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Re: Kriegers Flak SE Offshore Wind Farm

Swedish Agency for Marin and Water Management (Havs och Vattenmyndigheten) have given a statement (remissyttrande) dated 30-3-2020 regarding construction of an offshore wind farm on Kriegers Flak. They indicate a number of requests for further clarification and/or assessments regarding harbour porpoises (tumlare) and underwater noise, listed below and discussed further in this document. These requests are summarised into four points in the statement (our translation):

1. New calculations of impact on porpoises at population level (for the respective populations), where the total number of disturbance days for the construction period is included. [”Nya beräkningar av påverkan på tumlare på populationsnivå (för respektive population) där totala antalet störningsdagar för hela anläggningsperioden framgår”]
2. Better accounting for the exposure to underwater noise as well as an additional threshold value for underwater noise that considers the cumulative sound exposure level. [”Redovisning av tydligare villkor för undervattensbuller samt ytterligare ett gränsvarde för undervattensbuller som tar hänsyn även till den kumulativa ljudexponeringsnivån”]
3. Incorporation of further methods for noise abatement and modelling on the effect on noise propagation, with the aim of avoiding temporary threshold shifts (TTS). [”Redovisning av ytterligare metoder för dämpning av undervattensbuller enligt bästa möjliga teknik samt modelleringar av hur användandet av ytterligare dämpning påverkar ljudutbredningen så att (TTS undviks.”]
4. Consideration of possible deterrence devices better suited for porpoises, as an alternative to seal scarers. [”Redovisning av möjliga skrämseltekniker som är anpassade för tumlare (utöver salskrämmor)”]

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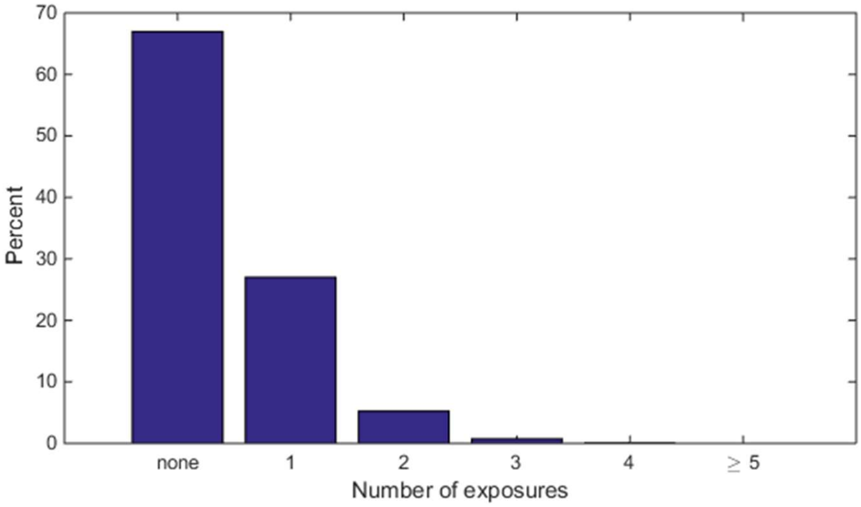
Re. point 1. Cumulative exposure over the entire construction period

HaV does not find that the modelling includes cumulative risk from multiple exposures and suggests modelling this with the PCoD model in order to obtain calculations of impact on porpoises at a population level (for the respective populations). No true PCOD model (see review by Booth et al., 2020) is available for porpoises. The only alternatives are the interim PCoD model for porpoises (iPCoD, King et al., 2015), and the true agent-based DEPONS model (Nabe-Nielsen et al., 2018). Although they are developed to model such cumulative effects at population level, they are, however, not suited for modelling at the fine scale needed for assessment of impact of individual projects in low-density areas. The uncertainty on the input parameters is significant and no empirical data is available known to be relevant for the Baltic proper population of porpoises. This means that the uncertainty on the output will be very large as well and unsuited for the purpose. What these models can robustly deliver is large-scale modelling, addressing whether the combined impact of several wind farms is small, medium or large at a population level. In case of the small and critically endangered Baltic porpoise population, the question is whether the impact of construction of a single wind farm is so small that it can be considered negligible, or it is non-negligible, which would be unacceptable due to the critically endangered status of the population. Neither of the two models are able to deliver results with sufficient precision to answer that question.
This means that the question can only be addressed qualitatively, by considering the likelihood that any animal, which happened to be disturbed by a given pile driving (on average four animals out of a population of around 500 animals, from table 6.1 in Tougaard and Mikaelsen, 2020), is disturbed again on a subsequent pile driving. This likelihood increases with the number of foundations piled and critically depends on assumptions on how much porpoises move around in the Baltic Proper. However, given that the probability of exposure to any one pile driving is low (roughly 4/500, or 0.8%) and the total number of foundations piled is moderate (somewhere between 30 and 50 turbine foundations), the likelihood of individuals being exposed to more than one pile driving remains low. This was simulated under the simplifying assumption that the entire population of Baltic proper porpoises (set at 500 individuals) move at random over the whole distribution range. Results are shown in the bar graph below. About 5% of the animals are likely to be exposed twice and less than 1% of the animals will be exposed 3 times or more. This means that a few individuals will experience to be disturbed twice, and possibly also three times during the entire construction period. These estimates should only be taken as rough indications on the likelihood of multiple exposures, as the actual number of affected animals depends strongly on the actual behaviour of the animals and their movement patterns in the Baltic, both of which are entirely unknown. However, the simulation indicate that most of the porpoises of the Baltic Proper population will either not be disturbed, or disturbed only once during the construction period. The importance of the cumulative exposure to single individuals is therefore assessed to be very low and therefore considered negligible.



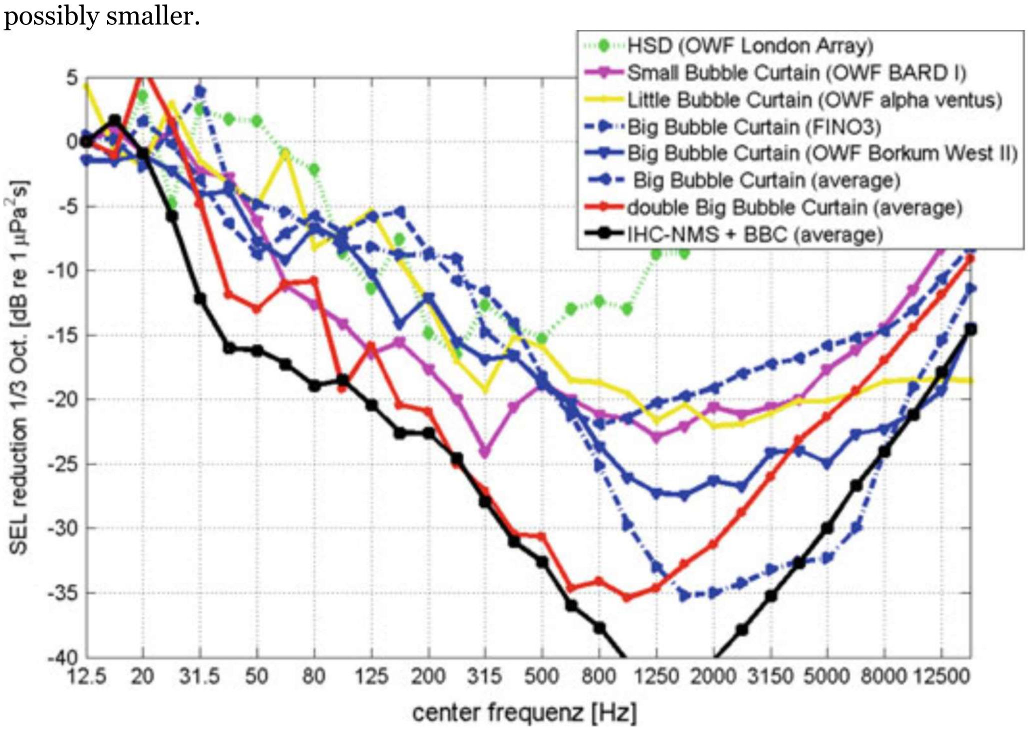
Re. point 2. Cumulative sound exposure level

HaV points to the fact that prediction of hearing loss is only conducted for separate foundations and not across piling at several foundations, noting that there is a risk that individual animals could be exposed to TTS during more than one pile driving and by that suffer an increased risk of accumulating a permanent hearing loss (PTS). HaV further points to adoption of a threshold for this cumulative impact. Such a threshold stretching across multiple pile driving operations and thereby spanning many days, is not possible to establish based on empirical data. The experience from humans and laboratory experiments on rodents and other terrestrial mammals indicate that repeated exposure to excessive amounts of TTS can, under some circumstances, lead to a permanent threshold shift. Recent reviews of marine mammal exposure criteria (Finneran, 2015; National Marine Fisheries Service, 2016; Southall et al., 2007; Southall et al., 2019)(Southall, NOAA, Finneran) conservatively assume that 40 dB of TTS implies an increased risk of PTS. There is little chance that any animal will be exposed to that level of TTS (the modelling suggest that an animal under worst-case assumptions could suffer 15-20 dB of TTS) and the likelihood that the same animal will ever experience this more than once appears very low, as this would require the animal to be within 1-2 km from a monopile at the time the first strike of piling occurs on more than one occasion.

HaV further points out a need for a threshold for PTS expressed as cumulative sound exposure level (SELcum). This we interpret as a value, which can be compared to a measured value in a fixed distance (for example 750 m) in order to test the assumptions of the model and thereby compliance with conditions for permitting. Such values were calculated by the cumulative model from the background report (Tougaard and Mikaelsen, 2020) under the assumption of a stationary receiver 750 m from the pile driving. The resulting values of SELcum for the 11 m and 12 m diameter piles were 182 dB re 1 μPa^2s and 184 dB re 1 μPa^2s, respectively. If measured SELcum at 750 m are below these values it is a good indication that the SELcum experienced by porpoises swimming away from the foundation also remained below the level needed to induce PTS. If measured values are found to be above the thresholds, there is a risk that individuals were exposed to levels high enough to induce PTS. This check is not exact and exceedance of the threshold does not imply that animals were actually affected (it requires that there actually was one or more porpoises close to the foundation at the start of the pile driving), but it can be used as a relatively simple and precautionary test for compliance with conditions for construction.

Re. point 3. Additional noise abatement systems

HaV points to the possibility of adding additional attenuation to the double Big Bubble Curtain used in the modelling already presented. In reply to this, it should be clarified that the attenuation curve used in the modelling was taken as a representative example of a commercially available noise abatement system, which has proved reliable and efficient. Few good measurements are available, but those available suggests that the double Big Bubble Curtain is among the most efficient systems, clearly outperforming the Hydrosound Damper system (see figure below from Bellmann et al., 2017; double Big Bubble Curtain in red, Hydrsound Damper in green). This does not rule out that other, even more efficient systems will become available before decision on abatement technology is finally decided. The modelling is therefore to be understood as a worst-case situation in the sense that actual noise exposure will never be larger than predicted and possibly smaller.



In addition, it should be noted that although there is additional attenuation to gain from employing multiple technologies at the same time, the combined effect is less than the simple sum of the attenuation of the individual systems in isolation. Examples can be found in the data from the DanTysk offshore wind farm (Dahne et al., 2017) and in the summary in Bellmann et al. (2017). This means that the additional attenuation becomes increasingly difficult to achieve by adding multiple noise abatement systems, recalling that the double big bubble curtain already is a double system. The increased complexity of adding a third system should be weighed against the gain, which will be a small reduction of the impact on the porpoises belonging to the Danish Belt population, an impact which has already been assessed to be insignificant. The same is the case for the Baltic Proper population, where the impact has been assessed to be minor and without long term consequences for the population.

Re point 4. Use of seal scarer

HaV and NV points to the undesired disturbance effect of seal scarers in particular for porpoises. This is a real issue, mentioned in the background report (Tougaard and Mikaelsen, 2020, section 7.4), as something, which should be looked further into before construction begins. There are currently only few seal scarers commercially available and none of these has been designed to work as mitigation devices. Instead, they are designed with the aim to deter seals as far as possible from fishing gear. Because of this, no commitment has been made to use a particular type of deterrence device. The problem has been pointed out previously (Dähne et al., 2017; Götz and Janik, 2013) and it is anticipated that better devices will be developed and become commercially available before construction begins. The design parameters of a deterrence device, when designed for mitigation are the range where all animals are deterred and the range where no animals are disturbed. The latter, by necessity, must be significantly larger than the former. The range, within which all porpoises are deterred before piling begins, should be large enough to protect porpoises from PTS, but not significantly larger, as this will also increase the range, where animals are disturbed. Modelling in the background report (Tougaard and Mikaelsen, 2020) suggests that 200 m would be sufficient as the deterrence distance, contrasting with the 1300 m of the Lofitech device. This could be achieved by attenuating the sound of the Lofitech device by approximately 16 dB ($20 \log_{10}\left(\frac{200}{1300}\right)$), which is expected to reduce the disturbance distance by a similar factor, almost amounting to one order of magnitude (i.e. from tens of km to a few km). A modification of the Lofitech device of this sort would require experimental testing and verification of results, but it is feasible to conduct this within the time available until construction starts. Other options include lowering the frequency of the transmitted signal of the deterrence device, as suggested by (Götz and Janik, 2013). By that, the audibility to porpoises will decrease more than the audibility to seals, which would reduce impact on porpoises more than on seals

Kind regards

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