Note

17th November 2023

Topic	Response to consultation responses from the Danish Environmental Protection Agency's 'Hav- og Vandmiljø' regarding permit for partial decommissioning of foundation A02 in Nysted Offshore Wind Farm
To	The Danish Energy Agency
Copy	Danish Maritime Authority, Danish Environmental Protection Agency
From	Ørsted NHP (JHAJE/CHBOE)
On	A02 NHP (Application and screening: Nysted Offshore Windfarm. Project Description and Environmental Assessment. Removal of remaining part of A02 foundation, including Annex 1)

1) Background

According to the consultation reply by the Danish Environmental Protection Agency's (MST) 'Hav- og Vandmiljø' of the 15-08-2023 concerning permission for partial decommissioning of foundation A02 in Nysted Offshore Wind Farm a specific assessment on the release of hazardous pollutants from concrete which may result in breach of the environmental quality requirements is required. The assessment must be made at individual level on all the substances involved in the project and, more specifically, for the water area concerned. The ecological and chemical condition of the water area must be taken into consideration. Lead and cadmium in biota have been identified as exceeding the requirements for water area ID 208 (Femern belt).

At a meeting held on 24 October 2023 and in subsequent minutes, the Danish Environmental Protection Agency specified that all substances, for which breach of the environmental quality requirements have been found in the water area, must be considered (see vandplandata.dk). This means that there must be a reasoned explanation as to why these substances are included in the assessment.

According to vandplandata.dk, water area ID 208 (Femern belt) has been found to be in breach of environmental quality requirements for lead and cadmium in biota. Present supplementary assessment will therefore focus on the assessment of lead and cadmium, cf. the section below on concrete content.

2) Project method and scope

During the planned work in total 7.5 m^3 (18 tons) concrete shall be removed from foundation A02 in Nysted Offshore Wind Farm (NHP). The part removed is the remaining of the foundation's shaft. See the method described in the presentation of the 24 October 2023 (enclosed).

Hydraulic concrete scissors shall be used for dismantling, and the supplier of the equipment indicate that spillage of concrete residues and particles of 0.5 kg/m^3 is expected. This means that 3.75 kg of concrete will not be removed, as the pieces/particles are too small to be taken by grab. The residues will be of different sizes, from smaller particles to pieces of several centimeters in size. It is assumed that the spill will primarily settle on the foundations' base plate and in the ballast chambers, as the work will take

place close to the baseplate and that the work is expected to be carried out in calm weather and low wind conditions and when the current conditions are optimal. The area is characterized by calm currents and a low tidal variation.

The foundation bottom plate and ballast chambers cover an area of 208 m^2 and the foundation shaft cover an area of 20 m^2.

There will be no need to dig into the seabed, remove or move sediment in the seabed in connection with the work. The work is carried out only on the foundation's shaft and over the bottom plate. Concrete pieces are removed directly from the shaft and/or collected with the grab from the base plate.

3) Substance concentration in concrete

The report by the Danish Environmental Protection Agency: Environmental project no. 1991, March 2018 “Forekomsts og udvaskning af problematiske stoffer i knust beton og tegl” indicate the following information on concrete content (page 11):

"The substances can originate from, for example, coal-fired ash, which has been added for many years to cement and concrete. Pulverising-fuel-ash often has significant contents of, among other things, carbon dioxide As, Ba, Cr, Cu, Ni, Pb, Se, V and Zn (Hjelmar, 1990). The substances also exist naturally in the raw materials (lime, sand and clay) which form part of the cement production (and the production of bricks). However, in normal circumstances, only a minor part of the total content of the concrete matrix of the above-mentioned substances could be leached. It can also be mentioned that the hydrocarbon content may, among other things, derive from additives to the concrete and form oils used in the casting of the concrete.

On this basis it is assumed that the concrete will contain concentrations of:
Arsen (As), barium (Ba), chrome (Cr), copper (Cu), nickel (Ni), lead (Pb), selenium (Se), vanadium (V), zinc (Zn), and hydrocarbons.

Cadmium (Cd) is not mentioned as a substance in concrete and is also not measured above the detection limit in the MST (2018), but cadmium has been included as it is a focus substance in the water area in question due to an exceeding of environmental quality requirements in biota.

The following sources are used for data on the content of the above-mentioned substances in concrete, see Table 1. These sources are considered to be representative of the concrete that the foundations of NHP are made of.

	Measured in concrete, general experience (MST 2015, Appendix 3) (mg/kg)	Measured in concrete, general data* (MST 2018) (mg/kg)	Measured in concrete from the foundations of Vindeby Offshore Wind Farm (NIRAS 2016b) (mg/kg)	Result of leaching tests from crushed concrete**(MST 2018) (mg/kg)
Arsen (As)	2-10	6,5	Not measured	0,013
Barium (Ba)	Not measured	80	Not measured	1,9
Cadmium (Cd)	0,1-0,3	0,5	0,06	0,001
Chrome (Cr)	7,5-40	12	11	0,068
Copper (Cu)	9,2-45	21	15	0,072
Nickel (Nine)	6,4-40	9,2	9	0,021

Lead (Pb)	6-30	13	9	0,016
Selenium (Se)	Not measured	0,19	Not measured	0,021
Vanadium (V)	40	20	Not measured	0,012
Zinc (Zn)	31-69	49	54	0,016
Hydrocarbons***	Up to 300	45	Not measured	0,076-0,88

Table 1: Concrete substance concentrations.

* From Table 4.1 Summary of results of analysis of the samples of crushed concrete from 2016/2017 for content of inorganic substances (after partial chemical digestion according to DS 259) and TOC. Mean values are used.

** From Table 4.12 Summary of the results of batch leaching tests on crushed concrete from 2011/2012 and 2016/2017. Mean values are used.

*** C6-C35 from Tables 4.6 and 4.15 in MST 2018, respectively

Red font: Below the detection limit for the analysis method (detection limit shown).

It is assumed that the concrete from Vindeby Offshore Wind Farm and NHP are comparable. As the results for MST (2018) and Vindeby Offshore Wind Farm are consistent, the results of leaching tests are used in the MST (2018).

On the assumption that all 3.75 kg of concrete which is expected to be spilled will be crushed to the fineness used in the leaching tests, the quantities below will be released as a result of the overall work. This assumption must be considered very conservative as not all concrete is expected to be crushed to the particle size in question, but rather to consist of pieces of varying size, some of which are several centimeters. Further, it is indicated in the MST (2018) that "*However, in normal circumstances, only a minor part of the total content of the concrete matrix of the above-mentioned substances could be leached.*

	Result of leaching tests from crushed concrete**(MST 2018) (mg/kg)	Volume to leach potentially from 3.75 kg concrete (mg)
Arsen (As)	0,013	0,049
Barium (Ba)	1,9	7,125
Cadmium (Cd)	0,001	0,004
Chrome (Cr)	0,068	0,255
Copper (Cu)	0,072	0,27
Nickel (Nine)	0,021	0,079
Lead (Pb)	0,016	0,06
Selenium (Se)	0,021	0,079
Vanadium (V)	0,012	0,045
Zinc (Zn)	0,016	0,06
Hydrocarbons***	0,076-0,88	0,285-3,3

Table 2: Results of the leaching test MST (2018)

4) Environmental quality requirements and water area ID 208 Femern belt

	General environmental quality requirements as set out in BEK 796 of 13 June 2023 on the determination of environmental targets (mg/l)*
Arsen (As)	0,0006
Barium (Ba)	0,0058
Cadmium (Cd)	0,0002
Chrome (Cr)	0,0034

Copper (Cu)	0,0049
Nickel (Nine)	0,0086
Lead (Pb)	0,0013
Selenium (Se)	0,0008
Vanadium (V)	0,0041
Zinc (Zn)	0,0078
Hydrocarbons	No

Table 3: Environmental quality requirements.

*In BEK 796, environmental quality requirements are stated as µg/L, here converted to mg/l.

For water area ID 208 Femern belt, lead and cadmium in biota have been exceeded.

According to MST (2023): "Consultation on draft updated guide – Questions and answers on discharge of certain pollutants to the aquatic environment October - November 2023" the following concerning environmental quality requirements in biota is stated (page 45 question 33):

"Thus, compliance with general quality requirements for water will, as a general rule, also ensure compliance with environmental quality requirements for biota, but there will be a small number of substances for which, due to a limited data basis, such an opinion cannot yet be definitively drawn. Until the data base is updated, it may be assumed that compliance with general quality requirements for water will also ensure compliance with environmental quality requirements for biota when reassessing emission permits."

I.e. the assessment of lead and cadmium compliance can be assessed based on compliance with general environmental quality requirements.

In order to take into account already occurring concentrations in the water body in question, measured concentrations of lead and cadmium from the Rødsand metering station have been applied (see water marin_20231030_130415.csv from Environmental Data/Denmark's environmental portal) at:

Pb <0.1 µg/liters
Cd <0.03 µg/liters

The dilution whereby the environmental quality requirements are met/not exceeded are calculated on the basis of MST Environmental Project No. 690, 2002 – Discharge of hazardous substances with wastewater, section 4.4 and the following formula:

$$K_{stof} = F \cdot (VKK - C_{region})$$

This can be adjusted as follows:

Substance volume (mg) = Dilution (l) x (environmental quality requirement (mg/l) – background concentration (mg/l))

Thus, the following results for necessary dilution:

Lead
0.06 mg = F x (0.0013 mg/l – 0.0001 mg/l)
F = 50 litres

Cadmium

0.004 mg = F x (0.0002 mg/L – 0.00003 mg/L)
F = 23.5 litres

It is assumed that the concrete is spread in the water column for the work area. The work area can be considered either broad or narrow – respectively for the area of the bottom plate and ballast chambers of 208 m^2 or the area of the shaft of 20 m^2.

The water depth is set to be 6.5 metres and the broad work area covers 1,352 m^3 (1,352,000 litres of water) and narrow work area 130 m^3 (130,000 litres of water).

I.e., substances that may be released from concrete residues/particles will be present in a large volume of water, regardless of whether the work area is considered broad or narrow. This means that content concentrations, considered conservatively, will not exceed the environmental quality requirements.

It is assessed that a possible release of potentially harmful substances from the removal of the concrete shaft at foundation A02 in Nysted offshore wind farm will not result in exceeding either environmental quality requirements in surface water or biota.

Here, the uncertainties and assumptions are summarized:

- Concrete residues and particles are assumed to be settled within the work area, i.e. in the area of the base plate and ballast chambers. The work will be carried out immediately above the base plate and the work is expected to be carried out in calm weather and wind conditions and when the current conditions are optimal. The area is characterized by calm currents and a low tidal variation. In addition, the amount of material expected to be wasted is low when the concrete is broken up into transportable pieces.

- For the assessment, it is assumed that the concrete is pulverized to the same particle size as used in the MST washout test (2018). This has to be considered a very conservative assumption. In addition, the MST (2018) specifies that "*However, in normal circumstances, only a minor part of the total content of the concrete matrix of the above-mentioned substances could be leached.".* This means that the content of substances leached under the specific conditions at the planned work must be expected to be significantly less than assessed.

- No correction has been done for the bioavailable concentration or dissolved fraction, which must also be considered as conservative.

- It is assumed that concrete from Nysted Offshore Wind Farm is comparable to concrete used in the Vindeby Offshore Wind Farm as well as concrete analysed in the MST (2018) i.e., the results of leaching tests in the MST (2018) can be applied.

- For a number of substances, including lead and cadmium, the result for leaching is below the detection limit i.e., the actual concentration must be lower than the detection limit.

- Background concentration is assessed based on data from a metering station in the area (Rødsand). It is assessed that environmental quality requirements are met even if the background concentration is higher than measured here.

- As environmental quality requirements for lead and cadmium are met/not exceeded, it’s assumed that the environmental quality requirements for the other relevant listed substances also will be met/not exceeded.

References

Miljødata/Danmarks miljøportal, vandkemi-marin_20231030_130415.csv

MST (2002) Miljøprojekt nr. 690, 2002: Udledning af miljøfarlige stoffer med spildevand

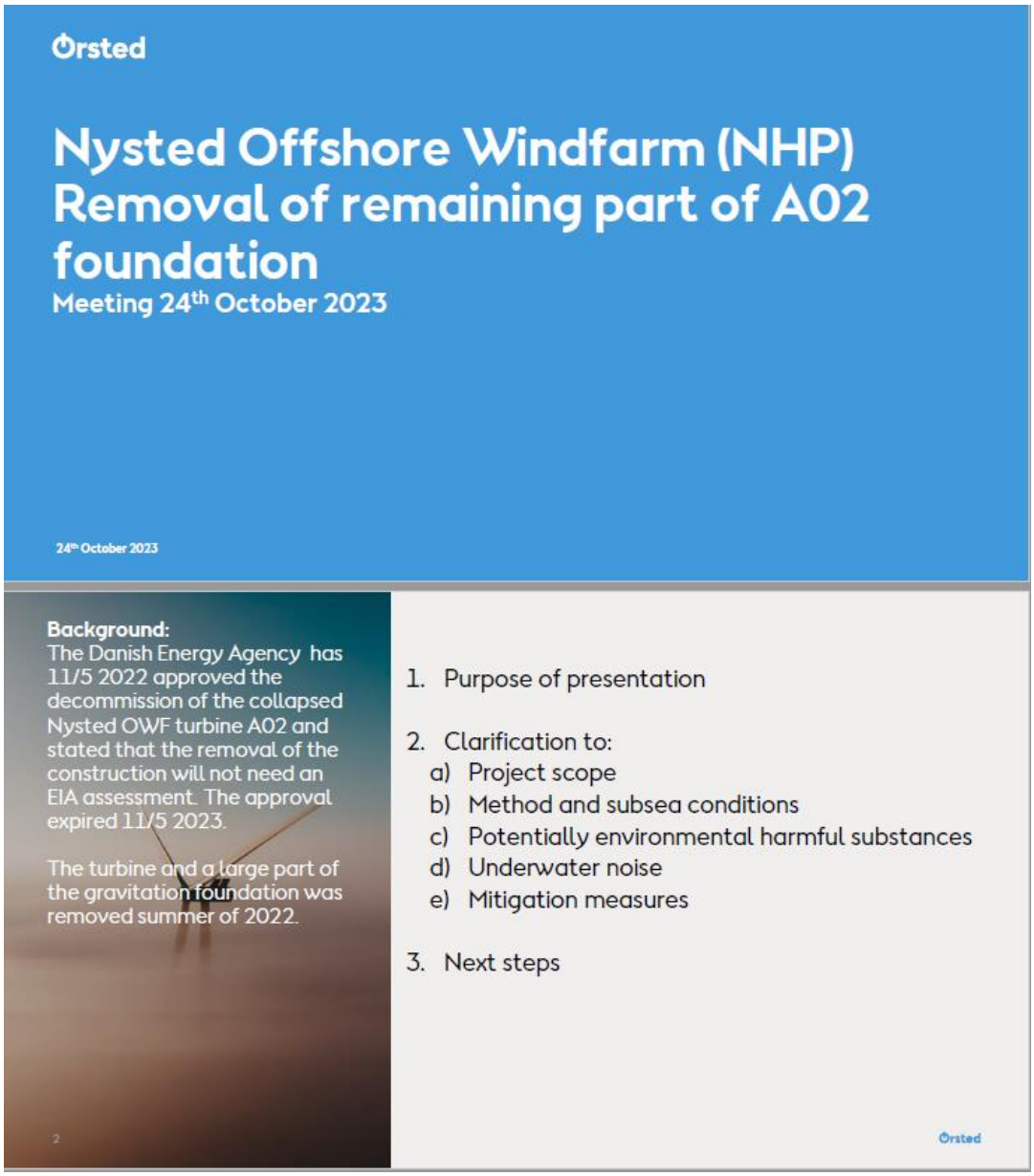
MST (2015): Miljøprojekt nr. 1806, 2015: Forurenende stoffer i beton og tegl

MST (2018): Miljøprojekt nr. 1991, marts 2018: Forekomsts og udvaskning af problematiske stoffer i knust beton og tegl

MST (2023): ”Høring over udkast til opdateret vejledning – spørgsmål og svar om udledning af visse forurenende stoffer til vandmiljøet oktober – november 2023

NIRAS (2016b): Vindeby offshore wind farm - Mapping of environmentally harmful substances in regards to decommissioning, April 2016.
bilag_1_kortlaegning_og_analyse_af_miljoefarlige_stoffer_vindeby_2.pdf (ens.dk)

Annex: Presentation of the 24 October 2023



Ørsted

Nysted Offshore Windfarm (NHP) Removal of remaining part of A02 foundation

Meeting 24th October 2023

24th October 2023

Background:
The Danish Energy Agency has 11/5 2022 approved the decommission of the collapsed Nysted OWF turbine A02 and stated that the removal of the construction will not need an EIA assessment. The approval expired 11/5 2023.

The turbine and a large part of the gravitation foundation was removed summer of 2022.

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1. Purpose of presentation

2. Clarification to:
   a) Project scope
   b) Method and subsea conditions
   c) Potentially environmental harmful substances
   d) Underwater noise
   e) Mitigation measures

3. Next steps

Ørsted

Project scope – 1/2
(projektets omfang)

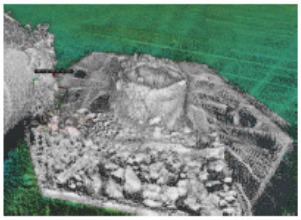
Task/project: Partial removal of foundation A02 at NHP

Dimensions of the foundation:
- Bottom plate (not to be removed): Approx. 15 m wide and covers approx. 208 m²
- The shaft (to be removed): approx. 3,44 m wide and 1 m high.
- The total construction area (for barge to be anchored and safety zone): 15.000 m²

Time schedule: The task is planned to be completed between November 2023-marts 2024 (timing will be weather dependant)

Duration: 1-2 weeks

Water dept at A02: 6-7 m



Survey picture of the bottom plate and shaft of the foundation A02 taken after the turbine and foundation collapsed

Project scope – 2/2
(projektets omfang)

Concrete: 7,5 m³ (18 tons) concrete to be removed.

Method: Crusher jaws (*hydraulisk betonsaks**) with removal of debris. No explosives, hammering - or similar - to be used.

Concrete particles: The contractor estimates that less than 0,5 kg pr. m³ of concrete particles/debris will not be removed by the grab.
= max. 3,75 kg (approx. 20%) concrete particles in total not removed**

*Same method used at the decommission of Vindeby Offshore Wind Farm (OWF) 2016-2017.

** At the decommissioning at Vindeby OWF a waste of 3 % concrete remains/debri were estimated.

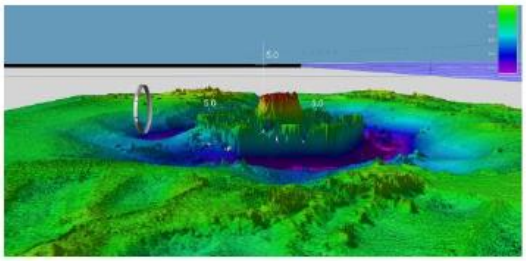
Project Description – Contractor method

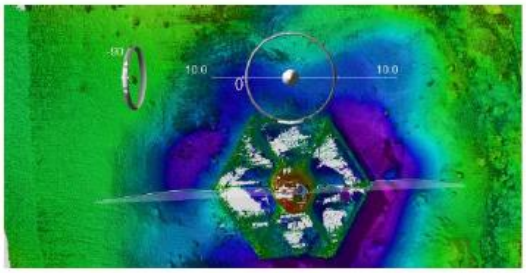
- JA shipping working from a flat top barge
- Barge will be moored in anchors during demolition of concrete
- Concrete cutter is operated with an Excavator
- Excavator will remove demolished concrete

Ørsted

Subsea conditions

- Barge will be moored on worksite next to A02
- During the operation the barge might shift position around A02
- Personnel will transfer to work site in smaller separate vessels
- Debris will fall into ballast chambers and removed to the extend possible with excavator
- Seabed survey will be performed after completion





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Potentially environmental harmful substances (*miljøfremmede stoffer*)

The remaining part of the shaft will be cut by the hydraulic cutter into transportable sizes, retrieved (by grab) and placed on a barge and transported to land. It's not expected that dredging or digging in the seabed as such will be necessary. The contractor will be required to remove as much possible of the debris produced.

A max of 3,75 kg concrete debris/particles are expected to not be retrieved and removed. Most of this are expected to settle within ballast cambers.

Before decommissioning of the Vindeby offshore wind farm, the concrete foundations were analysed for potentially harmful substances. Concrete particles were not considered necessary to include in sedimentary modelling for Vindby decommission. *(Ref. DONG Energy. Nedtagningsplan for Vindby Havmøllepark, Oktober 2016).*

At Vindeby OWF a total of 6.000 tons (2.500 m^2) of material was removed during decommissioning.

Underwater noise and harbour porpoise – 1/3 (*undervandsstøj*)

Noise emission from planned works:

- In air: the engine of the excavator placed on a barge
- In water: crusher jaw breaking up the concrete into transportable sizes.

The noise from the crusher jaw **in air** as described in INS, 2023, Faster demolition of concrete buildings with less dust and noise: *"The process noise from crushing is not higher than the carrier engine noise. The crusher jaws are causing a noise level less than 70 dBA."*

The noise from the crusher jaw **under water** is comparable to noise emitted from construction vessels

INTERNAL

Underwater noise and harbour porpoise – 2/3

- It's not possible to translate noise in air to noise in water
- A guideline for underwater noise from installation of impact or vibration driven piles is published by DEA, but there are no available thresholds or guidelines related to construction noise under water
- As no impulsive noises will be produced, assessment of hearing loss (TTS and PTS) is not relevant.
- Behavioral responses is relevant: Marine mammals will leave the area before the work commence due to vessel activity in the area and will return to the area after stop of the activities (*ref. HR1 and Nysted OFW monitoring and more*). Thus, the impact (habitat loss) will be local and temporary.
- It's assumed that the noise from the crusher jaw is comparable to underwater noise produced by vessels.
- Vessel noise includes propeller and thruster cavitation and a smaller fraction of noise produced by sound transmitted through the hull, including engines, gearing and other mechanical system noises.

INTERNAL

Underwater noise and harbour porpoise - 3/3

Report from DCE, 2021 Thresholds for behavioral responses to noise in marine mammals:
"...a generalized threshold for behavioral response (fleeing) to noise at around 95 dB re 1µPa, VHF-weighted. T."

"In this calculation it is assumed that each pile driving will cause a disturbance lasting d_{piling} and that there will be a smaller disturbed area around the construction vessel for the rest of the time, characterized by the impact range $r_{general}$. For clarity, the temporary loss caused by pile driving and general disturbance, respectively, are calculated separately: ...(formula)...

It is evident that in this particular case, the temporary habitat loss caused by the general presence of the construction vessel is insignificant compared to the loss caused by the pile driving and can be ignored in the combined assessment".

Conclusion: The effects on harbor porpoises from underwater noise will be non/negligible

Mitigation measures

Mitigations measures will consist of readiness measures in case of e.g., oil spills.

No mitigations in relation to adverse negative effects on species or habitats is considered needed.

No mitigation measures are being implemented to avoid sediment impact on the nearby Natura 2000 site, and/or significant noise impact on porpoises (due to scope and duration of planned works)

After completion:

- A multi beam survey to document that debris has been removed (in agreement with the Danish Maritime Authority).

Next steps

Process for application:

- Supplementary information and clarification
- Timeline
- Actions
- Next meeting (if needed)