Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex A to Appendix 1 to Deadline 5 Submission: Response to ExAQ2.1.8a

Relevant Examination Deadline: 5

Submitted by Vattenfall Wind Power Ltd

Date: April 2019

Revision A

Drafted By:	GoBe Consultants Ltd
Approved By:	Daniel Bates
Date of Approval:	April 2019
Revision:	A

Revision A	Original document submitted to the Examining Authority
N/A	
N/A	
N/A	

Copyright © 2019 Vattenfall Wind Power Ltd

All pre-existing rights retained

Contents

Tables

1 Construction Noise Effects on Fish Species

1 In the ExA's second set of Written Questions, the ExA noted that:

'a considerable degree of disagreement remains between the Applicant and the Marine Management Organisation in relation to the potential for construction noise effects on herring spawning grounds and sole spawning and nursery grounds in the Greater Thames Estuary. Whilst noting the responses provided by the Applicant to date, the most recent being at [REP4-005], the ExA is seeking justification for the Applicant's position sufficient to allow proper consideration of this matter. a) To this end, please could the Applicant respond to each of the points set out at Section 1.2 of the Marine Management Organisation's {REP4-031]?'

2 This document details the points set out at Section 1.2 of the MMO's [REP4-031] in tabulated form Table 1, along with the Applicant's response to those points.

Table 1: Applicant's responses to points set out in Section 1.2 of MMO [REP4-031].

Point	Text	Applicant's Response
1.2.1	The MMO has reviewed the applicant's position set out in its deadline 3 submission in response to action point 17. This remains an item under discussion in the SoCG. The MMO's position is unchanged from that stated in its relevant representation where the MMO advised that it is not aware of any empirical evidence that fish will flee from the source. It is therefore not appropriate to use an assumed fleeing speed to calculate the impact ranges based on SELcum thresholds, and the noise modelling for SELcum should be undertaken based on a stationary receptor.	Please see the Applicant's submission at D4c (Appendix 7 of the Deadline 4c Submission) in which stationary receptor modelling is detailed. The Applicant maintains that static modelling of fish represents an unrealistic scenario, insofar as fish are known to actively avoid simulated piling noise at a much lower level than expected close to the piling location. This is supported by scientific literature (Hawkins *et al*., 2014). Therefore, it remains suitably precautionary to use a 'fleeing' model for noise modelling, particularly when the fleeing speed is based on a swimming speed (which can be comfortably sustained over a long period) rather than a startle speed (which may only be maintained over a shorter period). Scientific literature on behavioural responses to underwater noise are also referenced in Volume 2, Chapter 6 of the Environmental Statement (Fish and Shellfish Ecology): • Avoidance (McCauley *et al*,. 2000); and • Startle response (c-turn) (Pearson *et al*., 1992).
1.2.2	A generic fish swimming speed of 1.5m/s, rather than fleeing speed was used by the applicant based on a publication by Hirata K, (1999) which considers swimming speeds of various fish species. This is not empirical evidence that fish will flee	See Appendix 7 to the Applicant's Deadline 4c Submission. As noted in point 1.2.2, Hawkins *et al.* (2014) lists swimming away as one of the responses to loud noise and vibration.

Point	Text	Applicant's Response
	from the source. There is some evidence that fish will respond to loud noise and vibration, through observed reactions including; schooling more closely, moving to the bottom of the water column, swimming away, and burying in substrate (Hawkins et al. 2014). However, this is not the same as fleeing, which would require a fish to flee directly away from the source over the distance shown in the modelling.	The use of a 'swimming speed' rather than a 'fleeing speed' is inherently more precautionary since the 'swimming speed' is that which can be comfortably sustained over a long period, whereas 'fleeing speed' may only be sustained for a short period. Considering the precautionary scenario that fish do not flee loud noises, the realistic magnitude of impact may lie somewhere between that for fleeing receptors (no significant effect) and the re-modelled stationary receptor scenario (no significant effect) (see Appendix 7 and Annex A to Appendix 7 of the Applicant's Deadline 4c Submission).
1.2.3	Furthermore, even if fish did respond by moving away from affected areas, the timescales in which this may occur are unknown. The fleeing assumption also overlooks the limited mobility of eggs and larvae; and that some animals may have a motivation to remain in a specific area. Herring have a biological need to spawn and require specific substrates to do this (e.g. gravel) and this strong driver to spawn means spawning herring are more likely to remain in situ.	See Appendix 7 to the Deadline 4c Submission. As described above, the swimming speed of 1.5 m/s is based on swimming speed (which can be sustained over a longer period), rather than startle speed (which may only be maintained over a short period), and is therefore precautionary. Eggs and larvae were assessed in relation to mortality and potentially mortal injury in Volume 2, Chapter 6 of the Environmental Statement. The maximum impact range for SPL_{peak} was concluded to be 330 m. To reflect the biological driver of spawning, stationary receptor modelling has now been undertaken and the Applicant notes that this scenario is highly precautionary. Even when considering herring as a stationary receptor, there are no TTS

Point	Text	Applicant's Response
		effects on the Thames/Herne Bay stock (the noise contour being approximately 18 km from the spawning area defined by Coull *et al.,* 1998). Impacts to the Downs stock considering this precautionary approach are sufficiently low that there will be no significant effects. Annex A to Appendix 7 of the Deadline 4c Submission concludes that as a worst-case, impacts represent a 0.049% effect on spawning potential for this stock. Furthermore, IHLS data over a 10-year time series demonstrates that the Downs stock has shifted in terms of spawning away from the area closest to Thanet Extension, south of the Dover Strait.
1.2.4	Having reviewed the scientific literature related to fish behavioural responses to noise, and justification which has been presented to support the use of a fleeing speed (i.e. a generic fish swimming speed, without supporting evidence to support an active fleeing response), the MMO considers there is presently a lack of scientific evidence to support this assumption, therefore under the precautionary principle, a stationary receptor should be assumed.	See responses above (1.2.1) and Appendix 7 to the Applicant's Deadline 4c Submission in which results of stationary receptor modelling are presented.
1.2.5	The applicant also states in action point 17 (88) that "the impact ranges for injurious effect is limited to 350m, and the nearest historic spawning ground is 3km away, noting that there is limited evidence that this is still in use and that the primary grounds are agreed as being at least 20km to the south…" However, when considering the cumulative sound exposure,	See Appendix 7 to the Applicant's Deadline 4c Submission which presents the results of stationary receptor modelling. Even when considering herring as a stationary receptor, there are no TTS effects on the Thames/Herne Bay stock (the noise contour being approximately 18 km from the spawning area

Point	Text	Applicant's Response
	predicted Temporary Threshold Shift ranges may extend out to such distances. In addition there are also potential behavioural effects to consider, which may occur beyond the predicted impact ranges for non-recoverable injury.	defined by Coull *et al.,* 1998). Impacts to the Downs stock considering this precautionary approach are sufficiently low that there will be no significant effects. Annex A to Appendix 7 of the Deadline 4c Submission concludes that as a worst-case, impacts represent a 0.049% effect on spawning potential for this stock. Furthermore, IHLS data over a 10-year time series demonstrates that the Downs stock has shifted in terms of spawning away from the area closest to Thanet Extension, south of the Dover Strait. Behavioural effects are assessed in Volume 2, Chapter 6 of the ES (Fish and Shellfish Ecology) based on criteria defined by Popper *et al*. (2014).
1.2.6	The MMO therefore does not agree that additional modelling will be inconsequential.	
1.2.7	Consequently, the MMO is concerned that the current modelling is not sufficient to fully assess the potential impact on herring spawning areas. Figure 6-14 shows an overlay of the 186 dB re 1 µPa2s SELcum (TTS threshold) noise contours along with herring spawning areas. This figure demonstrates that there is partial overlap between the TTS range and herring spawning grounds (to the East of the site, where IHLS survey data indicates herring larval abundance of between 27,700-50,100 per m2), however this area of overlap is small in the context of the wider habitat available (para 6.10.51). The predicted impact ranges for SELcum, if based on a stationary receptor, may be larger than this, and may extend into the Herne Bay and/or Eastern channel spawning grounds. However without the	Please see previous responses and the Appendix 7 of the Applicant's Deadline 4c Submission, which presents stationary receptor modelling.

Point	Text	Applicant's Response
	modelling presented, the MMO cannot fully assess the potential impact is on these spawning grounds.	
1.2.8	The MMO also raised in its Relevant Representation the potential impacts on Sole spawning grounds in the Greater Thames Estuary. Sole spawning and nursery grounds in the Thames estuary are considered to be of national and international importance to the North Sea stock. The MMO recognises that juvenile and adult sole are classified in the group of fish with no swim bladder and are less susceptible to barotrauma compared to the fish with swim bladder hearing group (which includes herring).	Please see Appendix 7, and Annex A to Appendix 7 of the Applicant's Deadline 4c Submission, which includes an assessment of the impacts to sole spawning potential (based on the precautionary modelling as a stationary receptor).
1.2.9	However, sole are still susceptible to the effects caused by piling noise including mortality, potential mortality injury, recoverable injury, TTS and masking and behavioural effects. Indeed the criteria thresholds for mortality and potential mortal injury as well as recoverable injury are higher for sole compared to herring. A significant population level impact may occur if noise causes fish to move away from foraging grounds breeding/spawning or, cease reproductive activities, or change their migratory behaviour, for example.	Please see Appendix 7, and Annex A to Appendix 7 of the Applicant's Deadline 4c Submission, which includes an assessment of the impacts to sole spawning potential (based on the precautionary modelling as a stationary receptor).
1.2.10	Given the potential impacts to and vulnerability of Thames Estuary sole, appropriate modelling is required to determine extent of the potential attenuation of the modelled piling noise (based on a stationary receptor) to and upon sole spawning	Please see Appendix 7, and Annex A to Appendix 7 of the Applicant's Deadline 4c Submission, which includes an assessment of the impacts to sole spawning potential (based on the precautionary modelling as a stationary receptor).

Point	Text	Applicant's Response
	grounds in the Greater Thames Estuary and whether it extends into known areas of higher spawning intensity. The Applicant's Environmental Statement (ES) presented an overlay of the 186 dB re 1µPa2s SELcum (TTS threshold) noise contours along with only herring spawning areas (ES Figure 6-14). The noise contours have not been overlaid onto identified sole spawning grounds (refer to ES Figure 6-4).	
1.2.11	The MMO would therefore welcome a figure being provided with the maximum impact ranges (modelled based on a stationary receptor) that illustrates the potential impact range for injury to herring and sole overlaid against the known active spawning grounds for consideration before it can agree with the conclusions of the ES.	Appendix 7 of the Applicant's Deadline 4c Submission contains figures illustrating the stationary receptor modelling impact ranges over herring spawning grounds. These are not illustrated over the sole spawning grounds in Annex A to Appendix 7 of the Applicant's Deadline 4c Submission, however Annex A does detail the impact to spawning potential, based on the high intensity spawning grounds defined by Ellis *et al*. (2012).
1.2.12	The MMO further suggested that to address the potential behavioural effects, the Applicant should model the received levels of single pulse Sound Exposure Level at the spawning grounds. The modelled piling location/s should be based on the worst case scenario. This would show the expected noise levels at the spawning ground, which can be used to make an assessment on the potential risk of impact e.g based on peer reviewed literature available.	Please see Appendix 7 and Annex A to Appendix 7 of the Applicant's Deadline 4c Submission. As described above, the Applicant undertook a qualitative assessment of behavioural impacts to fish, based on scientific literature (Popper *et al.,* 2014; McCauley *et al*., 2000; Pearson *et al*., 1992). No significant behavioural effects are predicted.
1.2.13	Long term impact on the benthic environment - The MMO notes that the applicant did not address its position on the long	The Applicant notes that this issue remains an item under discussion through the SoCG, subject to feedback from Cefas

Point	Text	Applicant's Response
	term effects on the benthic environment in its deadline 3 response to action point 17. The MMO has requested further justification to support the conclusions on the long-term effects due to changes of turbid wakes on benthic ecology (i.e. minor adverse to negligible). The applicant has provided some further detail that is currently under review by the MMO and this remains an item under discussion through the SoCG.	