Marine Mammal Commission

6 December 2022

Ms. Jolie Harrison, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3225

Dear Ms. Harrison:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the National Marine Fisheries Service's (NMFS) 26 October 2022 notice (87 Fed. Reg. 64868) and the letter of authorization (LOA) application submitted by Ocean Wind, LLC (Ocean Wind) seeking promulgation of regulations under section 101(a)(5)(A) of the Marine Mammal Protection Act (the MMPA). Taking of marine mammals would be incidental to construction of the Ocean Wind 1 wind energy facility and other associated activities. Ocean Wind's windfarm area is located approximately 24 km southeast of Atlantic City, New Jersey[1].

Background

Ocean Wind is proposing to conduct (1) impact pile driving to install up to 98 tapered 8/11-m monopiles to support wind turbine generators (WTGs) and either three monopiles or 48 2.44-m pin piles (16 pin piles per jacket foundation) to support three offshore substations (OSSs), (2) vibratory pile driving and removal of up to seven temporary cofferdams to assist in the installation of the export cable route, (3) detonation of up to 10 unexploded ordnances or munitions and explosives of concern (UXOs), as needed, and (4) high-resolution geophysical (HRG) site characterization surveys of the inter-array cable and export cable construction areas. Ocean Wind would install the monopiles (and pin piles, if used) using an impact hammer on up to 116 days[2] in water depths of 15 to 36 m. Vibratory pile driving and removal would occur on up to 28 days in water depths up to 20 m, and UXO detonations would occur for no more than 10 days in water depths up to 40 m. In addition, Ocean Wind could use non-parametric sub-bottom profilers (including chirps, sparkers, and boomers), parametric sub-bottom profilers, multibeam echosounders, side-scan sonar, and acoustic positioning systems for up to 624 days during its HRG surveys in water depths up to 40 m. Mitigation measures would include time-area restrictions, sound attenuation system usage and minimum operating requirements, visual and passive acoustic monitoring to implement delay and shut-down procedures, sound field verification (SFV) with

[1] In the Bureau of Ocean Energy Management (BOEM) lease area OCS-A 0498.

[2] For the joint monopile-jacket pile foundation scenario, Ocean Wind would install one monopile per day for the WTGs (98 days) and three pin piles per day for the OSS jacket foundations (18 days). Ocean Wind's alternative scenario would include installing two monopiles per day for the WTGs (49 days) and one monopile per day for the OSSs (3 days), for a total of 52 days of impact pile driving.

mitigation and monitoring zone adjustments and sound attenuation system additions as needed, soft-start and ramp-up procedures, and various vessel strike avoidance measures.

Impact pile driving

The Commission reviewed Ocean Wind's application, JASCO Applied Sciences Inc.'s (JASCO) underwater acoustic and exposure modeling reports[3], and NMFS's preamble to and the proposed rule. The Commission's review revealed numerous issues, and many of the same or similar issues were discussed in the Commission's 1 March 2021 letter regarding the request by South Fork Wind, LLC (South Fork Wind) to install monopiles off Rhode Island.

Level A and B harassment zones for impact pile driving of 8/11-m monopiles[4]—JASCO used its pile driving source model (PDSM) and various sound propagation models (see JASCO's underwater acoustic and exposure modeling report in Ocean Wind's application) to estimate the ranges to effect for the monopiles. PDSM has not been validated by in-situ measurements, but the model has underperformed when compared to other models as part of a benchmark validation[5] (Lippert et al. 2016). Lippert et al. (2016) indicated that JASCO's time-domain finite-difference (TDFD) PSDM model predicted lower sound exposure levels (SELs) in the far-field region than various finite-element (FE) models, because the PDSM model did not reproduce the secondary decaying pulses characteristic of the other models, resulting in a faster decay of the pile vibration and lower SEL estimates (see Figures 3, 4, and 6)[6]. While the exact source level difference between the TDFD PDSM and FE models was not reported, Lippert et al. (2016) indicated that the SELs predicted by the TDFD PDSM were approximately 2.5 dB lower than the FE models at 750 m. The authors suggested that adjusting the bottom boundary parameters of the PDSM could create a closer match with the other models. JASCO has indicated that no such adjustment had been made, and thus the accuracy of the PDSM model for piles up to 8/11 m in diameter remains unknown. To help resolve this issue, the Commission recommended in its 1 March 2021 letter that JASCO add 3 dB to the SEL predictions from the PDSM, which would be consistent with the differences identified in Lippert et al. (2016).

In response, NMFS indicated that Lippert et al. (2016) stated that a drawback of the FE approach was that it simulates the energy loss due to friction in an indirect and rather nonphysical way. Therefore, adding 3 dB to the SEL predictions from JASCO's TDFD PDSM was not warranted (87 Fed. Reg. 810). It is the Commission's view that estimating energy loss due to frictional boundary conditions between the pile and the sediment in an indirect manner is more reflective of real-world scenarios than assuming a reflection coefficient just at the pile foot, as is the case for TDFD PDSM—particularly since the frictional boundary conditions were estimated using a standard equivalent damping approach following Zampolli et al. (2013) that was validated, along with other FE modeling aspects, based on in-situ measurements.

[3] Appendix A in Ocean Wind's application is JASCO's underwater acoustic and exposure modeling report, and Appendix C is JASCO's underwater acoustic modeling of UXO detonations report.
[4] These issues may apply to the 2.44-m pin piles as well.
[5] For a 2-m pile in 10 m of water.
[6] Lippert et al. (2016) indicated that PDSM could not be compared to the frequency-domain damping coefficients specified in the benchmark case in a straightforward manner and that this issue highlights an important difference between time-domain and frequency-domain methods.

To substantiate the Level B harassment zones estimated by JASCO, NMFS could have used the damped cylindrical spreading model (DCSM; Lippert et al. 2018) *and* the source levels provided by TDFD PDSM, as DCSM was developed using, and validated by, in-situ measurements and is simple to implement[7]. Level B harassment zones also can be scaled based on differences in source levels and known initial zones. If one were to use DCSM and assume a 3-dB difference in source levels, the model-estimated Level B harassment zone of approximately 3,490 m, and α=1.22 dB/km (based on medium sand, the modeled scenario of 30.9 m of water depth, and DCSiE), the model-estimated Level B harassment zone would increase by 38 percent[8] resulting in a zone of more than 4,810 m. If, on the other hand, one were to assume a 3-dB difference in source levels and a worst-case scenario of 36 m of water depth[9], the model-estimated Level B harassment zone would increase by 41 percent[10] resulting in a zone of more than 4,920 m.

When comparing JASCO's model-estimated single-strike SELs (SEL_{ss}) at 750 m to those from the Institute of Technical and Applied Physics GmbH's (itap)[11] empirical model, JASCO's SEL_{ss} estimates were less than itap's (Appendix I in JASCO's underwater acoustic and exposure modeling report). Although JASCO's SEL_{ss} were based on median values (50th percentile) and itap's SEL_{ss} were based on 95th percentile values (Bellmann et al. 2020)[12], JASCO has indicated that the difference in those statistical metrics should equate to approximately 2 dB. However, JASCO's SEL_{ss} for monopiles across all hammer energies are on average 4 dB less than[13] those from itap (see Table I-1 in Appendix I of JASCO's underwater acoustic and exposure modeling report). The resulting 2- to 4-dB difference in SEL_{ss} for hammer energies of 3,000 kJ or less has implications regarding underestimated Level A harassment zones, particularly since 80 percent of the total estimated number of strikes would originate at energies of 3,000 kJ or less (Table 12 in the *Federal Register* notice).

In addition, in-situ measurements from other recent pile-driving activities suggest that the Level B harassment zones have been underestimated. JASCO estimated[14] the Level B harassment zone for impact driving of *8/11-m piles* to be 3,490 m, assuming a 10-dB sound attenuation reduction factor based on use of two sound attenuation devices and up to *4,000 kJ* of hammer

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[7] The Bureau of Ocean Energy Management (BOEM) funded the development of the DCSM spreadsheet tool (DCSiE; Heaney et al. 2020) for wind energy development. The spreadsheet tool incorporates information related to bathymetry and substrate type, in addition to the measured sound level at a reference distance (typically no less than three times the water depth at the source). Although the DCSiE results cut off at 5 km, DCSM-fit equations can be easily extended beyond 5 km. Heaney et al. (2020) indicated that DCSM is valid up to αr<20 dB and, for the studies they investigated, that equated to 8.7 km from the source, after which 25logR should be used as a precautionary estimate.
[8] A 31-percent increase is estimated when assuming a 2.5-dB difference in source levels.
[9] α=1.05 dB/km.
[10] A 34-percent increase is estimated when assuming a 2.5-dB difference in source levels.
[11] itap is a German agency accredited for measuring and forecasting sound levels produced during impact pile driving for installations, including wind farms (see Appendix I in JASCO's underwater acoustic and exposure modeling report).
[12] Bellmann n et al.'s (2020) SEL_{ss} data represent averaged empirical measurements from different locations and different conditions.
[13] Based on SEL_{ss} comparisons at each hammer energy during each season (i.e., JASCO 500-kJ SEL_{ss} in winter compared to itap 500-kJ SEL_{ss} in winter). A 6-dB SEL_{ss} difference was observed for hammer energies less than or equal to 2,000 kJ.
[14] Ocean Wind indicated in its application that water depths ranged from 15–36 m in the windfarm area, presumably the blue box in Figure 1-1 of the application. NMFS indicated that JASCO assumed medium sand substrate in a water depth of 30.9 m for its modeling of monopiles and a water depth of 26.4 m for pin piles.

energy (see Table 1-12 in Ocean Wind's application). In contrast, in-situ measurements[15] for impact driving of a *7.8-m pile* with a measured 9–12 dB sound attenuation reduction during use of a double big bubble curtain[16] for a hammer operating at a maximum of *550 kJ* estimated the Level B harassment zone to be 3,891 m[17] (WaterProof 2020). It is unrealistic that an impact hammer with five times more energy intensity would result in a smaller harassment zone; rather, one would expect the Level B harassment zone to nearly double[18]. When Ocean Wind's environmental propagation characteristics are accounted for in DCSM, the Level B harassment zone would increase by 150 percent from 3,891 m to 9,710 m[19].

Similar results of more than a 7-dB difference between source levels at 500 and 4,000 kJ hammer energies are evident in the itap data as well (Bellmann et al. 2020; see Table I-1 of Appendix I of JASCO's underwater acoustic and exposure modeling report). Further, JASCO has intimated that Dominion's 3,891-m Level B harassment zone was based on the maximum measured source level rather than the median source level, as was used in its modeling (87 Fed. Reg. 812). That may be the case, but the maximum measured source level is as close as one will get in the field to an acoustic range based on R_{max}[20]—the metric upon which Level B harassment zones for mitigation and monitoring purposes were based.

Since JASCO appears to be conducting underwater acoustic and exposure modeling for nearly all windfarm installation projects in the Atlantic, if its model(s) is inaccurate, it would have repercussions across the entire industry and could cause unnecessary delays, require additional costs, and hinder wind energy operators from meeting their milestones and adhering to their tight schedules. Further, given the scarcity of available installation vessels and appropriately-sized hammers in the United States, delays for a single project could ripple through the industry. So as not to hamper wind energy installation progress, the Commission recommends that, until JASCO's model has been validated with in-situ measurements of impact installation of monopiles and pin

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[15] In water depths of approximately 25 m with medium sand substrate. The observed sound propagation was fit and supported by DCSM from Lippert et al. (2018; see Figure 3.4 in WaterProof Marine Consultancy & Services BV (WaterProof) 2020). Based on Heaney et al.'s (2020) assertion that DCSM is valid for a range up to $\alpha r<20$ dB, WaterProof (2020) indicated that DCSM could be applied up to 13.6 km from the source based on its measurements and environmental parameters, including an α=1.47 dB/km.

[16] Deployed 84 and 124 m from the pile.

[17] Dominion Energy Virginia (Dominion) estimated the Level B harassment zone with a 10-dB sound attenuation reduction to be less than that measured in the field (85 Fed. Reg. 30940).

[18] The underlying source level should be proportional to the ratio of energy intensity over circumference of the pile. Since the impact hammer for Ocean Wind could exert 7 times more energy than the hammer used for Dominion but over a 1.02 times larger circumference, the source level for Ocean Wind should be more than 7 times larger than was determined by Dominion resulting in a source level increase of more than 8 dB. (4,000 kJ/550 kJ)/(25.1 m/24.5 m)=7.1, with 10log(7)=8.5 dB. Based on DCSM, an 8.5-dB difference in source levels, the measured Level B harassment zone of more than 3,890 m at Dominion, and α=1.47 dB/km for Dominion, the measured Level B harassment zone would increase by 96 percent resulting in a Level B harassment zone of approximately 7,640 m based on the increased hammer energies and pile size.

[19] To further adjust the revised Level B harassment zone based on the environmental propagation conditions at Ocean Wind, one must again use DCSM with α=1.05 dB/km. The revised Level B harassment zone would increase by more than 26 percent, resulting in a final Level B harassment zone of approximately 9,710 m based on the hammer energies, source levels, and propagation conditions expected for Ocean Wind.

[20] R_{max} represents the maximum distance in any direction that the threshold was exceeded, which is similar to using the maximum measured source level to estimate the Level B harassment zone.

piles in the northwest Atlantic, NMFS require Ocean Wind and thus JASCO to re-estimate the various Level A and B harassment zones for the final rule using source levels that are at a minimum 3 dB greater than those currently used.

Ocean Wind would be required to conduct in-situ measurements of the first three monopiles[21] to determine whether the in-situ Level A and B harassment zones are greater than the model-estimated zones and, if so, to add additional or modify the current sound attenuation measures and devices, increase the range(s) of the zones, and conduct additional measurements to ensure the model-estimated zones are not exceeded[22] (see section 217.264(d)(3) in the proposed rule). It is unclear how Ocean Wind will meet these requirements if the model-estimated Level A or B harassment zones have been vastly underestimated for monopiles, with similar issues applying to impact installation of pin piles. It also is unclear which model-estimated zones (i.e., acoustic ranges, exposure ranges[23], or mitigation and monitoring zones[24]) and which metric (flat R_{max}, flat $R_{95\%}$) the in-situ measurements would be compared to and which zone (i.e., acoustic or exposure ranges[25]) and metric would be calculated from the in-situ measurements. Specifically, exposure ranges are two to three times smaller than acoustic ranges for Level A harassment during installation of monopiles[26] (e.g., 1.58 vs. 4.31 km for LF cetaceans in summer and 2.33 vs. 6.69 km in winter; see Tables 1-11, 1-9, and 1-10 in Ocean Wind's application).

Further, it is unclear whether additional measurements would be required to be conducted beyond the first three piles, if subsequent piles need higher hammer energies or more strikes to be driven to depth or if a greater number of piles[27]is driven on a given day than was previously measured. All such circumstances must be considered to ensure that the model-estimated Level A and B harassment zones are not exceeded. For these reasons, the Commission recommends that in the final rule NMFS (1) specify which model-estimated zones (i.e., acoustic ranges, exposure ranges, mitigation zones, monitoring zones) and which metrics (i.e., flat R_{max}, flat $R_{95\%}$) should be compared to the in-situ Level A and B harassment zones, (2) specify which type of in-situ Level A harassment

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[21] And those thereafter that are not represented by the previous three locations (i.e., substrate composition, water depth).
[22] If use of additional and modification of current sound attenuation measures still do not achieve ranges less than or equal to those modeled, assuming a 10-dB attenuation, and no other actions can further reduce sound levels, the clearance and shut-down zones would be expanded in consultation with NMFS. If harassment zones are expanded beyond an additional 1,500 m, additional PSOs would be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m.
[23] Acoustic ranges represent the distance to a harassment threshold based on sound propagation through the environment (i.e., independent of any receiver); while exposure ranges represent the distance at which an animal can accumulate enough acoustic energy to exceed a harassment threshold based on how it moves through the environment (i.e., using animat movement modeling; 87 Fed. Reg. 64919).
[24] Level A harassment zones were based on exposure ranges and, depending on the species, inform the mitigation zones; while Level B harassment zones were based on acoustic ranges and inform the monitoring zones (see Tables 6 and 7 in Appendix B of Ocean Wind's application).
[25] Cumulative SELs (SEL_{cum}) can be measured in situ and weighted for acoustic ranges; while exposure ranges would need to be calculated based on an in-situ measured source level, environmental and animat modeling parameters, and the number of pile strikes that occurred.
[26] Exposure ranges are smaller than acoustic ranges for Level B harassment too, but to a much lesser degree (e.g., 3.49 vs. 3.78 km for low-frequency (LF) cetaceans in winter; see Tables 1-12 and 1-10 in Ocean Wind's application, respectively).
[27] i.e., two instead of one monopile, three instead of two pin piles, two instead of one pin pile, 5,000 strikes instead of 10,846 strikes for one monopile, etc.

zone (i.e., acoustic or exposure ranges) should be calculated, and (3) require that in-situ measurements be conducted for monopiles that are not represented by the previous three locations (i.e., substrate composition, water depth) *or* by the hammer energies and numbers of strikes needed or number of piles installed in a given day.

Level A and B harassment takes for impact pile driving—In addition to the underestimated harassment zones, some of JASCO's assumptions used to seed its exposure modeling were questionable or inappropriate. For example, JASCO used seven-day simulations[28] for its exposure modeling to inform its take estimates rather than single-day simulations adjusted by the respective density and multiplied by the number of days of each activity (30 days of the highest mean density month and 19 days of the second highest mean density month; see Table 17 in the *Federal Register* notice). Single-day simulations run 30 or 50 times per activity, species, and season are more consistent with other entities' methods for conducting exposure modeling and would reduce the variance and standard error in the predictions as compared to single seven-day[29] simulations.

JASCO indicated that its animat density was seeded at 0.5 animats/km^2 and is much greater than real-world densities. With the revised densities from Roberts et al. (2022), that is no longer the case for common bottlenose dolphins[30] during impact pile driving and UXO detonations. Underpopulating animats for exposure modeling can result in underestimation of rare events, particularly Level A harassment. JASCO similarly indicated that the probability of an event's occurrence is determined by the frequency with which it occurs in the simulation—the greater the number of random samples (i.e., animats) the better the approximation of the probability distribution function (Appendix J in JASCO's underwater acoustic and exposure modeling report).

NMFS also based the Level B harassment takes for WTG monopole installation on two piles being installed per day. If only one pile ultimately is installed per day, then the numbers of Level B harassment takes would be underestimated[31]. The number of proposed takes could be multiplied by two for simplicity, or recalculated based on 98 days of activities in the four highest mean density months. A similar issue could exist for impact installation of pin piles.

In general, an underestimation of takes is costly, both monetarily and time-wise, if the operator must shut down activities when the authorized number of takes is met and/or if any issued LOA must be revised. Other wind-energy operators have had to revise their incidental harassment authorization mid-authorization, and in some cases, twice when the authorized number of takes had been met (e.g., 86 Fed. Reg. 13695). Although delphinids have elicited authorization revisions, other species could as well. For example, 42 humpback whales were observed during Ocean Wind's HRG surveys from May 2021 to March 2022. NMFS proposed to authorize 19 harassment takes associated with impact installation of monopiles and one Level A harassment take for both OSS

[28] Seven-day simulations are more relevant for continuous activities such as seismic surveys. They are not relevant to 4 hours of impact pile driving for each monopole, with up to 8 hours per day.

[29] Seven-day simulations should not be retained because it is time consuming to rewrite the code for single-day simulations and additional Monte Carlo simulations. Rather they should be retained because they reflect the proposed activities more accurately.

[30] It also is the case for cofferdam vibratory installation and HRG surveys but exposure modeling was not used for those activities.

[31] NMFS acknowledged in the preamble to the proposed rule that only one monopile may be installed on some days (87 Fed. Reg. 64871).

installation scenarios (Tables 20 and 21, respectively, in the *Federal Register* notice). The Commission is not convinced that the number of humpback whale takes for impact installation of monopiles is sufficient given the size of the harassment zones, the number of days of potential activities, and the known presence of the whales in the area. Further, Level A harassment takes associated with OSS impact installation are less than group size.

For these reasons, the Commission recommends that NMFS (1) require Ocean Wind to revise its take estimates for impact installation of monopiles and pin piles based on an animat density that is greater than any species-specific, real-world density and the possibility that only a single monopile is installed per day rather than two per day and (2) increase Level A harassment takes of humpback whales to mean group size for OSS impact installation in the final rule. Similarly for cofferdam vibratory installation, the Commission recommends that NMFS increase the Level B harassment takes to mean group size for common dolphins and Atlantic white-sided dolphins in the final rule. Additionally, the Commission recommends that NMFS determine whether Department of the Navy's (2017) group size estimates are more appropriate or reflective of expected group size estimates for Ocean Wind than those used in the proposed rule and if so, amend the numbers of takes accordingly in the final rule for all activities that would be conducted. Moreover, JASCO should strongly consider revising its exposure modeling to include single-day simulations for stationary, discrete sound sources and numerous Monte Carlo simulations (e.g., at least 30) for modeling reports that inform any future proposed rule.

Coastal migratory bottlenose dolphin takes for impact pile driving—In addition to animat underpopulation issues associated with JASCO's modeling, Ocean Wind did not request and NMFS did not propose to authorize takes of coastal migratory[32] bottlenose dolphins during impact pile driving of monopiles or pin piles. JASCO indicated that portions of the wind farm area were seeded with animats representing the coastal migratory stock of bottlenose dolphins (see in Figure J-8 in Appendix J of JASCO's underwater acoustic and exposure modeling report). However, when JASCO accounted for the revised densities from Roberts et al. (2022), it indicated that it re-ran the animat movement modeling and seeded coastal migratory bottlenose dolphins only in waters less than 20 m depth and offshore[33] bottlenose dolphins only in waters greater than 20 m depth (see the Addendum to Ocean Wind's application). Although coastal migratory and offshore stocks of bottlenose dolphins were delineated using the 20-m isobath (87 Fed. Reg. 64913) and JASCO modeled impact installation of monopiles in 30.9 m of water and pin piles in 26.4 m, the water depths range from 15–36 m in the wind farm area (87 Fed. Reg. 64872). The revised coastal migratory bottlenose dolphin densities also were four to five times greater[34] than the offshore bottlenose dolphin densities (see Table 8 in the *Federal Register* notice). As such, it is curious that zero takes of the coastal migratory stock of bottlenose dolphins were estimated to occur during impact installation of monopiles and pin piles and, for example, 936 Level B harassment takes of offshore bottlenose dolphins were estimated to occur (see Tables 18 and 19 in the *Federal Register* notice).

NMFS did specify in the preamble to the proposed rule that the coastal migratory and offshore stocks of bottlenose dolphins were adjusted based on the 20-m isobath cutoff, such that take predicted to occur in any area less than 20 m in depth was apportioned to the coastal stock only

[32] Formally the western North Atlantic northern migratory coastal stock.
[33] Formally the western North Atlantic offshore stock.
[34] Which accounted for scaling based on relative abundance of the two stocks as well.

and take predicted to occur in waters of greater than 20 m depth was apportioned to the offshore stock (87 Fed. Reg. 64913). But, the agency also specified that the densities were adjusted based on relative abundance (see Table 8 in the *Federal Register* notice). Regardless, if either type of pile would be installed in 20 m or less of water or if any Level B harassment zone would extend into 20 m or less of water, then the agency should have proposed to authorize takes of coastal migratory bottlenose dolphins[35]. Therefore, the Commission recommends that NMFS include in the final rule Level B harassment takes of coastal migratory bottlenose dolphins during impact installation of monopiles and pin piles, if any pile will be installed in 20 m of water or less or if any Level B harassment zone extends into 20 m or less of water.

Mitigation and monitoring measures for impact pile driving—NMFS reduced the model-estimated number of Level A harassment takes of North Atlantic right whales during impact installation of monopiles based on the mitigation measures that Ocean Wind would be required to implement, including monitoring various mitigation zones and initiating a shut down if a right whale is detected at any distance using a combination of visual monitoring from the construction vessel, a secondary monitoring vessel stationed at 2 km in summer or 2.5 km in winter, and real-time passive acoustic monitoring (PAM; 87 Fed. Reg. 64928). If the intent is to minimize impacts on North Atlantic right whales as specified in the *Federal Register* notice (87 Fed. Reg. 64992), attempting to monitor a minimum assumed 3.5-km zone in the summer and 3.8-km zone in winter could prove difficult, and more so if the zones have been underestimated.

A single vessel stationed at 2 km would not be sufficient for monitoring the farther extents of the zones[36]—that is, the distance to the farthest extent of the Level A harassment zone would be 3.65 and 5 km based on the Level B harassment zone. Less than half of the Level B harassment zone could be monitored in summer, with even less of it in winter. NMFS clarified in the preamble to the proposed rule that if, after SFV, harassment zones are expanded beyond an additional 1,500 m, additional PSOs would be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m (87 Fed. Reg. 64982). Although no such requirement was included in the proposed rule, NMFS seems to acknowledge the limitations of visual monitoring. Recently Oedekoven and Thomas (2022) estimated effectiveness of marine mammal observers (MMOs) to be 54 percent for detecting rorquals at 914 m or more, 31 percent for small cetaceans in pods of more than six, and 14 percent for small cetaceans in pods of six or fewer. The presumption that mitigation can be effective with visual observations alone is unsubstantiated.

To supplement visual monitoring, NMFS indicated that Ocean Wind plans to implement PAM arrays outside of the shut-down zone(s) to monitor animals entering the zone(s) (87 Fed. Reg. 64981) and proposed to require the PAM operator to implement a shut down if an animal occurred within 1,650 m of the pile driving platform in summer (2,500 m in winter; Table 37 in the *Federal Register* notice). However, Ocean Wind did not provide a PAM plan, it merely provided examples of PAM devices and capabilities in Appendix B of its application. Not requiring Ocean Wind to have a fleshed-out PAM monitoring plan runs counter to NMFS being able to assess whether the company would be able to implement the mitigation measures successfully and would be effecting the least

[35] The total number of bottlenose dolphin takes that were all attributed to the offshore stock could be reapportioned to include takes of coastal migratory dolphins without having to remodel.
[36] Since NMFS assumes that the zones are radii of circles.

practicable adverse impact on the species. Rather, NMFS proposed to require that Ocean Wind provide the PAM plan at least 180 days prior to installation of the first pile (section 217.265(c)(1)(vii) of the proposed rule). In addition, failing to require a PAM plan compromises the transparency of the public review process.

Since neither Ocean Wind nor NMFS provided information on the minimum number, type (e.g., moored, drifting, or towed), location, bandwidth/sampling rate, estimated acoustic detection range, or sensitivity of the hydrophones or the detection software (e.g., PAMGUARD) that would be used, it is impossible to determine whether Ocean Wind would be able to monitor effectively in real time the currently-estimated 3.5- and 3.8-km Level B harassment zones. This information is necessary to ensure that Ocean Wind can detect, classify, and localize North Atlantic right whales, as intended. NMFS also did not appear to consider how the direct strike pulses and reverberation from impact pile driving could inhibit detection of marine mammal vocalizations, primarily those of right whales. The Commission recommends that NMFS require Ocean Wind to submit a PAM plan and allow for public comment prior to issuing any final rule. The PAM plan should include the number, type(s) (e.g., moored, towed, drifting, autonomous), deployment location(s), bandwidth/sampling rate, sensitivity of the hydrophones, estimated detection range(s) for ambient conditions and during pile driving, and the detection software to be used. Further, Ocean Wind and other wind energy applicants should consider whether vector sensors should be used in addition to hydrophones to enhance detections, particularly those vocalizations that may be drowned out by the hammer strikes and resulting reverberation.

Similar to the PAM plan, Ocean Wind did not provide and NMFS did not require an SFV plan to be submitted for impact pile driving before publishing the proposed rule. Ocean Wind will just have to provide the SFV plan to NMFS and BOEM at least 180 days prior to installation of the first pile (section 217.264(d)(3)(vi) of the proposed rule). In previous authorizations, the SFV requirements have been incomplete or incorrect. In this case, section 217.264(d)(3) of the proposed rule omitted the requirement to determine root-mean-square sound pressure level (SPL_{rms}) source levels and specified TTS thresholds instead of behavior thresholds for determining ranges to Level B harassment thresholds. Section 217.265(d)(11)(i)[37] of the proposed rule also omitted the requirement to specify the cumulative SEL, ranges to the Level A and B harassment zones, and type(s) and location(s) of the sound attenuation systems in the interim SFV reports. The Commission could not determine whether NMFS specified a minimum number of hydrophones that Ocean Wind would be required to deploy for SFV. The Commission recommends that NMFS address the aforementioned issues and include the noted omissions in sections 217.264 and 217.265 of the final rule and require in the final rule that Ocean Wind deploy a minimum of three hydrophones for SFV during impact pile driving.

UXO detonations

Behavior thresholds for explosives—With respect to detonations, NMFS has again assumed that temporary threshold shift (TTS) and startle responses, not behavioral responses[38], are the most likely

[37] This section also apparently applies to UXO detonations.
[38] NMFS incorrectly specified that UXO detonations are impulsive sources and that the 160-dB re 1 μPa threshold applied in cases of behavior takes (87 Fed. Reg. 64908). UXO detonations are explosive sources, and the behavior threshold for underwater detonations is 5 dB less than the TTS thresholds for each functional hearing group.

impact to result from the proposed underwater detonations (87 Fed. Reg. 64901). The Commission has disagreed for many years with NMFS's stance that single detonations do not have the potential to cause a behavioral response (see the Commission's 6 September 2022 letter detailing this issue). Although animals may not have been observed to exhibit significant behavioral reactions to temporally- and spatially-isolated detonations in the past, sufficient monitoring also has not occurred to verify that behavioral responses have not occurred. Evidence also has yet to be provided supporting that an animal exhibiting a significant behavioral response to two 5-lb charges detonated within a few minutes of each other would not exhibit a similar response to a single detonation of 100 lbs., let alone detonations of up to 1,000 lbs.

Changing behavior state, ceasing a vital function (e.g., feeding, resting, nursing), and/or avoiding the area are behavioral responses that are likely to occur, particularly when a 1,000-lb UXO detonates near a marine mammal. In fact, NMFS indicated in the preamble to the proposed rule that (1) behavioral avoidance alters energetic expenditures, as energy is required to move away from a sound source and (2) marine mammals disturbed by anthropogenic sound are commonly reported to shift from resting to active behavioral states, implying an energy cost (87 Fed. Reg. 64901). NMFS also specified that lower-level physiological stress responses (e.g., change in orientation, startle response, change in respiration, change in heart rate) are likely to co-occur with behavioral modifications (87 Fed. Reg. 64986). Continuing to deny that a single explosive event, including that of a 1,000-lb UXO, has the potential to cause behavior takes of marine mammals underwater is illogical, unsubstantiated, and reflective of an entrenched position rather than best available science. This is especially nonsensical since NMFS routinely authorizes behavior takes of marine mammals associated with exposure to *single* in-air explosive events (e.g., 84 Fed. Reg. 28462). The Commission again recommends that NMFS estimate and authorize behavior takes of marine mammals, in addition to Level B harassment TTS takes, for UXO detonations in the final rule.

Efficacy of sound attenuation systems for UXO detonations—Ocean Wind plans to use a sound attenuation system[39] during all UXO detonations and presumed, along with NMFS, that it would achieve at least a 10-dB sound reduction (87 Fed. Reg. 64938). NMFS also indicated that the potential for mortality and non-auditory injury during UXO detonations is *de minimis* (87 Fed. Reg. 64939). Mortality and non-auditory injury may be unlikely, but they are not *de minimis*. Furthermore, the potential for any of the various types of taking relies heavily on the assumed 10-dB sound reduction.

That assumption was based upon Bellmann et al. (2020) and Bellmann (2021)[40]. Bellmann et al. (2020) mentioned UXO detonations only once—

> Big Bubble Curtains [BBCs] were already successfully applied in Europe during detonations of ammunition dumpsites (UXO clearance) in up to 70 m water depth in the North- and Baltic Sea. However, in most cases, no underwater noise measurements were carried out to evaluate the applied Big Bubble Curtain.

[39] Termed noise mitigation system and noise abatement system in the preamble to and the proposed rule.
[40] This reference was cited incorrectly as Bellmann and Betke (2021) in the preamble to the final rule.

Successful deployment and efficacy are not synonymous. Bellmann (2021) indicated that currently the only reliable, offshore-tested noise mitigation system for UXO clearance is reduction of charge weights, which is not feasible with UXOs, and that the typical charge weight of UXOs was 10 kg. He went on to state that the only technically feasible and offshore-reliable *possibility* to reduce underwater sound during UXO clearance is the application of an optimized single or double BBC (DBBC). Although 750-kg UXOs may have a charge weight of only 10 kg or less in European waters, that might not be the case in U.S. waters. UXOs in Europe have been degrading in water for the last 75 years, compromising the integrity of the TNT-equivalent material. NMFS indicated that UXOs in U.S. waters typically could be left behind following Navy military training, testing, or other operations (87 Fed. Reg. 64872). Those activities are ongoing.

In addition, Bellmann (2021) discussed modeled and measured detonations of 100 g, 5 kg, and 10 kg, which are much less than the 1,000-lb, or 454-kg, UXO that Ocean Wind could detonate. Bellmann (2021) noted that an overall SEL reduction of 11 dB was observed with the first application of a BBC during UXO clearance, but did not specify how large of a charge was detonated. Since Bellmann (2021) was based on 10-kg (or less) charges, one can assume that the measurements of UXO clearance using a BBC were for small charges as well.

BBCs attenuate high-frequency (HF) sound (<1 kHz) more efficiently than LF sound (Bellmann et al. 2020) that corresponds to most of the UXO energy. There also was no discussion of whether the shockwave from the UXO detonation would disrupt or displace the bubble curtain. Shockwaves travel at supersonic speeds and would reach the BBC before the sound. Placement of the BBC around a UXO detonation was not discussed in any of Ocean Wind's documents but would greatly affect whether and to what degree the BBC could attenuate the sound.

Bellmann (2021) also indicated that currents >2 knots led to a reduction of sound attenuation that cannot be resolved with additional compressed air or larger distances to the source and that the overall achieved sound reduction of a BBC depends significantly on the configuration and application of the BBC. If neither is optimized, then the sound reduction decreases significantly. The Commission finally notes that NMFS would not require Ocean Wind to deploy a DBBC in the proposed rule (see section 217.264(f)(1)(ii)), which is inconsistent with requirements for impact pile driving. Given the lack of proven efficacy and limitations of use of sound attenuation systems during UXO detonations, <u>the Commission recommends</u> that in the final rule NMFS re-estimate the various mortality, Level A harassment, and Level B harassment zones and mitigation and monitoring zones based on 0 dB of sound attenuation and re-estimate the numbers of takes accordingly, increasing to group size where necessary. <u>The Commission also recommends</u> that in the final rule NMFS require Ocean Wind to use a DBBC during UXO detonations and prohibit Ocean Wind from conducting UXO detonations when currents are greater than 2 knots.

Level A harassment takes for UXO detonations—NMFS reduced the number of model-estimated Level A harassment takes during UXO detonations from four bottlenose dolphins and three minke whales to zero Level A harassment takes each, citing the mitigation measures that Ocean Wind would be required to implement (see Table 27 and 28 in the *Federal Register* notice). Presumably, that means the efficacy of such measures. As stated previously herein, the efficacy of visual monitoring is not 100 percent and the extent to which the PAM that would be employed can detect marine mammals is unknown. In this instance, NMFS has increased the clearance zones (compare Tables 25 and 26 to Table 39 in the *Federal Register* notice) to 10 km for LF and HF cetaceans, 5 km for phocids, and 2 km for mid-frequency (MF) cetaceans. NMFS would require that six PSOs and one PAM PSO monitor before, during, and after the detonation—two PSOs on two different vessels[41] and two PSOs in an aircraft. That number of PSOs would not guarantee that all LF and MF cetaceans are sighted, similar to HF cetaceans and phocids for which NMFS proposed to authorize Level A harassment takes. Minke whales are difficult to observe out to 10 km with only three platforms, and dolphins could occur within the Level A harassment zone undetected depending on group size and the speed at which they are traveling, as well as where the platforms are surveying (e.g., Oedekoven and Thomas 2022). For these reasons, the Commission recommends that NMFS authorize Level A harassment takes for minke whales and increase the Level A harassment takes to group size for bottlenose dolphins during UXO detonations in the final rule.

SFV plan for UXO detonations—Similar to impact pile driving, Ocean Wind did not provide and NMFS did not require an SFV plan to be submitted for UXO detonations before publishing the proposed rule. However, in this instance, NMFS also did not require Ocean Wind to provide the SFV plan to NMFS and BOEM at least 180 days prior to the first UXO detonation. Section 217.264(f)(5)(i) of the proposed rule also incorrectly specified the source levels as 'peak and cumulative sound exposure level', instead of impulse (Pa-sec), SPL_{peak}, and SEL for UXO detonations and omitted the requirement to provide ranges to the mortality isopleths. The proposed rule also omitted many of the details and requirements set forth for the impact pile-driving SFV plan in section 217.264(d)(3) of the proposed rule. A minimum number of hydrophones that Ocean Wind would be required to deploy was not specified, nor whether a pressure transducer would be required to capture the fast rise times and overpressure produced from a UXO detonation that are crucial for measuring impulse and SPL_{peak} metrics. The Commission recommends that NMFS address the aforementioned issues and include the noted omissions in sections 217.264(f)(5) and 217.265 of the final rule and require in the final rule that Ocean Wind deploy a minimum of two hydrophones and one pressure transducer for SFV during UXO detonations.

Mitigation and monitoring measures for UXO detonations—Section 216.24(d)(5) of the proposed rule would require that PAM operators review acoustic data from at least 24 hours prior to pile driving. As a precautionary measure, the Commission recommends that NMFS require Ocean Wind to have PAM operators also review acoustic data for at least 24 hours prior to UXO detonations, when available.

General mitigation and monitoring measures

Section 217.265(a)(1)(x) of the proposed rule stated that two of the PSOs (on the vessel or aircraft) must have a minimum of 90 days of at-sea experience and must have had this experience within the last 18 months. However, the experience required for the Lead PSO is not as specific with respect to length of experience or how recent that experience should be. Section 217.625(a)(1)(ix) merely states that "the Lead PSO must demonstrate prior experience working as a PSO in offshore environments, specifically with prior experience observing mysticetes, odontocetes, and pinnipeds in the Northwest Atlantic Ocean." Presumably, the Lead PSO should have the same experience as, or more experience than, the other experienced PSOs required for the project. The Commission recommends that NMFS specify in section 217.625(a)(1)(ix) of the final rule that the

[41] The Commission notes that the required numbers of PSOs and vessels for UXO detonations are inconsistent in sections 217.265(b)(4)(i) and (iii) of the proposed rule and should be consistent in the final rule.

Lead PSO must have a minimum of 90 days of at-sea experience and must have had this experience within the last 18 months.

The following omissions and errors were noted in the proposed rule and should be addressed in the final rule.

- Section 217.260(c)(2) should also specify 'removal' of cofferdams.
- Section 217.264(a)(4) omitted UXO detonations in the list of specified activities.
- The duration that PSOs must monitor the area around each foundation pile (monopiles or pin piles) after pile driving has stopped should be specified as 30 minutes in section 217.264(d)(4) or (d)(5), as noted in the preamble to the proposed rule.
- The terms 'small odontocetes', 'delphinids and harbor porpoises', and 'dolphins and porpoises' were used interchangeably throughout the various mitigation measures in section 217.264.
- The terms 'seals' and 'pinnipeds' were used interchangeably or omitted altogether from the various mitigation measures in section 217.264.

Please contact me if you have questions regarding the Commission's recommendations.

Sincerely,

Peter O Thomas

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cc: Amy Scholik-Schlomer, NMFS Office of Protected Resources
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References

Bellmann, M. A. 2021. Expert opinion report regarding underwater noise emissions during UXO-clearance activity and possible options for noise mitigation. Report number 3960, Institut für Technische und angewandte Physik (ITAP) GmbH, Oldenburg, Germany. 17 pages.

Bellmann, M.A., 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, Germany. 137 pages.

Department of the Navy. 2017. Dive distribution and group size parameters for marine species occurring in the U.S. Navy's Atlantic and Hawaii-Southern California Training and Testing Areas. Naval Undersea Warfare Center, Division Newport, Newport, Rhode Island. 114 pages.

Heaney K.D., M.A. Ainslie, M.B. Halvorsen, K.D. Seger, R.A.J. Müller, M.J.J. Nijhof, and T. Lippert. 2020. Parametric analysis and sensitivity study of the acoustic propagation for renewable energy sources. OCS Study BOEM 2020-011, U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, Virginia. 186 pages. https://espis.boem.gov/final%20reports/BOEM_2020-011.pdf.

Lippert, T., M.A. Ainslie, and O. von Estorff. 2018. Pile driving acoustics made simple: Damped cylindrical spreading model. The Journal of the Acoustical Society of America 143: 310–317.

Lippert, S., M. Nijhof, T. Lippert, D. Wilkes, A. Gavrilov, K. Heitmann, M. Ruhnau, O. von Estorff, A. Schäfke, I. Schäfer, J. Ehrlich, A. MacGillivray, J. Park, W. Seong, M.A. Ainslie, C. de Jong, M. Wood, L. Wang, and P. Theobald. 2016. COMPILE: A generic benchmark case for predictions of marine pile-driving noise. IEEE Journal of Oceanic Engineering 41(4):1061–1071. https://doi.org/10.1109/JOE.2016.2524738.

Oedekoven, C., and L. Thomas. 2022. Effectiveness of Navy lookout teams in detecting cetaceans. Report number CREEM-24289-1, University of St Andrews, St Andrews, Scotland. 41 pages.

Roberts, J.J., T. Yack, and P.N. Halpin. 2022. Habitat-based marine mammal density models for the U.S. Atlantic: Latest versions. Duke University Marine Geospatial Ecology Lab, Durham, North Carolina. https://seamap.env.duke.edu/models/Duke/EC/

WaterProof. 2020. Coastal Virginia Offshore Wind: Noise monitoring during monopile installation A01 and A02. WaterProof Marine Consultancy & Services BV, Lelystad, The Netherlands. 34 pages.

Zampolli, M., M.J.J. Nijhof, C.A.F. de Jong, M.A. Ainslie, E.H.W. Jansen, and B.A.J. Quesson. 2013. Validation of finite element computations for the quantitative prediction of underwater noise from impact pile driving. Journal of the Acoustical Society of America 133:72–81.