Hornsea Project Four

Clarification Note on Underwater Noise Abatement Systems

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Revision Summary

Rev	*Date*	*Prepared by*	*Checked by*	*Approved by*
01	29/03/2022	SMRU Consulting	David King, Orsted	Julian Carolan, Orsted

Revision Change Log

Rev	*Page*	*Section*	*Description*
01	N/A	N/A	Document prepared as a result of comments raised within the Natural England Relevant Representation (RR-029) and submitted to ExA at Deadline 2.

Noise Abatement Systems (NAS) Note

Natural England Relevant Representation (RR-029)

Detailed comments – F2.11: Outline Southern North Sea Special Area of Conservation Site Integrity Plan: Point 43

Section 4.1.3.9: *We request that the Applicant provide more information on the likelihood of NAS being suitable for the Hornsea 4 project. Several factors are listed as affecting the suitability of NAS, however these are factors that we would anticipate to be mostly already understood about the site, or possible to make generalisations on based on existing data. We wish to understand the likelihood of NAS being feasible as early as possible, given the Applicant's inclusion of this measure in both the OMMMP and the Outline SIP.*

We note that Natural England consider NAS to be the most effective way to manage down the impact of noisy activities. There are several different types of NAS but all of them work to reduce the level of noise generated at source, therefore reducing the area that is ensonified and reducing the overall impact to marine mammals. We strongly encourage the use of NAS on this project, and request further information on the feasibility of its use here.

Applicant Response

Limitations of Noise Abatement Systems (NAS)

The limitations of different NAS are reviewed in detail in Verfuss et al. (2019). In terms of environmental limitations, the data provided in Table 1 are based on responses to a questionnaire, by both NAS-suppliers and NAS-users. NAS-users reported more conservative environmental limits with regard to wave height for BBC, NMS and HSD, and for the BBC also with regard to wind speed, than the NAS-suppliers.

Table 1 Environmental limitations of the NAS for deployment (Dep) and operation (Op) with regard to wind speed (@10 m), significant wave height (m), current speed (m/s) and water depth (m). Adapted from Verfuss et al. (2019).

	Max wind speed (@10m)		Max wave height (m)		Max current speed (m/s)		Max water depth (m)			
NAS	Dep	Op	Dep	Op	Dep	Op	Theory	Field	OWF	Non-OWF
BBC[1]-HTL	14	20	2	3	1		>70	>70	40	-
BBC-Weyres	-		3		3		>70	>70	50	>70 (UXO)
BBC-user	10 - 13		1.5 - 2		-		>70	50	50	-
NMS[2]	-		2		1		50	50	50	-
NMS-user	-		1.5	1.5 - 2	-		>70	50	50	-
HydroNAS	15	-	3	-	1	-	>70	10 - 20		-
HSD[3]	-		-	2.5	-	2.5	50 to >70	50	20 - 50	-
HSD-user	-	15	-	1 - 1.5	-		>70	50	50	-
AdBm-NAS	-		4		3		>70	40	-	-

[1] Big Bubble Curtain

[2] Noise Mitigation Screen

[3] Hydro-Sound Damper

Noise Abatement Systems (NAS) Note

Environmental conditions at Hornsea Four

Information on the environmental conditions at the Hornsea Four array area are summarised below.

Wind speed: The expected mean wind speed at the Hornsea Four array is approximately 11.2 m/s (Volume A5, Annex 5.3: Offshore Ornithology Collision Risk Modelling (APP-076)). This is below the environmental limitations reported for the different NAS.

Wave Height: Metocean data were available for site L1 Well Bank Flat (29 June 2010 to 4 July 2011). This site is around 5.4 km to the southeast of the southern boundary of the Hornsea Four array area. Significant wave heights at this site in this time period were typically less than 1.0 m but reached 4.5 m during a storm event in November 2011 (Figure 1) (Volume A5, Annex 1.1: Marine Processes Technical Report (APP-067)). A typical significant wave height of <1 m is below the reported wave height limitations for all NAS.

A hindcast model for a point representative of Hornsea Four has shown that, over the last 40 years, the average significant wave height is 1.46 m. There are clear seasonal changes with higher average significant wave heights in winter months compared to summer months (Figure 2). The overall average significant wave height is within the limitations reported for the different NAS, though the average significant wave heights may reach the operational limits of some of the NAS in the winter months.

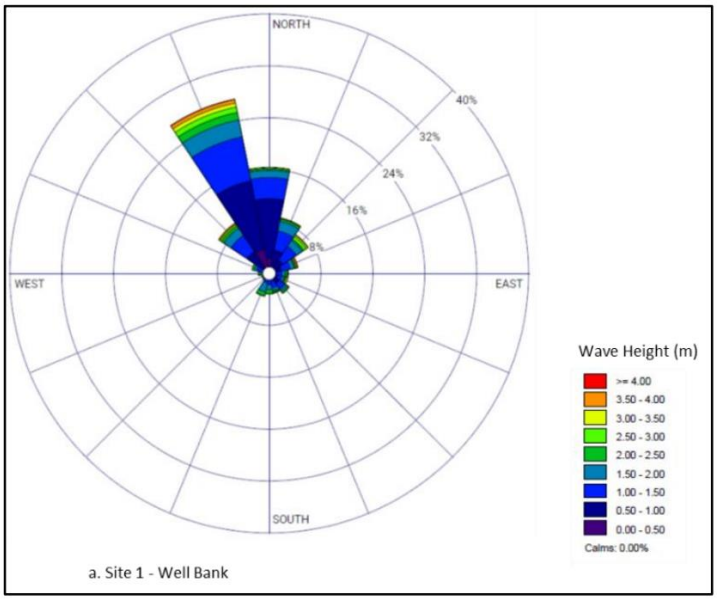

Figure 1 Wave rose for Site L1 – taken from Volume A5, Annex 1.1: Marine Processes Technical Report (APP-067).

Noise Abatement Systems (NAS) Note

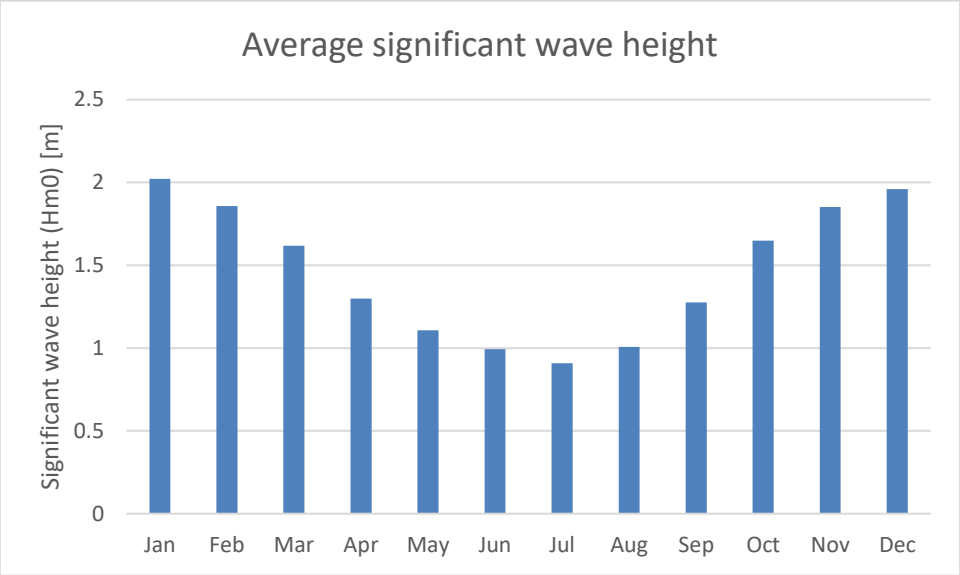

Figure 2 Average significant wave height per month over the last 40 years (data provided by Orsted).

Water depth: The water depth in the Hornsea Four array area varies between a minimum of 34 m below LAT to 62.07 m below LAT (Volume A5, Annex 1.1: Marine Processes Technical Report (APP-067)). Therefore, the water depths within the deepest parts of the Hornsea Four array area reach beyond those previously used for NAS at commercial OWF projects to date (40-50 m).

Big Bubble Curtains (BBCs) have previously been used commercially at non-OWF projects (UXO clearance) at water depths of >70 m. However, the following is stated in Verfuss et al. (2019): "*deployment and efficacy of BBC system is more challenging in waters deeper than 30 m and even though it has been commercially deployed at these depths, it resulted in a number of challenges due to the increased hydrostatic pressure and increased compression of air at depth to ensure that sufficient air gets from surface compressors to the hoses lying on the seabed. A larger number of compressors and a higher operating pressure are needed for deeper water to generate a higher air flow to ensure that large enough bubbles are released into the water at depth* (Koschinski, pers. comm.)".

The Hydro-Sound Damper (HSD) consists of a net with foam elements and air-filled balloons, which act as resonators and need to be adapted to the water depth to ensure efficacy. Noise reduction achieved using HSDs, are proven to be independent of water depth (up to 41 m – this was the deepest tested at a commercial OWF), based on differing layouts of the HSD-elements in the net (Bellmann et al. 2020). In theory they are suitable for depths >70 m but to date no OWF has been constructed in such depths and thus it remains unproven.

Noise reduction achieved using the IHC-NMS, a casing, is proven to be independent of water depth (up to 40 m – this was the deepest tested at a commercial OWF) (Bellmann et al. 2020). However, it is noted in Bellmann et al. (2020) that "*depending on the size of the pile to be driven and the expected water depth, the length and diameter of the double-walled tube must be adapted*". However, as the length of an IHC-NMS cannot be adapted to a larger range of water depths within a project, the use within the Hornsea Four area might be challenging. In theory the IHC-NMS is suitable for depths >70 m but to date no OWF has been constructed in such depths and thus it remains unproven.

In conclusion, the water depths at Hornsea Four are within the theoretical water depths that NAS such as BBCs, HSD and IHC-NMS should be able to operate to (>70 m).

Noise Abatement Systems (NAS) Note

Current state: Tidal data was obtained for Hornsea Four based upon information available from UK Admiralty charts. Table 2 provides the peak flood and ebb direction and speed values for tidal diamond "A" on UKHO Admiralty Chart 1187 (located 2.8 nm from the Hornsea Four array area). The current speeds reach up to 0.72 m/s in the array area, these are below the reported limiting current speeds for all NAS.

Table 2 Details for tidal diamond "A" on UKHO Admiralty Chart 1187.

Hours		Directions of Streams (°)	Spring Tide		Neap Tide	
			knots	m/s	knots	m/s
Before high water	6	134	1.4	0.72	0.8	0.41
	5	131	1.2	0.62	0.7	0.36
	4	125	0.9	0.46	0.5	0.26
	3	093	0.4	0.21	0.2	0.10
	2	345	0.4	0.21	0.2	0.10
	1	324	1.0	0.51	0.5	0.26
High water		317	1.4	0.72	0.8	0.41
After high water	1	311	1.4	0.72	0.8	0.41
	2	303	1.0	0.51	0.6	0.31
	3	271	0.4	0.21	0.2	0.10
	4	169	0.5	0.26	0.3	0.15
	5	145	1.0	0.51	0.6	0.31
	6	137	1.4	0.72	0.8	0.41

Conclusions

- The expected mean wind speed at the Hornsea Four array is approximately 11.2 m/s. This is below the environmental limitations reported for the different NAS.
- The typical wave heights in the vicinity of the Hornsea Four array area (<1 m) are not considered to be a limiting factor for any of the NAS considered here. The average significant wave heights at the site may reach the operational limits of some of the NAS during the worst of the winter months.
- The water depths within the Hornsea Four array area (34-62 m) reach beyond those previously used at commercial OWF projects to date (40-50 m), however they are within the theoretical water depths that the NAS can operate to (>70 m).
- The current speeds at the Hornsea Four array area will not be a limiting factor for any of the NAS considered here.

Noise Abatement Systems (NAS) Note

References

Hornsea Project Four: Environmental Statement (ES) PINS Document Reference: A2.1 APFP Regulation: 5(2)(a) Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes

Hornsea Project Four: Environmental Statement (ES) PINS Document Reference: A5.5.3 APFP Regulation 5(2)(a) Volume A5, Annex 5.3: Offshore Ornithology Collision Risk Modelling

Hornsea Project Four: Environmental Statement (ES) PINS Document Reference: A5.1.1 APFP Regulation: 5(2)(a) Volume A5, Annex 1.1: Marine Processes Technical Report

Bellmann, M., A. May, T. Wendt, S. Gerlach, P. Remmers, and J. Brinkmann. 2020. Underwater noise during percussive pile driving: Influencing factors on pile-driving noise and technical possibilities to comply with noise mitigation values. itap GmbH, Oldenburg.

Verfuss, U. K., R. R. Sinclair, and C. E. Sparling. 2019. A review of noise abatement systems for offshore wind farm construction noise, and the potential for their application in Scottish waters. Scottish Natural Heritage Commissioned Report No. 1070.