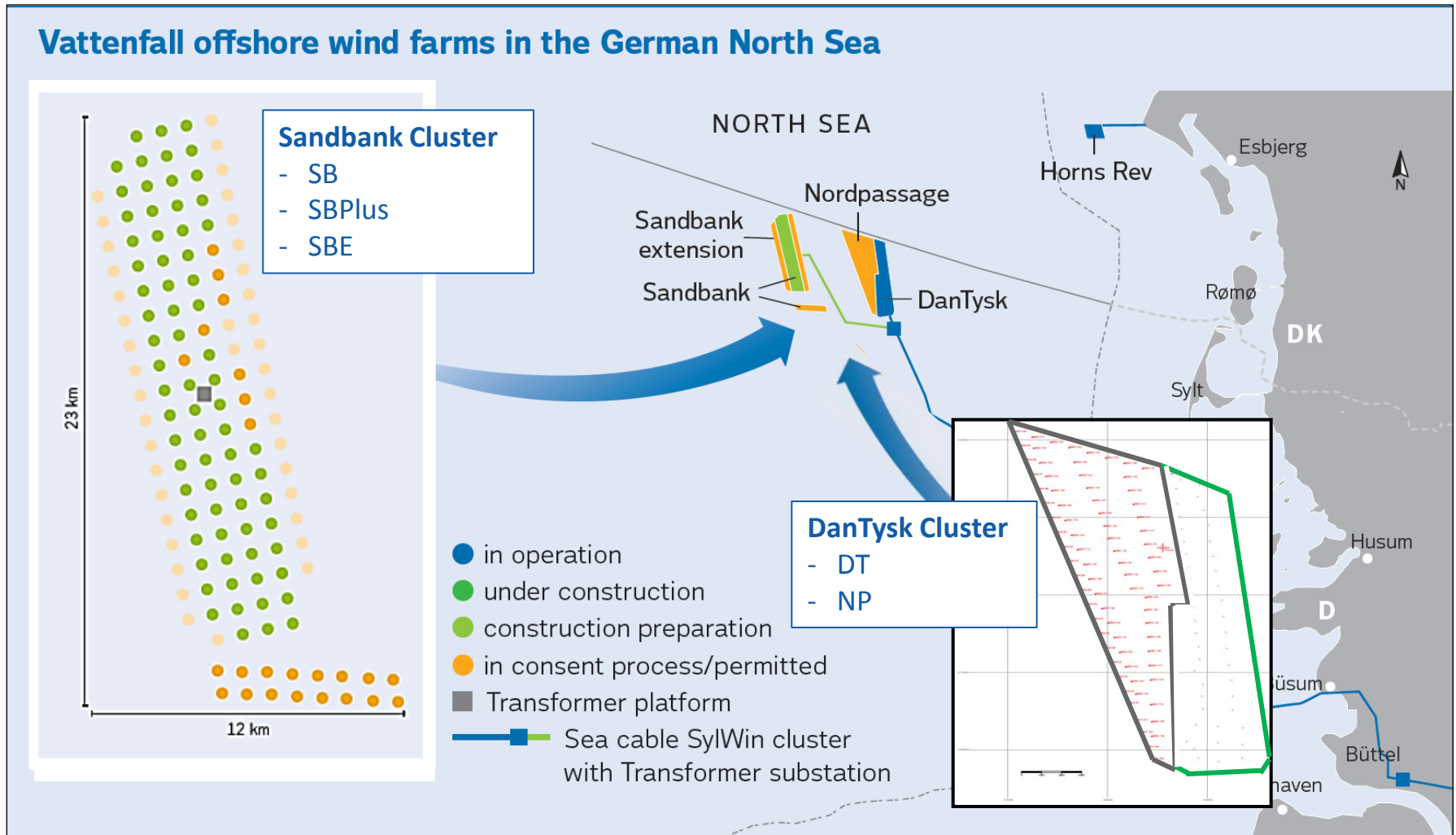
- **Vattenfall – a key player in Offshore Wind**
- **Noise mitigation regulations in different countries**
- **Noise mitigation regulations German EEZ**
- **Noise mitigation concepts**
- **Noise mitigation systems**
- **OWP DanTysk – monopile installation**
- **OWP Sandbank – monopile installation**
- **Summary**
- **DEPONS project**

A key player in offshore wind



Vattenfall Sylt-Cluster

Vattenfall offshore wind farms in the German North Sea



OWP foundation installation – country specific noise mitigation regulations

Noise mitigation	Country-specific regulations						
Parameters	Denmark	Germany	Netherlands	Sweden	UK /Wales/Scotland	Belgium	France
Authority	Danish Energy Agency (DEA) ⁽⁶⁾	Federal Maritime and Hydrographic Agency (BSH) ⁽⁴⁾	Rijkswaterstaat (Waterwet (Ww), Water act) ^{(8) (9)}	Swedish Agency for Marine and Water Management (SwAM) ⁽¹⁰⁾	UK/Wales: "Marine Management Organisation", The Planning Inspectorate" Scotland: Marine Scotland Licensing and Operations Team (MSLOT)	Flemish Government, the Department Leefmilieu, Natuur & Energie	Ministère de l'Écologie, du Développement durable et de l'Énergie ⁽³⁾
Soft start	Yes, but not standardised	Yes ⁽⁵⁾	Under discussion, most likely yes.	Not at present	Yes, but no general rule.	Yes, taken up in permit and not standardised ⁽¹⁾	No - at developers discretion
Marine Mammal Observers (MMO)	No	No	No	No	Yes, but no general rule.	No ⁽¹⁾	No - at developers discretion
Acoustic Deterrent Devices (ADD)	Yes, recommended but not standardised	Yes ⁽⁵⁾ Pinger and Seal scarer	Under discussion, most likely yes.	No	Occasionally, judged on case by case basis ⁽¹⁾	Yes, taken up in permit ⁽¹⁾	No - at developers discretion
Seasonal restrictions in piling (for marine mammals)	No	No ⁽⁵⁾ not in general	Yes, depending on season and turbine number	No	Not in general	Yes, but advice only: no piling between 1st January and 30th April ⁽¹⁾	No - at developers discretion
OWF development in protected areas	Not <i>a priori</i> forbidden	Not <i>a priori</i> forbidden	Not <i>a priori</i> forbidden	Not <i>a priori</i> forbidden	Not <i>a priori</i> forbidden ⁽¹⁾	Not <i>a priori</i> forbidden ⁽¹⁾	Not <i>a priori</i> forbidden
Noise thresholds	Yes, cumulative SEL 183 dB re 1 µPa (unweighted) on harbour porpoise ⁽⁷⁾	Yes, 160 dB SEL and 190 dB SPL at 750 m from piling event ⁽⁵⁾	Yes, depending on season and turbine number.	No	No ⁽¹⁾	No ⁽¹⁾	No
Restriction on parallel piling	No	Cumulative calculation necessary. Depending on season, OWP location and % impact on protected areas.	Under discussion, most likely no more than one construction activity.	No	No ⁽¹⁾	No ⁽¹⁾	No - at developers discretion

Noise mitigation regulations in the German EEZ

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)

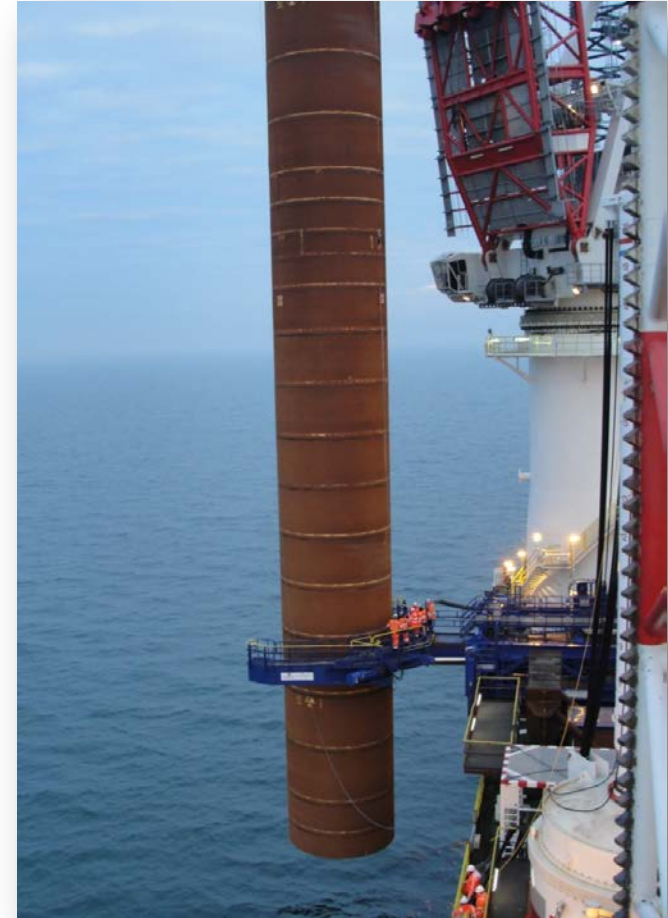


2015 - new piling regulation in practical implementation – max. 180min piling time (monopiles) including deterrence

Noise mitigation concept

Components of a noise mitigation concept:

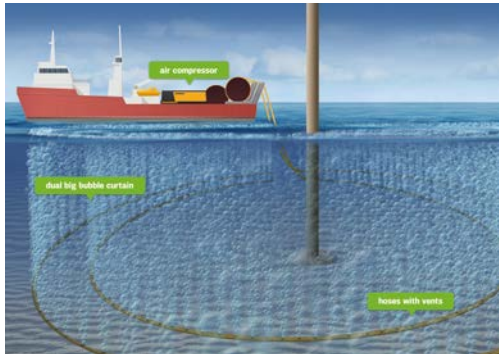
- Deterrence (Soft start, Pinger, Seal Scarer)
 - displace animals from areas of high noise levels
- Noise mitigation system (BBC, IHC, HSD...)
 - decrease piling noise
 - Mitigation of noise generation – decreased piling energy, alternative foundation installation
- Control of efficiency (Hydrophones, C-PODs)
 - document efficiency of noise mitigation and effect on harbour porpoise abundance
- Documentation



Noise mitigation systems used in OWPs

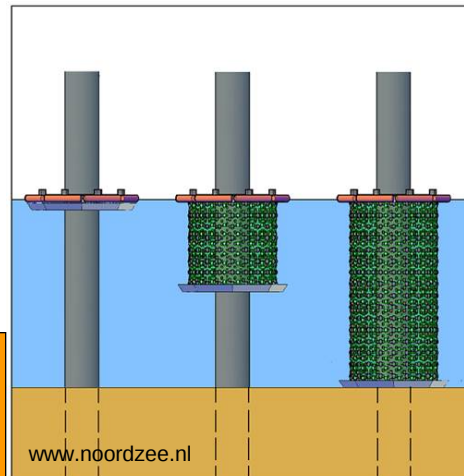
Far-field mitigation

Bubble curtain



Near-field mitigation

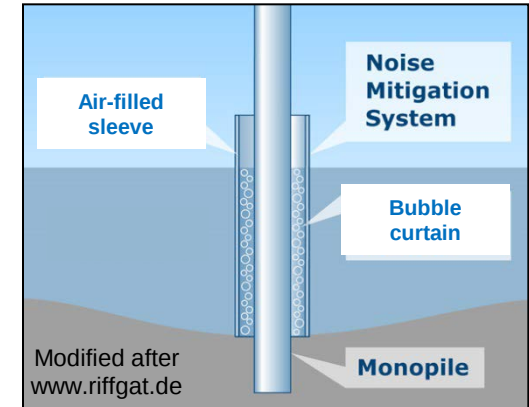
Hydrosound damper



Combination possible



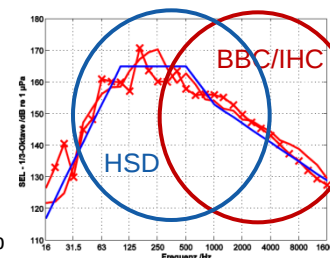
IHC sleeve



Systems ready for full Offshore test

- AdBm system
- BEKA sleeve
- W3G system

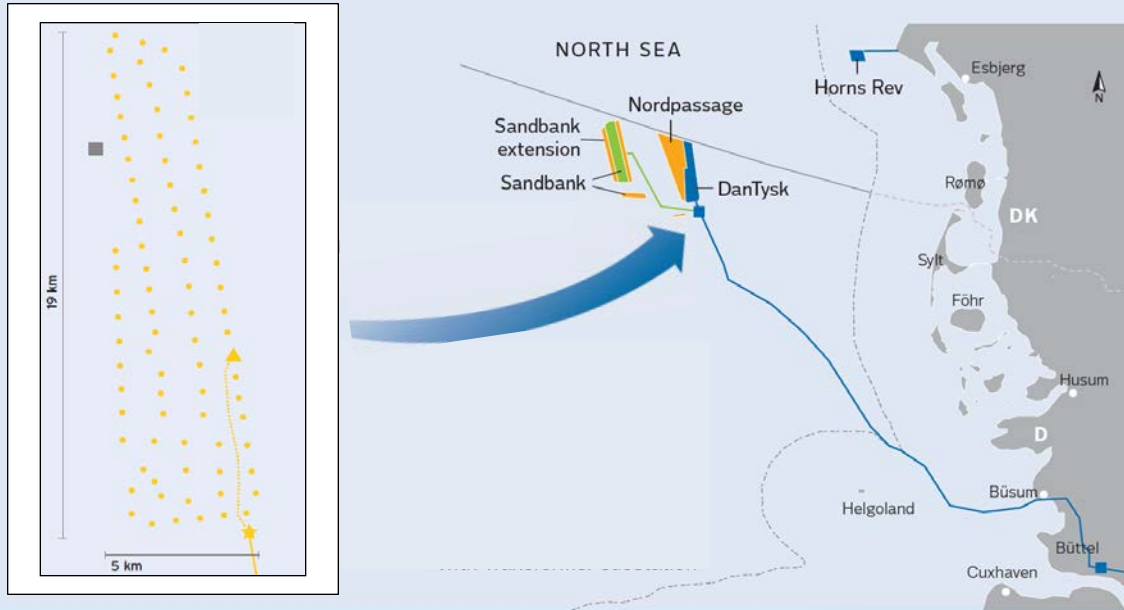
Generic piling noise spectrum without mitigation



Taken from itap

DanTysk Monopile installation – Noise mitigation: Big Bubble Curtain

Vattenfall offshore wind farms in the German North Sea

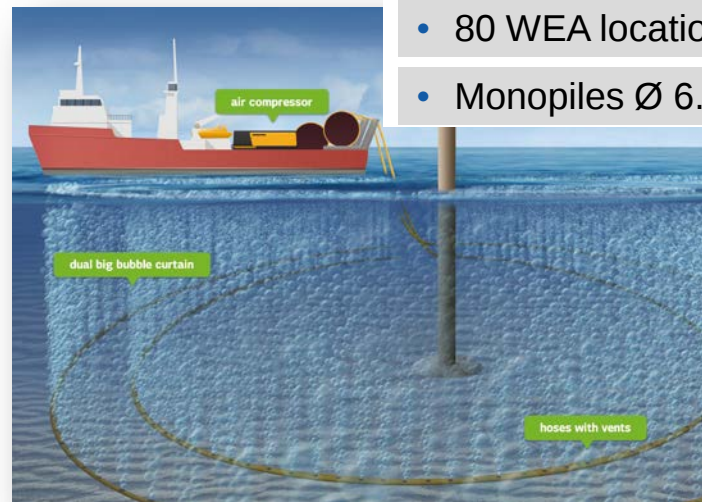


Project Set-up and current status:

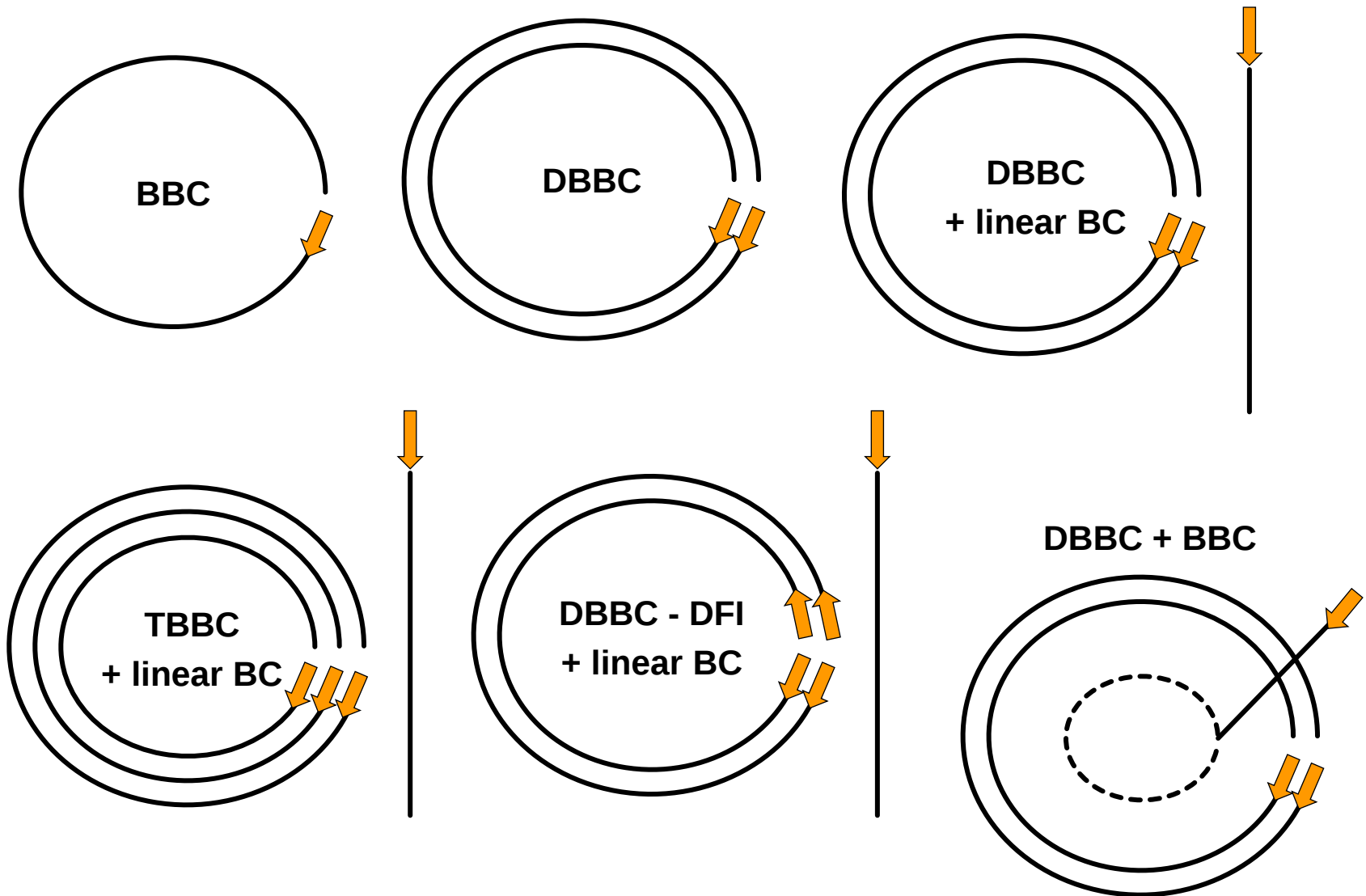
- Joint venture with SWM
- MP installation by ABJV
- Construction: Mar 2013 – Dec 13
- Commissioning: 2014/15
- Power 288 MW

Project Details:

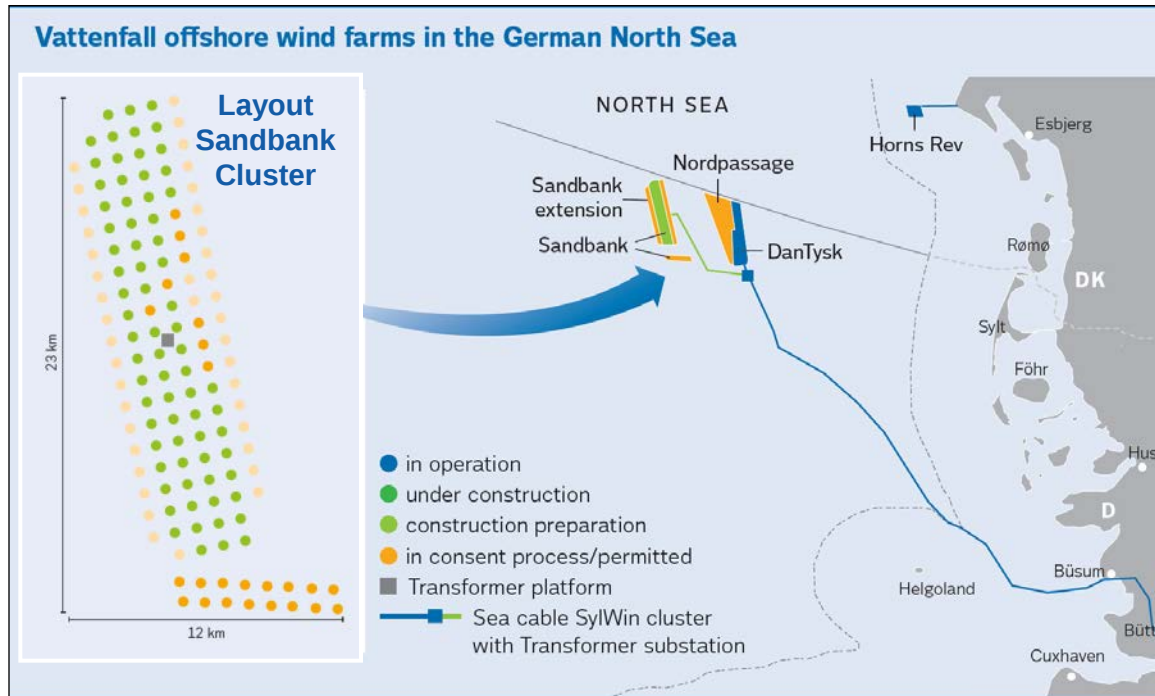
- 70 km West of Sylt island
- Water depth 21 to 31 m
- Size 72 km²
- 80 WEA locations
- Monopiles Ø 6.00 m



DanTysk - Big Bubble Curtain (BBC) variations



Sandbank Monopile installation – Noise mitigation: DBBC + HSD



Project Set-up and current status:

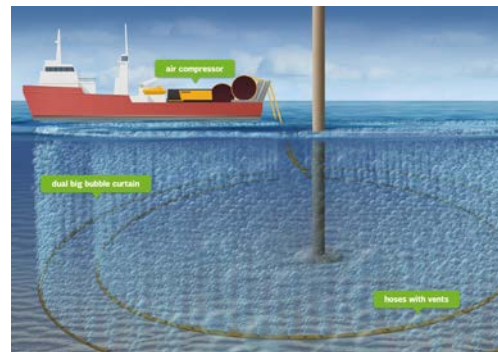
- Joint venture with SWM
- MP installation by Bilfinger
- Construction start: mid 2015
- Planned commissioning: 2017
- Power 288 MW

Project Details:

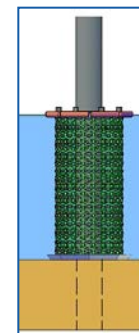
- 90 km West of Sylt island
- Water depth 25 to 34 m
- Size 59 km²
- 72 WEA locations (1. Phase) – Status 43 MPs installed
- Monopiles Ø 6.40-6.80m

Combination of two noise mitigation systems:

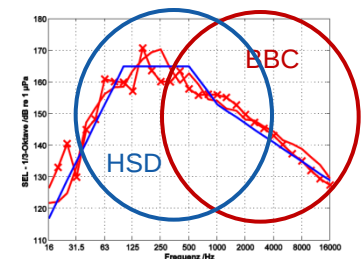
Hydrosound Damper + Double Big Bubble Curtain



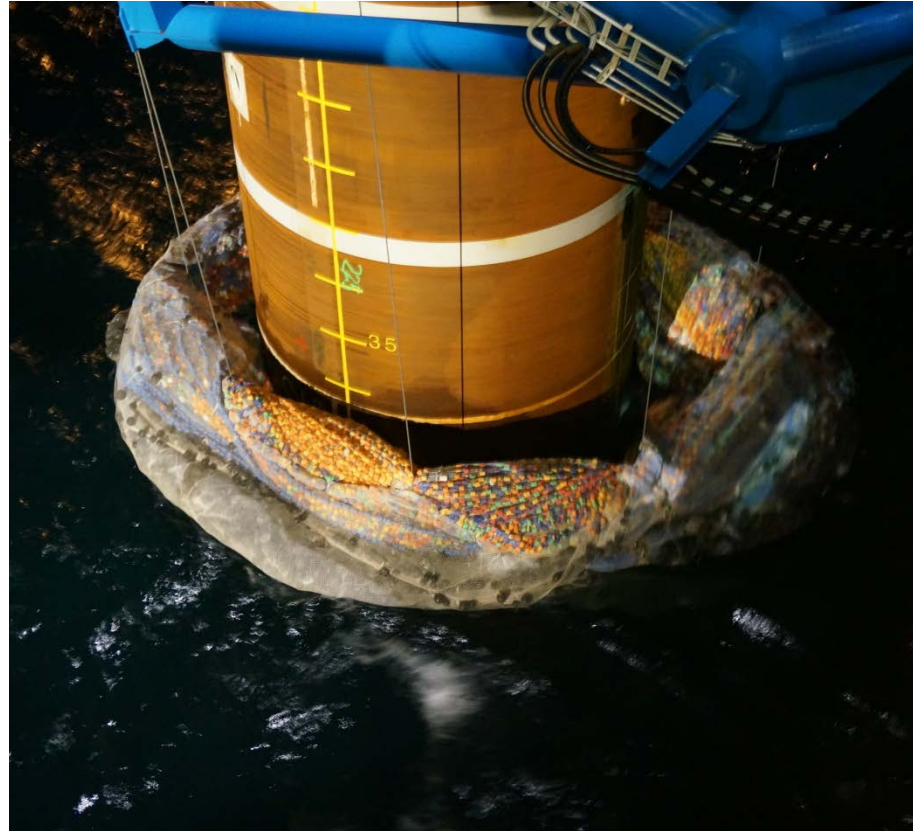
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Sandbank noise mitigation - Hydrosound Damper



Sandbank noise mitigation - Double Big Bubble Curtain



Foto by Bilfinger

Sandbank - Noise mitigation regulations and mitigations

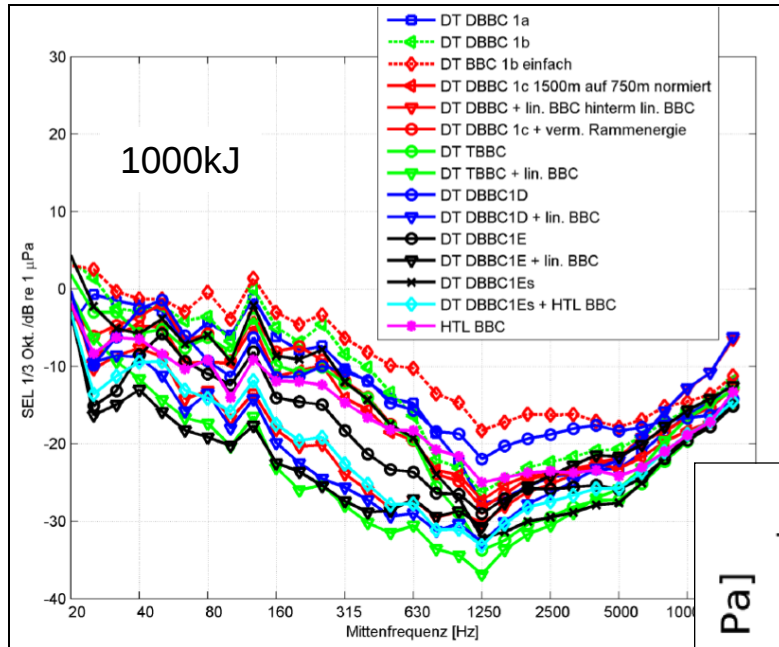
Regulations – SB/DT

- 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

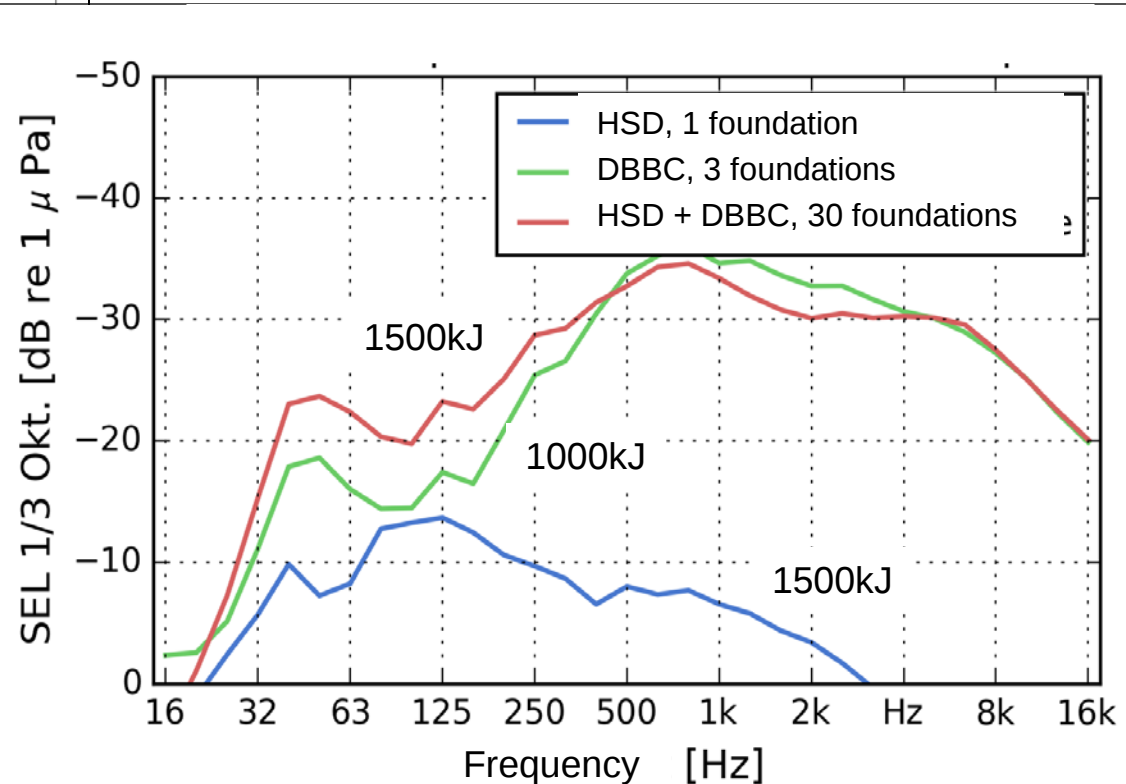
- Online hydrosound monitoring
- Hammer adjustments/checks (tests, software, maintenance, exchanges)
- Implementation of new inclination measurement tools
- Re-deployment of DBBC
- Adjustment of the piling protocol
- Piling analyses
- Deterrence analysis

HSD and BBC & combination of systems

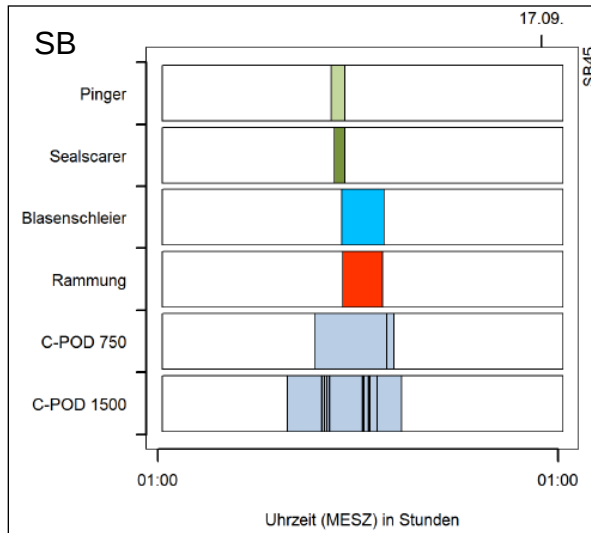


Spectra of noise mitigation at OWP DanTysk

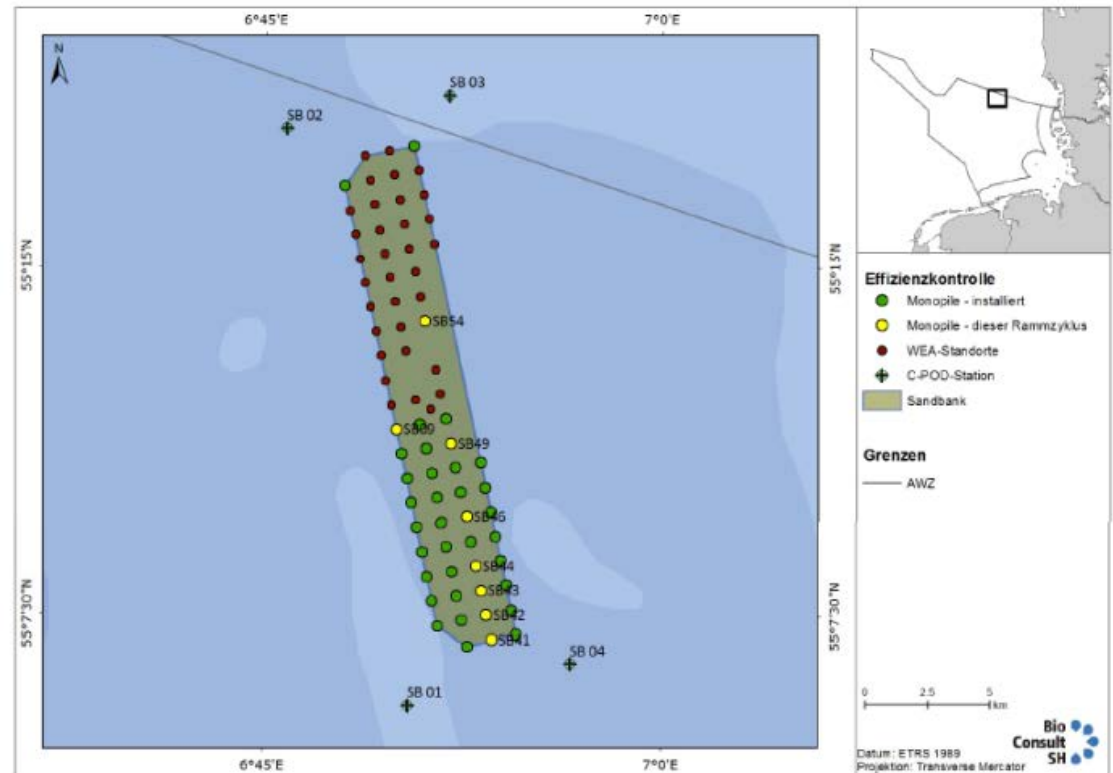
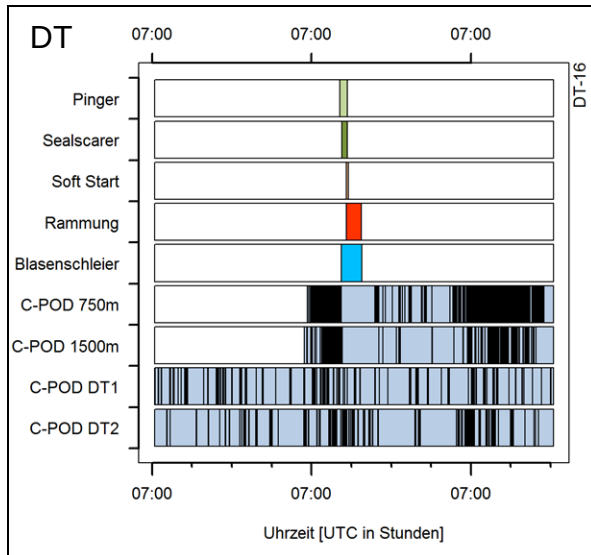
Spectra of noise mitigation at OWP Sandbank



Control of Efficiency vs deterrence

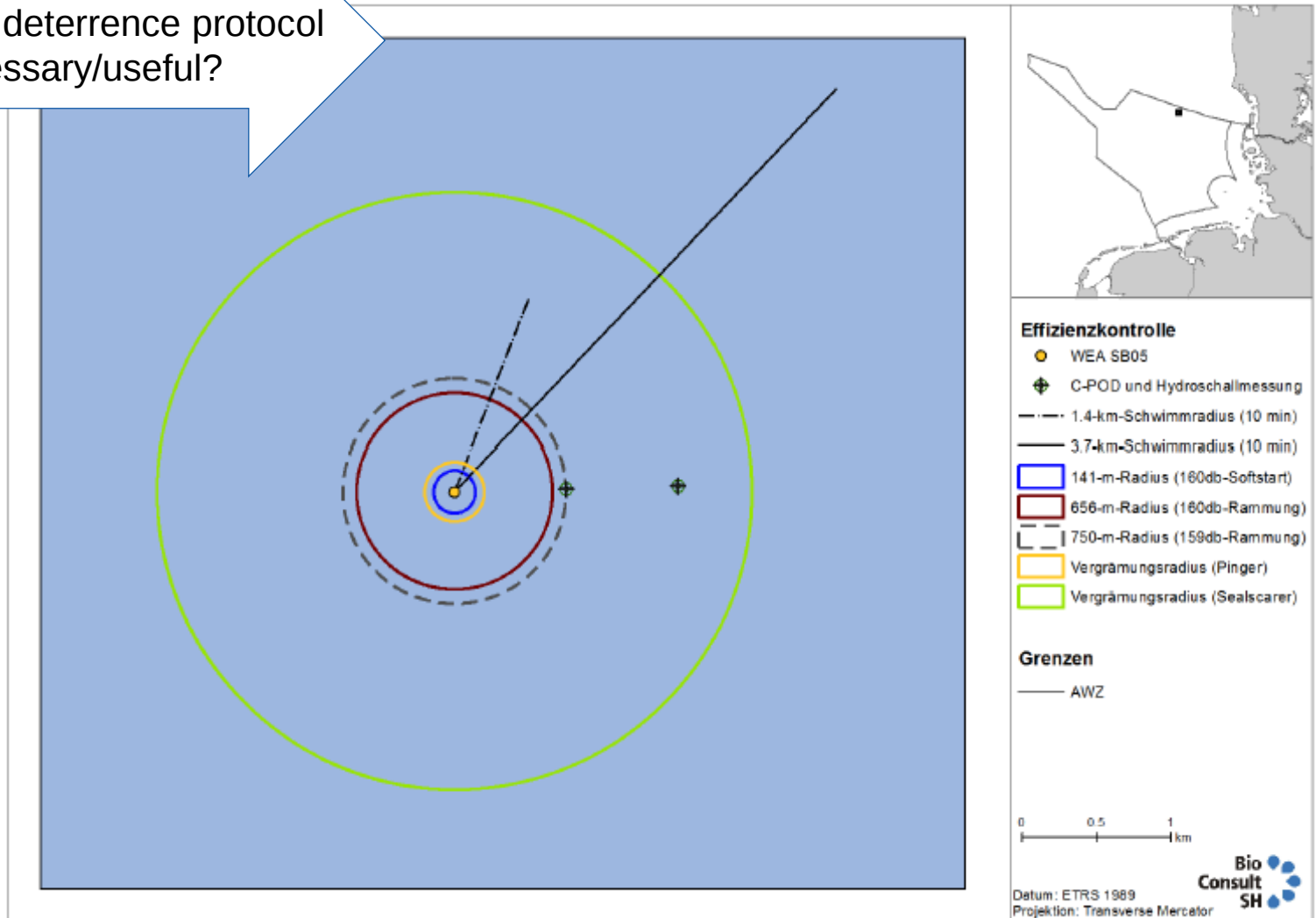


Measurements of C-PODs at DT and SB show close distance during piling and fast re-occurrence after piling to the piling site



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



AARHUS
UNIVERSITY
DCE - DANISH CENTRE FOR ENVIRONMENT AND ENERGY

DISTURBANCE EFFECTS ON

THE HARBOUR PORPOISE POPULATION

IN THE NORTH SEA



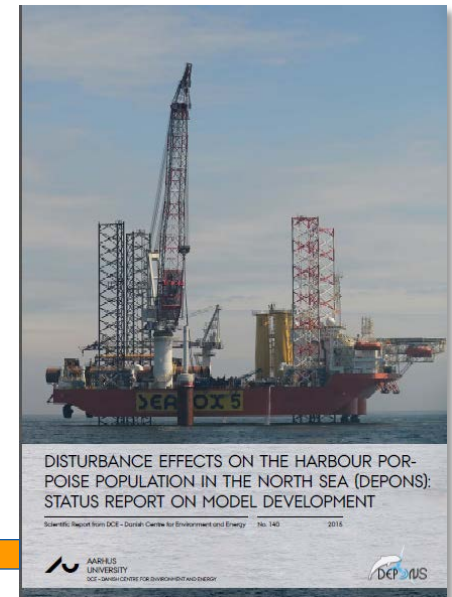
Timeline: 2013 – 2017

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)



Thanks for your attention!

