DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 217

[Docket No. 230201–0034]

RIN 0648–BL67

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to the Sunrise Wind Offshore Wind Farm Project Offshore New York

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; proposed letter of authorization; request for comments.

SUMMARY: NMFS has received a request from Sunrise Wind, LLC (Sunrise Wind), a 50/50 joint venture between Ørsted North America, Inc. (Ørsted) and Eversource Investment, LLC, for Incidental Take Regulations (ITR) and an associated Letter of Authorization (LOA) pursuant to the Marine Mammal Protection Act (MMPA). The requested regulations would govern the authorization of take, by Level A harassment and/or Level B harassment, of small numbers of marine mammals over the course of 5 years (2023–2028) incidental to construction of the Sunrise Wind Offshore Wind Farm Project offshore of New York in a designated lease area on the Outer Continental Shelf (OCS–A–0487). Project activities likely to result in incidental take include pile driving (impact and vibratory), potential unexploded ordnance or munitions and explosives of concern (UXO/MEC) detonation, and vessel-based site assessment surveys using high-resolution geophysical (HRG) equipment. NMFS requests comments on this proposed rule. NMFS will consider public comments prior to making any final decision on the promulgation of the requested ITR and issuance of the LOA; agency responses to public comments will be summarized in the final rule, if issued. The proposed regulations, if adopted, would be effective November 20, 2023–November 19, 2028.

DATES: Comments and information must be received no later than March 13, 2023.

ADDRESSES: Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov* and enter NOAA–NMFS–2023–0012 in the Search box. Click on the ''Comment'' icon, complete the required fields, and enter or attach your comments.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NMFS. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible. NMFS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous). Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Jaclyn Daly, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of Sunrise Wind's application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable.* In case of problems accessing these documents, please call the contact listed above (see **FOR FURTHER INFORMATION CONTACT**).

Purpose and Need for Regulatory Action

This proposed rule, if adopted, would provide a framework under the authority of the MMPA (16 U.S.C. 1361 *et seq.*) to allow for the authorization of take of marine mammals incidental to construction of the Sunrise Wind Offshore Wind Farm Project within the Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS–A 0487 and along an export cable corridor to a landfall location in New York. NMFS received a request from Sunrise Wind for 5-year regulations and an LOA that would authorize take of individuals of 16 species of marine mammals by harassment only (four species by Level A harassment and Level B harassment and 12 species by Level B harassment) incidental to Sunrise Wind's construction activities. No mortality or serious injury is anticipated or proposed for authorization. Please see the *Estimated Take of Marine Mammals* section below for definitions of harassment.

Legal Authority for the Proposed Action

The MMPA prohibits the ''take'' of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made, regulations are promulgated, and public notice and an opportunity for public comment are provided.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other ''means of effecting the least practicable adverse impact'' on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stocks for taking for certain subsistence uses (referred to as ''mitigation''); and requirements pertaining to the mitigation, monitoring and reporting of the takings are set forth. The definitions of all applicable MMPA statutory terms cited above are included below.

Section 101(a)(5)(A) of the MMPA and the implementing regulations at 50 CFR part 216, subpart I provide the legal basis for proposing and, if appropriate, issuing 5-year regulations and an associated LOA. This proposed rule also establishes required mitigation, monitoring, and reporting requirements for Sunrise Wind's activities.

Summary of Major Provisions Within the Proposed Rule

The major provisions within this proposed rule are as follows:

• Establishing a seasonal moratorium on impact pile driving during the months of highest North Atlantic right whale (*Eubalaena glacialis*) presence in the project area (January 1–April 30);

• Establishing a seasonal moratorium on any UXO/MEC detonations during the months of highest North Atlantic right whale present in the project area (December 1–April 30).

• Requiring that any UXO/MEC detonations may occur only during hours of daylight and not during hours of darkness or night.

• Conducting both visual and passive acoustic monitoring by trained, NOAA

Fisheries-approved Protected Species Observers (PSOs) and Passive Acoustic Monitoring (PAM) operators before, during, and after the in-water construction activities;

- Requiring the use of sound attenuation device(s) during all impact pile driving and UXO/MEC detonations to reduce noise levels;
- Delaying the start of pile driving if a North Atlantic right whale is observed at any distance by the PSO on the pile driving or dedicated PSO vessels;
- Delaying the start of pile driving if other marine mammals are observed entering or within their respective clearance zones;
- Shutting down pile driving (if feasible) if a North Atlantic right whale is observed or if other marine mammals enter their respective shut down zones;
- Implementing soft-starts for impact pile driving and using the least hammer energy possible;
- A requirement to implement noise abatement system(s) during all impact pile driving and UXO/MEC detonations;
- Implementing ramp-up for HRG site characterization survey equipment;
- Requiring PSOs to continue to monitor for 30 minutes after any impact pile driving occurs and for any and after all UXO/MEC detonations;
- Increasing awareness of North Atlantic right whale presence through monitoring of the appropriate networks and Channel 16 as well as reporting any sightings to the sighting network;
- Implementing vessel strike avoidance measures;
- Sound field verification requirements during impact pile driving and UXO/MEC detonation to measure *in situ* noise levels for comparison against the model results; and
- Implementing best management practices during fisheries monitoring surveys such as removing gear from the water if marine mammals are considered at-risk or are interacting with gear.

Under Section 105(a)(1) of the MMPA, failure to comply with these requirements or any other requirements in a regulation or permit implementing the MMPA may result in civil monetary penalties. Pursuant to 50 CFR 216.106, violations may also result in suspension or withdrawal of the Letter of Authorization (LOA) for the project. Knowing violations may result in criminal penalties under Section 105(b) of the MMPA.

National Environmental Policy Act (NEPA)

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216–6A, NMFS must evaluate the proposed action (*i.e.,* promulgation of regulations and subsequent issuance of a 5-year LOA) and alternatives with respect to potential impacts on the human environment.

Accordingly, NMFS proposes to adopt BOEM's Environmental Impact Statement (EIS), provided our independent evaluation of the document finds that it includes adequate information analyzing the effects of promulgating the proposed regulations and LOA issuance on the human environment. NMFS is a cooperating agency on BOEM's EIS. BOEM's draft EIS (Sunrise Wind Draft Environmental Impact Statement (DEIS) for Commercial Wind Lease OCS–A 0487) was made available for public comment on December 16, 2022 (87 FR 77136), beginning the 60-day comment period ending on February 14, 2023. Additionally, BOEM held three virtual public hearings on January 18, January 19, and January 23, 2023.

Information contained within Sunrise Wind's incidental take authorization (ITA) application and this proposed rule provide the environmental information related to these proposed regulations and associated 5-year LOA for public review and comment. NMFS will review all comments submitted in response to this proposed rule prior to concluding the NEPA process or making a final decision on the requested 5-year ITR and LOA.

Fixing America's Surface Transportation Act (FAST–41)

This project is covered under Title 41 of the Fixing America's Surface Transportation Act, or ''FAST–41.'' FAST–41 includes a suite of provisions designed to expedite the environmental review for covered infrastructure projects, including enhanced interagency coordination as well as milestone tracking on the public-facing Permitting Dashboard. FAST–41 also places a 2-year limitations period on any judicial claim that challenges the validity of a Federal agency decision to issue or deny an authorization for a FAST–41 covered project. 42 U.S.C. 4370m–6(a)(1)(A).

Sunrise Wind's proposed project is listed on the Permitting Dashboard, where milestones and schedules related to the environmental review and permitting for the project can be found: *https://www.permits.performance.gov/permitting-project/sunrise-wind-farm.*

Summary of Request

On November 10, 2021, Sunrise Wind submitted a request for the promulgation of regulations and issuance of an associated 5-year LOA to take marine mammals incidental to construction activities associated with implementation of the Sunrise Wind Offshore Wind Farm Project (herein ''SWF'') offshore of New York in the BOEM Lease Area OCS–A–0487. Sunrise Wind's request is for the incidental, but not intentional, taking of a small number of 16 marine mammal species (comprising 16 stocks) by Level B harassment (for all 16 species or stocks) and by Level A harassment (for 4 species or stocks). Neither Sunrise Wind nor NMFS expects serious injury or mortality to result from the specified activities nor is any proposed for authorization.

In response to our questions and comments and following extensive information exchange between Sunrise Wind and NMFS, Sunrise Wind submitted a final revised application on May 9, 2022, which NMFS deemed adequate and complete on May 10, 2022. This final application is available on NMFS' website at: *https://www.fisheries.noaa.gov/action/incidental-take-authorization-sunrise-wind-llc-construction-and-operation-sunrise-wind.*

On June 2, 2022, NMFS published a notice of receipt (NOR) of Sunrise Wind's adequate and complete application in the **Federal Register** (87 FR 33470), requesting comments and soliciting information related to Sunrise Wind's request during a 30-day public comment period. During the NOR public comment period, NMFS received comment letters from two environmental non-governmental organizations: Clean Ocean Action and Oceana. NMFS has reviewed all submitted material and has taken the material into consideration during the drafting of this proposed rule. Subsequently, in June 2022, new scientific information was released regarding marine mammal densities (Robert and Halpin, 2022) and, as such, Sunrise Wind submitted a final Updated Density and Take Estimation Memo to NMFS on December 15, 2022 that included updated marine mammal densities and take estimates. This memo is available on our website at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-sunrise-wind-llc-construction-and-operation-sunrise-wind*).

NMFS previously issued four Incidental Harassment Authorizations (IHAs) to Ørsted for the taking of marine mammals incidental to marine site characterization surveys (using HRG equipment) of the Sunrise Wind's BOEM Lease Area (OCS–A 0487) and surrounding BOEM Lease Areas (OCS–A 0486, OCS–A 0500) (see 84 FR 52464, October 2, 2019; 85 FR 63508, October 8 14, 2020; 87 FR 756, January 6, 2022; and 87 FR 61575, October 12, 2022). To date, Ørsted has complied with all IHA requirements (*e.g.,* mitigation, monitoring, and reporting). Information regarding Ørsted's monitoring results may be found in the Estimated Take of Marine Mammals section, and the full monitoring reports can be found on NMFS' website: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable.*

On August 1, 2022, NMFS announced proposed changes to the existing North Atlantic right whale vessel speed regulations to further reduce the likelihood of mortalities and serious injuries to endangered North Atlantic right whales from vessel collisions, which are a leading cause of the species' decline and a primary factor in an ongoing Unusual Mortality Event (87 FR 46921). Should a final vessel speed rule be issued and become effective during the effective period of this ITR (or any other MMPA incidental take authorization), the authorization holder would be required to comply with any and all applicable requirements contained within the final rule. Specifically, where measures in any final vessel speed rule are more protective or restrictive than those in this or any other MMPA authorization, authorization holders would be required to comply with the requirements of the rule. Alternatively, where measures in this or any other MMPA authorization are more restrictive or protective than those in any final vessel speed rule, the measures in the MMPA authorization would remain in place. The responsibility to comply with the applicable requirements of any vessel speed rule would become effective immediately upon the effective date of any final vessel speed rule and, when notice is published of the effective date, NMFS would also notify Sunrise Wind if the measures in the speed rule were to supersede any of the measures in the MMPA authorization such that they were no longer required.

Description of the Specified Activity

Overview

Sunrise Wind has proposed to construct and operate a 924 to 1,034 megawatt (MW) wind energy facility (known as Sunrise Wind Farm (SRWF)) in state and Federal waters in the Atlantic Ocean in lease area OCS–A–0487, located within the Massachusetts and Rhode Island Wind Energy Area (RI/MA WEA). Sunrise Wind's project would consist of several different types of permanent offshore infrastructure, including wind turbine generators (WTGs) and associated foundations, an offshore converter substation (OCS–DC), offshore substation array cables, and substation interconnector cables. Specifically, activities to construct the project include the installation of up to 94 WTGs (at 102 potential locations) and 1 OCS–DC via impact pile driving; impact and vibratory pile driving at the cable landfall site; trenching, laying, and burial activities associated with the installation of the export cable route from the OCS–DC to the shore-based converter station and inter-array cables between turbines; site preparation work (*e.g.,* boulder removal); placement of scour protection around foundations; HRG vessel-based site characterization surveys using active acoustic sources with frequencies of less than 180 kHz; detonating up to three UXO/MEC of different charge weights; and several types of fishery and ecological monitoring surveys. Vessels would transit within the project area and between ports and the wind farm to transport crew, supplies, and materials to support pile installation. All offshore cables will connect to onshore export cables, substations, and grid connections, which would be located on Long Island. Marine mammals exposed to elevated noise levels during impact and vibratory pile driving, detonations of UXOs, or site characterization surveys may be taken by Level A harassment and/or Level B harassment depending on the specified activity.

Dates and Duration

Sunrise Wind anticipates that activities with the potential to result in harassment of marine mammals would occur throughout all 5 years of the proposed regulations which, if promulgated, would be effective from November 20, 2023 through November 19, 2028.

The estimated schedule, including dates and duration, for various activities is provided in Table 1 (also see Table 4 and Figure 6 in Sunrise Wind's application); however, this proposed rule considers the potential for activity schedules to shift. Detailed information about the activities themselves may be found in the *Detailed Description of Specific Activity* subsection.

TABLE 1—ESTIMATED ACTIVITY SCHEDULE TO CONSTRUCT AND OPERATE THE SUNRISE WIND PROJECT

Project area	Project activity	Expected timing and duration
Sunrise Wind Farm (SRWF) Construction.	WTG Foundation Installation	Q3–Q4 2024; 4–5 months.
	OCS–DC Foundation Installation	Q4 2024; 2–3 days (48–72 hours).
	WTG Installation	Q4 2024–Q2 2025; 9 months.
	Seafloor preparation	Q1–Q2 2024
	Array Cable Installation	Q2–Q3 2025; 7 months.
	UXO/MEC detonation	Q2 2024; 3 days.
Sunrise Wind Export Corridor (SRWEC) Construction.	Cable Landfall Installation (casing pipe and sheetpile installation and removal, *HDD*).	Q4 2023–Q1 2024; 16 days.
	Offshore Export Cable Installation.	
	Route clearance	Q2 2024
	EC Installation	Q4 2024 to Q1 2025; 8 months.
	HRG Survey	Q4 2023–Q4 2025; Any time of year.
Operations	HRG Survey	Q4 2024–Q3 2028; Any time of year.

Italicized activities do not have the potential to result in take of marine mammals.

WTG and OCS–DC Foundation Installation

The installation of 94 WTG and 1 OCS–DC foundations would be limited to May through December, given the seasonal restriction on foundation impact pile driving from January 1–April 30. As described previously, Sunrise Wind intends to install all foundations in a single year over the course of 4 to 5 months. However, it is possible that monopile installation would continue into a second year depending on construction logistics and local and environmental conditions that may influence Sunrise Wind's ability to maintain the planned construction schedule.

Installation of a single monopile foundation is expected to require a maximum of 4 hours of active impact hammering, which can occur either in a continuous 4-hour interval or intermittently over a longer time period. Installation of a single piled jacket foundation is estimated to require approximately 48 hours of pile driving per jacket (which includes up to 6 hours of pile driving per pile). It is assumed that the pile driving would occur within a 72-hour window (~ 3 days) including wait time in between pile installation. Pile driving activity will include a 20-minute soft-start at the beginning of each pile installation.

Sunrise Wind has provided five scenarios for how many piles may be installed on a given day. Piles may be installed consecutively (one at a time) or concurrently (multiple piles at the same time). Potential daily pile driving scenarios include:

- Consecutive installation of two WTG monopiles or four OCS–DC pin piles consecutively in 1 day for 53 days;
- Consecutive installation of three WTG monopiles or four OCS–DC pin piles consecutively in 1 day for 36 days;
- Concurrent installation of four WTG monopiles in 1 day, two each by two different installation vessels operating concurrently in close proximity to each other (''Proximal'', *i.e.* 3 nautical miles apart) for 25.5 days, plus 4 OCS–DC pin piles per day for 2 days;
- Concurrent installation of four WTG monopiles in 1 day, two each by two different installation vessels operating concurrently at long distances from each other (''Distal'', *i.e.* opposite ends of the SRWF) for 25.5 days plus four OCS–DC pin piles per day for 2 days; or
- Concurrent installation of two WTG monopiles by one vessel and four OCS–DC pin piles by a second vessel for 2 days followed by two WTG monopiles per day by a single vessel for 49 days.

Sunrise Wind anticipates that the first WTGs would become operational in Q3 2025 after installation is completed and all necessary components, such as array cables, OCS–DC, export cable routes, and onshore substations are installed. Turbines would be commissioned individually by personnel on location, so the number of commissioning teams would dictate how quickly turbines would become operational. Sunrise Wind expects that all turbines will be commissioned by Q4 2025.

UXO/MEC Detonations

Based on preliminary survey data, Sunrise Wind estimates a maximum of 3 days of UXO/MEC detonation may occur with up to one UXO/MEC being detonated per day. Any UXO/MEC detonation would occur during daylight hours only after proper marine mammal monitoring is conducted (see Proposed Monitoring and Reporting section). Sunrise Wind anticipates UXO/MEC detonation would be limited to Q2 2024. Sunrise Wind would not detonate UXOs/MECs between December and April.

Cable Landfall Construction

Cable landfall construction is one of the first activities scheduled to occur, sometime between Q4 2023–Q1 2024. In their application, Sunrise Wind indicated they would install and remove up to two casing pipes and supporting goal posts over 36 days; however, the project has been refined such that only one casing pipe and goal posts would be installed and removed over 16 days. Installation of the single casing pipe may take up to 3 hours of pneumatic hammering on each of 2 days for installation. Removal of the casing pipe is anticipated to require approximately the same amount of pneumatic hammering and overall time, or less, meaning the pneumatic pipe ramming tool may be used for up to 3 hours per day over 4 days. Up to 22 sheet piles may be installed to support the work. Sheet pile may require up to 2 hours of vibratory piling and up to 4 sheet piles may be installed per day (total of 8 hours of vibratory pile driving per day). Removal of the goal posts may also involve the use of a vibratory hammer and likely require approximately the same amount of time as installation (6 days total). Thus, use of a vibratory pile driver to install and remove sheet piles may occur on up to 12 days at the landfall location.

HRG Surveys

High-resolution geophysical site characterization surveys would occur annually throughout the 5 years the rule and LOA would be effective with duration dependent on the activities occurring in that year (*i.e.,* construction versus non-construction year). HRG surveys would utilize up to a maximum of four vessels working concurrently in different sections of the Lease Area and SRWEC corridor. During the first year of construction (when the majority of foundations and cables are installed), Sunrise Wind estimates that a total of 12,275 km may be surveyed over 175 vessel days within the Lease Area and along the SRWEC corridor in water depths ranging from 2 m (6.5 ft) to 55 m (180 ft). During non-construction years (Yrs 3–5), Sunrise Wind estimates 6,311.2 km would be surveyed over 90.2 vessel days per year. Each day that a survey vessel covers 70 km (44 miles) of survey trackline is considered vessel day. For example, Sunrise Wind would consider two vessels operating concurrently, with each surveying 70 km (44 miles), two vessel days. Sunrise Wind anticipates that each vessel would survey an average of 70 km (44 miles) per day, assuming a 4 km/hour (2.16 knots) vessel speed and 24-hour operations. In some cases, vessels may conduct daylight-only 12-hour nearshore surveys covering half that distance (35 km or 22 miles). Over the course of 5 years, HRG surveys would be conducted at any time of year for a total of 48,484 km over 622 vessel days. In this schedule, Sunrise Wind accounted for periods of down-time due to inclement weather or technical malfunctions.

Specific Geographic Region

Sunrise Wind would construct the SRWF in Federal waters offshore of New York (Figure 1). The lease area OCS–A 0487 is part of the Rhode Island/Massachusetts Wind Energy Area (RI–MA WEA). The Lease Area covers approximately 86,823 acres (351 km^2) and is located approximately 18.9 statute miles (mi) (16.4 nautical miles (nmi), 30.4 kilometers (km)) south of Martha's Vineyard, Massachusetts; approximately 30.5 mi (26.5 nmi, 48.1 km) east of Montauk, New York; and 16.7 mi (14.5 nmi, 26.8 km) from Block Island, Rhode Island Water depths in the Lease Area range from 35 to 62 m (115–203 ft), averaging 49 m (160.8 ft), while water depths along the SRWEC corridor range from 5.7 to 67 m (18.7 to 219.8 ft). The cable landfall construction area would be approximately 5.7 m (18.7 ft) in depth. Cables would come ashore at the Smith Point County Park.

Sunrise Wind's specified activities would occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem (NES LME), an area of approximately 260,000 km^2 from Cape Hatteras in the south to the Gulf of

Maine in the north. Specifically, the lease area and cable corridor are located within the Mid-Atlantic Bight subarea of the NES LME, which extends between Cape Hatteras, North Carolina, and Martha's Vineyard, Massachusetts, extending westward into the Atlantic to the 100-m isobath. In the Mid-Atlantic Bight, which extends from Massachusetts to North Carolina,the pattern of sediment distribution is relatively simple. The continental shelf south of New England is broad and flat, dominated by fine grained sediments. Most of the surficial sediments on the continental shelf are sands and gravels. Silts and clays predominate at and beyond the shelf edge, with most of the slope being 70–100 percent mud. Fine sediments are also common in the shelf valleys leading to the submarine canyons, as well as in areas such as the ''Mud Patch'' south of Rhode Island. There are some larger materials, including boulders and rocks, left on the seabed by retreating glaciers, along the coast of Long Island and to the north and east.

In support of the Rhode Island Ocean Special Area Management Plan development process, Codiga and Ullman (2011) reviewed and summarized the physical oceanography of coastal waters off Rhode Island. Conditions off the coast of Rhode Island are shaped by a complex interplay among wind-driven variability, tidal processes, and density gradients that arise from combined effects of interaction with adjacent estuaries, solar heating, and heat flux through the air-sea interface. In winter and fall, the stratification is minimal and circulation is a weak upwelling pattern directed offshore at shallow depths and onshore near the seafloor. In spring and summer strong stratification develops due to an important temperature contribution, and a system of more distinct currents occurs, including a narrow flow that proceeds counterclockwise around the perimeter of RIS likely in association with a tidal mixing front.

The waters in the vicinity of the SRWF and SRWEC are transitional waters positioned between the continental slope and the coastal environments of Long Island Sound and Narragansett Bay. The region is generally characterized by predominantly mobile sandy substrate, and the associated benthic communities are adopted to survive in a dynamic environment. The WEAs are composed of a mix of soft and hard bottom environments as defined by the dominant sediment grain size and composition (Continental Margin Mapping Program [Department of the Interior 2020]; usSEABED [USGS 2020]. The benthic environment of the RI–MA WEA is dominated by sandy sediments that ranged from very fine to medium sand; very fine sands tend to be more prevalent in deeper, lower energy areas (*i.e.,* the southern portion of the MA WEA), whereas coarser sediments, including gravels (*e.g.,* patchy cobbles and boulders) were found in shallower areas (Bay State Wind 2019, Deepwater Wind South Fork, LLC 2019; DWW Rev I, LLC 2020; Stokesbury 2014; LaFrance *et al.* 2010; McMaster 1960; Popper *et al.* 2014). The species that inhabit the benthic habitats of the OCS are typically described as infaunal species, those living in the sediments (*e.g.,* polychaetes, amphipods, mollusks), and epifaunal species, those living on the seafloor surface (mobile, *e.g.,* sea starts, sand dollars, sand shrimp) or attached to substrates (sessile, *e.g.,* barnacles, anemones, tunicates). Further detail on the benthic habitats found at the SRWF and along the SRWEC, including the results of site-specific benthic habitat assessments, can be found within COP section 4.4.2, COP Appendices M1—Benthic Resources Characterization Report—Federal Waters, M2—Benthic Resources Characterization Report—New York State Waters, and M3—Benthic Habitat Mapping Report.

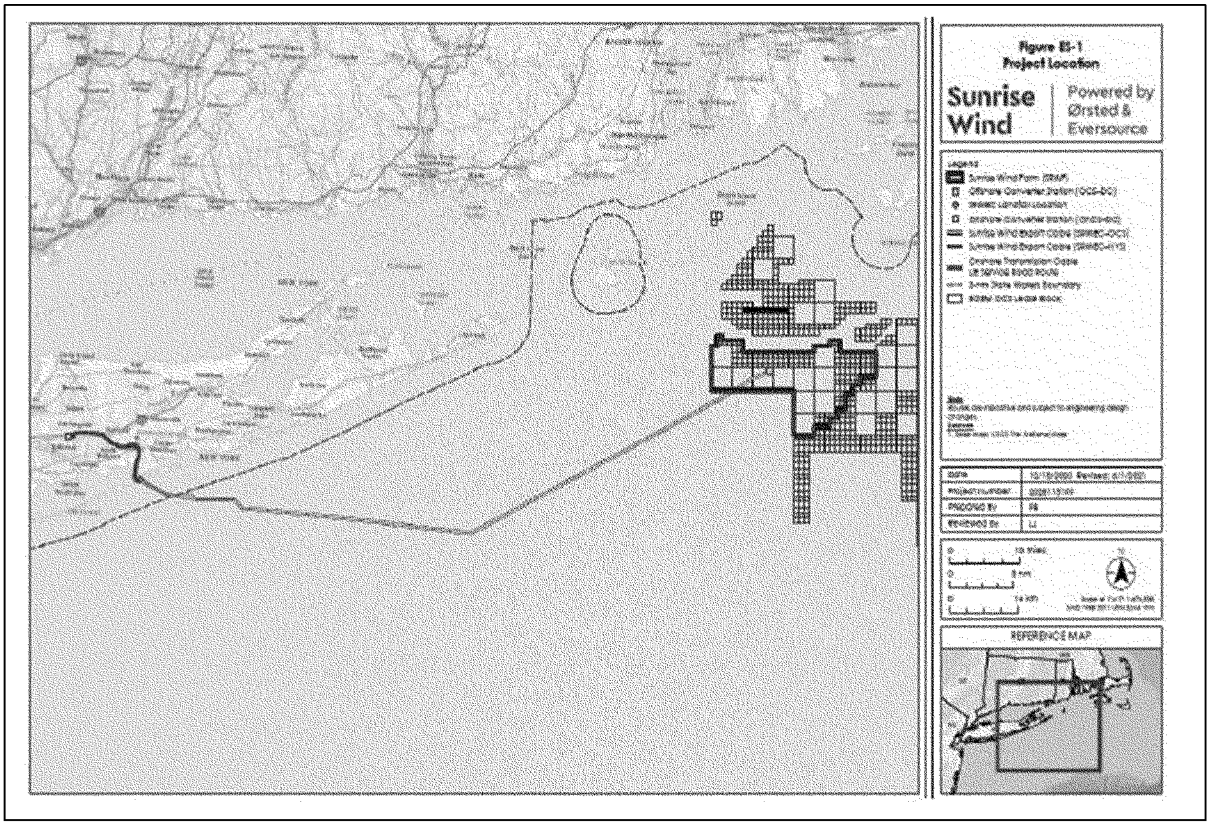

Figure 1. Sunrise Wind Project Location.

Detailed Description of Specific Activity

Below, we provide detailed descriptions of Sunrise Wind's activities, explicitly noting those that are anticipated to result in the take of marine mammals and for which incidental take authorization is requested. Additionally, a brief explanation is provided for those activities that are not expected to result in the take of marine mammals.

Installation of WTG Foundations

Sunrise Wind plans to install up to 94 WTG monopile foundations with a maximum diameter tapering from 7 m above the waterline to 12 m (39 ft) below the waterline (7/12 m monopile (see Figure 3 in Sunrise Wind's application)) in lease area OCS–0487 spaced in a 1 nmi x 1 nmi grid pattern. The Project will generate between 924 to 1,034 MW of renewable energy. Although up to 94 WTGs are expected to be installed, Sunrise Wind has accounted for up to 8 potential locations where WTG installation is begun but unable to be completed due to environmental or engineering constraints (*i.e.,*only 94 WTGs will be installed but within 102 potential locations).

Figure 3 in Sunrise Wind's application provides a conceptual example of the WTG support structures (*i.e.,* towers and foundations), which will be designed to withstand 500-year hurricane wind and wave conditions, and the external platform level will be designed above the 1,000-year wave scenario. A WTG monopile foundation typically consists of a single steel tubular section with several sections of rolled steel plate welded together. Secondary structures on each WTG monopile foundation will include a boat landing or alternative means of safe access (*e.g.,* Get Up Safe—a motion compensated hoist system allowing vessel to foundation personnel transfers without a boat landing), ladders, a crane, and other ancillary components.

A typical monopile installation sequence begins with the monopiles transported directly to the Sunrise Wind Farm for installation or to the construction staging port by an installation vessel or a feeding barge. At the foundation location, the main installation vessel upends the monopile in a vertical position in the pile gripper mounted on the side of the vessel. The hammer is then lifted on top of the pile and pile driving commences with a soft-start and proceeds to completion. Piles are driven until the target embedment depth is met (up to 50 m), then the pile hammer is removed and the monopile is released from the pile gripper. Once installation of the monopile is complete, the vessel moves to the next installation location.

Monopiles would be installed using a 4,000 kJ impact pile driver (although, in general, only up to 3,200 kJ will be necessary except for potentially 1 strike at 4,000 kJ) to a maximum penetration depth of 50 m (164 ft). Installation of each monopile will include a 20-minute soft-start where lower hammer energy is used at the beginning of each pile installation. Under normal conditions, after completion of the 20-minute soft-start period, installation of a single monopile foundation is estimated to require 1–4 hours of active pile driving; however, breaks may be necessary such that 1–4 hours of pile driving occurs over several more hours (up to 12 hours). Sunrise Wind anticipates it would then take approximately 4 hours to move to the next piling location. Once at the new location, a 1-hour monitoring period would occur such that there would be no less than 5 hours between each pile installation. In total, 376 hours (94 WTGs × 4 hours each) would be the maximum amount of time impact monopile driving would occur over the course of 1 year. Sunrise Wind is proposing to install foundations consecutively or concurrently (see Dates and Duration section). Impact pile driving associated with WTG foundation installation would be limited to the months of May through December and is currently scheduled to be conducted during Q3 and Q4 2024. Installation of WTG foundations is anticipated to result in the take of marine mammals due to noise generated during pile driving.

Sunrise Wind has proposed to conduct pile driving 24-hours per day. Once construction begins, Sunrise Wind would proceed as rapidly as possible, while meeting all required mitigation and monitoring measures, to reduce the total duration of construction. Orsted, the parent company of Sunrise Wind, is currently analyzing data from pilot projects investigating the efficacy of technology to monitor (visually and acoustically) marine mammals during nighttime and reduced visibility conditions. NMFS acknowledges the benefits of completing construction quickly during times when North Atlantic right whales are unlikely to be in the area but also recognizes challenges associated with monitoring during reduced visibility conditions such as night. Should Sunrise Wind submit a NMFS-approved Alternative Monitoring Plan, pile driving may be initiated at night. NMFS intends to condition the final rule, if issued, identifying if initiating pile driving at night may occur.

Offshore Converter Station (OCS–DC)

Sunrise Wind would install a single OCS–DC for the project on a jacket foundation (see Figure 4 in Sunrise Wind's application). A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seabed by means of hollow steel pin piles attached to the jacket. The piled jacket foundation will have four legs with two pin piles per leg (eight piles total). The platform height will be up to 26.8 m (88 ft) with a leg diameter of up to 4.6 m (15 ft) and a pile diameter of up to 4 m (13 ft). Installation of OCS–DC jacket foundation pin piles (two per leg, eight total) will be performed using an impact pile driver with a maximum hammer energy of 4,000-kJ to a maximum penetration depth of 90 m (295 ft). It is assumed that installation of the jacket foundation would require 48 hours of pile driving total (6 hours per pile), which would occur over 3 days. The current schedule estimates the OCS–DC jacket foundation would be installed in Q4 2024. Installation of the OCS–DC jacket foundation is anticipated to result in the take of marine mammals due to noise generated during pile driving.

The OCS–DC requires the withdrawal of raw seawater through a cooling water intake structure (CWIS) to dissipate heat produced through the AC to DC conversion and then discharge this water as thermal effluent to the marine receiving waters. It includes intake pipes and sweater lift pumps (SWLP), course filters, electrochlorination system, heat exchange system, and a dump caisson. The OCS–DC would discharge non-contact cooling water (NCCW) and non-contact stormwater to the marine receiving waters. The design intake flow (DIF) for the OCS–DC is 8.1 million gallons per day (MGD); however, the Average Flow Intake (AFI) will generally range from 4.0 MGD to 5.3 MGD. The rate at which seawater would be taken (*e.g.* maximum through-screen velocity [TSV]) is 0.1525 m/s [0.5 ft/s]). The dump caisson consists of a single outlet vertical pipe oriented downward in the water column. The dump caisson is the primary discharge point for the OCS–DC. Pollutants discharged at the dump caisson will include NCCW and residual chlorine. The temperature of the water exiting the heat exchange system will depend on the ambient air temperature, ambient water temperature, power output, and other factors. Sunrise Wind indicated the maximum temperature under all operating scenarios and conditions will not exceed 32 °C (90 °F) and the thermal plume is not expected to extend beyond 30 m of the dump caisson. No take of marine mammals would occur due to water withdrawal or thermal discharge.

Cable Landfall Construction

Installation of the SRWF export cable landfall will be accomplished using a horizontal directional drilling (HDD) methodology. HDD will be used to connect the SRWEC offshore cable to the Onshore Transmission Cable at the landfall location and to cross the Intercoastal Waterway (ICW) from Fire Island to mainland Long Island. The drilling equipment will be located onshore and used to create a borehole, one for each cable, from shore to an exit point on the seafloor approximately 0.5 mi (800 m) offshore. At the seaward exit site for each borehole, construction activities may include the temporary installation of a casing pipe, supported by sheet pile goal posts, to collect drilling mud from the borehole exit point. Additionally, 10 sheet piles may be used to support the casing pipe and help to anchor/stabilize the vessel which will be collecting drilling fluid. Installation of up to two casing pipes (one at each HDD exit pit location) would be completed using pneumatic pipe ramming equipment while installation of sheet pile for goal posts would be completed using a vibratory pile driving hammer. These activities would not occur simultaneously as some of the same equipment on the barge is necessary to conduct both types of installations. All installation activities would occur during daylight periods.

Sunrise Wind would install a single casing pipe at an 11–12-degree angle with the seabed so that the casing pipe creates a straight alignment between the point of penetration at the seabed and the construction barge. Casing pipe installation will occur from the construction barge and be accomplished using a pneumatic pipe ramming tool (*e.g.,* Grundoram Taurus or similar) with a hammer energy of up to 18 kJ. If necessary, additional sections of casing pipe may be welded together on the barge to extend the length of the casing pipe from the barge to the penetration depth in the seabed.

Installation of the single casing pipe may take up to 3 hours of pneumatic hammering on each of the 2 days for installation. Installation time will be dependent on the number of pauses required to weld additional sections onto the casing pipe. Removal of the casing pipe is anticipated to require approximately the same amount of pneumatic hammering and overall time, or less, meaning the pneumatic pipe ramming tool may be used for up to 3 hours per day on up to 4 days.

Up to six goal posts may be installed to support the casing pipe between the barge and the penetration point on the seabed. Each goal post would be composed of two vertical sheet piles installed using a vibratory hammer such as an American Pile Equipment (APE) model 300 (or similar). A horizontal cross beam connecting the two sheet piles would then be installed to provide support to the casing pipe. Up to 10 additional sheet piles may be installed to help anchor the barge and support the construction activities. This results in a total of up to 22 sheet piles. Installation of the goal posts would require up to 6 days. Sheet pile may require up to 2 hours of vibratory piling and up to four sheet piles may be installed per day (total of 8 hours of vibratory pile driving per day). Removal of the goal posts may also involve the use of a vibratory hammer and likely require approximately the same amount of time as installation (6 days total). Thus, use of a vibratory pile driver to install and remove sheet piles may occur on up to 12 days at the landfall locations. Installation and removal of the casing pipe and goal posts is anticipated to result in the take of marine mammals due to noise generated during pile driving.

UXO/MEC Detonations

Sunrise Wind anticipates the potential for construction activities to encounter UXO/MECs on the seabed within the SRWF and along the SRWEC corridor. UXO/MECs include explosive munitions such as bombs, shells, mines, torpedoes, *etc.,* that did not explode when they were originally deployed or were intentionally discarded in offshore munitions dump sites to avoid land-based detonations. The risk of incidental detonation associated with conducting seabed-altering activities, such as cable laying and foundation installation in proximity to UXO/MECs, jeopardizes the health and safety of project participants (Sunrise Wind 2022). Sunrise Wind follows an industry standard As Low as Reasonably Practicable (ALARP) process that minimizes the number of potential detonations (COP Appendix G2, (Sunrise-Wind 2021).

For UXO/MECs that are positively identified in proximity to planned activities on the seabed, several alternative strategies will be considered prior to in-situ UXO/MEC disposal. These may include (1) relocating the activity away from the UXO/MEC (avoidance), (2) moving the UXO/MEC away from the activity (lift and shift), (3) cutting the UXO/MEC open to apportion large ammunition or deactivate fused munitions, using shaped charges to reduce the net explosive yield of a UXO/MEC (low-order detonation), or (4) using shaped charges to ignite the explosive materials and allow them to burn at a slow rate rather than detonate instantaneously (deflagration). Only after these alternatives are considered would in-situ high-order UXO/MEC detonation be pursued. To detonate a UXO/MEC, a small charge would be placed on the UXO/MEC and ignited, causing the UXO/MEC to then detonate, which could result in the take of marine mammals.

To better assess the likelihood of encountering UXO/MECs during project construction, Sunrise Wind has and will continue to conduct HRG surveys to identify potential UXO/MECs that have not been previously mapped. As these surveys and analysis of data from them are still underway, the exact number and type of UXO/MECs in the project area are not yet known. However, Sunrise Wind assumes that up to three UXO/MEC 454-kg (1000 pounds; lbs) charges, which is the largest charge that is reasonably expected to be encountered, may require *in situ* detonation. Although it is highly unlikely that all three charges would weigh 454 kg, this approach was determined to be the most conservative for the purposes of impact analysis. If necessary, these detonations would occur on up to 3 different days (*i.e.,* only one detonation would occur per day). In the event that high-order removal (detonation) is determined to be the preferred and safest method of disposal, all detonations would occur during daylight hours. Sunrise Wind would avoid detonating UXO/MECs from December 1 through April 30 to provide protection for North Atlantic right whales during the timeframe they are expected to occur more frequently in the project area. UXO/MEC detonation is anticipated to result in the take of marine mammals due to noise.

HRG Surveys

HRG surveys would be conducted to identify any seabed debris and to support micrositing of the WTG and OCS–DC foundations and cable routes. These surveys may utilize active acoustic equipment such as multibeam echosounders, side scan sonars, shallow penetration sub-bottom profilers (SBPs) (*e.g.,* Compressed High-Intensity Radiated Pulses (CHIRPs) non-parametric SBP), medium penetration sub-bottom profilers (*e.g.,* sparkers and boomers), ultra-short baseline positioning equipment, and marine magnetometers, some of which are expected to result in the take of marine mammals. Equipment may be mounted to the survey vessel or Sunrise Wind may use autonomous surface vehicles (SFV) to carry out this work. Surveys would occur annually, with durations dependent on the activities occurring in that year (*i.e.,* construction years versus operational years).

As summarized previously, HRG surveys will be conducted using up to four vessels. On average, 70-line km will be surveyed per vessel each survey day at approximately 7.4 km/hour (4 knots) on a 24-hour basis although some vessels may only operate during daylight hours (~12-hour survey vessels). During the construction phase (Yr1 and Yr2), an estimated 24,550 survey line km, plus in-fill and re-surveys, may be necessary to survey the inter-array cables and the Sunrise Wind Export Cable in water depths ranging from 2 m (6.5 ft) to 55 m (180 ft). HRG surveys are anticipated to operate at any time of year for a maximum of 351 active sound source days over the 2 years of construction. During the operations phase (Yrs 3–5), an estimated 6,311 km per year for 3 years (18,933 km total) may be surveyed in the Sunrise Wind Farm and along the Sunrise Wind Export Cable. Using the same estimate of 70 km of survey completed each day per vessel, approximately 90 days of survey would occur each year for a total of up to 270 active sound source days over the 3-year operations period. In total, across all 5 years, a total of 43,484 kms of trackline may be surveyed.

Of the HRG equipment types proposed for use, the following sources have the potential to result in take of marine mammals:

• Shallow penetration sub-bottom profilers (SBPs) to map the near-surface stratigraphy (top 0 to 5 m (0 to 16 ft) of sediment below seabed). A CHIRP system emits sonar pulses that increase in frequency over time. The pulse length frequency range can be adjusted to meet project variables. These are typically mounted on the hull of the vessel or from a side pole.

• Medium penetration SBPs (boomers) to map deeper subsurface stratigraphy as needed. A boomer is a broad-band sound source operating in the 3.5 Hz to 10 kHz frequency range. This system is typically mounted on a sled and towed behind the vessel.

• Medium penetration SBPs (sparkers) to map deeper subsurface stratigraphy as needed. A sparker creates acoustic pulses from 50 Hz to 4 kHz omni-directionally from the source that can penetrate several hundred meters into the seafloor. These are typically towed behind the vessel with adjacent hydrophone arrays to receive the return signals.

Table 2 identifies all the representative survey equipment that operate below 180 kilohertz (kHz) (*i.e.,* at frequencies that are audible and have the potential to disturb marine mammals) that may be used in support of planned geophysical survey activities and are likely to be detected by marine mammals given the source level, frequency, and beamwidth of the equipment. Equipment with operating frequencies above 180 kHz and equipment that does not have an acoustic output (*e.g.,* magnetometers) will also be used but are not discussed further because they are outside the general hearing range of marine mammals likely to occur in the project area or do not produce noise. Hence, no harassment is reasonably expected to occur from the operation of these sources.

TABLE 2—SUMMARY OF REPRESENTATIVE HRG SURVEY EQUIPMENT

Equipment type	Representative model	Operating frequency (kHz)	Source level SPLrms (dB)	Source level 0-pk (dB)	Pulse duration (ms)	Repetition rate (Hz)	Beamwidth (degrees)	Source
Sub-bottom profiler	EdgeTech 216	2–16	195	-	20	6	24	MAN
	EdgeTech 424	4–24	176	-	3.4	2	71	CF
	Edgetech 512	0.7–12	179	-	9	8	80	CF
	GeoPulse 5430A	2–17	196	-	50	10	55	MAN
	Teledyn Benthos CHIRP III—TTV 170	2–17	197	-	60	15	100	MAN
Sparker	Applied Acoustics Dura-Spark UHD (400 tips, 500 J).	0.3–1.2	203	211	1.1	4	Omni	CF
Boomer	Applied Acoustics triple plate S-Boom (700–1,000 J).	0.1–5	205	211	0.6	4	80	CF

- = not applicable; ET = EdgeTech; J = joule; kHz = kilohertz; dB = decibels; SL = source level; UHD = ultra-high definition; AA = Applied Acoustics; rms = root-mean square; µPa = microPascals; re = referenced to; SPL = sound pressure level; PK = zero-to-peak pressure level; Omni = omnidirectional source.

[a] The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the survey. These include variants of the Dura-spark sparker system and various configurations of the GeoMarine Geo-Source sparker system. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available.

[b] Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP–D700 and CSP–N). The CSP–D700 power source was used in the 700 J measurements but not in the 1,000 J measurements. The CSP–N source was measured for both 700 J and 1,000 J operations but resulted in a lower SL; therefore, the single maximum SL value was used for both operational levels of the S-Boom.

Cable Laying and Installation

Cable burial operations would occur both in SRWF for the inter-array cables connecting the 94 WTGs to single OCS–DC and in the SRWEC corridor for cables carrying power from the OCS–DC to shore. The offshore export and inter-array cables would be buried in the seabed at a target depth of up to 1.2 to 2.8 m (4 to 6 ft) and buried onshore up to the transition joint bays. All cable burial operations would follow installation of the monopile foundations as the foundations must be in place to provide connection points for the export cable and inter-array cables. Cable laying, cable installation, and cable burial activities planned to occur during the construction of the Sunrise Wind project may include the following: jetting; vertical injection; leveling; mechanical cutting; plowing (with or without jet-assistance); pre-trenching; boulder removal; and controlled flow excavation.

Some dredging may be required prior to cable laying due to the presence of sandwaves. Sandwave clearance may be undertaken where cable exposure is predicted over the lifetime of the Project due to seabed mobility. This facilitates cable burial below the reference seabed. Alternatively, sandwave clearance may be undertaken where slopes become greater than approximately 10 degrees (17.6 percent), which could cause instability to the burial tool. The work could be undertaken by traditional dredging methods such as a trailing suction hopper. Alternatively, controlled flow excavation or a sandwave removal plough could be used. In some cases, multiple passes may be required. The method of sandwave clearance Sunrise Wind chooses would be based on the results from the site investigation surveys and cable design.

As the noise levels generated from cable laying and installation work are low, the potential for take of marine mammals to result is discountable. Sunrise Wind is not requesting, and NMFS is not proposing to authorize, take associated with cable laying activities. Therefore, cable laying activities are not analyzed further in this document.

Temporary Pier Construction

Construction of the cable landfall at Smith Point County Park parking lot will require equipment and materials to transit from Long Island to Fire Island. The Smith Point Bridge, the only vehicle access to the Smith Point County Park parking lot, has had its posted weight limitation of 15 tons gross weight due to structural condition issues and concerns over accelerated aging. Due to these weight limitations, Sunrise Wind will utilize a transport barge and temporary landing structure (pier) to transport the heavy construction equipment and materials necessary to construct the Sunrise Wind Farm Project across the Intracoastal Waterway (ICW) to Smith Point County Park. The materials moved using the barge and temporary equipment are required to construct the Project and includes equipment needed to complete the HDD work and onshore civil works that are otherwise too heavy to travel across the Smith Point Bridge. In addition to the temporary pier on Fire Island, temporary mooring and breasting dolphins will be installed near the boat ramp at the Smith Point Marina on the Long Island side of the ICW to facilitate safe loading and unloading of the barge at the Smith Point Marina boat launch on Long Island.

The temporary pier will require the installation of up to 26 total production piles that will remain the entire time the temporary pier is in place. Temporary piles may be used to support a steel-framed template used to ensure installation of the bent production piles in the correct positions. The temporary piles may include up to 24 H-shaped or cylinder piles of the same size as the production piles. Therefore, a total of 50 piles (up to 26 production piles and up to 24 temporary piles) may be installed, and in some cases removed, during construction.

Installation and removal of the up to 24 temporary piles would be completed using only vibratory pile driving equipment. The up to 26 production piles would first be driven using a vibratory hammer followed by an impact hammer. Both production and temporary piles will be removed using vibratory pile driving. It is anticipated that installation of the pier will occur over approximately 3 to 4 weeks in and around December 2023. Installation of up to 26 production piles may result in a total of up to 351 minutes (5 hours 51 min) of vibratory pile driving (26×13.5 min) and 39 minutes of impact pile driving (26×1.5 min). Installation and removal of up to 24 temporary piles may require up to 720 minutes (16 hours) of vibratory pile driving only ($2 \times 24 \times 15$ min). The maximum total pile driving time for installation is therefore 1,071 min (17 hours 51 min) of vibratory pile driving and 39 minutes of impact pile driving. Following completion of the landfall construction work on Fire Island, the temporary pier is expected to be removed in approximately April or May of 2025. Removal of the temporary pier would involve the removal of all 26 production piles using a vibratory hammer. Thus, the total duration of vibratory pile driving during pier removal may be up to 390 min (6 hours 30 min; 26 × 15 min).

While pile driving would result in Level B harassment isopleths up to approximately 750 m from the piles (as described in Sunrise Wind's Temporary Pier Memo (available at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable*), the very short duration of pile driving, the limited harassment area, the location of the harassment area (in an area where marine mammals are not typically present), and the implementation of monitoring and mitigation measures (see Proposed Mitigation and Proposed Monitoring and Reporting sections), Sunrise Wind is not requesting, and NMFS is not proposing to authorize, take of marine mammals incidental to temporary pier and breasting and mooring dolphin construction activities.

Vessel Operation

Sunrise Wind will utilize various types of vessels over the course of the 5-year proposed regulations. Sunrise Wind is evaluating the potential use of several existing port facilities located in New York, Connecticut, Maryland, Massachusetts, New Jersey, Rhode Island, and Virginia to support offshore construction, assembly and fabrication, crew transfer and logistics. The primary construction ports that are expected to be used during construction include: Albany and/or Coeymans, New York; Port of New London, Connecticut; and Port of Dainsville-Quonset Point, Rhode Island.

The largest vessels are expected to be used during the WTG installation phase with floating/jackup crane barges, cable-laying vessels, supply/crew vessels, and associated tugs and barges transporting construction equipment and materials. Large work vessels (*e.g.,* jack-up installation vessels and cable-laying vessels) for foundation and WTG installation will generally transit to the work location and remain in the area until installation time is complete. These large vessels will move slowly over a short distance between work locations. Transport vessels will travel between several ports and the SRWF over the course of the construction period following mandatory vessel speed restrictions (see Proposed Mitigation section). These vessels will range in size from smaller crew transport boats to tug and barge vessels. However, construction crews responsible for assembling the WTGs will hotel onboard installation vessels at sea, thus limiting the number of crew vessel transits expected during the installation of the SRWF.

As part of various vessel-based construction activities, including cable laying and construction material delivery, dynamic positioning thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of dynamic positioning thrusters is similar to that produced by transiting vessels, and dynamic positioning thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. Sound produced by dynamic positioning thrusters would be preceded by, and associated with, sound from ongoing vessel noise and would be similar in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence. Construction-related vessel activity, including the use of dynamic positioning thrusters, is not expected to result in take of marine mammals. Sunrise Wind did not request, and NMFS does not propose to authorize, any take associated with vessel activity.

During operation, up to three crew transfer vessels and a service operation vessel will be used to conduct maintenance activities. Sunrise Wind has also included potential for helicopters to be used in lieu of crew transfer vessels. The use of helicopters is included in Table 3 below; however, it is important to note that Sunrise Wind has indicated that there are a number of uncertainties regarding the how many trips will be made using helicopters, the number of passengers to be carried, and the vessels to which those passengers would be transported. Therefore, the total number of vessel trips shown in Table 3 has not been reduced based on the anticipated helicopter flights. As such, the number of crew transfer vessel trips may be less than depicted here.

TABLE 3—TYPE AND NUMBER OF VESSELS AND NUMBER OF VESSEL TRIPS ANTICIPATED DURING CONSTRUCTION AND OPERATIONS

Vessel types	Max number of simultaneous vessels	Max annual number of return trips
Wind Turbine Foundation Installation (Yrs 1–2)		
Heavy Lift Installation Vessel	2	20
Heavy Transport Vessel	4	50
Platform Supply Vessel	2	80
In-field support tug	2	50
Vessel for Bubble Curtain	1	30
Crew Transport Vessel	1	50
Monitoring Vessel	4	102
Completion Vessel	1	50
Fall Pipe Vessel	1	6
Turbine Installation (Yrs 1–2)		
Installation Vessel	1	26
Support Vessel	1	9
Array Cable Installation (Yrs 1–2)		
Pre-Lay Grapnel Run	1	5
Boulder Clearance Vessel	1	5
Sandwave Clearance Vessel	1	3
Cable Laying Vessel	3	3

TABLE 3—TYPE AND NUMBER OF VESSELS AND NUMBER OF VESSEL TRIPS ANTICIPATED DURING CONSTRUCTION AND OPERATIONS—Continued

Vessel types	Max number of simultaneous vessels	Max annual number of return trips
Cable Burial Vessel	2	3
Walk to Work Vessel (SOV)	1	6
Crew Transport Vessel	1	260
Survey Vessel	4	8
Construction Vessel	2	4
Fall Pipe Vessel	2	10
Offshore Converter Station Installation (Yrs 1–2)		
Primary Installation Vessel	3	3
Transport Vessel	2	2
Support Vessels	11	5
Fall Pipe Vessel	1	2
Offshore Export Cable Installation (Yrs 1–2)		
Pre-Lay Grapnel Run	1	1
Boulder Clearance Vessel	1	1
Sandwave Clearance Vessel	1	1
Cable Laying Vessel	3	6
Cable Burial Vessel	2	4
Tugs	4	8
Crew Transport Vessel	1	260
Guard Vessel/Scout Vessel	5	9
Survey Vessel	2	6
Fall Pipe Vessel	1	2
Construction Vessel	2	2
All Construction Activities (Yrs 1–2)		
Safety Vessel	2	114
Crew Transport Vessel	3	300
Jack-up/Lift Boat	1	1
Supply Vessel	1	10
Service Operation Vessel	1	6
Helicopter	2	350
Operations Vessels (Yrs 3–5)		
Crew Transport Vessel	3	300
Service Operation Vessel	1	40

Helicopters may be used during Sunrise Wind Farm construction and operation phases for crew transfer activities to provide a reduction in the overall transfer time as well as to reduce the number of vessels on the water. Sunrise Wind estimates crew transfer time could be decreased by 92 percent (16 to 30 minutes via a helicopter versus 3.5 to 6 hours using a vessel). However, use of helicopters may be limited by many factors, such as logistical constraints (*e.g.,* ability to land on the vessels) and weather conditions that affect flight operations. Helicopter use also adds significant health, safety and environment (HSE) risk to personnel and therefore, requires substantially more crew training and additional safety procedures. These factors can result in significant limitations to helicopter usage. The use of helicopters to conduct crew transfers is likely to provide an overall benefit to marine mammals in the form of reduced vessel activity.

Project-related aircraft would only occur at low altitudes over water during takeoff and landing at an offshore location where one or more vessels are located. Helicopters produce sounds that can be audible to marine mammals; however, most sound energy from aircraft reflects off the air-water interface as only sound radiated downward within a 26-degree cone penetrates below the surface water (Urick 1972). Due to the intermittent nature and the small area potentially ensonified by this sound source, Sunrise Wind did not request, and NMFS is not proposing to authorize, take of marine mammals incidental to helicopter flights; therefore, it will not be discussed further.

Seafloor Preparation

For export cable installation, seafloor preparation will include required sand wave leveling, boulder clearance, and removal of any out of service cables. Boulder clearance trials may be performed prior to wide-scale seafloor preparation activities to evaluate efficacy of boulder clearing techniques. Additionally, pre-lay grapnel runs (PLGR) will be undertaken to remove any seafloor debris along the export cable route. A specialized vessel will tow a grapnel rig along the centerline of each cable to recover any debris to the deck for appropriate licensed disposal ashore. Rock berm or concrete mattress separation layers will also be installed at the eight known telecommunications cables crossed by the SRWEC and/or inter-array cable (IAC) routes prior to cable installation for both in-service assets as well as out-of-service assets that cannot be safely removed and pose a risk to the SRWEC or IAC.

For monopile and jacket pile installation, seafloor preparation will include required boulder clearance and removal of any obstructions within the seafloor preparation area at each foundation location. Scour protection installation will occur prior to installation and will involve a rock dumping vessel placing scour at each foundation location.

Boulder clearance may be required in targeted locations to clear boulders along the SRWEC, inter-array cable (IAC) routes, and/or foundations prior to installation. Boulder removal can be performed using a combination of methods to optimize clearance of boulder debris of varying size and frequency. Removal is based on pre-surveys to identify location, size, and density of boulders. The size of boulders that can be relocated is dependent on a number of factors including the boulder weight, dimensions, embedment, density and ground conditions. Typically, boulders with dimensions less than 8 ft (2.5 m) can be relocated with standard tools and equipment. Where required, Sunrise Wind has assumed the route would be cleared of boulders up to 98 feet (30-m) in width along the final SRWEC and IAC centerlines. Around the foundations, Sunrise Wind assumes boulder clearance will occur within a 722-ft (220-m) radius centered on the foundations to ensure safe foundation installation as well as safe vessel jack-up.

Boulder removal would occur prior to installation and would be completed by a support vessel based on pre-construction surveys. A boulder grab or a boulder plow may be used to complete boulder removal prior to installation. A boulder grab involves a grab most likely deployed from a dynamic positioning offshore support vessel being lowered to the seabed over the targeted boulder. Once ''grabbed'', the boulder is relocated away from the cable route and/or foundation location. Boulder clearance using a boulder plow is completed by a high-bollard pull vessel with a towed plow generally forming an extended V-shaped configuration splaying from the rear of the main chassis. The V-shaped configuration displaces any boulders to the extremities of the plow, thus clearing the corridor. A tracked plow with a front blade similar to a bulldozer may also be used to push boulders away from the corridor.

Sand leveling (inclusive of leveling of sand accumulation areas) may be required during seafloor preparation activities prior to installation of the SRWEC. Two installation methods may be used to complete sand leveling including Suction Hopper Dredging and controlled flow excavation (CFE). The dredging technique consists of one or more suction downpipes equipped with a seafloor drag head. The drag head is towed over the sand wave by the vessel while a pump system sucks fluidized sand into the vessel's storage hopper. Any sediment removed would be relocated within the local sand wave field along the SRWEC and IAC using continuous overflow from the vessel. Alternatively, the removed sediment can be caught in the hopper storage and the vessel can relocate to a designated storage or disposal area and either offload material through a hatch in the vessel's hull or more carefully position material subsea using a downpipe. CFE is a contactless dredging tool, providing a method of clearing loose sediment below submarine cables, enabling burial. CFE utilizes thrust to direct waterflow into sediment, creating liquefaction and subsequent dispersal. The CFE tool draws in seawater from the sides and then jets this water out from a vertical down pipe at a specified pressure and volume, which is then positioned over the cable alignment, enabling the stream of water to fluidize the sands around the cable. This allows the cable to settle into the trench under its own weight.

NMFS does not expect site preparation work, including boulder removal and sand leveling, to generate noise levels that would cause take of marine mammals. Underwater noise associated with these activities is expected to be similar in nature to the sound produced by the dynamic positioning (DP) cable lay vessels used during cable installation activities within the SRWEC. Sound produced by DP vessels is considered non-impulsive and is typically more dominant than mechanical or hydraulic noises produced from the cable trenching or boulder removal vessels and equipment. Therefore, noise produced by the high bollard pull vessel with a towed plow or a support vessel carrying a boulder grab would be comparable to or less than the noise produced by DP vessels, so impacts are also expected to be similar. Boulder clearance is a discreet action occurring over a short duration resulting in short term direct effects. Additionally, sound produced by boulder clearance vessels and equipment would be preceded by, and associated with, sound from ongoing vessel noise and would be similar in nature.

NMFS expects that marine mammals would not be exposed to sounds levels or durations from seafloor preparation work that would disrupt behavioral patterns. Therefore, the potential for take of marine mammals to result from these activities is discountable and Sunrise Wind did not request, and NMFS does not propose to authorize, any takes associated with seafloor preparation work and these activities are not analyzed further in this document.

Fisheries and Benthic Monitoring

Fisheries and benthic monitoring surveys have been designed for the Project in accordance with recommendations set forth in ''Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf'' (BOEM 2019). Sunrise Wind would conduct trawl surveys, acoustic telemetry studies, benthic habitat monitoring using a remotely operated vehicle (ROV), video surveillance, grab surveys, and Habcam surveys using towed video surveillance. Because the gear types and equipment used for the acoustic telemetry study, benthic habitat monitoring, and Habcam surveys do not have components with which marine mammals are likely to interact (*i.e.,*become entangled in or hooked by), these activities are unlikely to have any impacts on marine mammals. Therefore, only trawl surveys, in general, have the potential to result in harassment to marine mammals. However, Sunrise Wind would implement mitigation and monitoring measures to avoid taking marine mammals, including, but not limited to, monitoring for marine mammals before and during trawling activities, not deploying or pulling trawl gear in certain circumstances, limiting tow times, and fully repairing nets. A full description of mitigation measures can be found in the Proposed Mitigation section.

With the implementation of these measures, Sunrise Wind does not anticipate, and NMFS is not proposing to authorize, take of marine mammals incidental to research trawl surveys. Any lost gear associated with the fishery surveys will be reported to the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division as soon as possible. Given no take is anticipated from these surveys, impacts from fishery surveys will not be discussed further in this document.

Description of Marine Mammals in the Area of Specified Activities

Thirty-nine marine mammal species (comprising 40 stocks) have geographic ranges within the western North Atlantic OCS (Hayes et al., 2022). However, for reasons described below, Sunrise Wind has requested, and NMFS proposes to authorize, take of only 16 species (comprising 16 stocks) of marine mammals. Sections 3 and 4 of Sunrise Wind's application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species (Sunrise Wind, 2021). NMFS fully considered all of this information, and we refer the reader to these descriptions in the application, incorporated here by reference, instead of reprinting the information. Additional information regarding population trends and threats may be found in NMFS's Stock Assessment Reports (SARs; *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.,* physical and behavioral descriptions) may be found on NMFS's website (*https://www.fisheries.noaa.gov/find-species*).

Table 4 lists all species and stocks for which take is expected and proposed to be authorized for this action and summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) and potential biological removal (PBR) level, where known. The MMPA defines PBR as ''the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population'' (16 U.S.C. 1362(20)) PBR values are identified in NMFS's SARs. While no mortality is anticipated or proposed to be authorized, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS's stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some stocks, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS's U.S. Atlantic and Gulf of Mexico SARs. All values presented in Table 4 are the most recent available at the time of publication and are available in NMFS' 2021 SARs (Hayes *et al.,* 2022) available online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports.*

TABLE 4—MARINE MAMMAL SPECIES LIKELY TO OCCUR NEAR THE PROJECT AREA THAT MAY BE TAKEN BY SUNRISE WIND'S ACTIVITIES

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR	Annual M/SI [3]
Order Artiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)						
Family Balaenidae:						
North Atlantic right whale	*Eubalaena glacialis*	Western Atlantic	E, D, Y	368 (0; 364; 2019) [5]	0.7	7.7
Family Balaenopteridae (rorquals)						
Blue whale	*Balaenoptera musculus*	Western North Atlantic	E, D, Y	UNK (UNK; 402; 1980–2008).	0.8	0
Fin whale	*Balaenoptera physalus*	Western North Atlantic	E, D, Y	6,802 (0.24; 5,573; 2016)	11	1.8
Sei whale	*Balaenoptera borealis*	Nova Scotia	E, D, Y	6,292 (1.02; 3,098; 2016)	6.2	0.8
Minke whale	*Balaenoptera acutorostrata*	Canadian Eastern Coastal	-, -, N	21,968 (0.31; 17,002; 2016).	170	10.6
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	-, -, Y	1,396 (0; 1,380; 2016)	22	12.15
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)						
Family Physeteridae:						
Sperm whale	*Physeter macrocephalus*	North Atlantic	E, D, Y	4,349 (0.28; 3,451; 2016)	3.9	0
Family Delphinidae						
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	-, -, N	93,233 (0.71; 54,433; 2016).	544	27
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	-, -, N	39,921 (0.27; 32,032; 2016).	320	0
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Offshore	-, -, N	62,851 (0.23; 51,914; 2016).	519	28
Long-finned pilot whales	*Globicephala melas*	Western North Atlantic	-, -, N	39,215 (0.3; 30,627; 2016).	306	29
Common dolphin (short-beaked).	*Delphinus delphis*	Western North Atlantic	-, -, N	172,974 (0.21; 145,216; 2016).	1,452	390
Risso's dolphin	*Grampus griseus*	Western North Atlantic	-, -, N	35,215 (0.19; 30,051; 2016).	301	34
Family Phocoenidae (porpoises):						
Harbor porpoise	*Phocoena*	Gulf of Maine/Bay of Fundy	-, -, N	95,543 (0.31; 74,034; 2016).	851	16
Order Carnivora—Superfamily Pinnipedia						
Family Phocidae (earless seals)						
Gray seal [4]	*Halichoerus grypus*	Western North Atlantic	-, -, N	27,300 (0.22; 22,785; 2016).	1,389	4,453

TABLE 4—MARINE MAMMAL SPECIES LIKELY TO OCCUR NEAR THE PROJECT AREA THAT MAY BE TAKEN BY SUNRISE WIND'S ACTIVITIES—Continued

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR	Annual M/SI [3]
Harbor seal	*Phoca vitulina*	Western North Atlantic	-, -, N	61,336 (0.08; 57,637; 2018).	1,729	339

[1] ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] NMFS marine mammal stock assessment reports online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments* (Hayes *et al.,* 2022). CV is the coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable.

[3] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.,* commercial fisheries, ship strike).

[4] NMFS' stock abundance estimate (and associated PBR value) applies to the U.S. population only. Total stock abundance (including animals in Canada) is approximately 451,431. The annual M/SI value given is for the total stock.

[5] The values represent abundance estimates from NMFS 2021 Stock Assessment Report (Hayes *et al.,* 2022). On Monday, October 24, 2022, the North Atlantic Right Whale Consortium announced that the North Atlantic right whale population estimate for 2021 was 340 individuals. NMFS' website also indicates that less than 350 animals remain (*https://www.fisheries.noaa.gov/species/north-atlantic-right-whale*).

Of the 40 marine mammal species and/or stocks with geographic ranges that include the western North Atlantic OCS (Table 5 in Sunrise Wind ITA application), 24 are not expected to be present or are considered rare or unexpected in the project area based on sighting and distribution data; they are, therefore, not discussed further beyond the explanation provided here. The following species are not expected to occur in the project area due to the location of preferred habitat outside the SRWF and SRWEC based on the best scientific information available: Dwarf and pygmy sperm whales (*Kogia sima and K breviceps*), northern bottlenose whale (*hyperoodon ampullatus*), cuvier's beaked whale (*Ziphius cavirostris*), four species of Mesoplodont beaked whales (*Mesoplodon densitostris, M. europaeus, M. mirus, and M. bidens*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuate*), short-finned pilot whale (*Globicephalus macrohynchus*), melon-headed whale (*Peponocephala electra*), Fraser's dolphin (*Lagenodelphis hosei*), white-beaked dolphin (*Lagenorhynchus albirotris*), pantropical spotted dolphin (*Stenella attenuata*), Clymene dolphin (*Stenella clymene*), striped dolphin (*Stenella coeruleoalba*), spinner dolphin (*Stenella longirostris*), rough-toothed dolphin (*Steno bredanensis*), and the northern migratory coastal stock of common bottlenose dolphins (*Tursiops truncatus truncatus*). The following species may occur in the project area but at such low densities that take is not anticipated: hooded seal (*Cystophora cristata*) and harp seal (*Pagophilus groenlandica*).

In addition, the Florida manatees (*Trichechus manatus;* a sub-species of the West Indian manatee) has been previously documented as an occasional visitor to the Northeast region during summer months (U.S. Fish and Wildlife Service (USFWS, 2019). However, manatees are managed by the USFWS and are not considered further in this document.

Between October 2011 and June 2015, a total of 76 aerial surveys were conducted throughout the MA and RI/MA WEAs (the SRWF is contained within the RI/MA WEA along with several other offshore renewable energy Lease Areas). Between November 2011 and March 2015, Marine Autonomous Recording Units (MARU; a type of static passive acoustic monitoring (PAM) recorder) were deployed at nine sites in the MA and RI/MA WEAs. The goal of the study was to collect visual and acoustic baseline data on distribution, abundance, and temporal occurrence patterns of marine mammals (Kraus *et al.,* 2016). The New England Aquarium conducted additional aerial surveys throughout the MA and RI/MA WEAs from February 2017 through July 2018 (38 surveys), October 2018 through August 2019 (40 surveys), and March 2020 through July 2021 (12 surveys) (Quintana and Kraus, 2019; O'Brien *et al.,* 2021a; O'Brien *et al.,* 2021b). The lack of detections of any of the 24 species listed above during these surveys reinforces the fact that they are not expected to occur in the project area. In addition, none of these species were observed during HRG surveys conducted by Orsted in from 2018 to 2021. As these species are not expected to occur in the project area during the proposed activities, NMFS does not propose to authorize take of these species, and they are not discussed further in this document.

As indicated above, all 16 species and stocks in Table 4 temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur. Five of the marine mammal species for which take is requested are listed as threatened or endangered under the ESA: North Atlantic right, blue, fin, sei, and sperm whales. In addition to what is included in Sections 3 and 4 of Sunrise Wind's ITA application (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-sunrise-wind-llc-construction-and-operation-sunrise-wind*), the SARs (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*), and NMFS' website (*https://www.fisheries.noaa.gov/species-directory/marine-mammals*), we provide further detail below informing the baseline for select species (*e.g.,* information regarding current Unusual Mortality Events (UME) and known important habitat areas, such as Biologically Important Areas (BIAs) (Van Parijs, 2015)). There are no ESA-designated critical habitats for any species within the project area.

Under the MMPA, a UME is defined as ''a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response'' (16 U.S.C. 1421h(6)). As of November 7, 2022, seven UMEs are active. Five of these UMEs are occurring along the U.S. Atlantic coast for various marine mammal species; of these, the most relevant to the Sunrise Wind project are the minke whale, North Atlantic right whale, humpback whale, and harbor and gray seal UMEs given the prevalence of these species in the project area. More information on UMEs, including all active, closed, or pending, can be found on NMFS' website at *https://www.fisheries.noaa.gov/national/marine-life-distress/*

active-and-closed-unusual-mortality-events.

Below we include information for a subset of the species that presently have an active or recently closed UME occurring along the Atlantic coast or for which there is information available related to areas of biological significance. For the majority of species potentially present in the specific geographic region, NMFS has designated only a single generic stock (*e.g.,* ''western North Atlantic'') for management purposes. This includes the ''Canadian east coast'' stock of minke whales, which includes all minke whales found in U.S. waters and is also a generic stock for management purposes. For humpback and sei whales, NMFS defines stocks on the basis of feeding locations (*i.e.,* Gulf of Maine and Nova Scotia, respectively). However, references to humpback whales and sei whales in this document refer to any individuals of the species that are found in the project area. Any areas of known biological importance (including the BIAs identified in La Brecque *et al.,* 2015) that overlap spatially with the project area are addressed in the species sections below.

North Atlantic Right Whale

The North Atlantic right whale has been listed as Endangered since the ESA's enactment in 1973. The species was recently uplisted from Endangered to Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Cooke, 2020). The uplisting was due to a decrease in population size (Pace *et al.,* 2017), an increase in vessel strikes and entanglements in fixed fishing gear (Daoust *et al.,* 2017; Davis & Brillant, 2019; Knowlton *et al.,* 2012; Knowlton *et al.,* 2022; Moore *et al.,* 2021; Sharp *et al.,* 2019), and a decrease in birth rate (Pettis *et al.,* 2021; Reed *et al.,* 2022). The Western Atlantic stock is considered depleted under the MMPA (Hayes *et al.,* 2022). There is a recovery plan (NOAA Fisheries, 2005) for the North Atlantic right whale, and NMFS completed 5-year reviews of the species in 2012 and 2017 (NOAA Fisheries, 2012; NOAA Fisheries, 2017). In February 2022, NMFS initiated a subsequent 5-year review process (*https://www.fisheries.noaa.gov/action/initiation-5-year-review-north-atlantic-right-whale*). Designated by NMFS as a Species in the Spotlight, the North Atlantic right whale is considered among the species with the greatest risk of extinction in the near future (*https://www.fisheries.noaa.gov/topic/endangered-species-conservation/species-in-the-spotlight*).

The North Atlantic right whale population had only a 2.8 percent recovery rate between 1990 and 2011 and an overall abundance decline of 23.5percent from 2011–2019 (Hayes *et al.* 2022). Since 2010, the North Atlantic right whale population has been in decline (Pace *et al.,* 2017; Pace *et al.,* 2021), with a 40 percent decrease in calving rate (Kraus *et al.,* 2016; Moore *et al.,* 2021). North Atlantic right whale calving rates dropped from 2017 to 2020 with zero births recorded during the 2017–2018 season. The 2020–2021 calving season had the first substantial calving increase in 5 years with 20 calves born followed by 15 calves during the 2021–2022 calving season. However, mortalities continue to outpace births, and best estimates indicate fewer than 100 reproductively active females remain in the population. Presently, the best available peer-reviewed population estimate for North Atlantic right whales is 368 per the 2021 SARs (Hayes *et al.,* 2022). As of this writing, the draft 2022 SARs have yet to be released; however, as reflected on NMFS' species web page, new estimates indicate that the right whale population has continued to decline to fewer than 350 animals (*https://www.fisheries.noaa.gov/species/north-atlantic-right-whale*). We note that the application of either abundance estimate in our analysis would not change the estimated take of right whales or the take NMFS has proposed to authorize as take estimates are based on the habitat-density models (Roberts and Halpin 2022).

Since 2017, dead, seriously injured, or sublethally injured or ill North Atlantic right whales along the U.S. and Canadian coasts have been documented, necessitating a UME declaration and investigation. The leading category for the cause of death for this ongoing UME is ''human interaction,'' specifically from entanglements or vessel strikes. As of January 12, 2023, there have been 35 confirmed mortalities (dead stranded or floaters; 21 in Canada; 14 in the United States) and 22 seriously injured free-swimming whales for a total of 57 whales. Beginning on October 14, 2022, the UME also considers animals with sublethal injury or illness bringing the total number of whales in the UME to 94. Approximately 42 percent of the population is known to be in reduced health (Hamilton *et al.,* 2021) likely contributing to smaller body sizes at maturation, making them more susceptible to threats and reducing fecundity (Moore *et al.,* 2021; Reed *et al.,* 2022; Stewart *et al.,* 2022). More information about the North Atlantic right whale UME is available online at *www.fisheries.noaa.gov/national/marine-life-distress/2017–2021-north-atlantic-right-whale-unusual-mortality-event.*

North Atlantic right whale presence in the project area is predominately seasonal; however, year-round occurrence is documented with irregular occurrence during summer months (O'Brien *et al.,* 2022, Quintano-Rizzo *et al.,* 2021). As a result of recent years of aerial surveys and PAM deployments within the RI/MA WEA, we have confidence that North Atlantic right whales are expected in the project area with higher numbers of animals present in winter and spring followed by decreasing abundance into summer and early fall (*e.g.,* (O'Brien *et al.,* 2022, Quintano-Rizzo *et al.,* 2021). The project area both spatially and temporally overlaps a portion of the migratory corridor BIA within which North Atlantic right whales migrate south to calving grounds generally in November and December, followed by a northward migration into feeding areas east and north of the project area in March and April (LaBrecque *et al.,* 2015; Van Parijs *et al.,* 2015). While the project does not overlap previously identified critical feeding habitat or a feeding BIA, it is located west of a more recently described important feeding area south of Martha's Vineyard and Nantuck*et al*ong the western side of Nantucket Shoals. Finally, the project overlaps the currently established November 1 through April 30th Block Island Seasonal Management Area (SMA) (73 FR 60173, October 10, 2008) and the proposed November 1 through May 30th Atlantic Seasonal Speed Zone (87 FR 46921, August 1, 2022), which may be used by North Atlantic right whales for various activities, including feeding and migration. Due to the current status of North Atlantic right whales and the overlap of the proposed project with areas of biological significance (*i.e.,* a migratory corridor, SMA), the potential impacts of the proposed project on North Atlantic right whales warrant particular attention.

Southern New England and New York waters are both a migratory corridor in the spring and early winter and a primary feeding habitat for North Atlantic right whales during late winter through spring. North Atlantic right whales feed primarily on the copepod *Calanus finmarchicus,* a species whose availability and distribution has changed both spatially and temporally over the last decade due to an oceanographic regime shift that has been ultimately linked to climate change (Meyer-Gutbrod *et al.,* 2021;

Record *et al.,* 2019; Sorochan *et al.,* 2019). This distribution change in prey availability has led to shifts in North Atlantic right whale habitat-use patterns within the region over the same time period (Davis *et al.,* 2020; Meyer-Gutbrod *et al.,* 2022; Quintano-Rizzo *et al.,* 2021, O'Brien *et al.,* 2022). Since 2010, North Atlantic right whales have reduced their use of foraging habitats in the Great South Channel and Bay of Fundy while increasing their use of habitat within Cape Cod Bay as well as a region south of Martha's Vineyard and Nantucket Islands to the east of the SRWF and SRWEC corridor (Stone *et al.,* 2017; Mayo *et al.,* 2018; Ganley *et al.,* 2019; Record *et al.,* 2019; Meyer-Gutbrod *et al.,* 2021). Pendleton *et al.* (2022) found that peak use of North Atlantic right whale foraging habitat in Cape Cod Bay has shifted over the past 20 years to later in the spring, likely due to variations in seasonal conditions. However, initial sightings of individual North Atlantic right whales in Cape Cod Bay have started earlier, indicating that they may be using regional water temperature as a cue for migratory movements between habitats (Ganley *et al.* 2022). North Atlantic right whales have recently been observed feeding year-round in the region south of Martha's Vineyard and Nantucket (Quintana-Rizzo *et al.,* 2021) with larger numbers in this area in the winter making it the only known winter foraging habitat for the species (Leiter *et al.,* 2017). North Atlantic right whale use of habitats, such as in the Gulf of St. Lawrence and East Coast mid-Atlantic waters of the United States., have also increased over time (Davis *et al.,* 2017; Davis and Brillant, 2019; Crowe *et al.,* 2021; Quintana-Rizzo *et al.,* 2021). Simard *et al.* (2019) documented the presence of North Atlantic right whales in the southern Gulf of St. Lawrence foraging habitat from late April through mid-January annually from 2010–2018 using passive acoustics with occurrences peaking in the area from August through November each year (Simard *et al.,* 2019). Observations of these transitions in North Atlantic right whale habitat use, variability in seasonal presence in identified core habitats, and utilization of habitat outside of previously focused survey effort prompted the formation of a NMFS' Expert Working Group, which identified current data collection efforts, data gaps, and provided recommendations for future survey and research efforts (Oleson *et al.,* 2020).

Around November, a portion of the North Atlantic right whale population (including pregnant females) typically departs the feeding grounds in the North Atlantic, move south along the migratory corridor BIA, including through the project area, to North Atlantic right whale calving grounds off Georgia and Florida. However, recent research indicates understanding of their movement patterns remains incomplete and not all of the population undergoes a consistent annual migration (Davis *et al.,* 2017; Gowan *et al.,* 2019; Krzystan *et al.,* 2018). The results of multistate temporary emigration capture-recapture modeling, based on sighting data collected over the past 22 years, indicate that non-calving females may remain in the feeding grounds during the winter in the years preceding and following the birth of a calf to increase their energy stores (Gowen *et al.,* 2019).

Within the project area, North Atlantic right whales have primarily been observed during the winter and spring seasons through recent visual surveys (Kraus *et al.,* 2016; Quintana-Rizzo *et al.,* 2021). During aerial surveys conducted in the RI/MA and MA WEAs from 2011–2015, the highest number of North Atlantic right whale sightings occurred in March (n=21), with sightings also occurring in December (n=4), January (n=7), February (n=14), and April (n=14), and no sightings in any other months (Kraus *et al.,* 2016). There was not significant variability in sighting rate among years, indicating consistent annual seasonal use of the area by North Atlantic right whales. Despite the lack of visual detection, North Atlantic right whales were acoustically detected in 30 out of the 36 recorded months (Kraus *et al.,* 2016). Since 2017, whales have been sighted in the southern New England area nearly every month with peak sighting rates between late winter and spring. Model outputs suggest that 23 percent of the North Atlantic right whale population is present from December through May, and the mean residence time has tripled to an average of 13 days during these months (Quintano-Rizzo *et al.,* 2021).

North Atlantic right whale distribution can also be derived from acoustic data. A review of passive acoustic monitoring data from 2004 to 2014 collected throughout the western North Atlantic demonstrated nearly continuous year-round North Atlantic right whale presence across their entire habitat range with a decrease in summer months, including in locations previously thought of as migratory corridors suggesting that not all of the population undergoes a consistent annual migration (Davis *et al.,* 2017). To describe seasonal trends in North Atlantic right whale presence, Estabrook *et al.* (2022) analyzed North Atlantic right whale acoustic detections collected between 2011–2015 during winter (January–March), spring (April–June), summer (July–September), and autumn (October–December). Winter had the highest presence (75percent array-days, n = 193), and summer had the lowest presence (10percent array-days, n = 27). Spring and autumn were similar, where 45percent (n = 117) and 51percent (n = 121) of the array-days had detections, respectively. Across all years, detections were consistently lowest in August and September. In Massachusetts Bay and Cape Cod Bay, located outside of the project area, acoustic detections of North Atlantic right whales increased in more recent years in both the peak season of late winter through early spring and in summer and fall, likely reflecting broadscale regional habitat changes (Charif *et al.,* 2020). NMFS' Passive Acoustic Cetacean Map (PACM) contains up-to-date acoustic data that contributes to our understanding of when and where specific whales (including North Atlantic right whales), dolphin, and other cetacean species are acoustically detected in the North Atlantic. These data support the findings of the aforementioned literature.

While density data from Roberts *et al.* (2022) confirm that the highest average density of North Atlantic right whales in the project area (both the lease area and SRWEC corridor) occurs in May (0.0018 whales/km^2), which aligns with available sighting and acoustic data, it is clear that that habitat use is changing and North Atlantic right whales are present to some degree in or near the project area throughout the year, most notably south of Martha's Vineyard and Nantucket Islands (Leiter *et al.,* 2017; Stone *et al.,* 2017; Oleson *et al.,* 2020, Quintano-Rizzo *et al.,* 2021). Since 2010, North Atlantic right whale abundances have increased in Southern New England waters, south of Martha's Vineyard and Nantucket Islands. O'Brien *et al.* (2022) detected significant increases in North Atlantic right whale abundance during winter and spring seasons from 2013–2019 likely due to changes in prey availability. Since 2017, North Atlantic right whales were also detected in small numbers during summer and fall, suggesting that southern New England waters provide year-round habitat for North Atlantic right whales (O'Brien *et al.,* 2022).

NMFS' regulations at 50 CFR 224.105 designate nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. SMAs for North Atlantic right whales in 2008. These specific SMAs were developed to reduce the threat of collisions between ships and North Atlantic right whales around their migratory route and calving grounds. As mentioned previously, the Block Island SMA overlaps spatially with the proposed project area (*https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html*). The SMA is currently active from November 1 through April 30 of each year and may be used by North Atlantic right whales for feeding (although to a lesser extent than the area to the east near Nantucket Shoals) and/or migrating. As noted above, NMFS is proposing changes to the North Atlantic right whale speed rule (87 FR 46921; August 1, 2022).

Humpback Whale

Humpback whales were listed as endangered under the Endangered Species Conservation Act (ESCA) in June 1970. In 1973, the ESA replaced the ESCA, and humpbacks continued to be listed as endangered. On September 8, 2016, NMFS divided the once single species into 14 distinct population segments (DPS), removed the species-level listing, and, in its place, listed 4 DPSs as endangered and 1 DPS as threatened (81 FR 62259, September 8, 2016). The remaining nine DPSs were not listed. The West Indies DPS, which is not listed under the ESA, is the only DPS of humpback whales that is expected to occur in the project area. Bettridge *et al.* (2015) estimated the size of the West Indies DPS population at 12,312 (95 percent CI 8,688–15,954) whales in 2004–05, which is consistent with previous population estimates of approximately 10,000–11,000 whales (Stevick *et al.,* 2003; Smith *et al.,* 1999) and the increasing trend for the West Indies DPS (Bettridge *et al.,* 2015).

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to abundance of prey species (Payne *et al.,* 1986, 1990). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes spp.*), and other small fishes, as well as euphausiids in the northern Gulf of Maine (Paquet *et al.,* 1997). Kraus *et al.* (2016) observed humpbacks in the RI/MA & MA WEAs and surrounding areas during all seasons but most often during spring and summer months with a peak from April to June. Acoustic data indicate that this species may be present within the RI/MA WEA year-round with the highest rates of acoustic detections in the winter and spring (Kraus *et al.,* 2016).

The project area does not overlap any ESA-designated critical habitat, BIAs, or other important areas for the humpback whales. A humpback whale feeding BIA extends throughout the Gulf of Maine, Stellwagen Bank, and Great South Channel from May through December, annually (LeBrecque *et al.,* 2015). However, this BIA is located further east and north of, and thus, does not overlap, the project area.

Since January 2016, elevated humpback whale mortalities along the Atlantic coast from Maine to Florida led to the declaration of a UME. As of January 12, 2023, 174 humpback whales have stranded as part of this UME. Partial or full necropsy examinations have been conducted on approximately half of the 161 known cases (as of November 7, 2022). Of the whales examined, about 50 percent had evidence of human interaction, either ship strike or entanglement. While a portion of the whales have shown evidence of pre-mortem vessel strike, this finding is not consistent across all whales examined and more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. More information is available at: *https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2023-humpback-whale-unusual-mortality-event-along-atlantic-coast.*

Fin Whale

Fin whales typically feed in the Gulf of Maine and the waters surrounding New England, but their mating and calving (and general wintering) areas are largely unknown (Hain *et al.* 1992, Hayes *et al.* 2022). Acoustic detections of fin whale singers augment and confirm these visual sighting conclusions for males. Recordings from Massachusetts Bay, New York Bight, and deep-ocean areas have detected some level of fin whale singing from September through June (Watkins *et al.* 1987, Clark and Gagnon 2002, Morano *et al.* 2012). These acoustic observations from both coastal and deep-ocean regions support the conclusion that male fin whales are broadly distributed throughout the western North Atlantic for most of the year (Hayes *et al.* 2022).

Kraus *et al.* (2016) suggest that, compared to other baleen whale species, fin whales have a high multi-seasonal relative abundance in the RI/MA & MA WEAs and surrounding areas. Fin whales were observed in the MA WEA in spring and summer. This species was observed primarily in the offshore (southern) regions of the RI/MA & MA WEAs during spring and was found closer to shore (northern areas) during the summer months (Kraus *et al.,* 2016). Calves were observed three times and feeding was observed nine times during the Kraus *et al.* (2016) study. Although fin whales were largely absent from visual surveys in the RI/MA & MA WEAs in the fall and winter months (Kraus *et al.,* 2016), acoustic data indicated that this species was present in the RI/MA & MA WEAs during all months of the year.

New England waters represent a major feeding ground for fin whales. Almost the entire lease area (351 km^2) overlaps approximately 12 percent of a relatively small fin whale feeding BIA (2,933 km^2) offshore of Montauk Point, New York from March to October (Hain *et al.,* 1992; LaBrecque *et al.* 2015). A separate larger year-round feeding BIA (18,015 km^2) located far to the northeast in the southern Gulf of Maine does not overlap with the project area and would thus not be impacted by project activities.

Minke Whale

Minke whale occurrence is common and widespread in New England from spring to fall, although the species is largely absent in the winter (Hayes *et al.,* 2022; Risch *et al.,* 2013). Surveys conducted in the RI/MA WEAs from October 2011 through June 2015 reported 103 minke whale sightings within the area, predominantly in the spring followed by summer and fall (Kraus *et al.,* 2016). Recent surveys conducted in the RI/MA WEAs from February 2017 through July 2018, October 2018 through August 2019, and March 2020 through July 2021 documented minke whales as the most common rorqual (baleen whales with pleated throat grooves) sighted in the WEAs. Surveys also reported a shift in the greatest seasonal abundance of minke whales from spring (2017–2018) (Quintana and Kraus, 2018) to summer (2018–2019 and 2020–2021) (O'Brien *et al.,* 2021a, b).

There are two minke whale feeding BIAs identified in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay and Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge from March through November, annually (LeBrecque *et al.,* 2015). However, these BIAs do not overlap the project area as they are located further east and north. A migratory route for minke whales transiting between northern feeding grounds and southern breeding areas may exist to the east of the proposed project area as minke whales may trac warmer waters along the continental shelf while migrating (Risch *et al.,* 2014).

Since January 2017, elevated minke whale mortalities detected along the Atlantic coast from Maine through South Carolina resulted in the declaration of a UME. As of January 12 2023, a total of 136 minke whales have stranded during this UME. Full or partial necropsy examinations were conducted on more than 60 percent of the whales. Preliminary findings in several of the whales have shown evidence of human interactions or infectious disease, but these findings are not consistent across all of the minke whales examined, so more research is needed. More information is available at: *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-minke-whale-unusual-mortality-event-along-atlantic-coast.*

Phocid Seals

Since June 2022, elevated numbers of harbor seal and gray seal mortalities have occurred across the southern and central coast of Maine. This event has been declared a UME. Preliminary testing of samples has found some harbor and gray seals positive for highly pathogenic avian influenza. While the UME is not occurring in the Sunrise Wind project area, the populations affected by the UME are the same as those potentially affected by the project.

The above event was preceded by a different UME, occurring from 2018–2020 (closure of the 2018–2020 UME is pending). Beginning in July 2018, elevated numbers of harbor seal and gray seal mortalities occurred across Maine, New Hampshire, and Massachusetts. Additionally, stranded seals have shown clinical signs as far south as Virginia, although not in elevated numbers, therefore the UME investigation encompassed all seal strandings from Maine to Virginia. A total of 3,152 reported strandings (of all species) occurred from July 1, 2018, through March 13, 2020. Full or partial necropsy examinations have been conducted on some of the seals and samples have been collected for testing. Based on tests conducted thus far, the main pathogen found in the seals is phocine distemper virus. NMFS is performing additional testing to identify any other factors that may be involved in this UME, which is pending closure. Information on this UME is available online at: *www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018–2020-pinniped-unusual-mortality-event-along.*

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 5.

TABLE 5—MARINE MAMMAL HEARING GROUPS

[NMFS, 2018]

Hearing group	Generalized hearing range *
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz.
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz.
High-frequency (HF) cetaceans (true porpoises, *Kogia,* river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*).	275 Hz to 160 kHz.
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz.

* Represents the generalized hearing range for the entire group as a composite (*i.e.,* all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.* 2007) and PW pinniped (approximation).

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.,* 2006; Kastelein *et al.,* 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Sixteen marine mammal species (14 cetacean species (6 mysticetes and 8 odontocetes) and 2 pinniped species (both phocid)) have the reasonable potential to co-occur with the proposed project activities (Table 4).

NMFS notes that in 2019, Southall *et al.* recommended new names for hearing groups that are widely recognized. However, this new hearing group classification does not change the weighting functions or acoustic thresholds (*i.e.,* the weighting functions and thresholds in Southall *et al.* (2019) are identical to NMFS 2018 Revised Technical Guidance). When NMFS updates our Technical Guidance, we will be adopting the updated Southall *et al.* (2019) hearing group classification.

Potential Effects of Specified Activities to Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The Estimated Take of Marine Mammals section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The Negligible Impact Analysis and Determination section considers the content of this section, the Estimated Take of Marine Mammals section, and the Proposed Mitigation section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks. General background information on marine mammal hearing was provided previously (see the Description of Marine Mammals in the Area of Specified Activities section). Here, the potential effects of sound on marine mammals are discussed.

Sunrise Wind has requested authorization to take marine mammals incidental to construction activities associated with in the Sunrise Wind project area. In the ITA application, Sunrise Wind presented analyses of potential impacts to marine mammals from use of acoustic and explosive sources. NMFS carefully reviewed the information provided by Sunrise Wind and independently reviewed applicable scientific research and literature and other information to evaluate the potential effects of Sunrise Wind's activities on marine mammals.

The proposed activities would result in placement of up to 95 permanent foundations (94 WTGs and 1 OCS–DC) and a temporary casing pipe in the marine environment. Up to three UXO/MEC detonations may occur during construction if any found UXO/MEC cannot be removed by other means. There are a variety of types and degrees of effects to marine mammals, prey species, and habitat that could occur as a result of the project. Below we provide a brief description of the types of sound sources that would be generated by the project, the general impacts from these types of activities, and an analysis of the anticipated impacts on marine mammals from the project in consideration of the proposed mitigation measures.

Description of Sound Sources

This section contains a brief technical background on sound, on the characteristics of certain sound types, and on metrics used in this proposal inasmuch as the information is relevant to the specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document. For general information on sound and its interaction with the marine environment, please see, *e.g.,* Au and Hastings (2008); Richardson *et al.* (1995); Urick (1983) as well as the Discovery of Sound in the Sea (DOSITS) website at *https://dosits.org/.*

Sound is a vibration that travels as an acoustic wave through a medium such as a gas, liquid or solid. Sound waves alternately compress and decompress the medium as the wave travels. These compressions and decompressions are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones (underwater microphones). In water, sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam (narrow beam or directional sources) or sound beams may radiate in all directions (omnidirectional sources).

Sound travels in water more efficiently than almost any other form of energy, making the use of acoustics ideal for the aquatic environment and its inhabitants. In seawater, sound travels at roughly 1,500 meters per second (m/s). In air, sound waves travel much more slowly at about 340 m/s. However, the speed of sound can vary by a small amount based on characteristics of the transmission medium such as water temperature and salinity.

The basic components of a sound wave are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in Hz or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds and typically attenuate (decrease) more rapidly except in certain cases in shallower water. The intensity (or amplitude) of sounds are measured in decibels (dB), which are a relative unit of measurement that is used to express the ratio of one value of a power or field to another. Decibels are measured on a logarithmic scale, so a small change in dB corresponds to large changes in sound pressure. For example, a 10 dB increase is a ten-fold increase in acoustic power. A 20 dB increase is then a 100-fold increase in power and a 30 dB increase is a 1000-fold increase in power. However, a ten-fold increase in acoustic power does not mean that the sound is perceived as being 10 times louder. Decibels are a relative unit comparing two pressures; therefore, a reference pressure must always be indicated. For underwater sound, this is 1 microPascal (μPa). For in-air sound, the reference pressure is 20 microPascal (μPa). The amplitude of a sound can be presented in various ways; however, NMFS typically considers three metrics.

Sound exposure level (SEL) represents the total energy in a stated frequency band over a stated time interval or event and considers both amplitude and duration of exposure (represented as dB re 1 μPa^2-s). SEL is a cumulative metric; it can be accumulated over a single pulse (for pile driving this is often referred to as single-strike SEL; SEL_{ss}) or calculated over periods containing multiple pulses (SEL_{cum}). Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. The SEL metric is useful because it allows sound exposures of different durations to be related to one another in terms of total acoustic energy. The duration of a sound event and the number of pulses, however, should be specified as there is no accepted standard duration over which the summation of energy is measured. Sounds are typically classified by their spectral and temporal properties.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Root mean square is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Root mean square accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure. Along with SEL, this metric is used in evaluating the potential for PTS (permanent threshold shift) and TTS (temporary threshold shift). Peak pressure is also used to evaluate the potential for gastro-intestinal tract injury (Level A harassment) from explosives.

For explosives, an impulse metric (Pa-s), which is the integral of a transient sound pressure over the duration of the pulse, is used to evaluate the potential for mortality (*i.e.,* severe lung injury) and slight lung injury. These impulse metric thresholds account for animal mass and depth.

Sounds can be either impulsive or non-impulsive. The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing *(e.g.,* Ward, 1997 in Southall *et al.,* 2007). Please see NMFS *et al.* (2018) and Southall *et al.* (2007,

2019) for an in-depth discussion of these concepts. Impulsive sound sources (*e.g.,* airguns, explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than 1 second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Impulsive sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features. Impulsive sounds are typically intermittent in nature.

Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-impulsive sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-impulsive sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems.

Sounds are also characterized by their temporal component. Continuous sounds are those whose sound pressure level remains above that of the ambient sound with negligibly small fluctuations in level (NIOSH, 1998; ANSI, 2005) while intermittent sounds are defined as sounds with interrupted levels of low or no sound (NIOSH, 1998). NMFS identifies Level B harassment thresholds based on if a sound is continuous or intermittent.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound, which is defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995). The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.,* wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.,* vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including wind and waves, which are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (ICES, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can become an important component of total sound at frequencies above 500 Hz and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, geophysical surveys, sonar, and explosions. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz, and if higher frequency sound levels are created, they attenuate rapidly.

The sum of the various natural and anthropogenic sound sources that comprise ambient sound at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10–20 dB from day to day (Richardson *et al.,* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals. Underwater ambient sound in the Atlantic Ocean southeast of Rhode Island comprises sounds produced by a number of natural and anthropogenic sources. Human-generated sound is a significant contributor to the acoustic environment in the project location.

Potential Effects of Underwater Sound on Marine Mammals and Their Habitat

Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life from none or minor to potentially severe responses depending on received levels, duration of exposure, behavioral context, and various other factors. Broadly, underwater sound from active acoustic sources, such as those in the Sunrise Wind project, can potentially result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2003; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Tal *et al.,* 2015). Potential effects from explosive sound sources can range in severity from behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973).

In general, the degree of effect of an acoustic exposure is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure, in addition to the contextual factors of the receiver (*e.g.,* behavioral state at time of exposure, age class, *etc*). In general, sudden, high level sounds can cause hearing loss as can longer exposures to lower level sounds. Moreover, any temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We describe below the specific manifestations of acoustic effects that may occur based on the activities proposed by Sunrise Wind.

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur in relation to distance from a source and assuming that the signal is within an animal's hearing range. First (at the greatest distance) is the area within which the acoustic signal would be audible (potentially perceived) to the animal but not strong enough to elicit any overt behavioral or physiological response. The next zone (closer to the receiving animale) corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. The third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.,* when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

Below, we provide additional detail regarding potential impacts on marine mammals and their habitat from noise in general, starting with hearing impairment, as well as from the specific activities Sunrise Wind plans to conduct, to the degree it is available (noting that there is limited information regarding the impacts of offshore wind construction on marine mammals).

Threshold Shift

Marine mammals exposed to high-intensity sound or to lower-intensity sound for prolonged periods can experience hearing threshold shift (TS), which NMFS defines as a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level expressed in decibels (NMFS, 2018). Threshold shifts can be permanent, in which case there is an irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range or temporary, in which there is reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range and the animal's hearing threshold would fully recover over time (Southall *et al.,* 2019). Repeated sound exposure that leads to TTS could cause PTS.

When PTS occurs, there can be physical damage to the sound receptors in the ear (*i.e.,* tissue damage) whereas TTS represents primarily tissue fatigue and is reversible (Henderson *et al.,* 2008). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997; Southall *et al.,* 2019). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, and there is no PTS data for cetaceans. However, such relationships are assumed to be similar to those in humans and other terrestrial mammals. Noise exposure can result in either a permanent shift in hearing thresholds from baseline (PTS; a 40 dB threshold shift approximates a PTS onset; *e.g.,* Kryter *et al.,* 1966; Miller, 1974; Henderson *et al.,* 2008) or a temporary, recoverable shift in hearing that returns to baseline (a 6 dB threshold shift approximates a TTS onset; *e.g.,* Southall *et al.,* 2019). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds, expressed in the unweighted peak sound pressure level metric (PK), for impulsive sounds (such as impact pile driving pulses) are at least 6 dB higher than the TTS thresholds and the weighted PTS cumulative sound exposure level thresholds are 15 (impulsive sound) to 20 (non-impulsive sounds) dB higher than TTS cumulative sound exposure level thresholds (Southall *et al.,* 2019). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, PTS is less likely to occur as a result of these activities, but it is possible and a small amount has been proposed for authorization for several species.

TTS is the mildest form of hearing impairment that can occur during exposure to sound, with a TTS of 6 dB considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability (Schlundt *et al.,* 2000; Finneran *et al.,* 2000; Finneran *et al.,* 2002). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. There is data on sound levels and durations necessary to elicit mild TTS for marine mammals, but recovery is complicated to predict and dependent on multiple factors.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious depending on the degree of interference of marine mammals hearing. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical (*e.g.* for successful mother/calf interactions, consistent detection of prey) could have more serious impacts.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale (*Delphinapterus leucas*), harbor porpoise, and Yangtze finless porpoise (*Neophocoena asiaeorientalis*)) and six species of pinnipeds (northern elephant seal (*Mirounga angustirostris*), harbor seal, ring seal, spotted seal, bearded seal, and California sea lion (*Zalophus californianus*)) that were exposed to a limited number of sound sources (*i.e.,* mostly tones and octave-band noise with limited number of exposure to impulsive sources such as seismic airguns or impact pile driving) in laboratory settings (Southall *et al.,* 2019). There is currently no data available on noise-induced hearing loss for mysticetes. For summaries of data on TTS or PTS in marine mammals or for further discussion of TTS or PTS onset thresholds, please see Southall *et al.* (2019), and NMFS (2018).

Recent studies with captive odontocete species (bottlenose dolphin, harbor porpoise, beluga, and false killer whale) have observed increases in hearing threshold levels when individuals received a warning sound prior to exposure to a relatively loud sound (Nachtigall and Supin, 2013, 2015, Nachtigall *et al.,* 2016a,b,c, Finneran, 2018, Nachtigall *et al.,* 2018). These studies suggest that captive animals have a mechanism to reduce hearing sensitivity prior to impending loud sounds. Hearing change was observed to be frequency dependent and Finneran (2018) suggests hearing attenuation occurs within the cochlea or auditory nerve. Based on these observations on captive odontocetes, the authors suggest that wild animals may have a mechanism to self-mitigate the impacts of noise exposure by dampening their hearing during prolonged exposures of loud sound or if conditioned to anticipate intense sounds (Finneran, 2018, Nachtigall *et al.,* 2018).

Behavioral Disturbance

Exposure of marine mammals to sound sources can result in, but is not limited to, no response or any of the following observable responses: increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson (1995). More recent reviews (Nowacek *et al.,* 2007; DeRuiter *et al.,* 2012 and 2013; Ellison *et al.,* 2012; Gomez *et al.,* 2016) address studies conducted since 1995 and focused on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. Gomez *et al.* (2016) conducted a review of the literature considering the contextual information of exposure in addition to received level and found that higher received levels were not always associated with more severe behavioral responses and vice versa. Southall *et al.* (2021) states that results demonstrate that some individuals of different species display clear yet varied responses, some of which have negative implications while others appear to tolerate high levels and that responses may not be fully predictable with simple acoustic exposure metrics (*e.g.,* received sound level). Rather, the authors state that differences among species and individuals along with contextual aspects of exposure (*e.g.,* behavioral state) appear to affect response probability. Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of and response to (nature and magnitude) an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately predisposed to respond to certain sounds in certain ways) (Southall *et al.,* 2019). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), the similarity of a sound to biologically relevant sounds in the animal's environment (*i.e.,* calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007, DeRuiter *et al.,* 2013). Individuals (of different age, gender, reproductive status, *etc.*) among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (*i.e.,* proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone. Overall, the variability of responses to acoustic stimuli depends on the species receiving the sound, the sound source, and the social, behavioral, or environmental contexts of exposure (*e.g.,* DeRuiter *et al.,* 2012). For example, Goldbogen *et al.* (2013) demonstrated that individual behavioral state was critically important in determining response of blue whales to sonar, noting that some individuals engaged in deep (greater than 50 m) feeding behavior had greater dive responses than those in shallow feeding or non-feeding conditions. Some blue whales in the Goldbogen *et al.* (2013) study that were engaged in shallow feeding behavior demonstrated no clear changes in diving or movement even when received levels were high (~160 dB re 1µPa) for exposures to 3–4 kHz sonar signals, while deep feeding and non-feeding whales showed a clear response at exposures at lower received levels of sonar and pseudorandom noise. Southall *et al.* 2011 found that blue whales had a different response to sonar exposure depending on behavioral state, more pronounced when deep feeding/travel modes than when engaged in surface feeding.

With respect to distance influencing disturbance, DeRuiter *et al.* (2013) examined behavioral responses of Cuvier's beaked whales to MF sonar and found that whales responded strongly at low received levels (89–127 dB *re 1µPa*) by ceasing normal fluking and echolocation, swimming rapidly away, and extending both dive duration and subsequent non-foraging intervals when the sound source was 3.4–9.5 km away. Importantly, this study also showed that whales exposed to a similar range of received levels (78–106 dB *re 1µPa*) from distant sonar exercises (118 km away) did not elicit such responses, suggesting that context may moderate reactions. Thus, distance from the source is an important variable in influencing the type and degree of behavioral response and this variable is independent of the effect of received levels (*e.g.,* DeRuiter *et al.,* 2013; Dunlop *et al.,* 2017a; Dunlop *et al.,* 2017b; Falcone *et al.,* 2017; Dunlop *et al.,* 2018; Southall *et al.,* 2019).

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as described, greatly influences the type of behavioral response exhibited by the animal. Forney *et al.* (2017) also point out that an apparent lack of response (*e.g.,* no displacement or avoidance of a sound source) may not necessarily mean there is no cost to the individual or population, as some resources or habitats may be of such high value that animals may choose to stay, even when experiencing stress or hearing loss. Forney *et al.* (2017) recommend considering both the costs of remaining in an area of noise exposure such as TTS, PTS, or masking, which could lead to an increased risk of predation or other threats or a decreased capability to forage, and the costs of displacement, including potential increased risk of vessel strike, increased risks of predation or competition for resources, or decreased habitat suitable for foraging, resting, or socializing. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. However, distance is one contextual factor for which data exist to quantitatively inform a take estimate, and the method for predicting Level B harassment in this rule does consider distance to the source. Other factors are often considered qualitatively in the analysis of the likely consequences of sound exposure where supporting information is available.

Behavioral change, such as disturbance manifesting in lost foraging time, in response to anthropogenic activities is often assumed to indicate a biologically significant effect on a population of concern. However, individuals may be able to compensate for some types and degrees of shifts in behavior, preserving their health and thus their vital rates and population dynamics. For example, New *et al.,* 2013 developed a model simulating the complex social, spatial, behavioral and motivational interactions of coastal bottlenose dolphins in the Moray Firth, Scotland, to assess the biological significance of increased rate of behavioral disruptions caused by vessel traffic. Despite a modeled scenario in which vessel traffic increased from 70 to 470 vessels a year (a sixfold increase in vessel traffic) in response to the construction of a proposed offshore renewables' facility, the dolphins' behavioral time budget, spatial distribution, motivations and social structure remained unchanged.

Similarly, two bottlenose dolphin populations in Australia were also modeled over 5 years against a number of disturbances, (Reed *et al.,* 2020) and results indicate that habitat/noise disturbance had little overall impact on population abundances in either location, even in the most extreme impact scenarios modeled.

Friedlaender *et al.* (2016) provided the first integration of direct measures of prey distribution and density variables incorporated into across-individual analyses of behavior responses of blue whales to sonar and demonstrated a fivefold increase in the ability to quantify variability in blue whale diving behavior. These results illustrate that responses evaluated without such measurements for foraging animals may be misleading, which again illustrates the context-dependent nature of the probability of response.

The following subsections provide examples of behavioral responses that give an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound, contextual factors, and the wide range of potential acoustic sources to which a marine mammal may be exposed. Behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists, along with contextual factors.

Avoidance and Displacement

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.,* 1995). For example, gray whales or humpback whales are known to change direction—deflecting from customary migratory paths—in order to avoid noise from airgun surveys (Malme *et al.,* 1984; Dunlop *et al.,* 2018). Avoidance is qualitatively different from the flight response but also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, *etc.*). Avoidance may be short-term with animals returning to the area once the noise has ceased (*e.g.,* Bowles *et al.,* 1994; Goold, 1996; Stone *et al.,* 2000; Morton and Symonds, 2002; Gailey *et al.,* 2007; Dähne *et al.,* 2013; Russel *et al.,* 2016; Malme *et al.,* 1984). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.,* Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006; Forney *et al.,* 2017). Avoidance of marine mammals during the construction of offshore wind facilities (specifically, impact pile driving) has been documented in the literature with some significant variation in the temporal and spatial degree of avoidance and with most studies focused on harbor porpoises as one of the most common marine mammals in European waters (*e.g.,* Tougaard *et al.,* 2009; Dähne *et al.,* 2013; Thompson *et al.,* 2013; Russell *et al.,* 2016; Brandt *et al.,* 2018).

Available information on impacts to marine mammals from pile driving associated with offshore wind is limited to information on harbor porpoises and seals, as the vast majority of this research has occurred at European offshore wind projects where large whales and other odontocete species are uncommon. Harbor porpoises and harbor seals are considered to be behaviorally sensitive species (*e.g.,* Southall *et al.,* 2007) and the effects of wind farm construction in Europe on these species has been well documented. These species have received particular attention in European waters due to their abundance in the North Sea (Hammond *et al.,* 2002; Nachtsheim *et al.,* 2021). A summary of the literature on documented effects of wind farm construction on harbor porpoise and harbor seals is described below.

Brandt *et al.* (2016) summarized the effects of the construction of eight offshore wind projects within the German North Sea (*i.e.,* Alpha Ventus, BARD Offshore I, Borkum West II, DanTysk, Global Tech I, Meerwind Süd/Ost, Nordsee Ost, and Riffgat) between 2009 and 2013 on harbor porpoises, combining PAM data from 2010–2013 and aerial surveys from 2009–2013 with data on noise levels associated with pile driving. Results of the analysis revealed significant declines in porpoise detections during pile driving when compared to 25–48 hours before pile driving began, with the magnitude of decline during pile driving clearly decreasing with increasing distances to the construction site. During the majority of projects, significant declines in detections (by at least 20 percent) were found within at least 5–10 km of the pile driving site, with declines at up to 20–30 km of the pile driving site documented in some cases. Similar results demonstrating the long-distance displacement of harbor porpoises (18–25 km) and harbor seals (up to 40 km) during impact pile driving have also been observed during the construction at multiple other European wind farms (Haleters *et al.,* 2015; Lucke *et al.,* 2012; Dähne *et al.,* 2013; Tougaard *et al.,* 2009; Bailey *et al.,* 2010.)

While harbor porpoises and seals tend to move several kilometers away from wind farm construction activities, the duration of displacement has been documented to be relatively temporary. In two studies at Horns Rev II using impact pile driving, harbor porpoise returned within 1–2 days following cessation of pile driving (Tougaard *et al.,* 2009, Brandt *et al.,* 2011). Similar recovery periods have been noted for harbor seals off England during the construction of four wind farms (Carroll *et al.,* 2010; Hamre *et al.,* 2011; Hastie *et al.,* 2015; Russell *et al.,* 2016; Brasseur *et al.,* 2010). In some cases, an increase in harbor porpoise activity has been documented inside wind farm areas following construction (*e.g.,* Lindeboom *et al.,* 2011). Other studies have noted longer term impacts after impact pile driving. Near Dogger Bank in Germany, harbor porpoises continued to avoid the area for over 2 years after construction began (Gilles *et al.* 2009). Approximately 10 years after construction of the Nysted wind farm, harbor porpoise abundance had not recovered to the original levels previously seen, although the echolocation activity was noted to have been increasing when compared to the previous monitoring period (Teilmann and Carstensen, 2012). However, overall, there are no indications for a population decline of harbor porpoises in European waters (*e.g.,* Brandt *et al.,* 2016). Notably, where significant differences in displacement and return rates have been identified for these species, the occurrence of secondary project-specific influences such as use of mitigation measures (*e.g.,* bubble curtains, acoustic deterrent devices (ADDs)) or the manner in which species use the habitat in the project area are likely the driving factors of this variation.

NMFS notes the aforementioned studies from Europe involve installing much smaller piles than Sunrise Wind proposes to install. Therefore, we anticipate noise levels from impact pile driving to be louder. For this reason, we anticipate that the greater distances of displacement observed in harbor porpoise and harbor seals documented in Europe are likely to occur off New York. However, we do not anticipate any greater severity of response due to harbor porpoise and harbor seal habitat use off New York or population level consequences similar to European findings. In many cases, harbor porpoises and harbor seals are resident to the areas where European wind farms have been constructed. However, off New York, harbor porpoises are transient (with higher abundances in winter when impact pile driving would not occur) and a very small percentage of the large harbor seal population are only seasonally present with no rookeries established. In summary, we anticipate that harbor porpoise and harbor seals will likely respond to pile driving by moving several kilometers away from the source but return to typical habitat use patterns when pile driving ceases. As previously noted, the literature on marine mammal responses to offshore wind farms is limited to species which are known to be more behaviorally sensitive to auditory stimuli than the other species that occur in the project area. Therefore, the documented behavioral responses of harbor porpoises and harbor seals to pile driving in Europe should be considered as a worst-case scenario in terms of the potential responses among all marine mammals to offshore pile driving, and these responses cannot reliably predict the responses that will occur in other marine mammal species.

Some avoidance behavior of other marine mammal species has been documented to be dependent on distance from the source in response to playbacks. As described above, DeRuiter *et al.* (2013) noted that distance from a sound source may moderate marine mammal reactions in their study of Cuvier's beaked whales (an acoustically sensitive species), which showed the whales swimming rapidly and silently away when a sonar signal was 3.4–9.5 km away while showing no such reaction to the same signal when the signal was 118 km away even though the received levels were similar. Tyack *et al.* (1983) conducted playback studies of Surveillance Towed Array Sensor System (SURTASS) low frequency active (LFA) sonar in a gray whale migratory corridor off California. Similar to North Atlantic right whales, gray whales migrate close to shore (approximately +2 kms) and are low frequency hearing specialists. The LFA sonar source was placed within the gray whale migratory corridor (approximately 2 km offshore) and offshore of most, but not all, migrating whales (approximately 4 km offshore). These locations influenced received levels and distance to the source. For the inshore playbacks, not unexpectedly, the louder the source level of the playback (*i.e.,* the louder the received level), whale avoided the source at greater distances. Specifically, when the source level was 170 dB rms and 178 dB rms, whales avoided the inshore source at ranges of several hundred meters, similar to avoidance responses reported by Malme *et al.* (1983, 1984). Whales exposed to source levels of 185 dB rms demonstrated avoidance levels at ranges of +1 km. Responses to the offshore source broadcasting at source levels of 185 and 200 dB, avoidance responses were greatly reduced. While there was observed deflection from course, in no case did a whale abandon its migratory behavior.

The signal context of the noise exposure has been shown to play an important role in avoidance responses. In the 2007–2008 Bahamas study, playback sounds of a potential predator—a killer whale—resulted in a similar but more pronounced reaction in beaked whales (an acoustically sensitive species), which included longer inter-dive intervals and a sustained straight-line departure of more than 20 km from the area (Boyd *et al.,* 2008; Southall *et al.,* 2009; Tyack *et al.,* 2011). Sunrise Wind does not anticipate, and NMFS is not proposing to authorize, take of beaked whales and, moreover, the sounds produced by Sunrise Wind do not have signal characteristics similar to predators. Therefore, we would not expect such extreme reactions to occur. Southall *et al.* 2011 found that blue whales had a different response to sonar exposure depending on behavioral state, more pronounced when deep feeding/travel modes than when engaged in surface feeding.

One consequence of behavioral avoidance results in the altered energetic expenditure of marine mammals because energy is required to move and avoid surface vessels or the sound field associated with active sonar (Frid and Dill, 2002). Most animals can avoid that energetic cost by swimming away at slow speeds or speeds that minimize the cost of transport (Miksis-Olds, 2006), as has been demonstrated in Florida manatees (Miksis-Olds, 2006).

Those energetic costs increase, however, when animals shift from a resting state, which is designed to conserve an animal's energy, to an active state that consumes energy the animal would have conserved had it not been disturbed. Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting to active behavioral states, which would imply that they incur an energy cost.

Forney *et al.* (2017) detailed the potential effects of noise on marine mammal populations with high site fidelity, including displacement and auditory masking, noting that a lack of observed response does not imply absence of fitness costs and that apparent tolerance of disturbance may have population-level impacts that are less obvious and difficult to document. Avoidance of overlap between disturbing noise and areas and/or times of particular importance for sensitive species may be critical to avoiding population-level impacts because (particularly for animals with high site fidelity) there may be a strong motivation to remain in the area despite negative impacts. Forney *et al.* (2017) stated that, for these animals, remaining in a disturbed area may reflect a lack of alternatives rather than a lack of effects.

Flight Response

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.,* directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996; Frid and Dill, 2002). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, beaked whale strandings (Cox *et al.,* 2006; D'Amico *et al.,* 2009). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response. Flight responses of marine mammals have been documented in response to mobile high intensity active sonar (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Wensveen *et al.,* 2019), and more severe responses have been documented when sources are moving towards an animal or when they are surprised by unpredictable exposures (Watkins 1986; Falcone *et al.* 2017). Generally speaking, however, marine mammals would be expected to be less likely to respond with a flight response to either stationery pile driving (which they can sense is stationery and predictable) or significantly lower-level HRG surveys unless they are within the area ensonified above behavioral harassment thresholds at the moment the source is turned on (Watkins, 1986; Falcone *et al.,* 2017). A flight response may also be possible in response to UXO/MEC detonation; however, given a detonation is instantaneous, only one detonation would occur on a given day, only 3 detonations may occur over 5 years, and the proposed mitigation and monitoring would result in any animals being far from the detonation (*i.e.,* the clearance zone extends 10 km from the UXO/MEC location), any flight response would be spatially and temporally limited.

Alteration of Diving and Foraging

Changes in dive behavior in response to noise exposure can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark, 2000; Costa *et al.,* 2003; Ng and Leung, 2003; Nowacek *et al.,* 2004; Goldbogen *et al.,* 2013a, 2013b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (*e.g.,* increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. The alerting stimulus was in the form of an 18 minute exposure that included three 2-minute signals played three times sequentially. This stimulus was designed with the purpose of providing signals distinct to background noise that serve as localization cues. However, the whales did not respond to playbacks of either North Atlantic right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. All signals were relatively brief in duration, similar to the proposed Sunrise construction and HRG activities. Although source levels for the proposed pile driving activities may exceed the received level of the alerting stimulus described by Nowacek *et al.* (2004), proposed mitigation strategies (further described in the Proposed Mitigation section) will reduce the severity of any response to proposed pile driving activities. Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and speed of approach seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.,* 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation as well as differences in species sensitivity are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.,* 2001; Nowacek *et al.;* 2004; Madsen *et al.,* 2006a; Yazvenko *et al.,* 2007; Southall *et al.,* 2019b). An understanding of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal can facilitate the assessment of whether foraging disruptions are likely to incur fitness consequences (Goldbogen *et al.,* 2013; Farmer *et al.,* 2018; Pirotta *et al.,* 2018; Southall *et al.,* 2019; Pirotta *et al.,* 2021).

Impacts on marine mammal foraging rates from noise exposure have been documented, though there is little data regarding the impacts of offshore turbine construction specifically. Several broader examples follow, and it is reasonable to expect that exposure to noise produced during the 5-years the proposed rule would be effective could have similar impacts.

Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to air gun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006a; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the air guns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were six percent lower during exposure than control periods (Miller *et al.,* 2009). Miller *et al.* (2009) noted that more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior.

Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll *et al.,* 2001) whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received SPLs were similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. The source levels of the proposed construction and HRG activities exceed the source levels of the signals described by Nowacek *et al.* (2004) and Croll *et al.* (2001), yet noise generated by Sunrise Wind's activities would overlap in frequency with the described signals. Blue whales exposed to mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, Melcón *et al.* (2012) were unable to determine if suppression of low frequency calls reflected a change in their feeding performance or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. Results from the 2010–2011 field season of a behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012b, Southall *et al.,* 2019b).

Information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal will help better inform a determination of whether foraging disruptions incur fitness consequences. Foraging strategies may impact foraging efficiency, such as by reducing foraging effort and increasing success in prey detection and capture, in turn promoting fitness and allowing individuals to better compensate for foraging disruptions. Surface feeding blue whales did not show a change in behavior in response to mid-frequency simulated and real sonar sources with received levels between 90 and 179 dB *re 1* μ*Pa,* but deep feeding and non-feeding whales showed temporary reactions including cessation of feeding, reduced initiation of deep foraging dives, generalized avoidance responses, and changes to dive behavior (DeRuiter *et al.,* 2017; Goldbogen *et al.* (2013b); Sivle *et al.,* 2015). Goldbogen *et al.* (2013b) indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure.

Similarly, while the rates of foraging lunges decrease in humpback whales due to sonar exposure, there was variability in the response across individuals with one animal ceasing to forage completely and another animal starting to forage during the exposure (Sivle *et al.,* 2016). In addition, almost half of the animals that demonstrated avoidance were foraging before the exposure but the others were not; the animals that avoided while not feeding responded at a slightly lower received level and greater distance than those that were feeding (Wensveen *et al.,* 2017). These findings indicate the behavioral state of the animal and foraging strategies play a role in the type and severity of a behavioral response. For example, when the prey field was mapped and used as a covariate in examining how behavioral state of blue whales is influenced by mid-frequency sound, the response in blue whale deep-feeding behavior was even more apparent, reinforcing the need for contextual variables to be included when assessing behavioral responses (Friedlaender *et al.,* 2016).

Breathing

Respiration naturally varies with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey *et al.,* 2007). Studies with captive harbor porpoises show increased respiration rates upon introduction of acoustic alarms (Kastelein *et al.,* 2001; Kastelein *et al.,* 2006a) and emissions for underwater data transmission (Kastelein *et al.,* 2005). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.,* 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Vocalizations (Also see the Auditory Masking Section)

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, production of echolocation clicks, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result directly from increased vigilance (also see the *Potential Effects of Behavioral Disturbance on Marine Mammal Fitness* section) or a startle response, or from a need to compete with an increase in background noise (see Erbe *et al.,* 2016 review on communication masking), the latter of which is described more in the Auditory Masking section below.

For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003; Foote *et al.,* 2004) and blue whales increased song production (Di Iorio and Clark, 2009) while North Atlantic right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). In some cases, animals may cease or reduce sound production during production of aversive signals (Bowles *et al.,* 1994; Thode *et al.,* 2020; Cerchio *et al.* (2014); McDonald *et al.* (1995)). Blackwell *et al.* (2015) showed that whales increased calling rates as soon as air gun signals were detectable before ultimately decreasing calling rates at higher received levels.

Orientation

A shift in an animal's resting state or an attentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone. As previously mentioned, the responses may co-occur with other behaviors; for instance, an animal may initially orient toward a sound source and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

Habituation and Sensitization

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a ''progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial,'' rather than as, more generally, moderation in response to human disturbance having a neutral or positive outcome (Bejder *et al.,* 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Both habituation and sensitization require an ongoing learning process. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003; Southall *et al.,* 2019b). Controlled experiments with captive marine mammals have shown pronounced behavioral reactions, including avoidance of loud sound sources (*e.g.,* Ridgway *et al.,* 1997; Finneran *et al.,* 2003; Houser *et al.* (2013a, b); Kastelein *et al.* (2018). Observed responses of wild marine mammals to loud impulsive sound sources (typically airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Tougaard *et al.,* 2009; Brandt *et al.,* 2011, Brandt *et al.,* 2012, Dähne *et al.,* 2013; Brandt *et al.,* 2014; Russell *et al.,* 2016; Brandt *et al.,* 2018). However, many delphinids approach low-frequency airgun source vessels with no apparent discomfort or obvious behavioral change (*e.g.,* Barkaszi *et al.,* 2012), indicating the importance of frequency output in relation to the species' hearing sensitivity.

Stress Response

An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.,* Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.,* Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.,* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and ''distress'' is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.,* Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Lusseau and Bejder, 2007; Romano *et al.,* 2002a; Rolland *et al.,* 2012). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. Lusseau and Bejder (2007) present data from three long-term studies illustrating the connections between disturbance from whale-watching boats and population-level effects in cetaceans. In Shark Bay, Australia, the abundance of bottlenose dolphins was compared within adjacent control and tourism sites over three consecutive 4.5-year periods of increasing tourism levels. Between the second and third time periods, in which tourism doubled, dolphin abundance decreased by 15 percent in the tourism area and did not change significantly in the control area. In Fiordland, New Zealand, two populations (Milford and Doubtful Sounds) of bottlenose dolphins with tourism levels that differed by a factor of seven were observed and significant increases in traveling time and decreases in resting time were documented for both. Consistent short-term avoidance strategies were observed in response to tour boats until a threshold of disturbance was reached (average 68 minutes between interactions), after which the response switched to a longer-term habitat displacement strategy. For one population, tourism only occurred in a part of the home range. However, tourism occurred throughout the home range of the Doubtful Sound population and once boat traffic increased beyond the 68-minute threshold (resulting in abandonment of their home range/preferred habitat), reproductive success drastically decreased (increased stillbirths) and abundance decreased significantly (from 67 to 56 individuals in a short period).

These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as ''distress.'' In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003, 2017).

Auditory Masking

Sound can disrupt behavior through masking or interfering with an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, or navigation) (Richardson *et al.,* 1995; Erbe and Farmer, 2000; Tyack, 2000; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction) in relation to each other, an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age, or TTS hearing loss), and existing ambient noise and propagation conditions. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations. Masking can lead to behavioral changes, including vocal changes (*e.g.,* Lombard effect, increasing amplitude, or changing frequency), cessation of foraging or lost foraging opportunities, and leaving an area, to both signalers and receivers in an attempt to compensate for noise levels (Erbe *et al.,* 2016) or because sounds that would typically have triggered a behavior were not detected. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus decreases also. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Therefore, when the coincident (masking) sound is man-made, it may be considered Level B harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and

PTS, which persist after the sound exposure, from masking, which only occurs during the sound exposure. Because masking (without resulting in threshold shift) is not associated with abnormal physiological function, it is not considered a physiological effect but rather, a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.,* Clark *et al.,* 2009; Matthews *et al.,* 2016) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.,* Miller *et al.,* 2000; Foote *et al.,* 2004; Parks *et al.,* 2007; Di Iorio and Clark, 2009; Holt *et al.,* 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.,* 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.,* Erbe, 2008), but in wild populations, it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.,* Branstetter *et al.,* 2013; Cholewiak *et al.,* 2018).

High-frequency sounds may mask the echolocation calls of toothed whales. Human data indicate low-frequency sound can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high-frequencies these cetaceans use to echolocate but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A study by Nachtigall and Supin (2008) showed that false killer whales adjust their hearing to compensate for ambient sounds and the intensity of returning echolocation signals.

Impacts on signal detection, measured by masked detection thresholds, are not the only important factors to address when considering the potential effects of masking. As marine mammals use sound to recognize conspecifics, prey, predators, or other biologically significant sources (Branstetter *et al.,* 2016), it is also important to understand the impacts of masked recognition thresholds (often called ‘‘informational masking’’). Branstetter *et al.* (2016) measured masked recognition thresholds for whistle-like sounds of bottlenose dolphins and observed that they are approximately 4 dB above detection thresholds (energetic masking) for the same signals. Reduced ability to recognize a conspecific call or the acoustic signature of a predator could have severe negative impacts. Branstetter *et al.* (2016) observed that if ‘‘quality communication’’ is set at 90 percent recognition the output of communication space models (which are based on 50 percent detection) would likely result in a significant decrease in communication range.

As marine mammals use sound to recognize predators (Allen *et al.,* 2014; Cummings and Thompson, 1971; Curé *et al.,* 2015; Fish and Vania, 1971), the presence of masking noise may also prevent marine mammals from responding to acoustic cues produced by their predators, particularly if it occurs in the same frequency band. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by mammal-eating killer whales. The seals acoustically discriminate between the calls of mammal-eating and fish-eating killer whales (Deecke *et al.,* 2002), a capability that should increase survivorship while reducing the energy required to attend to all killer whale calls. Similarly, sperm whales (Curé *et al.,* 2016; Isojunno *et al.,* 2016), long-finned pilot whales (Visser *et al.,* 2016), and humpback whales (Curé *et al.,* 2015) changed their behavior in response to killer whale vocalization playbacks; these findings indicate that some recognition of predator cues could be missed if the killer whale vocalizations were masked. The potential effects of masked predator acoustic cues depends on the duration of the masking noise and the likelihood of a marine mammal encountering a predator during the time that detection and recognition of predator cues are impeded.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio.

Masking affects both senders and receivers of acoustic signals and, at higher levels and longer duration, can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009; Cholewiak *et al.,* 2018). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.,* from commercial vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

In addition to making it more difficult for animals to perceive and recognize acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the ‘‘active space’’ (or communication space) of their vocalizations, which is the maximum area within which their vocalizations can be detected before it drops to the level of ambient noise (Brenowitz, 2004; Brumm *et al.,* 2004; Lohr *et al.,* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations from other sounds, which is more important than simply detecting that a vocalization is occurring (Brenowitz, 1982; Brumm *et al.,* 2004; Dooling, 2004; Marten and Marler, 1977; Patricelli *et al.,* 2006). Most species that vocalize have evolved with an ability to make adjustments to their vocalizations to increase the signal-to-noise ratio, active space, and recognizability/distinguishability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.,* 2004; Patricelli *et al.,* 2006). Vocalizing animals can make adjustments to vocalization characteristics such as the frequency structure, amplitude, temporal structure, and temporal delivery (repetition rate), or ceasing to vocalize.

Many animals will combine several of these strategies to compensate for high levels of background noise.

Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals' listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communication between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments are not directly known in all instances, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006; Noren *et al.,* 2017; Noren *et al.,* 2020). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996).

Marine mammals are also known to make vocal changes in response to anthropogenic noise. In cetaceans, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying (see the following for examples: Gordon *et al.,* 2003; Di Iorio and Clark, 2009; Hatch *et al.,* 2012; Holt *et al.,* 2009; Holt *et al.,* 2011; Lesage *et al.,* 1999; McDonald *et al.,* 2009; Parks *et al.,* 2007, Risch *et al.,* 2012, Rolland *et al.,* 2012), as well as changes in the natural acoustic environment (Dunlop *et al.,* 2014). Vocal changes can be temporary or can be persistent. For example, model simulation suggests that the increase in starting frequency for the North Atlantic right whale upcall over the last 50 years resulted in increased detection ranges between North Atlantic right whales. The frequency shift, coupled with an increase in call intensity by 20 dB, led to a call detectability range of less than 3 km to over 9 km (Tennessen and Parks, 2016). Holt *et al.* (2009) measured killer whale call source levels and background noise levels in the one to 40 kHz band and reported that the whales increased their call source levels by one dB SPL for every one dB SPL increase in background noise level. Similarly, another study on St. Lawrence River belugas reported a similar rate of increase in vocalization activity in response to passing vessels (Scheifele *et al.,* 2005). Di Iorio and Clark (2009) showed that blue whale calling rates vary in association with seismic sparker survey activity with whales calling more on days with surveys than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

In some cases, these vocal changes may have fitness consequences, such as an increase in metabolic rates and oxygen consumption, as observed in bottlenose dolphins when increasing their call amplitude (Holt *et al.,* 2015). A switch from vocal communication to physical, surface-generated sounds, such as pectoral fin slapping or breaching, was observed for humpback whales in the presence of increasing natural background noise levels indicating that adaptations to masking may also move beyond vocal modifications (Dunlop *et al.,* 2010).

While these changes all represent possible tactics by the sound-producing animal to reduce the impact of masking, the receiving animal can also reduce masking by using active listening strategies such as orienting to the sound source, moving to a quieter location, or reducing self-noise from hydrodynamic flow by remaining still. The temporal structure of noise (*e.g.,* amplitude modulation) may also provide a considerable release from masking through comodulation masking release (a reduction of masking that occurs when broadband noise, with a frequency spectrum wider than an animal's auditory filter bandwidth at the frequency of interest, is amplitude modulated) (Branstetter and Finneran, 2008; Branstetter *et al.,* 2013). Signal type (*e.g.,* whistles, burst-pulse, sonar clicks) and spectral characteristics (*e.g.,* frequency modulated with harmonics) may further influence masked detection thresholds (Branstetter *et al.,* 2016; Cunningham *et al.,* 2014).

Masking is more likely to occur in the presence of broadband, relatively continuous noise sources such as vessels. Several studies have shown decreases in marine mammal communication space and changes in behavior as a result of the presence of vessel noise. For example, North Atlantic right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007) as well as increasing the amplitude (intensity) of their calls (Parks, 2009; Parks *et al.,* 2011). Clark *et al.* (2009) observed that North Atlantic right whales' communication space decreased by up to 84 percent in the presence of vessels. Cholewiak *et al.* (2018) also observed loss in communication space in Stellwagen National Marine Sanctuary for North Atlantic right whales, fin whales, and humpback whales with increased ambient noise and shipping noise. Although humpback whales off Australia did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected based on source level changes to wind noise, potentially indicating some signal masking (Dunlop, 2016). Multiple delphinid species have also been shown to increase the minimum or maximum frequencies of their whistles in the presence of anthropogenic noise and reduced communication space (for examples see: Holt *et al.,* 2009; Holt *et al.,* 2011; Gervaise *et al.,* 2012; Williams *et al.,* 2013; Hermannsen *et al.,* 2014; Papale *et al.,* 2015; Liu *et al.,* 2017). While masking impacts are not a concern from lower intensity, higher frequency HRG surveys, some degree of masking would be expected in the vicinity of turbine pile driving and concentrated support vessel operation. However, pile driving is an intermittent sound and would not be continuous throughout a day.

Potential Effects of Behavioral Disturbance on Marine Mammal Fitness

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the well-being (survival, reproduction, *etc.*) of an animal. There is little quantitative marine mammal data relating the exposure of marine mammals from sound to effects on reproduction or survival, though data exists for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli may cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); may cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or may cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or subconsciously (for example, when an animal hears sounds that it associates with the approach of a predator) and the shift in attention can be sudden (Dukas, 2002; van Rij, 2007). Once a stimulus has captured an animal's attention, the animal can respond by ignoring the stimulus, assuming a ''watch and wait'' posture, or treat the stimulus as a disturbance and respond accordingly, which includes scanning for the source of the stimulus or ''vigilance'' (Cowlishaw *et al.,* 2004).

Vigilance is an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or to attend cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, however, vigilance has a cost of time; when animals focus their attention on specific environmental cues, they are not attending to other activities such as foraging or resting. These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (*e.g.,* when they are giving birth or accompanied by a calf).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget and, as a result, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). In a study of northern resident killer whales off Vancouver Island, exposure to boat traffic was shown to reduce foraging opportunities and increase traveling time (Holt *et al.,* 2021). A simple bioenergetics model was applied to show that the reduced foraging opportunities equated to a decreased energy intake of 18 percent while the increased traveling incurred an increased energy output of 3–4 percent, which suggests that a management action based on avoiding interference with foraging might be particularly effective.

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant for fitness if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than 1 day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). It is important to note the difference between behavioral reactions lasting or recurring over multiple days and anthropogenic activities lasting or recurring over multiple days. For example, just because certain activities last for multiple days does not necessarily mean that individual animals will be either exposed to those activity-related stressors (*i.e.,* sonar) for multiple days or further exposed in a manner that would result in sustained multi-day substantive behavioral responses. However, special attention is warranted where longer-duration activities overlay areas in which animals are known to congregate for longer durations for biologically important behaviors.

Stone (2015a) reported data from at-sea observations during 1,196 airgun surveys from 1994 to 2010. When large arrays of airguns (considered to be 500 in 3 or more) were firing, lateral displacement, more localized avoidance, or other changes in behavior were evident for most odontocetes. However, significant responses to large arrays were found only for the minke whale and fin whale. Behavioral responses observed included changes in swimming or surfacing behavior with indications that cetaceans remained near the water surface at these times. Cetaceans were recorded as feeding less often when large arrays were active. Behavioral observations of gray whales during an air gun survey monitored whale movements and respirations pre-, during-, and post-seismic survey (Gailey *et al.,* 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and after considering natural variation, none of the response variables were significantly associated with survey or vessel sounds.

In order to understand how the effects of activities may or may not impact species and stocks of marine mammals, it is necessary to understand not only what the likely disturbances are going to be but how those disturbances may affect the reproductive success and survivorship of individuals and then how those impacts to individuals translate to population-level effects. Following on the earlier work of a committee of the U.S. National Research Council (NRC, 2005), New *et al.* (2014), in an effort termed the Potential Consequences of Disturbance (PCoD), outline an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. This framework is a four-step process progressing from changes in individual behavior and/or physiology, to changes in individual health, then vital rates, and finally to population-level effects. In this framework, behavioral and physiological changes can have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation; indirect and long-term (chronic) effects on vital rates, such as when changes in time/energy budgets or increased disease susceptibility affect health, which then affects vital rates; or no effect to vital rates (New *et al.,* 2014). In addition to outlining this general framework and compiling the relevant literature that supports it, the authors chose four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, Ziphiidae beaked whales, and bottlenose dolphins) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts from behavioral changes. While these are very specific models with very specific data requirements that cannot yet be applied broadly to project-specific risk assessments for the majority of species, they are a critical first step towards being able to quantify the likelihood of a population level effect. Since New *et al.* (2014), several publications have described models developed to examine the long-term effects of environmental or anthropogenic disturbance of foraging on various life stages of selected species (*e.g.,* sperm whale, Farmer *et al.* (2018); California sea lion, McHuron *et al.* (2018); blue whale, Pirotta *et al.* (2018a); humpback whale, Dunlop *et al.* (2021)). These models continue to add to refinement of the approaches to the PCoD framework. Such models also help identify what data inputs require further investigation. Pirotta *et al.* (2018b) provides a review of the PCoD framework with details on each step of the process and approaches to applying real data or simulations to achieve each step.

Despite its simplicity, there are few complete PCoD models available for any marine mammal species due to a lack of data available to parameterize many of the steps. To date, no PCoD model has been fully parameterized with empirical data (Pirotta *et al.,* 2018a) due to the fact they are data intensive and logistically challenging to complete. Therefore, most complete PCoD models include simulations, theoretical modeling, and expert opinion to move through the steps. For example, PCoD models have been developed to evaluate the effect of wind farm construction on the North Sea harbor porpoise populations (*e.g.,* King *et al.,* 2015; Nabe-Nielsen *et al.,* 2018). These models include a mix of empirical data, expert elicitation (King *et al.,* 2015) and simulations of animals' movements, energetics, and/or survival (New *et al.,* 2014; Nabe-Nielsen *et al.,* 2018). In another example, by integrating different sources of data (*e.g.,* controlled exposure data, activity monitoring, telemetry tracking, and prey sampling) into a theoretical model to predict effects from sonar on a blue whale's daily energy intake, Pirotta *et al.* (2021) found that tagged blue whales' activity budgets, lunging rates, and ranging patterns caused variability in their predicted cost of disturbance.

PCoD models may also be approached in different manners. Dunlop *et al.* (2021) modeled migrating humpback whale mother-calf pairs in response to seismic surveys using both a forwards and backwards approach. While a typical forwards approach can determine if a stressor would have population-level consequences, Dunlop *et al.* demonstrated that working backwards through a PCoD model can be used to assess the ''worst case'' scenario for an interaction of a target species and stressor. This method may be useful for future management goals when appropriate data becomes available to fully support the model. In another example, harbor porpoise PCoD model investigating the impact of seismic surveys on harbor porpoise included an investigation on underlying drivers of vulnerability. Harbor porpoise movement and foraging were modeled for baseline periods and then for periods with seismic surveys as well; the models demonstrated that temporal (*i.e.,* seasonal) variation in individual energetics and their link to costs associated with disturbances was key in predicting population impacts (Gallagher *et al.,* 2021).

Nearly all PCoD studies and experts agree that infrequent exposures of a single day or less are unlikely to impact individual fitness, let alone lead to population level effects (Booth *et al.,* 2016; Booth *et al.,* 2017; Christiansen and Lusseau 2015; Farmer *et al.,* 2018; Wilson *et al.,* 2020; Harwood and Booth 2016; King *et al.,* 2015; McHuron *et al.,* 2018; NAS 2017; New *et al.,* 2014; Pirotta *et al.,* 2018; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015). As described through this proposed rule, NMFS expects that any behavioral disturbance that would occur due to animals being exposed to construction activity would be of a relatively short duration, with behavior returning to a baseline state shortly after the acoustic stimuli ceases or the animal moves far enough away from the source. Given this, and NMFS' evaluation of the available PCoD studies, and the required mitigation discussed later, any such behavioral disturbance resulting from Sunrise's activities is not expected to impact individual animals' health or have effects on individual animals' survival or reproduction, thus no detrimental impacts at the population level are anticipated. Marine mammals may temporarily avoid the immediate area but are not expected to permanently abandon the area or their migratory or foraging behavior. Impacts to breeding, feeding, sheltering, resting, or migration are not expected nor are shifts in habitat use, distribution, or foraging success.

Potential Effects From Explosive Sources

With respect to the noise from underwater explosives, the same acoustic-related impacts described above apply and are not repeated here. Noise from explosives can cause hearing impairment if an animal is close enough to the sources; however, because noise from an explosion is discrete, lasting less than approximately 1 second, no behavioral impacts below the TTS threshold are anticipated considering that Sunrise Wind would not detonate more than one UXO/MEC per day and only three during the life of the proposed rule. This section focuses on the pressure-related impacts of underwater explosives, including physiological injury and mortality.

Underwater explosive detonations send a shock wave and sound energy through the water and can release gaseous by-products, create an oscillating bubble, or cause a plume of water to shoot up from the water surface. The shock wave and accompanying noise are of most concern to marine animals. Depending on the intensity of the shock wave and size, location, and depth of the animal, an animal can be injured, killed, suffer non-lethal physical effects, experience hearing related effects with or without behavioral responses, or exhibit temporary behavioral responses or tolerance from hearing the blast sound. Generally, exposures to higher levels of impulse and pressure levels would result in greater impacts to an individual animal.

Injuries resulting from a shock wave take place at boundaries between tissues of different densities. Different velocities are imparted to tissues of different densities, and this can lead to their physical disruption. Blast effects are greatest at the gas-liquid interface (Landsberg, 2000). Gas-containing organs, particularly the lungs and gastrointestinal tract, are especially susceptible (Goertner, 1982; Hill, 1978; Yelverton *et al.,* 1973). Intestinal walls can bruise or rupture, with subsequent hemorrhage and escape of gut contents into the body cavity. Less severe gastrointestinal tract injuries include contusions, petechiae (small red or purple spots caused by bleeding in the skin), and slight hemorrhaging (Yelverton *et al.,* 1973).

Because the ears are the most sensitive to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related damage associated with sound energy from detonations can be theoretically distinct from injury from the shock wave, particularly farther from the explosion. If a noise is audible to an animal, it has the potential to damage the animal's hearing by causing decreased sensitivity (Ketten, 1995). Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source and are not, technically, pure acoustic trauma (Ketten, 1995). Sublethal impacts include hearing loss, which is caused by exposures to perceptible sounds. Severe damage (from the shock wave) to the ears includes tympanic membrane rupture, fracture of the ossicles, and damage to the cochlea, hemorrhage, and cerebrospinal fluid leakage into the middle ear. Moderate injury implies partial hearing loss due to tympanic membrane rupture and blood in the middle ear. Permanent hearing loss also can occur when the hair cells are damaged by one very loud event as well as by prolonged exposure to a loud noise or chronic exposure to noise. The level of impact from blasts depends on both an animal's location and, at outer zones, its sensitivity to the residual noise (Ketten, 1995).

Given the mitigation measures proposed, it is unlikely that any of the more serious injuries or mortality discussed above are likely to result from any UXO/MEC detonation that Sunrise Wind might need to undertake. PTS, TTS, and brief startle reactions are the most likely impacts to result from this activity, if it occurs (noting detonation is the last method to be chosen for removal).

Potential Effects of Vessel Strike

Vessel collisions with marine mammals, also referred to as vessel strikes or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. Superficial strikes may not kill or result in the death of the animal. Lethal interactions are typically associated with large whales, which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007; Conn and Silber, 2013). Impact forces increase with speed as does the probability of a strike at a given distance (Silber *et al.,* 2010; Gende *et al.,* 2011).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some baleen whales seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). These species are primarily large, slow moving whales. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike occurs and, if so, whether it results in injury, serious injury, or mortality (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Pace and Silber, 2005; Vanderlaan and Taggart, 2007; Conn and Silber 2013). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 13 knots.

Jensen and Silber (2003) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these 58 cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water, propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae, hemorrhaging, massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 kn. The majority (79 percent) of these strikes occurred at speeds of 13 kn or greater. The average speed that resulted in serious injury or death was 18.6 kn. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded 90 percent at 17 kn. Higher speeds during collisions result in greater force of impact and also appear to increase the chance of severe injuries or death. While modeling studies have suggested that hydrodynamic forces pulling whales toward the vessel hull increase with increasing speed (Clyne, 1999; Knowlton *et al.,* 1995), this is inconsistent with Silber *et al.* (2010), which demonstrated that there is no such relationship (*i.e.,* hydrodynamic forces are independent of speed).

In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between 8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward 100 percent above 15 kn.

The Jensen and Silber (2003) report notes that the Large Whale Ship Strike Database represents a minimum number of collisions because the vast majority probably goes undetected or unreported. In contrast, Sunrise Wind's personnel are likely to detect any strike that does occur because of the required personnel training and lookouts, along with the inclusion of Protected Species Observers (as described in the Proposed Mitigation section), and they are required to report all ship strikes involving marine mammals.

In the Sunrise Wind project area, NMFS has no documented vessel strikes of marine mammals by Sunrise Wind or Orsted during previous site characterization surveys. Given the comprehensive mitigation and monitoring measures (see the Proposed Mitigation and Proposed Monitoring and Reporting section) that would be required of Sunrise Wind, NMFS believes that vessel strike is not likely to occur.

Potential Effects to Marine Mammal Habitat

Sunrise Wind's proposed construction activities could potentially affect marine mammal habitat through the introduction of impacts to the prey species of marine mammals, acoustic habitat (sound in the water column), water quality, and important habitat for marine mammals.

The presence of structures, such as wind turbines, are likely to result in both local and broader oceanographic effects. However, the scale of impacts is difficult to predict and may vary from hundreds of meters for local individual turbine impacts (Schultze *et al.,* 2020) to large-scale dipoles of surface elevation changes stretching hundreds of kilometers (Christiansen *et al.,* 2022).

Effects on Prey

Sound may affect marine mammals through impacts on the abundance, behavior, or distribution of prey species (*e.g.,* crustaceans, cephalopods, fish, and zooplankton). Marine mammal prey varies by species, season, and location and, for some, is not well documented. Here, we describe studies regarding the effects of noise on known marine mammal prey.

Fish utilize the soundscape and components of sound in their environment to perform important functions such as foraging, predator avoidance, mating, and spawning (*e.g.,* Zelick *et al.,* 1999; Fay, 2009). The most likely effects on fishes exposed to loud, intermittent, low-frequency sounds are behavioral responses (*i.e.,* flight or avoidance). Short duration, sharp sounds (such as pile driving or air guns) can cause overt or subtle changes in fish behavior and local distribution. The reaction of fish to acoustic sources depends on the physiological state of the fish, past exposures, motivation (*e.g.,* feeding, spawning, migration), and other environmental factors. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality. While it is clear that the behavioral responses of individual prey, such as displacement or other changes in distribution, can have direct impacts on the foraging success of marine mammals, the effects on marine mammals of individual prey that experience hearing damage, barotrauma, or mortality is less clear, though obviously population scale impacts that meaningfully reduce the amount of prey available could have more serious impacts.

Fishes, like other vertebrates, have a variety of different sensory systems to glean information from ocean around them (Astrup and Mohl, 1993; Astrup, 1999; Braun and Grande, 2008; Carroll *et al.,* 2017; Hawkins and Johnstone, 1978; Ladich and Popper, 2004; Ladich and Schulz-Mirbach, 2016; Mann, 2016; Nedwell *et al.,* 2004; Popper *et al.,* 2003; Popper *et al.,* 2005). Depending on their hearing anatomy and peripheral sensory structures, which vary among species, fishes hear sounds using pressure and particle motion sensitivity capabilities and detect the motion of surrounding water (Fay *et al.,* 2008) (terrestrial vertebrates generally only detect pressure). Most marine fishes primarily detect particle motion using the inner ear and lateral line system while some fishes possess additional morphological adaptations or specializations that can enhance their sensitivity to sound pressure, such as a gas-filled swim bladder (Braun and Grande, 2008; Popper and Fay, 2011).

Hearing capabilities vary considerably between different fish species with data only available for just over 100 species out of the 34,000 marine and freshwater fish species (Eschmeyer and Fong, 2016). In order to better understand acoustic impacts on fishes, fish hearing groups are defined by species that possess a similar continuum of anatomical features, which result in varying degrees of hearing sensitivity (Popper and Hastings, 2009a). There are four hearing groups defined for all fish species (modified from Popper *et al.,* 2014) within this analysis, and they include: fishes without a swim bladder (*e.g.,* flatfish, sharks, rays, *etc.*); fishes with a swim bladder not involved in hearing (*e.g.,* salmon, cod, pollock, *etc.*); fishes with a swim bladder involved in hearing (*e.g.,* sardines, anchovy, herring, *etc.*); and fishes with a swim bladder involved in hearing and high-frequency hearing (*e.g.,* shad and menhaden). Most marine mammal fish prey species would not be likely to perceive or hear mid- or high-frequency sonars. While hearing studies have not been done on sardines and northern anchovies, it would not be unexpected for them to have hearing similarities to Pacific herring (up to 2–5 kHz) (Mann *et al.,* 2005). Currently, less data are available to estimate the range of best sensitivity for fishes without a swim bladder.

In terms of physiology, multiple scientific studies have documented a lack of mortality or physiological effects to fish from exposure to low- and mid-frequency sonar and other sounds (Halvorsen *et al.,* 2012; Jørgensen *et al.,* 2005; Juanes *et al.,* 2017; Kane *et al.,* 2010; Kvadsheim and Sevaldsen, 2005; Popper *et al.,* 2007; Popper *et al.,* 2016; Watwood *et al.,* 2016). Techer *et al.* (2017) exposed carp in floating cages for up to 30 days to low-power 23 and 46 kHz source without any significant physiological response. Other studies have documented either a lack of TTS in species whose hearing range cannot perceive sonar (such as Navy sonar), or for those species that could perceive sonar-like signals, any TTS experienced would be recoverable (Halvorsen *et al.,* 2012; Ladich and Fay, 2013; Popper and Hastings, 2009a, 2009b; Popper *et al.,* 2014; Smith, 2016). Only fishes that have specializations that enable them to hear sounds above about 2,500 Hz (2.5 kHz) such as herring (Halvorsen *et al.,* 2012; Mann *et al.,* 2005; Mann, 2016; Popper *et al.,* 2014) would have the potential to receive TTS or exhibit behavioral responses from exposure to mid-frequency sonar. In addition, any sonar induced TTS to fish whose hearing range could perceive sonar would only occur in the narrow spectrum of the source (*e.g.,* 3.5 kHz) compared to the fish's total hearing range (*e.g.,* 0.01 kHz to 5 kHz).

In terms of behavioral responses, Juanes *et al.* (2017) discuss the potential for negative impacts from anthropogenic noise on fish, but the author's focus was on broader based sounds, such as ship and boat noise sources. Watwood *et al.* (2016) also documented no behavioral responses by reef fish after exposure to mid-frequency active sonar. Doksaeter *et al.* (2009; 2012) reported no behavioral responses to mid-frequency sonar (such as naval sonar) by Atlantic herring; specifically, no escape reactions (vertically or horizontally) were observed in free swimming herring exposed to mid-frequency sonar transmissions. Based on these results (Doksaeter *et al.,* 2009; Doksaeter *et al.,* 2012; Sivle *et al.,* 2012), Sivle *et al.* (2014) created a model in order to report on the possible population-level effects on Atlantic herring from active sonar. The authors concluded that the use of sonar poses little risk to populations of herring regardless of season, even when the herring populations are aggregated and directly exposed to sonar. Finally, Bruintjes *et al.* (2016) commented that fish exposed to any short-term noise within their hearing range might initially startle, but would quickly return to normal behavior.

Occasional behavioral reactions to activities that produce underwater noise sources are unlikely to cause long-term consequences for individual fish or populations. The most likely impact to fish from impact and vibratory pile driving activities at the project areas would be temporary behavioral avoidance of the area. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity. The duration of fish avoidance of an area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the expected short daily duration of individual pile driving events and the relatively small areas being affected. SPLs of sufficient strength have been known to cause injury to fish and fish mortality. However, in most fish species, hair cells in the ear continuously regenerate and loss of auditory function likely is restored when damaged cells are replaced with new cells. Halvorsen *et al.* (2012a) showed that a TTS of 4–6 dB was recoverable within 24 hours for one species. Impacts would be most severe when the individual fish is close to the source and when the duration of exposure is long. Injury caused by barotrauma can range from slight to severe and can cause death and is most likely for fish with swim bladders. Barotrauma injuries have been documented during controlled exposure to impact pile driving (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013). As described in the Proposed Mitigation section below, Sunrise Wind would utilize a sound attenuation device which would reduce potential for injury to marine mammal prey. Other fish that experience hearing loss as a result of exposure to explosions and impulsive sound sources may have a reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. However, PTS has not been known to occur in fishes and any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Popper *et al.,* 2005; Popper *et al.,* 2014; Smith *et al.,* 2006). It is not known if damage to auditory nerve fibers could occur, and if so, whether fibers would recover during this process.

It is also possible for fish to be injured or killed by an explosion from UXO/MEC detonation. Physical effects from pressure waves generated by underwater sounds (*e.g.,* underwater explosions) could potentially affect fish within proximity of training or testing activities. The shock wave from an underwater explosion is lethal to fish at close range, causing massive organ and tissue damage and internal bleeding (Keevin and Hempen, 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen, 1997; Wright, 1982). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran, 2006; O'Keeffe, 1984; O'Keeffe and Young, 1984; Wiley *et al.,* 1981; Yelverton *et al.,* 1975). Species with gas-filled organs are more susceptible to injury and mortality than those without them (Gaspin, 1975; Gaspin *et al.,* 1976; Goertner *et al.,* 1994). Barotrauma injuries have been documented during controlled exposure to impact pile driving (an impulsive noise source, as are explosives and air guns) (Halvorsen *et al.,* 2012b; Casper *et al.,* 2013).

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright, 1982). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation. The abundances of various fish (and invertebrates) near the detonation point for explosives could be altered for a few hours before animals from surrounding areas repopulate the area. However, these populations would likely be replenished as waters near the detonation point are mixed with adjacent waters. Repeated exposure of individual fish to sounds from underwater explosions is not likely and are expected to be short-term and localized. Long-term consequences for fish populations would not be expected. Several studies have demonstrated that air gun sounds might affect the distribution and behavior of some fishes, potentially impacting foraging opportunities or increasing energetic costs (*e.g.,* Fewtrell and McCauley, 2012; Pearson *et al.,* 1992; Skalski *et al.,* 1992; Santulli *et al.,* 1999; Paxton *et al.,* 2017).

UXO/MEC detonations would be dispersed in space and time; therefore, repeated exposure of individual fishes are unlikely. Mortality and injury effects to fishes from explosives would be localized around the area of a given in-water explosion but only if individual fish and the explosive (and immediate pressure field) were co-located at the same time. Fishes deeper in the water column or on the bottom would not be affected by water surface explosions. Repeated exposure of individual fish to sound and energy from underwater explosions is not likely given fish movement patterns, especially schooling prey species. Most acoustic effects, if any, are expected to be short-term and localized. Long-term consequences for fish populations, including key prey species within the project area, would not be expected.

Required soft-starts would allow prey and marine mammals to move away from the source prior to any noise levels that may physically injure prey and the use of the noise attenuation devices would reduce noise levels to the degree any mortality or injury of prey is also minimized. Use of bubble curtains, in addition to reducing impacts to marine mammals, for example, is a key mitigation measure in reducing injury and mortality of ESA-listed salmon on the West Coast. However, we recognize some mortality, physical injury and hearing impairment in marine mammal prey may occur, but we anticipate the amount of prey impacted in this manner is minimal compared to overall availability. Any behavioral responses to pile driving by marine mammal prey are expected to be brief. We expect that other impacts, such as stress or masking, would occur in fish that serve as marine mammals prey (Popper *et al.,* 2019); however, those impacts would be limited to the duration of impact pile driving and during any UXO/MEC detonations and, if prey were to move out the area in response to noise, these impacts would be minimized.

In addition to fish, prey sources such as marine invertebrates could potentially be impacted by noise stressors as a result of the proposed activities. However, most marine invertebrates' ability to sense sounds is limited. Invertebrates appear to be able to detect sounds (Pumphrey, 1950; Frings and Frings, 1967) and are most sensitive to low-frequency sounds (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Data on response of invertebrates such as squid, another marine mammal prey species, to anthropogenic sound is more limited (de Soto, 2016; Sole *et al.,* 2017b). Data suggest that cephalopods are capable of sensing the particle motion of sounds and detect low frequencies up to 1–1.5 kHz, depending on the species, and so are likely to detect air gun noise (Kaifu *et al.,* 2008; Hu *et al.,* 2009; Mooney *et al.,* 2010; Samson *et al.,* 2014). Sole *et al.* (2017) reported physiological injuries to cuttlefish in cages placed at-sea when exposed during a controlled exposure experiment to low-frequency sources (315 Hz, 139 to 142 dB *re 1* μPa^2 and 400 Hz, 139 to 141 dB *re 1* μPa^2). Fewtrell and McCauley (2012) reported squids maintained in cages displayed startle responses and behavioral changes when exposed to seismic air gun sonar (136–162 *re 1* $\mu Pa^2 \cdot s$). Jones *et al.* (2020) found that when squid (*Doryteuthis pealeii*) were exposed to impulse pile driving noise, body pattern changes, inking, jetting, and startle responses were observed and nearly all squid exhibited at least one response. However, these responses occurred primarily during the first eight impulses and diminished quickly, indicating potential rapid, short-term habituation. Cephalopods have a specialized sensory organ inside the head called a statocyst that may help an animal determine its position in space (orientation) and maintain balance (Budelmann, 1992). Packard *et al.* (1990) showed that cephalopods were sensitive to particle motion, not sound pressure, and Mooney *et al.* (2010) demonstrated that squid statocysts act as an accelerometer through which particle motion of the sound field can be detected. Auditory injuries (lesions occurring on the statocyst sensory hair cells) have been reported upon controlled exposure to low-frequency sounds, suggesting that cephalopods are particularly sensitive to low-frequency sound (Andre *et al.,* 2011; Sole *et al.,* 2013). Behavioral responses, such as inking and jetting, have also been reported upon exposure to low-frequency sound (McCauley *et al.,* 2000b; Samson *et al.,* 2014). Squids, like most fish species, are likely more sensitive to low frequency sounds and may not perceive mid- and high-frequency sonars. Cumulatively for squid as a prey species, individual and population impacts from exposure to explosives, like fish, are not likely to be significant, and explosive impacts would be short-term and localized.

There is little information concerning potential impacts of noise on zooplankton populations. However, one recent study (McCauley *et al.,* 2017) investigated zooplankton abundance, diversity, and mortality before and after exposure to air gun noise, finding that the exposure resulted in significant depletion for more than half the taxa present and that there were two to three times more dead zooplankton after air gun exposure compared with controls for all taxa. The majority of taxa present were copepods and cladocerans; for these taxa, the range within which effects on abundance were detected was up to approximately 1.2 km. In order to have significant impacts on r-selected species such as plankton, the spatial or temporal scale of impact must be large in comparison with the ecosystem concerned (McCauley *et al.,* 2017).

The presence of large numbers of turbines has been shown to impact meso- and sub-meso-scale water column circulation, which can affect the density, distribution, and energy content of zooplankton and thereby, their availability as marine mammal prey. The presence and operation of structures such as wind turbines are, in general, likely to result in local and broader oceanographic effects in the marine environment and may disrupt marine mammal prey, such as dense aggregations and distribution of zooplankton through altering the strength of tidal currents and associated fronts, changes in stratification, primary production, the degree of mixing, and stratification in the water column (Chen *et al.,* 2021, Johnson *et al.,* 2021, Christiansen *et al.,* 2022, Dorrell *et al.,* 2022). However, the scale of impacts is difficult to predict and may vary from meters to hundreds of meters for local individual turbine impacts (Schultze *et al.,* 2020) to large-scale dipoles of surface elevation changes stretching hundreds of kilometers (Christiansen *et al.,* 2022).

Sunrise Wind intends to install up to 94 turbines that would be operational towards the end of Year 1. As described above, there is scientific uncertainty around the scale of oceanographic impacts (meters to kilometers) associated with turbine operation. Sunrise Wind is located in an area of the New England that experiences coastal upwelling, a consequence of the predominant wind direction and the orientation of the coastline. Along the coast of Rhode Island and southern Massachusetts, upwelling of deeper, nutrient-rich waters frequently leads to late summer blooms of phytoplankton and subsequently increased biological productivity (Gong *et al.,* 2010; Glenn *et al.,* 2004). However, the project area does not include key foraging grounds for marine mammals with planktonic diets (*e.g,* North Atlantic right whale), and prime foraging habitat near Nantucket Shoals is unlikely to be influenced.

These potential impacts on prey could impact the distribution of marine mammals within the project area, potentially necessitating additional energy expenditure to find and capture prey, but at the temporal and spatial scales anticipated for this activity are not expected to impact the reproduction or survival of any individual marine mammals. Although studies assessing the impacts of offshore wind development on marine mammals are limited, the repopulation of wind energy areas by harbor porpoises (Brandt *et al.,* 2016; Lindeboom *et al.,* 2011) and harbor seals (Lindeboom *et al.,* 2011; Russell *et al.,* 2016) following the installation of wind turbines are promising. Overall, any impacts to marine mammal foraging capabilities due to effects on prey aggregation from Sunrise Wind turbine presence and operation during the effective period of the proposed rule is likely to be limited and nearby habitat that is known to support North Atlantic right whale foraging would be unaffected by SWF operation.

In general, impacts to marine mammal prey species are expected to be relatively minor and temporary due to the expected short daily duration of individual pile driving events and the relatively small areas being affected. The most likely impacts of prey fish from UXO/MEC detonations, if determined to be necessary, are injury or mortality if they are located within the vicinity when detonation occurs. However, given the likely spread of any UXOs/MECs in the project area, the low chance of detonation (as lift-and-shift and deflagration are the primary removal approaches), and that this area is not a biologically important foraging ground, overall effects should be minimal to marine mammal species. NMFS does not expect HRG acoustic sources to impact fish and most sources are likely outside the hearing range of the primary prey species in the project area.

Overall, the combined impacts of sound exposure, explosions, and oceanographic impacts on marine mammal habitat resulting from the proposed activities would not be expected to have measurable effects on populations of marine mammal prey species. Prey species exposed to sound might move away from the sound source, experience TTS, experience masking of biologically relevant sounds, or show no obvious direct effects.

Acoustic Habitat

Acoustic habitat is the soundscape, which encompasses all of the sound present in a particular location and time, as a whole when considered from the perspective of the animals experiencing it. Animals produce sound for, or listen for sounds produced by, conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.,* produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic or may be intentionally introduced to the marine environment for data acquisition purposes (as in the use of air gun arrays) or for Navy training and testing purposes (as in the use of sonar and explosives and other acoustic sources). Anthropogenic noise varies widely in its frequency, content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please also see the previous discussion on Masking), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). For more detail on these concepts see, *e.g.,* Barber *et al.,* 2009; Pijanowski *et al.,* 2011; Francis and Barber, 2013; Lillis *et al.,* 2014.

The term ''listening area'' refers to the region of ocean over which sources of sound can be detected by an animal at the center of the space. Loss of communication space concerns the area over which a specific animal signal, used to communicate with conspecifics in biologically important contexts (*e.g.,* foraging, mating), can be heard, in noisier relative to quieter conditions

(Clark *et al.,* 2009). Lost listening area concerns the more generalized contraction of the range over which animals would be able to detect a variety of signals of biological importance, including eavesdropping on predators and prey (Barber *et al.,* 2009). Such metrics do not, in and of themselves, document fitness consequences for the marine animals that live in chronically noisy environments. Long-term population-level consequences mediated through changes in the ultimate survival and reproductive success of individuals are difficult to study, and particularly so underwater. However, it is increasingly well documented that aquatic species rely on qualities of natural acoustic habitats with researchers quantifying reduced detection of important ecological cues (*e.g.,* Francis and Barber, 2013; Slabbekoorn *et al.,* 2010) as well as survivorship consequences in several species (*e.g.,* Simpson *et al.,* 2014; Nedelec *et al.,* 2015).

Sound produced from construction activities in the Sunrise Wind project area would be temporary and transitory. The sounds produced during construction activities may be widely dispersed or concentrated in small areas for varying periods. Any anthropogenic noise attributed to construction activities in the project area would be temporary and the affected area would be expected to immediately return to the original state when these activities cease.

Water Quality

Impacts to the immediate substrate during installation of piles are anticipated, but these would be limited to minor, temporary suspension of sediments, which could impact water quality and visibility for a short amount of time but which would not be expected to have any effects on individual marine mammals. Indirect effects of explosives and unexploded ordnance to marine mammals via sediment is possible in the immediate vicinity of the ordnance but through the implementation of the mitigation, is it not anticipated marine mammals would be in the direct area of the explosive source. Further, contamination of water is not anticipated. Degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo, 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6–12 in (0.15–0.3 m) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3–6 ft (1–2 m) from the degrading ordnance. Sunrise Wind anticipates that, at most, they would detonate up to three UXO/MECs during the effective period of the rule. As such, no water quality concerns exist.

Equipment used by Sunrise Wind within the project area, including ships and other marine vessels, potentially aircrafts, and other equipment, are also potential sources of by-products. All equipment is properly maintained in accordance with applicable legal requirements. All such operating equipment meets Federal water quality standards, where applicable.

Reef Effects

The presence of the SRWF foundations, scour protection, and cable protection will result in a conversion of the existing sandy bottom habitat to a hard bottom habitat with areas of vertical structural relief (Sunrise Wind 2022). This could potentially alter the existing habitat by creating an ''artificial reef effect'' that results in colonization by assemblages of both sessile and mobile animals within the new hard-bottom habitat (Wilhelmsson *et al.* 2006; Reubens *et al.* 2013; Bergström *et al.* 2014; Coates *et al.* 2014).

Artificial structures can create increased habitat heterogeneity important for species diversity and density (Langhamer 2012). The WTG and OCS–DC foundations will extend through the water column, which may serve to increase settlement of meroplankton or planktonic larvae on the structures in both the pelagic and benthic zones (Boehlert and Gill 2010). Fish and invertebrate species are also likely to aggregate around the foundations and scour protection which could provide increased prey availability and structural habitat (Boehlert and Gill 2010; Bonar *et al.* 2015).

Numerous studies have documented significantly higher fish concentrations including species like cod and pouting (*Trisopterus luscus*), flounder (*Platichthys flesus*), eelpout (*Zoarces viviparus*), and eel (*Anguilla anguilla*) near in-water structures than in surrounding soft bottom habitat (Langhamer and Wilhelmsson 2009; Bergström *et al.* 2013; Reubens *et al.* 2013). In the German Bight portion of the North Sea, fish were most densely congregated near the anchorages of jacket foundations, and the structures extending through the water column were thought to make it more likely that juvenile or larval fish encounter and settle on them (RI–CRMC 2010; Krone *et al.* 2013). In addition, fish can take advantage of the shelter provided by these structures while also being exposed to stronger currents created by the structures, which generate increased feeding opportunities and decreased potential for predation (Wilhelmsson *et al.* 2006). The presence of the foundations and resulting fish aggregations around the foundations is expected to be a long-term habitat impact, but the increase in prey availability could potentially be beneficial for some marine mammals.

The most likely impact to marine mammal habitat from the project is expected to be from impact and vibratory pile driving and UXO/MEC detonations, which may affect marine mammal food sources such as forage fish and could also affect acoustic habitat (see the *Auditory Masking* section) effects on marine mammal prey (*e.g.,* fish).

Potential Effects From Offshore Wind Farm Operational Noise

Although this proposed rulemaking primarily covers the noise produced from construction activities relevant to the Sunrise Wind offshore wind facility, operational noise was a consideration in NMFS' analysis of the project, as all 94 turbines would become operational within the effective dates of the rule, beginning no sooner than Q2 2024. It is expected that all turbines would be operational by Q4 2024. Once operational, offshore wind turbines are known to produce continuous, non-impulsive underwater noise, primarily below 8 kHz.

In both newer, quieter, direct-drive systems (such as what has been proposed for Sunrise Wind) and older generation, geared turbine designs, recent scientific studies indicate that operational noise from turbines is on the order of 110 to 125 dB re 1 µPa root-mean-square sound pressure level (SPL_{rms}) at an approximate distance of 50 m (Tougaard *et al.,* 2020). Tougaard *et al.* (2020) further noted that sound levels could reach as high as 128 dB re 1 µPa SPL_{rms} in the 10 Hz to 8 kHz range. However, the Tougaard *et al.* (2020) study assumed that the largest WTG was 3.6 MW, which is much smaller than those being considered for the Sunrise Wind project. Tougaard further stated that the operational noise produced by WTGs is static in nature and lower than noise produced by passing ships. This is a noise source in this region to which marine mammals are likely already habituated. Furthermore, operational noise levels are likely lower than those ambient levels already present in active shipping lanes, such that operational noise would likely only be detected in very close proximity to the WTG (Thomsen *et al.,* 2006; Tougaard *et al.,* 2020). In addition, Madsen *et al.* (2006) found the intensity of noise generated by operational wind turbines to be much less than the noises present during construction, although this observation was based on a single turbine with a maximum power of 2 MW. Other studies by Jansen and de Jong (2016) and Tougaard *et al.* (2009) determined that, while marine mammals would be able to detect operational noise from offshore wind farms (again, based on older 2 MW models) for several thousand kilometer, they expected no significant impacts on individual survival, population viability, marine mammal distribution, or the behavior of the animals considered in their study (harbor porpoises and harbor seals).

More recently, Stöber and Thomsen (2021) used monitoring data and modeling to estimate noise generated by more recently developed, larger (10 MW) direct-drive WTGs. Their findings, similar to Tougaard *et al.* (2020), demonstrate that there is a trend that operational noise increases with turbine size. Their study found noise levels could exceed 170 (to 177 dB *re 1* µ*Pa* SPL_{rms} for a 10 MW WTG); however, those noise levels were generated by geared turbines, but newer turbines operate with direct drive technology. The shift from using gear boxes to direct drive technology is expected to reduce the sound level by 10 dB. The findings in the Stöber and Thomsen (2021) study have not been validated. Sunrise Wind did not request, and NMFS is not proposing to authorize, take incidental to operational noise from WTGs. Therefore, the topic is not discussed or analyzed further herein.

Estimated Take of Marine Mammals

This section provides an estimate of the number of incidental takes proposed for authorization through these regulations, which will inform both NMFS' consideration of ''small numbers'' and the negligible impact determination.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines ''harassment'' as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized takes would primarily be by Level B harassment, as noise from impact and vibratory pile driving, HRG surveys, and UXO/MEC detonations could result in behavioral disturbance. Impacts such as masking and TTS can contribute to behavior disturbances. There is also some potential for auditory injury (Level A harassment) of mysticetes (fin whales, humpback whales, minke whales, sei whales), high frequency cetaceans (harbor porpoises), and phocids (gray seals and harbor seals) due to their hearing sensitivities and the nature of the activities. As described below, the larger distances to the PTS thresholds, when considering marine mammal weighting functions, demonstrate this potential. For mid-frequency hearing sensitivities, when thresholds and weighting and the associated PTS zone sizes are considered, the potential for PTS from the noise produced by the project is negligible. Similarly, non-auditory injury (Level A harassment) resulting from UXO/MEC detonation is considered unlikely, given the thresholds, associated impact zone sizes, and required mitigation, and none is anticipated or proposed for authorization. While NMFS is proposing to authorize Level A harassment and Level B harassment, the proposed mitigation and monitoring measures are expected to minimize the amount and severity of such taking to the extent practicable (see Proposed Mitigation).

As described previously, no serious injury or mortality is anticipated or proposed to be authorized incidental to Sunrise Wind's specified activities. Pile driving does not inherently have the potential to elicit marine mammal mortality or serious injury. While mortality and serious injury of marine mammals could occur from vessel strikes or UXO/MEC detonation if an animal is close enough to the source, the mitigation and monitoring measures contained within this proposed rule would avoid this manner of take. Hence, no mortality or serious injury is anticipated or proposed to be authorized. The proposed mitigation and monitoring measures are expected to minimize the amount and severity of the taking proposed to be authorized to the maximum extent practicable. Below we describe how the proposed take numbers are estimated.

For acoustic impacts, we estimate take by considering: (1) acoustic thresholds above which the best scientific information available indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) the number of days of activities. We note that while these factors can contribute to a basic calculation to provide an initial prediction of potential takes; additional information that can qualitatively inform take estimates is also sometimes available (*e.g.,* previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the proposed take estimates.

In this case, as described below, there are multiple lines of data with which to address density or occurrence and, for each species and activity, the largest value resulting from the three take estimation methods described below (*i.e.,* density-based, PSO-based, or mean group size) was carried forward as the amount of requested take by Level B harassment. The amount of requested take by Level A harassment reflects the density-based exposure estimates and for some species and activities, consideration of the effectiveness of mitigation measures to avoid or minimize the potential for injury.

Below, we describe the acoustic thresholds NMFS uses, discuss the marine mammal density and occurrence information used, and then describe the modeling and methodologies applied to estimate take for each of Sunrise Wind's proposed construction activities. NMFS has carefully considered all information and analysis presented by the applicant as well as all other applicable information and, based on the best scientific information available, concurs that the applicant's estimates of the types and amounts of take for each species and stock are reasonable and is what NMFS is proposing to authorize. NMFS notes the take estimates described herein for foundation installation can be considered conservative as the estimates do not reflect the implementation of clearance and shutdown zones for any marine mammal species or stock, with the exception of the North Atlantic right whale. In the case of North Atlantic right whales, the potential for Level A harassment (PTS) has been determined to be reduced to a de minimis likelihood due to the enhanced mitigation and monitoring measures. The amount of Level B harassment take proposed to be authorized for North Atlantic right whales does not consider the implementation of the enhanced mitigation measures (except for use of sound attenuation devices) and therefore, is considered conservative.

Marine Mammal Acoustic Thresholds

NMFS recommends the use of acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment). Thresholds have also been developed to identify the pressure levels above which animals may incur different types of tissue damage (non-auditory injury or mortality) from exposure to pressure waves from explosive detonation. A summary of all NMFS' thresholds can be found at (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*).

Level B Harassment

Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source or exposure context (*e.g.,* frequency, predictability, duty cycle, duration of the exposure, signal-to-noise ratio, distance to the source, ambient noise, and the receiving animals (hearing, motivation, experience, demography, behavior at time of exposure, life stage, depth)) and can be difficult to predict (*e.g.,* Southall *et al.,* 2007, 2021; Ellison *et al.,* 2012). Based on what the best scientific information available indicates and the practical need to use a threshold based on a metric that is both predictable and measurable for most activities, NMFS typically uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS generally predicts that marine mammals are likely to be behaviorally harassed in a manner considered to be Level B harassment when exposed to underwater anthropogenic noise above the received root-mean-square sound pressure levels (RMS SPL) of 120 dB (referenced to 1 micropascal (re 1 μPa)) for continuous (*e.g.,* vibratory pile-driving, drilling) and above the received RMS SPL 160 dB re: 1 μPa for non-explosive impulsive (*e.g.,* seismic airguns) or intermittent (*e.g.,* scientific sonar) sources (Table 6). Generally speaking, Level B harassment take estimates based on these behavioral harassment thresholds are expected to include any likely takes by TTS as, in most cases, the likelihood of TTS occurs at distances from the source less than those at which behavioral harassment is likely. TTS of a sufficient degree can manifest as behavioral harassment, as reduced hearing sensitivity and the potential reduced opportunities to detect important signals (conspecific communication, predators, prey) may result in changes in behavior patterns that would not otherwise occur.

TABLE 6—UNDERWATER LEVEL B HARASSMENT ACOUSTIC THRESHOLDS

[NMFS, 2005]

Source type	Level B harassment threshold (RMS SPL)
Continuous	120 dB re 1 μPa.
Non-explosive impulsive or intermittent	160 dB re 1 μPa.

Sunrise Wind's construction activities include the use of continuous (*e.g.,* vibratory pile driving), intermittent (*e.g.,* impact pile driving, HRG acoustic sources), and impulsive (*e.g.,* UXO/MEC detonations) sources, and, therefore, the 120 and 160 dB *re 1* μ*Pa* (rms) thresholds are applicable.

Level A Harassment

NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (*i.e.,* metric resulting in the largest isopleth). Sunrise Wind's proposed activities include the use of both impulsive and non-impulsive sources.

These thresholds are provided in Table 7 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS' 2018 Technical Guidance, which may be accessed at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

TABLE 7—ONSET OF PERMANENT THRESHOLD SHIFT (PTS)

[NMFS, 2018]

Hearing group	PTS onset thresholds * (received level)	
	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	*Cell 1:* $L_{p,0\text{-}pk,flat}$: 219 dB; $L_{E,p,LF24h}$: 183dB	*Cell 2:* $L_{E,p,LF,24h}$: 199 dB.
Mid-Frequency (MF) Cetaceans	*Cell 3:* $L_{p,0\text{-}pk,flat}$: 230 dB; $L_{E,p,MF,24h}$: 185 dB	*Cell 4:* $L_{E,p,MF,24h}$: 198 dB.
High-Frequency (HF) Cetaceans	*Cell 5:* $L_{p,0\text{-}pk,flat}$: 202 dB; $L_{E,p,HF,24h}$: 155 dB	*Cell 6:* $L_{E,p,HF,24h}$: 173 dB.
Phocid Pinnipeds (PW) (Underwater)	*Cell 7:* $L_{p,0\text{-}pk.flat}$: 218 dB; $L_{E,p,PW,24h}$: 185 dB	*Cell 8:* $L_{E,p,PW,24h}$: 201 dB.

* Dual metric thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.

Note: Peak sound pressure level ($L_{p,0\text{-}pk}$) has a reference value of 1 μPa, and weighted cumulative sound exposure level ($L_{E,p}$) has a reference value of 1μPa²s. In this table, thresholds are abbreviated to be more reflective of International Organization for Standardization standards (ISO, 2017). The subscript "flat" is being included to indicate peak sound pressure are flat weighted or unweighted within the generalized hearing range of marine mammals (*i.e.,* 7 Hz to 160 kHz). The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW pinnipeds) and that the recommended accumulation period is 24 hours. The weighted cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.,* varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these thresholds will be exceeded.

Explosive Sources

Based on the best scientific information available, NMFS uses the acoustic and pressure thresholds indicated in Tables 8 and 9 to predict the onset of behavioral harassment, TTS, PTS, tissue damage, and mortality.

TABLE 8—PTS ONSET, TTS ONSET, FOR UNDERWATER EXPLOSIVES
[NMFS, 2018]

Hearing group	PTS impulsive thresholds	TTS impulsive thresholds	Behavioral threshold (multiple detonations)
Low-Frequency (LF) Cetaceans	*Cell 1:* $L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB	*Cell 2:* $L_{pk,flat}$: 213 dB; $L_{E,LF,24h}$: 168 dB	*Cell 3:* $L_{E,LF,24h}$: 163 dB.
Mid-Frequency (MF) Cetaceans	*Cell 4:* $L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB	*Cell 5:* $L_{pk,flat}$: 224 dB; $L_{E,MF,24h}$: 170 dB	*Cell 6:* $L_{E,MF,24h}$: 165 dB.
High-Frequency (HF) Cetaceans	*Cell 7:* $L_{pk,flat}$: 202 dB; $L_{E,HF,24h}$: 155 dB	*Cell 8:* $L_{pk,flat}$: 196 dB; $L_{E,HF,24h}$: 140 dB	*Cell 9:* $L_{E,HF,24h}$: 135 dB.
Phocid Pinnipeds (PW) (Underwater)	*Cell 10:* $L_{pk,flat}$: 218 dB; $L_{E,PW,24h}$: 185 dB	*Cell 11:* $L_{pk,flat}$: 212 dB; $L_{E,PW,24h}$: 170 dB	*Cell 12:* $L_{E,PW,24h}$: 165 dB.

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS/TTS onset.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa²s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI, 2013). However, ANSI defines peak sound pressure as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the overall marine mammal generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.,* varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Additional thresholds for non-auditory injury to lung and gastrointestinal (GI) tracts from the blast shock wave and/or onset of high peak pressures are also relevant (at relatively close ranges) as UXO/MEC detonations, in general, have potential to result in mortality and non-auditory injury (Table 9). Marine mammal lung injury criteria have been developed by the U.S. Navy (DoN (U.S. Department of the Navy), 2017) and are based on the mass of the animal and the depth at which it is present in the water column due to blast pressure. This means that specific decibel levels for each hearing group are not provided and instead, the criteria are presented as equations that allow for incorporation of specific mass and depth values. The GI tract injury threshold is based on peak pressure. The modified Goertner equations below represent the potential onset of lung injury and GI tract injury (Table 9).

TABLE 9—LUNG AND G.I. TRACT INJURY THRESHOLDS
[DoN, 2017]

Hearing group	Mortality (severe lung injury) *	Slight lung injury *	G.I. tract injury
All Marine Mammals	*Cell 1:* Modified Goertner model; Equation 1	*Cell 2:* Modified Goertner model; Equation 2	*Cell 3:* $L_{pk,flat}$: 237 dB.

* Lung injury (severe and slight) thresholds are dependent on animal mass (Recommendation: Table C.9 from DoN (2017) based on adult and/or calf/pup mass by species).

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI, 2013). However, ANSI defines peak sound pressure as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the overall marine mammal generalized hearing range.

Modified Goertner Equations for severe and slight lung injury (pascal-second):

Equation 1: $103M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s.

Equation 2: $47.5M^{1/3}(1 + D/10.1)^{1/6}$ Pa-s.

M animal (adult and/or calf/pup) mass (kg) (Table C.9 in DoN, 2017).

D animal depth (meters).

Below, we describe, in detail, the assumptions and methodologies used to estimate take, in consideration of acoustic thresholds and appropriate marine mammal density and occurrence information for WTG and OCS–DC foundation installation and landfall construction activities. Details on the methodologies used to estimate take for HRG surveys and UXO/MEC detonation can be found in the activity-specific subsection below. Resulting distances to thresholds, densities used, activity-specific exposure estimates (as relevant to the analysis), and activity-specific take estimates can be found in each activity subsection below. At the end of this section, we present the total annual and 5-year take estimates that Sunrise Wind requested, and NMFS proposes to authorize.

Acoustic Modeling

As described above, underwater noise associated with the construction of offshore components of the SRWF will predominantly result from impact pile driving for the monopile and jacket foundations while noise from cable landfall construction will primarily result from impact pile driving for the casing pipe and vibratory pile driving of the goal posts. Sunrise Wind employed JASCO to conduct acoustic and animal movement exposure modeling to better understand sound fields produced during these activities and to estimate exposures (Küsel *et al* 2022). For installation of foundation piles, animal movement modeling was used to estimate exposures. The basic modeling approach is to characterize the sounds produced by the source, determine how the sounds propagate within the surrounding water column, and then estimate species-specific exposure probability by considering the range- and depth-dependent sound fields in relation to animal movement in simulated representative construction scenarios.

JASCO's Pile Driving Source Model (PDSM), a physical model of pile vibration and near-field sound radiation (MacGillivray 2014), was used in conjunction with the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010) to predict source levels associated with impact pile driving activities (WTG and OCS–DC foundation installation and casing pipe installation). The PDSM physical model computes the underwater vibration and sound radiation of a pile by solving the theoretical equations of motion for axial and radial vibrations of a cylindrical shell. Piles are modeled as a vertical installation using a finite-difference structural model of pile vibration based on thin-shell theory. To model the sound emissions from the piles, the force of the pile driving hammers also had to be modeled. The force at the top of each 7/12 m monopile, jacket foundation pile, and casing pipe was computed using the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010), which includes a large database of simulated hammers. The forcing functions from GRLWEAP were used as inputs to the finite difference model to compute the resulting pile vibrations. The sound radiating from the pile itself was simulated using a vertical array of discrete point sources. These models account for several parameters that describe the operation—pile type, material, size, and length—the pile driving equipment, and approximate pile penetration depth. The model assumed direct contact between the representative hammers, helmets, and piles (*i.e.,*no cushioning material).

Sunrise Wind would employ a noise attenuation system during all impact pile driving of monopile and jacket foundations. Noise attenuation systems, such as bubble curtains, are sometimes used to decrease the sound levels radiated from a source. Hence, hypothetical broadband attenuation levels of 0 dB, 6 dB, 10 dB, 15 dB, and 20 dB were incorporated into the foundation source models to gauge effects on the ranges to thresholds given these levels of attenuation. Although five attenuation levels were evaluated, Sunrise Wind and NMFS anticipates that the noise attenuation system ultimately chosen will be capable of reliably reducing source levels by 10 dB; therefore, modeling results assuming 10 dB attenuation are carried forward in this analysis for WTG and OCS–DC foundation installation. See the Proposed Mitigation section for more information regarding the justification for the 10 dB assumption.

To estimate sound propagation during foundation installation, JASCO's used the Full Waveform Range-dependent Acoustic Model (FWRAM) (Küsel *et al.* 2022, Appendix E.4) to combine the outputs of the source model with spatial and temporal environmental factors (*e.g.,* location, oceanographic conditions, and seabed type) to get time-domain representations of the sound signals in the environment and estimate sound field levels. Because the foundation pile is represented as a linear array and FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman, 2012), using FWRAM ensures accurate characterization of vertical directivity effects in the near-field zone. Due to seasonal changes in the water column, sound propagation is likely to differ at different times of the year. To capture this variability, acoustic modeling was conducted using an average sound speed profile for a ''summer'' period including the months of May through November, and a ''winter'' period including December through April. FWRAM computes pressure waveforms via Fourier synthesis of the modeled acoustic transfer function in closely spaced frequency bands. This model is used to estimate the energy distribution per frequency (source spectrum) at a close distance from the source (10 m). Examples of decidecade spectral levels for each foundation pile type, hammer energy, and modeled location, using average summer sound speed profile are provided in Küsel *et al.* (2022).

Sounds produced by installation of the 7/12 m WTG monopiles were modeled at two locations: one in the northwest section of the SRWF area and one in the southeast section (Figure 8 in Sunrise Wind's application). The two WTG locations were selected to represent the relatively shallow (44.9 m; ID–97) northwest section of the SRWF and the somewhat deeper (56.6 m; ID–259) southeast section. The installation of pin piles to secure the OCS–DC jacket foundation were modeled at one location in the central portion of the SRWF area (50.6 m water depth; ID–200). All piles were assumed to be vertical and driven to a maximum expected penetration depth of 50 m for the WTG monopiles and 90 m for the OCS–DC jacket foundation pin piles monopiles.

For the 7/12 m WTG monopiles, 10,398 total hammer strikes were assumed, with hammer energy varying from 1,000 to 3,200 kJ. A single strike at 4,000 kJ on a 7/12 m WTG monopile was also modeled in case the use of the maximum hammer energy is required during some installations. The smaller 4 m pin piles for the OCS–DC jacket foundation were assumed to require 17,088 total strikes with hammer energy ranging from 300 to 4,000 kJ during the installation. Representative hammering schedules (Table 10), including increasing hammer energy with increasing penetration depth, were modeled for both foundation types because maximum sound levels usually occur during the last stage of impact pile driving, where the great resistance is typically encountered (Betke, 2008). Sediment types with greater resistance (*e.g.,* gravel versus sand) require hammers that deliver higher energy strikes and/or an increased number of strikes relative to installations in softer sediment. The project area includes a predominantly sandy bottom habitat, which is a softer sediment and the model accounted for this. Additional details on modeling inputs and assumptions are described in Appendix A in Sunrise Wind's application.

TABLE 10—HAMMER ENERGY SCHEDULES FOR MONOPILE AND JACKET FOUNDATION INSTALLATION

WTG monopile foundations (7/12-m diameter)			OCS–DC jacket foundations (4-m diameter)		
Hammer: IHC S–4000			Hammer: IHC S–4000		
Energy level (kilojoule, kJ) [a]	Strike count	Pile penetration depth (m)	Energy level (kilojoule, kJ)	Strike count	Pile penetration depth
1,000	3,015	0–14	Assume pile self-setting	....	0–4
1,500	2,140	14–24	300	1,336	4–12
2,000	2,084	24–34	750	2,182	12–25
2,500	1,843	34–43	1,000	4,437	25–43
3,2000	1,316	43–50	2,000	4,058	43–63
4,000 [a]	1	50	3,000	3,272	63–80
	....	....	4,000	1,803	80–90
Total	10,398	50	Total	17,088	90

[a] Though not included in the exposure analysis, the 7/12 m monopile was additionally modeled at the highest hammer energy of 4,000 kJ, by considering just one strike at the maximum seabed penetration depth (50 m), and a penetration rate similar to that of the 3,200 kJ energy level, implying penetration to refusal. Results for the 4,000 kJ energy level are presented in Appendices G.1, G.2, and G.3 of the JASCO report (Kusel *et al.,* 2022) for single-strike PK, SEL and SPL, respectively, since only one strike was considered.

The proposed casing pipe would be installed at an angle towards the exiting drill using a pipe ramming method with a Grundoram pneumatic hammer. The source modeling assumed the parameters identified in Table 11 while sound fields were modeled at one representative location along the SRWEC route near to the HDD exit pit locations (ID–01), which represents a location approximately 0.5 mi (800 m) offshore of the landfall site. The modeling used a winter sound speed profile and assumed up to 3 hours of pneumatic hammer use per day for 2 days to install each casing pipe. Assuming 180 strikes per minute over 3 hours of operations results in up to 32,400 total strikes per day.

TABLE 11—CASING PIPE INSTALLATION ACOUSTIC MODELING ASSUMPTIONS AND INPUTS

Parameter	Model input
Hammer	Grundoram Taurus (impact).
Impact Hammer Energy	18 kJ.
Strike Rate (min^{-1})	180.
Strikes Per Pile (and Per Day)	32,400.
Total Number of Casing Pipes	1.
Maximum Piles Installed Per Day	0.5.
Pile Diameter	1.2 m.
Pile Length	137.16 m.
Pile Wall Thickness	25.4 millimeter (mm).
Seabed Penetration	10 m.
Angle of Installation (Relative to Horizontal)	11–12 degrees.

For vibratory driving activities of the goal post sheet piles at the cable landfall site, source levels were modeled using decidecade band SEL levels obtained from vibratory pile driving measurements available in the literature (Illingworth & Rodkin 2017). The SEL band levels were corrected for spherical spreading (+20 dB, corresponding to 10 m range) to generate a source level spectrum (Küsel *et al.* 2022; Figure 2.2–2). These levels represent the sheet pile as a point source located in the middle of the water column. Assumptions associated with the source level modeling are found in Table 12.

TABLE 12—SHEET PILE INSTALLATION ACOUSTIC MODELING ASSUMPTIONS

Parameter	Model input
Vibratory Hammer	APE 300.
Pile Type	Sheet Piles.
Pile Length	30 m.
Pile Width	600 mm.
Pile Wall Thickness	25 mm.
Seabed Penetration	10 m.
Time to Install One Pile	2 hours.
Number of Piles Per Day	4.
Total Number of Piles	44.

Sounds fields produced during vibratory pile driving of goal post sheet piles were predicted by propagating measured spectra as a noise-radiating point source in the middle of the water column using JASCO's Marine Operations Noise Model (MONM–BELLHOP; see Appendix E.3 of Küsel *et al.* 2022). At frequencies less than 2 kHz, MONM computes acoustic propagation via a wide-angle parabolic equation (PE) solution to the acoustic wave equation based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM) modified to account for an elastic seabed. MONM–RAM incorporates bathymetry, underwater sound speed as a function of depth, and a geo-acoustic profile based on seafloor composition, and accounts for source horizontal directivity. The PE method has been extensively benchmarked and is widely employed in the underwater acoustics community, and MONM–RAM's predictions have been validated against experimental data in several underwater acoustic measurement programs conducted by JASCO. At frequencies greater than 2 kHz, MONM accounts for increased sound attenuation due to volume absorption at higher frequencies with the widely used BELLHOP Gaussian beam ray-trace propagation model. This modeling component incorporates bathymetry and underwater sound speed as a function of depth with a simplified representation of the sea bottom, as sub-bottom layers have a negligible influence on the propagation of acoustic waves with frequencies above 1 kHz. MONM–BELLHOP accounts for horizontal directivity of the source and vertical variation of the source beam pattern. Both FWAM and MONM–BELLHOP propagation models account for full exposure from a direct acoustic wave as well as exposure from acoustic wave reflections and refractions (*i.e.,* multi-path arrivals at the receiver).

Animal Movement Modeling

To estimate the probability of exposure of animals to sound above NMFS' harassment thresholds during foundation installation, JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) was used to integrate the sound fields generated from the source and propagation models described above with species-typical behavioral parameters (*e.g.,* dive patterns). Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3–D sound fields with movement rules derived from animal observations. Animats that exceed NMFS' acoustic thresholds are identified and the range for the exceedances determined. The output of the simulation is the exposure history for each animat within the simulation, and the combined history of all animats gives a probability density function of exposure during the project. The number of animals expected to exceed the regulatory thresholds is determined by scaling the probability of exposure by the species-specific density of animals in the area. By programming animats to behave like marine species that may be present near the SRWF, the sound fields are sampled in a manner similar to that expected for real animals. The parameters used for forecasting realistic behaviors (*e.g.,* diving, foraging, and surface times) were determined and interpreted from marine species studies (*e.g.,* tagging studies) where available, or reasonably extrapolated from related species (Küsel *et al.* 2022, Appendix I).

Specifically, the sound level estimates are calculated from three-dimensional sound fields and then, at each horizontal sampling range, the maximum received level that occurs within the water column is used as the received level at that range. These maximum-over-depth (R_{max}) values are then compared to predetermined threshold levels to determine exposure and acoustic ranges to Level A harassment and Level B harassment threshold isopleths. However, the ranges to a threshold typically differ among radii from a source and also might not be continuous along a radii because sound levels may drop below threshold at some ranges and then exceed threshold at farther ranges. To minimize the influence of these inconsistencies, 5 percent of the farthest such footprints were excluded from the model data. The resulting range, $R_{95percent}$, was chosen to identify the area over which marine mammals may be exposed above a given threshold because, regardless of the shape of the maximum-over-depth footprint, the predicted range encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified threshold. The difference between R_{max} and $R_{95percent}$ depends on the source directivity and the heterogeneity of the acoustic environment. $R_{95percent}$ excludes ends of protruding areas or small isolated acoustic foci not representative of the nominal ensonified zone.

As described in Section 2.8 of JASCO's acoustic modeling report for Sunrise Wind, for modeled animals that have received enough acoustic energy to exceed a given harassment threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. The resulting exposure range for each species is the 95th percentile of the CPA distances for all animals that exceeded threshold levels for that species (termed the 95 percent exposure range ($ER_{95percent}$)). The $ER_{95percent}$ ranges are species-specific rather than categorized only by any functional hearing group, which allows for the incorporation of more species-specific biological parameters (*e.g.,* dive durations, swim speeds, *etc.*) for assessing the impact ranges into the model. Furthermore, because these $ER_{95percent}$ ranges are species-specific, they can be used to develop mitigation monitoring or shutdown zones.

We note that Sunrise Wind also calculated acoustic ranges, which represent the distance to a harassment threshold based on sound propagation through the environment (*i.e.,* independent of any receiver) while exposure range considers received levels in consideration of how an animal moves through the environment which influences the duration of exposure. As described above, applying animal movement and behavior within the modeled noise fields allows for a more realistic indication of the distances at which PTS acoustic thresholds are reached that considers the accumulation of sound over different durations. The acoustic ranges to the SEL_{cum} Level A harassment thresholds for WTG and OCS–DC foundation installation can be found in Tables 15 and 16 of Sunrise Wind's application but will not be discussed further in this analysis. Because NMFS Level B harassment threshold is an instantaneous exposure, acoustic ranges are more relevant to the analysis and are used to derive mitigation and monitoring measures. Acoustic ranges to the Level B harassment threshold for each activity are provided in the activity-specific subsections below.

Sunrise Wind proposed five different construction schedules involving either consecutive (*i.e,* sequential) foundation installation (schedule 1–2) or concurrent foundation installation (*i.e,* schedules 3–5) as described in the Dates and Duration section. JASMINE was run for a representative seven-day period for each scenario. Each of the five construction schedules includes a combination of scenarios that assume either fully sequential operations or a combination of sequential and concurrent operations. For each scenario, a subset of simulated sites was chosen to capture the range of acoustic variability across the lease area.

For concurrent operations, different sites were modeled on each day of the simulation. For one monopile per day, 7 representative locations were selected in the lease area (one location for each day). Similarly, for two monopiles per day, 14 locations were selected, and 21 locations were selected for three monopiles per day. For jacket foundations, 7 representative locations were chosen. Animats were exposed to only one sound field at a time. Received levels were summed over each animat's track over a 24-hour time window to derive sound exposure levels (SEL). Single-exposure metrics (*e.g.,* SPL) were recorded at each simulation time step, and the maximum received level is reported. For each pile type and each exposure modeling location the closest modeled sound field was used.

Concurrent operations were handled slightly differently to best capture the effects of installing piles spatially close to each other (proximal) or further apart (distal). The sites chosen for exposure modeling for concurrent operations were repeated each day for all seven days (see Figure 1.2–4 in Sunrise Wind's application). When simulating concurrent operations in JASMINE, sound fields from separate sources may be overlapping. For cumulative metrics (SEL), received energy from each source is summed over a 24-hour time window. For SPL, received levels are summed within each simulation time step and the resultant maximum SPL over all time steps is reported. Sources are summed such that receiving two equally loud sounds results in a 3 dB increase (incoherent summation). The installation schedules for concurrent scenarios are as follows:

- Construction Schedule 3 includes a concurrent scenario, simulating two vessels, each installing two monopiles per day. The first vessel installs both monopiles in the southeast corner of the lease area (purple circle markers). The second vessel installs both monopiles at the proximal location (light blue circle markers).
- Construction Schedule 4 also includes a concurrent scenario with two vessels installing two monopiles per day. In this case, the first vessel installs both monopiles in the southeast corner, while the second vessel installs both monopiles at the distal location (green circle markers).
- Construction Schedule 5 includes a concurrent scenario with two vessels, one installing two monopiles per day, and a second installing 4 jacket pin piles per day. In this case, the jacket foundation pin piles are installed at a single location (yellow square marker), while the monopile foundations are installed at two proximal locations (yellow circle markers).

Whether sequential or concurrent operations are done, the resulting cumulative or maximum receive levels are then compared to the NMFS' thresholds criteria within each analysis period.

Marine Mammal Density and Occurrence

In this section we provide the information about marine mammal presence, density, or group dynamics that will inform the take calculations for all activities. Sunrise Wind applied the Duke University Marine Geospatial Ecology Laboratory 2022 marine mammal habitat-based density models (*https://seamap.env.duke.edu/models/Duke/EC/*) to estimate take from WTG and OCS–DC foundation installation, casing pipe and goal post installation, UXO/MEC detonations, and site characterization surveys. On May 10, 2022 Sunrise Wind submitted their adequate and complete application; however, on June 20, 2022, the Duke Marine Geospatial Ecology Laboratory released a updated set of density models for all marine mammals along the East Coast of the United States (Roberts *et al.,* 2016; Roberts and Halpin, 2022). Subsequently, Sunrise Wind provided revised take estimates based on the updated density models, where appropriate. Sunrise Wind also incorporated revisions (relative to the ITA application) to how the density data were selected from the model output for each activity based on discussions with NMFS. Specifically, the width of the perimeter around the activity area used to select density data is now based on the largest exposure range (typically the Level B harassment range) applicable to that activity and then rounded up to the nearest 5-km increment, (which reflects the spatial resolution of the Roberts and Halpin (2022) density models). For example, if the largest exposure range was 7.1 km, a 10-km perimeter around the lease area was created and used to calculate densities used in foundation installation take estimates. All information provided by Sunrise Wind since submission of their adequate and complete application is contained within the memo (referred to as the Updated Density and Take Estimation Memo) submitted to NMFS on December 15, 2022. The Updated Density and Take Estimation Memo is available at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-sunrise-wind-llc-construction-and-operation-sunrise-wind.*

For some species and activities, observational data from Protected Species Observers (PSOs) aboard HRG and geotechnical (GT) survey vessels indicate that the density-based exposure estimates may be insufficient to account for the number of individuals of a species that may be encountered during the planned activities. PSO data from geophysical and geotechnical surveys conducted in the area surrounding the Sunrise Wind Lease Area and SWEC route from October 2018 through February 2021 (AIS-Inc., 2019; Bennett, 2021; Stevens *et al.,* 2021; Stevens and Mills, 2021) were analyzed to determine the average number of individuals of each species observed per vessel day. For each species, the total number of individuals observed (including the ''proportion of unidentified individuals'') was divided by the number of vessel days during which observations were conducted in 2018–2021 HRG surveys (407 survey days) to calculate the number of individuals observed per vessel day, as shown in the final columns of Tables 7 and 8 as found in the Updated Density and Take Estimation Memo.

For other less-common species, the predicted densities from Roberts and Halpin (2022) are very low and the resulting density-based exposure estimate is less than a single animal or a typical group size for the species. In such cases, the mean group size was considered as an alternative to the density-based or PSO data-based take estimates to account for potential impacts on a group during an activity. Mean group sizes for each species were calculated from recent aerial and/or vessel-based surveys, as shown in Table 13. Additional detail regarding the density and occurrence as well as the methodology used to estimate take for specific activities is included in the activity-specific subsections below.

TABLE 13—MEAN GROUP SIZES OF SPECIES FOR WHICH INCIDENTAL TAKE IS BEING REQUESTED

Marine mammal species	Individuals	Sightings	Mean group size	Information source
Mysticetes:				
Blue whale *	3	3	1.0	Palka *et al.* (2017).
Fin whale *	155	86	1.8	Kraus *et al.* (2016).
Humpback whale	160	82	2.0	Kraus *et al.* (2016).
Minke whale	103	83	1.2	Kraus *et al.* (2016).
North Atlantic right whale *	145	60	2.4	Kraus *et al.* (2016).
Sei whale *	41	25	1.6	Kraus *et al.* (2016).
Odontocetes:				
Atlantic spotted dolphin	1,335	46	29.0	Palka *et al.* (2017).
Atlantic white-sided dolphin	223	8	27.9	Kraus *et al.* (2016).
Bottlenose dolphin	259	33	7.8	Kraus *et al.* (2016).
Common dolphin	2,896	83	34.9	Kraus *et al.* (2016).
Harbor porpoise	121	45	2.7	Kraus *et al.* (2016).
Pilot whales	117	14	8.4	Kraus *et al.* (2016).
Risso's dolphin	1,215	224	5.4	Palka *et al.* (2017).
Sperm whale *	208	138	1.5	Palka *et al.* (2017).
Pinnipeds:				
Seals (harbor and gray)	201	144	1.4	Palka *et al.* (2017).

* Denotes species listed under the Endangered Species Act.

Alternative Density-Based Take Estimate Method

In addition to conducting the JASMINE exposure modeling described above to estimate both Level A harassment and Level B harassment from foundation installation, Sunrise Wind estimated the potential for Level B harassment from foundation installation using a simplified ''static'' method wherein the take estimates are the product of density, ensonified area, and number of days of installation. Take estimates from landfall construction activities, HRG surveys, and UXOs/MECs detonations were also calculated based on the static method (animal movement modeling was not conducted for these activities).

The ''static'' take estimates are calculated by multiplying the expected densities of marine mammals in the activity area(s) by the area of water likely to be ensonified above the NMFS defined threshold levels in a single day (24-hour period). For foundation installation, the maximum monthly density is multiplied by the total ensonified area (highest between summer or winter) for the first month of construction of WTG monopile installation. The second highest monthly density is multiplied by the total ensonified area (highest between summer or winter) for the second month of WTG monopile installation. Lastly, the maximum monthly density is multiplied by the total ensonified area for OCS–DC installation. These three values are then summed together to come up with the ''static'' take estimate value for all foundation installation. Total ensonified area is calculated by multiplying the single pile ensonified area by the total number of piles installed within the first and second month of construction. For example, if 56 WTG monopiles were assumed to be installed during the month with the highest density (*e.g.,* July) and 46 were installed in the month with the second highest density (*e.g.,* August), the resulting equation would be:

max monthly density [July] × total ensonified area for first month [summer WTG monopile] + 2nd highest monthly density [August] × total ensonified area for the 2nd month [summer WTG monopile] + max monthly density [July] × total ensonified area for first month [summer OCS–DC] = Total ''static'' take estimate

In some cases, the exposure estimates from the animal movement modeling methods described above directly informed the take estimates; in other cases, adjustments were made based on previously collected monitoring data or average group size as described above. In all cases, Sunrise Wind requested, and NMFS proposes to authorize, take based on the highest amount of exposures estimated from any given method.

Below we present the distances to NMFS thresholds and take estimates associated with each activity as a result of exposure modeling (WTG and OCS–DC foundation installation) or the static method as described above.

WTG and OCS–DC Foundation Installation

To complete the project, Sunrise proposed five total pile installation schedules, as construction schedules cannot be fully predicted due to uncontrollable environmental factors (*e.g.,* weather) and installation schedules include variability (*e.g.,* due to drivability). Table 14 demonstrates the assumptions in each scenario with regard to how piles are installed relative to each other as well as the amount of pile driving time (days) allocated to each month. As described previously,

TABLE 14—SUNRISE WIND'S FIVE POTENTIAL FOUNDATION INSTALLATION SCHEDULES

Schedule analyzed	Installation details	Foundation structure	Configuration	1st highest species density month		2nd highest species density month	
				Days of piling	Total piles	Days of piling	Total piles
Schedule 1	Sequential operations; assumptions for WTG (one vessel installing two monopiles per day) foundations and the OCS–DC foundation.	OCS–DC	Jacket pin pile, 4 per day.	2	8	0	0
		WTG	Monopile, 2 per day.	28	56	23	46

TABLE 14—SUNRISE WIND'S FIVE POTENTIAL FOUNDATION INSTALLATION SCHEDULES—Continued

Schedule analyzed	Installation details	Foundation structure	Configuration	1st highest species density month		2nd highest species density month	
				Days of piling	Total piles	Days of piling	Total piles
Schedule 2	Sequential operations; assumptions for WTG (one vessel installing three monopiles per day) foundations and the OCS–DC foundation.	OCS–DC	Jacket pin pile, 4 per day.	2	8	0	0
		WTG	Monopile, 3 per day.	28	84	6	18
Schedule 3	Concurrent operations; proximal assumptions for concurrent piling of WTG (two vessels, each installing two monopiles per day) foundations, and the OCS–DC foundation.	OCS–DC	Jacket pin pile, 4 per day.	2	8	-	-
		WTG	2 vessels, each 2 per day.	25.5	102	-	-
Schedule 4	Concurrent operations; distal assumptions for concurrent piling of WTG (two vessels, each installing two monopiles per day) foundations, and the OCS–DC foundation.	OCS–DC	Jacket pin pile, 4 per day.	2	8	-	-
		WTG	2 vessels, each 2 per day.	25.5	102	-	-
Schedule 5	Concurrent operations; proximal assumptions for concurrent piling of WTG (one vessel installing two monopiles per day) and the OCS–DC foundation (one vessel installing four pin piles per day), and remaining WTG foundations.	OCS–DC & WTG.	Jacket pin pile, 4 per day + Monopile, 2 per day.	2	8 (pin) + 4 (monopile)	0	0
		WTG	Monopile, 2 per day.	28	60	21	42

* **Note:** No specific installation Schedule was carried forward; however, the highest Level A and Level B exposure estimates produced from across all five installation Schedules was selected and summarized as the most conservative for analysis purposes, given uncertainty in the exact construction approach at this stage of the project.

- not applicable.

Sunrise Wind assumed that a maximum of three (if consecutive installation) or four (if concurrent installation) WTG monopile foundations and four pin piles related to the jacket foundation for the OCS–DC may be driven in 24 hours. It is unlikely that this installation rate would be consistently possible throughout the SRWF construction phase, but this schedule was considered to have the greatest potential for Level A harassment (*i.e.,* PTS) and was, therefore, carried forward into take estimation. Exposure ranges (ER95percent) to Level A SELcum thresholds resulting from animal exposure modeling assuming various consecutive pile installation scenarios and 10 dB of attenuation by a NAS are summarized in Table 15. In the event two installation vessels are able to work simultaneously, exposure ranges (ER95percent) to Level A SELcum thresholds from the three concurrent pile installation scenarios summarized in Section 6.3 and 10 dB of attenuation by a NAS are summarized in Table 16. Comparison of the results in Table 15 and Table 16 show that the scenario assuming consecutive installation of 2 WTG monopiles per day (which assumes the piles are located close to each other) and concurrent installation of 4 WTG monopiles per day at distant locations yield very similar results. This makes logical sense because the close proximity of the two piles installed at each location in the concurrent scenario is very similar to the 2 piles installed in the consecutive installation scenario and animals are unlikely to occur in both locations in the concurrent scenarios when they are far apart. Exposure ranges from the ''Proximal'' concurrent installation scenario (assuming close distances between concurrent pile installations) are slightly greater than from the ''Distal'' concurrent installation scenario (assuming long distances between concurrent pile installations) reflecting the fact that animals may be exposed to slightly higher cumulative sound levels when concurrent pile installations occur close to each other.

Table 15 -- Exposure ranges (ER95percent) to Level A cumulative sound exposure level (SELcum) thresholds for marine mammals from consecutive installation of two and three 7/12 m WTG monopiles (10,398 strikes each) and four 4-m OCS-DC jacket foundation pin piles (17,088 strikes each) in 1 day during the summer and winter seasons using a IHC S-4000 hammer and assuming 10 dB of broadband noise attenuation

Hearing Group	SEL_{cum} Threshold (dB re 1 μPa^2·s)	Range (km)					
		WTG Monopile 2-Piles/Day		WTG Monopile 3-Piles/Day		OCS-DC Jacket 4 piles/Day	
		Summer	Winter	Summer	Winter	Summer	Winter
Low-frequency	183						
Fin Whale*		3.91	4.19	3.68	4.24	5.55	6.42
Humpback Whale		3.63	3.8	3.4	3.82	5.13	3.2
Minke Whale		1.98	2.12	1.86	2.02	2.88	6.03
NA Right Whale*		2.66	2.81	2.51	2.9	3.62	4.06
Sei Whale*		2.69	3.09	2.67	3.01	4.22	4.73
Mid-frequency	185	0	0	0	0	0	0
High-frequency	155	0	0	0	0	0.81	0.59
Phocid pinnipeds	185	<0.01	<0.01	0.03	0.03	1.72	1.73

Table 16 -- Exposure ranges (ER95percent) to Level A cumulative sound exposure level (SELcum) thresholds for marine mammals from concurrent installation scenarios including up to four 7/12 m WTG monopiles (10,398 strikes each) per day in close proximity to each other ("Proximal") and distant from each other ("Distal") or two 7/12 m WTG monopiles and four 4-m OCS-DC jacket foundation pin piles (17,088 strikes each) in 1 day during the summer and winter seasons using a IHC S-4000 hammer and assuming 10 dB of broadband noise attenuation

Hearing Group	SEL_{cum} Threshold (dB re 1 μPa^2·s)	Range (km)					
		Proximal WTG Monopiles 4-Piles/Day		Distal WTG Monopiles 4-Piles/Day		2 WTG Monopiles and 4 OCS-DC Jacket	
		Summer	Winter	Summer	Winter	Summer	Winter
Low-frequency	183						
Fin Whale*		4.23	4.83	3.8	3.8	5.25	6.21
Humpback Whale		4.02	4.32	3.66	3.66	4.83	5.68
Minke Whale		2.17	2.37	1.96	1.96	2.71	3.07
NA Right Whale*		2.94	3.31	2.61	2.61	3.49	3.85
Sei Whale*		3.18	3.37	2.74	2.74	3.97	4.65
Mid-frequency	185	0	0	0	0	0	0
High-frequency	155	0	0	0	0	0.61	0.57
Phocid pinnipeds	185	0.22	0.16	0.22	0.22	1.62	1.74

As described previously, Sunrise Wind also modeled acoustic ranges to NMFS harassment thresholds. Because the Level B harassment threshold is instantaneous, the acoustic range to the 160dB thresholds is the more appropriate and conservative method used in this analysis (although NMFS notes the differences between the exposure ranges calculated assuming animal movement modeling and acoustic ranges are negligible). Table 17 presents the acoustic ranges resulting from JASCO's source and propagation models.

TABLE 17—ACOUSTIC RANGES (R95PERCENT) IN KM TO THE LEVEL B, 160 DB RE 1 µPA SOUND PRESSURE LEVEL (SPLRMS) THRESHOLD FOR IMPACT PILE DRIVING DURING 7/12 M WTG MONOPILE AND OCS–DC JACKET FOUNDATION PIN PILE (4 M) INSTALLATION USING AN IHC S–4000 HAMMER AND ASSUMING 10 DB OF BROADBAND NOISE ATTENUATION.

Range					
WTG monopile foundation (3,200 kJ)	WTG monopile foundation (4,000 kJ)	OCS–DC jacket foundation (4,000 kJ)			
Summer	Winter	Summer	Winter	Summer	Winter
6.07	6.5	6.49	6.97	6.47	6.63

Sunrise Wind modeled potential Level A harassment and Level B harassment density-based exposure estimates for all five foundation installation scenarios: consecutive pile driving (Schedules 1 and 2) and concurrent pile driving (Schedules 3, 4, and 5). For both WTG monopile and OCS–DC jacket foundation installation, mean monthly densities for all species were calculated by first selecting density data from 5 × 5 km (3.1 × 3.1 mile) grid cells (Roberts *et al.,* 2016; Roberts and Halpin, 2022) both within the Lease Area and out to 10 km (6.2 mi) from the perimeter of the Lease Area. This is a reduction from the 50 km (31 mi) perimeter used in the adequate & complete ITR application from May 2022. The relatively large area selected for density estimation encompasses and extends approximately to the largest estimated exposure acoustic range ($ER_{95percent}$ to the isopleth corresponding to Level B harassment, assuming 10 dB of noise attenuation) for all hearing groups using the unweighted threshold of 160 dB re 1 µPa (rms). Please see Figure 11 in Sunrise Wind's Updated Density and Take Estimation Memo for an example of a density map showing the Roberts and Halpin (2022) density grid cells overlaid on a map of the SRWF.

For monopile installation, the exposure calculations assumed 84 WTG monopiles would be installed in the highest density month and that the remaining 18 WTG monopiles would be installed within the second highest density month for each marine mammal species (excluding January–April). Sunrise Wind assumed that the OCS–DC jacket foundation would be installed in the month with the highest density for each species. Due to differences in the seasonal migration and occurrence patterns, the month selected for each species differs. Table 18 identifies the months and density values used in the exposure estimate models for foundation installation.

TABLE 18—MAXIMUM AVERAGE MONTHLY MARINE MAMMAL DENSITIES DURING FOUNDATION PILE INSTALLATION

Marine mammal species	Maximum monthly (May–December) density (individual/km²)	Maximum density month	2nd highest monthly density (individual/km²)	2nd highest density month
Mysticetes:				
Blue whale *	N/A	Annual	N/A	Annual.
Fin whale *	0.0043	July	0.037	August.
Humpback whale *	0.0025	May	0.0024	June.
Minke whale	0.0180	May	0.0137	June.
North Atlantic right whale *	0.0018	May	0.0015	December.
Sei whale *	0.0017	May	0.0007	November.
Odontocetes:				
Atlantic spotted dolphin	0.0030	October	0.0015	September.
Atlantic white-sided dolphin	0.0270	May	0.0234	June.
Bottlenose dolphin	0.0162	August	0.0160	July.
Common dolphin	0.1816	September	0.1564	October.
Harbor porpoise	0.0529	May	0.0451	December.
Pilot whales	0.0018	Annual	0.0018	Annual.
Risso's dolphin	0.0021	December	0.0010	November.
Sperm whale *	0.0006	August	0.0004	September.
Phocid (Pinnipeds):				
Seals (Harbor and Gray)	0.1712	May	0.1668	December.

* Denotes species listed under the Endangered Species Act.

For some species, modifications to the densities used were necessary; these are described here. The estimated monthly density of seals provided in Roberts and Halpin (2022) includes all seal species present in the region as a single guild. To split the resulting "seal" density-based exposure estimate by species (harbor and gray seals), the estimate was multiplied by the proportion of the combined abundance attributable to each species. Specifically, the SAR N_{best}

abundance estimates (Hayes *et al.,* 2021) for the two species (gray seal = 27,300, harbor seal = 61,336; total = 88,636) were summed and divided the total by the estimate for each species to get the proportion of the total for each species (gray seal = 0.308; harbor seal = 0.692). The total estimated exposure from the pooled seal density provided by Roberts and Halpin (2022) was then multiplied by these proportions to get the species specific exposure estimates. Monthly densities were unavailable for pilot whales, so the annual mean density was used instead. The blue whale density was considered too low to be carried into exposure estimation so the amount of blue whale take that Sunrise Wind requests (see Estimated Take) is instead based on group size. Table 18 shows the first and second maximum average monthly densities by species that were incorporated in exposure modeling to obtain conservative exposure estimates.

No single schedule resulted in the greatest amount of potential for injury or behavioral harassment. Sunrise Wind identified the following trends when looking across all construction schedules:

- Schedule 2 (consecutive installation) resulted in the highest number of Level B harassment exposures.
- Schedule 3 (concurrent proximal monopile installation) resulted in slightly higher Level A harassment exposures than sequential operations or other types of concurrent operations. This is likely because marine mammals would be exposed to two sources at the same moment and as one event rather than by two separate and distinct construction events.
- There were no SEL injury exposures at any attenuation level for any construction schedule.
- Harbor porpoise Level A harassment exposures were consistent regardless of the construction schedule.
- Schedule 3 tended to result in a reduced amount of take than other construction schedules for phocid pinnipeds.
- Construction Schedule 5 has similar results to Construction Schedule 1. These two schedules are almost identical except that the 2 days of sequential operations in Construction Schedule 1 would be replaced by 2 days of concurrent operations in Construction Schedule 5 while the remaining 28 days of operations would remain the same.

As several of these schedules assume nearby concurrent operations, modeling efforts found that, because of the SEL metric used to evaluate PTS and the greater energy accumulated from multiple sources over a larger footprint, concurrent nearby operations may marginally increase the total number of injurious takes of marine mammals by PTS (Level A harassment) even though the number of days of operations goes down in these situations. Alternately, while the footprint ensonified above the behavioral harassment threshold by two concurrent installations may be larger than that of a single operation, because the behavioral harassment threshold is based on SPL and not accumulated energy, the number of behavioral disruptions of marine mammals (Level B harassment) are reduced when the number of days of pile driving is reduced. The fact that concurrent operations will likely result in the construction activities being completed in a shorter amount of time (fewer days), this is also considered a benefit, and more broadly, in the context of how repeated or longer total duration activities may impact marine mammals and their habitat.

As described above, no single schedule was carried forward specifically for take estimates. Sunrise Wind compiled the maximum amount of take modeled for each species from each construction schedule to consider in their take estimates. Moreover, as described above, other factors influenced Sunrise Wind's take request. However, we note that final take estimates and the amount of take NMFS proposes to authorize, represent the maximum amount of take from any method considered (exposure modeling, static Level B harassment calculations (*i.e.,* density × ensonified area × days of pile driving), PSO data, or group size. Tables 19 and 20 represent take estimates from all methods for consecutive and concurrent pile driving schedules. Table 19 represents the highest amount of take from all methods and all schedules, which was used in the total take tables representing all activities presented later in this section.

As previously discussed, only 94 WTG foundations would be permanently installed for the Sunrise Wind project; however, Sunrise Wind has considered the possibility that some piles may be started but not fully installed in some locations due to installation feasibility issues. Therefore, the take estimates reflect pile driving activities associated with 102 foundations to account for up to 8 piles that may be started but then re-driven at another position.

TABLE 19—CONSECUTIVE SCHEDULES—ESTIMATED LEVEL A AND LEVEL B HARASSMENT TAKE FROM INSTALLATION OF 102 WTG MONOPILE FOUNDATIONS [a] AND 1 OCS–DC PILED JACKET FOUNDATION AMONG SCHEDULES 1 AND 2, ASSUMING 10 dB OF NOISE ATTENUATION

Marine mammal species	Exposure modeling take estimate		Static Level B take estimates [b]	PSO data take estimates	Mean group size	Highest take by Level B harassment
	Level A (SPL_{cum})	Level B (SPL_{rms})				
Mysticetes:						
Blue whale *	N/A	N/A	0.2		1.0	1
Fin whale *	17.8	38.3	57.7	20.3	1.8	58
Humpback whale *	13.6	27.3	34.4	60.5	2.0	61
Minke whale	114.6	354.6	237.0	7.4	1.2	355
North Atlantic right whale *	7.8	21.1	24.5	1.8	2.4	25
Sei whale *	6.0	16.3	20.8	0.5	1.6	21
Odontocetes:						
Atlantic spotted dolphin	0.0	8.2	37.1		29.0	38
Atlantic white-sided dolphin	0.0	533.3	363.0	5.9	27.9	534
Bottlenose dolphin	0.0	237.6	222.0	66.0	7.8	238
Common dolphin	0.0	5,049.4	2,750.6	1,680.6	34.9	5,050
Harbor porpoise	3.9	631.2	726.2	1.7	2.7	727
Pilot whales	0.0	33.4	25.3		8.4	34
Risso's dolphin	0.0	28.5	25.8	4.6	5.4	29

TABLE 19—CONSECUTIVE SCHEDULES—ESTIMATED LEVEL A AND LEVEL B HARASSMENT TAKE FROM INSTALLATION OF 102 WTG MONOPILE FOUNDATIONS [a] AND 1 OCS–DC PILED JACKET FOUNDATION AMONG SCHEDULES 1 AND 2, ASSUMING 10 dB OF NOISE ATTENUATION—Continued

Marine mammal species	Exposure modeling take estimate		Static Level B take estimates [b]	PSO data take estimates	Mean group size	Highest take by Level B harassment
	Level A (SPL_{cum})	Level B (SPL_{rms})				
Sperm whale *	0.0	7.1	7.9		1.5	8
Phocid (Pinnipeds):						
Gray Seal	2.1	453.9	765.4	4.6	1.4	766
Harbor Seal	7.5	1,261.7	1,719.7	5.9	1.4	1,720

* Denotes species listed under the Endangered Species Act.
[a] Only 94 WTG foundations would be installed but to account for up to 8 pilesthat may have to be re-installed at a different position, Sunrise Wind has estimated take from installation of 102 WTG foundations.
[b] "Static" Level B take estimates are from the standard density × area × number of days method, not from exposure modeling.

TABLE 20—CONCURRENT SCHEDULES—ESTIMATED LEVEL A AND LEVEL B HARASSMENT TAKE FROM INSTALLATION OF 102 WTG MONOPILE FOUNDATIONS [a] AND 1 OCS–DC PILED JACKET FOUNDATION AMONG SCHEDULES 3, 4, AND 5, ASSUMING 10 dB OF NOISE ATTENUATION

Marine mammal species	Proximal WTG monopiles (4 piles/day)		Distal WTG monopiles (4 piles/day)		2 WTG monopiles and 4 OCS–DC jacket pin piles		Maximum among all three schedules	
	Level A harassment (SPL_{cum})	Level B harassment (SPL_{rms})	Level A harassment (SPL_{cum})	Level B harassment (SPL_{rms})	Level A harassment (SPL_{cum})	Level B harassment (SPL_{rms})	Level A harassment (SPL_{cum})	Level B harassment (SPL_{rms})
Mysticetes:								
Blue whale *	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fin whale *	18.9	33.2	18.5	37.1	18.7	37.7	18.9	37.7
Humpback whale *	13.2	22.1	11.9	24.4	13.8	25.8	13.8	25.8
Minke whale	130.1	287.1	118.4	363.2	122.5	361.6	130.1	363.2
North Atlantic right whale *	8.4	16.8	8.3	21.8	7.3	20.1	8.4	21.8
Sei whale *	6.6	14.7	6.6	17.4	6.3	17.5	6.6	17.5
Odontocetes:								
Atlantic spotted dolphin	0.0	18.9	0.0	18.2	0.0	10.2	0.0	18.9
Atlantic white-sided dolphin	0.0	421.6	0.0	537.0	0.0	522.7	0.0	537.0
Bottlenose dolphin	0.0	191.5	0.0	226.3	0.0	233.0	0.0	233.0
Common dolphin	0.0	4,109.4	0.0	5,151.1	0.0	5,196.9	0.0	5,196.9
Harbor porpoise	3.9	522.5	3.9	628.1	4.0	621.1	4.0	628.1
Pilot whales	0.0	26.5	0.0	33.0	0.0	32.5	0.0	33.0
Risso's dolphin	0.0	23.7	0.0	31.4	0.0	29.8	0.0	31.4
Sperm whale *	0.0	5.8	0.0	6.9	0.0	7.1	0.0	7.1
Phocid (Pinnipeds):								
Gray Seal	1.6	354.1	2.0	409.9	1.7	416.6	2.0	416.6
Harbor Seal	6.9	1,068.9	8.7	1,238.2	7.8	1,157.5	8.7	1,238.2

* Denotes species listed under the Endangered Species Act.
[a] Only 94 WTG foundations would be installed but to account for up to 8 pilesthat may have to be re-installed at a different position, Sunrise Wind has estimated take from installation of 102 WTG foundations.

Table 21 presents the maximum amount exposures among all five schedule modeled (see Küsel *et al.,* 2022 for exposure estimates for each schedule), results from a static approach to calculate Level B harassment take, other available data to consider (mean group size and PSO data), and importantly, the amount of take Sunrise Wind requested and NMFS proposes to authorize incidental to installing WTG and OCS–DC foundations. NMFS notes that in its application, Sunrise Wind requested take by Level A harassment for humpback whales only as this was based on the largest predicted exposure range for this specific species. However, the new Roberts and Halpin (2022) density estimates resulted in Level A harassment takes for other marine mammal species' (*i.e.,* fin whale, humpback whale, minke whale, sei whale, harbor porpoise, gray seal, harbor seal) during foundation installation, which led to a reevaluation of how Level A harassment takes were determined during the foundation installation associated with the Sunrise Wind proposed project. As it is possible for some animals to occur within the relevant distances for durations long enough to result in Level A harassment, additional take was evaluated and requested. Although Sunrise Wind expects that most species will temporarily avoid the area during the foundation installation activities, and in combination with the proposed mitigation and monitoring measures, the potential for Level A harassment is very low. However, there may be some situations where pile driving cannot be stopped due to safety concerns related to pile instability. To estimate the potential for PTS, Sunrise Wind assumed that some animals may go undetected near the outer perimeter of the largest modeled exposure range (approximately within 500 m). Given the area of the water is represented by a band that is around 500-m wide on the inside of the modeled exposure ranges, it was estimated that this made up approximately 20 to 25 percent of the total area of the exposure range. Because of these reasons, Sunrise Wind evaluated that up to 20 percent of the model-predicted Level A harassment take (except North Atlantic right whales) could occur. Therefore, Sunrise Wind requested and NMFS proposed to authorize, take in the amount of 20 percent of the modeled PTS exposures for each species. However, due to the enhanced mitigation measures for North Atlantic right whales (see Proposed Mitigation section), no Level A harassment takes are requested for this species nor is NMFS proposing to authorize any.

Per Sunrise Wind's estimated schedule, it is anticipated that all foundations would be installed in Year 1; therefore, Table 21 represents the maximum amount of take that would occur in any given year from foundation installation; however, NMFS notes construction schedules may shift.

TABLE 21—MAXIMUM ESTIMATED AMOUNT OF LEVEL A HARASSMENT AND LEVEL B HARASSMENT TAKE FROM INSTALLATION OF 102 WTG MONOPILE FOUNDATIONS [a] AND 1 OCS–DC PILED JACKET FOUNDATION AMONG ALL FIVE SCHEDULES, ASSUMING 10 dB OF NOISE ATTENUATION

Marine mammal species	Exposure modeling take estimate		Static level B take estimates [b]	PSO data take estimates	Mean group size	Proposed level A take	Proposed level B take
	Level A (SPL_{cum})	Level B (SPL_{rms})					
Mysticetes:							
Blue whale *	n/a	n/a	0.2		1.0		1
Fin whale *	18.9	37.7	59.3	20.3	1.8	4	60
Humpback whale *	13.8	25.8	34.8	60.5	2.0	3	61
Minke whale	130.1	363.2	247.1	7.4	1.2	27	364
North Atlantic right whale *	8.4	21.8	24.6	1.8	2.4	0	25
Sei whale *	6.6	17.5	23.3	0.5	1.6	2	24
Odontocetes:							
Atlantic spotted dolphin	0.0	18.9	40.6		29.0	0	41
Atlantic white-sided dolphin	0.0	537.0	371.7	5.9	27.9	0	537
Bottlenose dolphin	0.0	237.6	222.4	66.0	7.8	0	238
Common dolphin	0.0	5,196.9	2,876.9	1,680.6	34.9	0	5,197
Harbor porpoise	4.0	628.1	728.5	1.7	2.7	1	729
Pilot whales	0.0	33.4	25.3		8.4	0	34
Risso's dolphin	0.0	31.4	28.5	4.6	5.4	0	32
Sperm whale *	0.0	7.1	8.4		1.5	0	9
Phocid (Pinnipeds):							
Gray Seal	2.0	449.8	765.4	4.6	1.4	1	766
Harbor Seal	8.7	1,242.1	1,719.7	5.9	1.4	2	1,720

* Denotes species listed under the Endangered Species Act.

[a] Only 94 WTG foundations would be installed but to account for up to 8 pilesthat may have to be re-installed at a different position, Sunrise Wind has estimated take from installation of 102 WTG foundations.

[b] "Static" Level B take estimates are from the standard density × area × number of days method, not from exposure modeling.

Export Cable Landfall Construction

We previously described Sunrise Wind's acoustic modeling methodologies and identified that Sunrise Wind applied the static method to estimate take (*i.e,* no exposure modeling was conducted for cable landfall construction work). Here, we present the results from that modeling. Table 22 identifies the modeled acoustic ranges to the PTS (SEL_{cum}) thresholds from impact pile driving (via pneumatic hammering) of the casing pipe. Level A harassment (SPL_{pk}) thresholds were not exceeded in the model and therefore, will not be discussed further. The modeled Level B harassment threshold distance is 920 m (Table 22).

Modeled distances to PTS thresholds are larger than distances to the Level B harassment threshold due to the high strike rate of the pneumatic hammer (Table 22). However, low-frequency cetaceans are not expected to occur frequently close to this nearshore site and individuals of any species (including seals) are not expected to remain within the estimated SEL_{cum} threshold distances for the entire 3-hour duration of piling in a day. Furthermore, with the implementation of planned monitoring and mitigation (see Proposed Mitigation and Monitoring section), the potential for PTS incidental to pneumatic hammering is not anticipated. Sunrise Wind did not request nor is NMFS proposing to authorize Level A harassment incidental to installation of the casing pipe.

TABLE 22—ACOUSTIC RANGES ($R_{95percent}$) IN METERS TO LEVEL A HARASSMENT (PTS) AND LEVEL B HARASSMENT THRESHOLDS FROM IMPACT PILE DRIVING DURING CASING PIPE INSTALLATION FOR MARINE MAMMAL FUNCTIONAL HEARING GROUPS, ASSUMING A WINTER SOUND SPEED PROFILE

Marine mammal hearing group	$R_{95percent}$ (m)	
	Level A harassment SEL_{cum} thresholds (dB re 1 µPa2·s)	Level B harassment SPL_{rms} threshold (120 dB re 1 µPa)
Low-frequency cetaceans	3,870	920
Mid-frequency cetaceans	230	
High-frequency cetaceans	3,950	
Phocid pinnipeds	1,290	

Each casing pipe would be supported by six goal posts to allow the borehole exit point to remain clear of mud. Each goal post would be supported by two vertical sheet piles (a total of 12 sheet piles) that would be installed using a vibratory hammer (*i.e.,* an American Piledriving Equipment model 300 or similar),with a potential for up to 10 additional sheet piles being installed to support ongoing construction activities (a total of 22 sheet piles). Sunrise Wind anticipates installing the 22 sheet piles over 6 days (approximately four piles per day). Each sheet pile would take up to 2 hours to install for a total of 8 hours per day. Removal timelines would be similar (up to six days total), equating to a total of 12 days for both installation and removal.

Similar to the modeling approach for impact pile driving, distances to harassment thresholds are reported as $R_{95percent}$ values (Table 23). Given the nature of vibratory pile driving and the very small distances to Level A harassment thresholds (5–190 m), which accounts for eight hours of vibratory pile driving per day, vibratory driving is not expected to result in Level A harassment. Sunrise Wind did not request nor is NMFS proposing to authorize any Level A harassment incidental to installation or removal of sheet piles.

TABLE 23—ACOUSTIC RANGES ($R_{95percent}$) IN METERS TO LEVEL A HARASSMENT (PTS) AND LEVEL B HARASSMENT THRESHOLDS FROM VIBRATORY PILE DRIVING DURING SHEET PILE INSTALLATION FOR MARINE MAMMAL FUNCTIONAL HEARING GROUPS, ASSUMING A WINTER SOUND SPEED PROFILE

Marine mammal hearing group	$R_{95percent}$ (m)	
	Level A harassment SEL_{cum} thresholds (dB re 1 µPa2·s)	Level B harassment SPL_{rms} threshold (120 dB re 1 µPa)
Low-frequency cetaceans	50	9,740
Mid-frequency cetaceans		
High-frequency cetaceans	190	
Phocid pinnipeds	10	

The acoustic ranges to the Level B harassment threshold were used to calculate the ensonified area around the cable landfall construction site. The Ensonified Area is calculated as the following:

Ensonified Area = pi x r^2,

where *r* is the linear acoustic range distance from the source to the isopleth to the Level B harassment thresholds.

Based on the duration of both the installation/removal of the sheet piles and the casing pipe, different daily ensonified values are necessary to pull into this calculation for the cable landfall take analysis. For the vibratory pile driving associated with the sheet pile installation and removal, it was assumed that the daily ensonified area was 149 km^2 (57.53 mi^2) or a total ensonified area of 1,788 km^2 (1,111 mi^2). For impact pile driving associated with the casing pipe by the pneumatic hammer, it was assumed that the daily ensonified area was 0.92 km^2 (0.36 mi^2) with a total ensonified area of 10.6 km^2 (6.58 mi^2) to result.

To estimate marine mammal density around the nearshore landfall site, the greatest ensonified area plus a 10-km buffer was then intersected with the density grid cells for each individual species to select all of those grid cells that the buffer intersects (Figure 10 in Sunrise Wind's Updated Density and Take Estimation Memo). Since the timing of landfall construction activities may vary somewhat from the proposed schedule, the highest average monthly density from January through December for each species was selected and used to estimate exposures from landfall construction (Table 24).

For some species where little density information is available (*i.e.,* blue whales, pilot whales), the annual density was used instead. Given overlap with the pinniped density models as the Roberts and Halpin (2022) dataset does not distinguish between species, a collective ''pinniped'' density was used and then split based on the relative abundance for each species for the estimated take (Roberts *et al.,* 2016). These approaches were the same as described in the WTG and OCS–DC Foundation Installation section.

TABLE 24—MAXIMUM AVERAGE MONTHLY MARINE MAMMAL DENSITIES IN AND NEAR THE LANDFALL LOCATION AND THE MONTH IN WHICH EACH MAXIMUM DENSITY OCCURS

Marine mammal species	Maximum monthly density (individual/km^2)	Maximum density month
Mysticetes:		
Blue whale *	0.000	Annual.
Fin whale *	0.0013	January.
Humpback whale *	0.0016	December.
Minke whale	0.0072	May.
North Atlantic right whale *	0.0009	February.
Sei whale *	0.0006	December.
Odontocetes:		
Atlantic Spotted Dolphin	0.000	September.
Atlantic White-sided Dolphin	0.0040	May.
Bottlenose Dolphin	0.0540	July.
Common Dolphin	0.0336	November.
Harbor Porpoise	0.0384	January.
Pilot Whales	0.0000	Annual.
Risso's Dolphin	0.0001	December.
Sperm Whale *	0.0002	November.
Phocid (Pinnipeds):		
Seals (Harbor and Gray)	0.3789	June.

* Denotes species listed under the Endangered Species Act.

To calculate exposures, the average marine mammal densities from Table 24 were multiplied by the daily ensonified area (149 km^2) for installation/removal of sheet piles and for the installation/removal of the casing pipe (0.92 km^2). Given that use of the vibratory hammer during sheet pile installation and removal may occur on up to 12 days, the daily estimated take (which is the product of density × ensonified area) was multiplied by 12 to produce the results shown in Table 25. The same approach was undertaken for the use of the pneumatic hammer for the casing pipe with the exception that the 8 total days was used.

To be conservative, Sunrise Wind has requested take by Level B harassment based on the highest exposures predicted by the density-based, PSO based, or average group size-based estimates, and the take proposed for authorization is indicated in the last column of Table 25. As described above, given the small distances to Level A harassment isopleths, Level A harassment incidental to this activity is not anticipated, even absent mitigation, although mitigation measures are proposed that would further reduce the risk. Therefore, Sunrise Wind is not requesting and NMFS is not proposing to authorize Level A harassment related to cable landfall construction activities.

TABLE 25—ESTIMATE LEVEL B HARASSMENT FROM EXPORT CABLE LANDFALL CONSTRUCTION

Marine mammal species	Density-based take estimate		Total density-based take estimate	PSO data take estimate	Mean group size	Highest level B takes
	Sheet piles	Casing pipe				
Mysticetes:						
Blue whale *	0.0	0.0	0.0		1.0	1
Fin whale	2.3	0.0	2.3	3.1	1.8	4
Humpback whale	2.8	0.0	2.9	9.3	2.0	10
Minke whale	12.8	0.1	12.9	1.1	1.2	13
North Atlantic right whale *	1.7	0.0	1.7	0.3	2.4	3
Sei whale *	1.0	0.0	1.0	0.1	1.6	2
Odontocetes:						
Atlantic spotted dolphin	0.1	0.0	0.1		29.0	29
Atlantic white-sided dolphin	7.2	0.0	7.2	0.9	27.9	28
Bottlenose dolphin	96.6	0.6	97.2	10.2	7.8	98
Common dolphin	60.0	0.4	60.4	258.5	34.9	259
Harbor porpoise	68.7	0.4	69.1	0.3	2.7	70
Pilot whales	0.0	0.0	0.0		8.4	9
Risso's dolphin	0.2	0.0	0.2	0.7	5.4	6
Sperm whale *	0.3	0.0	0.3		1.5	2
Phocid (Pinnipeds):						
Gray Seal	208.7	1.2	209.9	0.7	1.4	210
Harbor Seal	468.9	2.8	471.7	0.9	1.4	472

* Denotes species listed under the Endangered Species Act.

UXO/MEC Detonation

Sunrise Wind may detonate up to three UXO/MECs within the project's Lease Area over the 5-year effective period of the proposed rule. Charge weights of 2.3 kgs, 9.1 kgs, 45.5 kgs, 227 kgs, and 454 kgs, were modeled to determine acoustic ranges to mortality, gastrointestinal injury, lung injury, PTS, and TTS thresholds. To do this, the source pressure function used for estimating peak pressure level and impulse metrics was calculated with an empirical model that approximates the rapid conversion of solid explosive to gaseous form in a small bubble under high pressure, followed by exponential pressure decay as that bubble expands (Hannay and Zykov, 2022). This initial empirical model is only valid close to the source (within tens of meters), so alternative formulas were used beyond those distances to a point where the sound pressure decay with range transitions to the spherical spreading model. The SEL thresholds occur at distances of many water depths in the relatively shallow waters of the Project (Hannay and Zykov, 2022). As a result, the sound field becomes increasingly influenced by the contributions of sound energy reflected from the sea surface and sea bottom multiples times. To account for this, propagation modeling was carried out in decidecade frequency bands using JASCO's MONM, as described in the WTG and OCS–DC Foundation Installation section above. This model applies a parabolic equation approach for frequencies below 4 kHz and a Gaussian beam ray trace model at higher frequencies (Hannay and Zykov, 2022). In Sunrise Wind project's location, sound speed profiles generally change little with depth, so these environments do not have strong seasonal dependence (see Figure 2 in the Sunrise Wind Underwater Acoustic Modeling of UXO/MEC report on NMFS' website). The propagation modeling for UXO/MEC detonations was performed using an average sound speed profile for ''September'', which is representative of the most likely time of year UXO/MEC detonation activities would occur for Sunrise Wind's proposed action in the Lease Area. Please see the supplementary report for Sunrise Wind's ITA application titled ''Underwater Acoustic Modeling of Detonations of Unexploded Ordnance (UXO) for Orsted Wind Farm Construction, US East Coast'', as found on NMFS' website (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-sunrise-wind-llc-construction-and-operation-sunrise-wind*) for more technical details about the modeling methods, assumptions and environmental parameters used as inputs (Hannay and Zykov, 2022).

The exact type and net explosive weight of UXO/MECs that may be detonated are not known at this time; however, they are likely to fall into one of the bins identified in Table 26. To capture a range of potential UXO/MECs, five categories or ''bins'' of net explosive weight, as established by the U.S. Navy (2017a), were selected for acoustic modeling (Table 26).

TABLE 26—NAVY "BINS" AND CORRESPONDING MAXIMUM CHARGE WEIGHTS (EQUIVALENT TNT) MODELED

Navy bin designation	Maximum equivalent (kg)	Weight (TNT) (lbs)
E4	2.3	5
E6	9.1	20
E8	45.5	100
E10	227	500
E12	454	1,000

These charge weights were modeled at four different locations off Rhode Island, consisting of different depths, including: 12 m (Site S1), 20 m (Site S2), 30 m (Site S3), and 45 m (Site S4). Sites S3 (30 m depth) and S4 (45 m depth) were deemed to be representative of the Sunrise Wind Lease Area where detonations could occur (see Figure 1 in Hannay and Zykov, 2022).

All distances to isopleths modeled can be found in Hannay and Zykov (2022). It is not currently known how easily Sunrise Wind would be able to identify the size and charge weights of UXOs/MECs in the field. Therefore, NMFS has proposed to require Sunrise Wind to implement mitigation measures assuming the largest E12 charge weight as a conservative approach. As such, distances to PTS and TTS thresholds for only the 454 kg UXO/MEC is presented in Table 27 and 28, respectively, as this size UXO has the greatest potential for these impacts and is what is used to estimate take. NMFS notes that it is extremely unlikely that all three of the UXO/MECs found and needed to be detonated for the Sunrise Wind project would consist of this 454 kg charge weight. If Sunrise Wind is able to reliably demonstrate that they can easily and accurately identify charge weights in the field, NMFS will consider mitigation and monitoring zones based on UXO/MEC charge weight for the final rulemaking rather than assuming the largest charge weight in every situation.

To further reduce impacts to marine mammals, Sunrise Wind would deploy a noise attenuation system during detonation events similar to that described for monopile installation and expects that this system would be able to achieve 10 dB attenuation. This expectation is based on an assessment of UXO/MEC clearance activities in European waters as summarized by Bellman and Betke (2021). Because Sunrise Wind committed to using a noise abatement system during any UXO/MEC denotation event, attenuated acoustic ranges were applied to the take estimates.

Given the impact zone sizes and the required mitigation and monitoring measures, neither mortality nor non-auditory injury are considered likely to result from the activity. NMFS preliminarily concurs with Sunrise Wind's analysis and does not expect or propose to authorize any non-auditory injury, serious injury, or mortality of marine mammals from UXO/MEC detonation. The modeled distances, assuming 10 dB of sound attenuation, to the mortality threshold for all UXO/MECs sizes for all animal masses are small (*i.e.,* 5–353 m; see Tables 35–38 in Sunrise Wind's supplemental UXO/MEC modeling report; Hannay and Zykov, 2022), as compared to the distance/area that can be effectively monitored. The modeled distances to non-auditory injury thresholds range from 5–648 m, assuming 10 dB of sound attenuation (see Tables 30–34 in Sunrise Wind's supplemental UXO/MEC modeling report; Hannay and Zykov, 2022). Sunrise Wind would be required to conduct extensive monitoring using both PSOs and PAM operators and clear an area of marine mammals prior to any detonation of UXOs/MECs. Given that Sunrise Wind would be employing multiple platforms to visually monitor marine mammals as well as passive acoustic monitoring, it is reasonable to assume that marine mammals would be reliably detected within approximately 660 m of the UXO/MEC being detonated, the potential for mortality or non-auditory injury is *de minimis.*

Sunrise Wind did not request and NMFS is not proposing to authorize take by mortality or non-auditory injury. For this reason, we are not presenting all modeling results here; however, they can be found in Sunrise Wind's UXO/MEC acoustic modeling report (Hannay and Zykov, 2022).

To estimate the maximum ensonified zones that could result from UXO/MEC detonations, the largest acoustic range ($R_{95percent}$; assuming 10dB attenuation) to PTS and TTS thresholds of a E12 UXO/MEC charge weight were used as radii to calculate the area of a circle ($pi \times r^2$; where r is the range to the threshold level) for each marine mammal hearing group. The results represent the largest area potentially ensonified above threshold levels from a single detonation within the Sunrise Wind Lease Area (Tables 27 and 28).

TABLE 27—LARGEST SEL-BASED $R_{95percent}$ PTS-ONSET RANGES (IN METERS) SITE S3 (LEASE AREA) MODELED DURING UXO/MEC DETONATION, ASSUMING 10 dB SOUND REDUCTION

Marine mammal hearing group	Representative site used for modeling	Distance (m) to PTS threshold during E12 (454 kg) detonation		Maximum ensonified zone (km^2)
		R_{max}	$R_{95percent}$	
Low-frequency cetaceans	Site S3	3,900	3,610	40.9
Mid-frequency cetaceans	Site S3	484	412	0.53
High-frequency cetaceans	Site S3	6,840	6,190	12.0
Phocid pinnipeds (in water)	Site S3	1,600	1,480	6.88

TABLE 28—LARGEST SEL-BASED $R_{95percent}$ TTS-ONSET RANGES (IN METERS) FROM SITE S4 (LEASE AREA) MODELED DURING UXO/MEC DETONATION, ASSUMING 10 dB SOUND REDUCTION

Marine mammal hearing group	Representative site used for modeling	Distance (m) to TTS threshold during E12 (454 kg) detonation		Maximum ensonified zone (km^2)
		R_{max}	$R_{95percent}$	
Low-frequency cetaceans	Site S4	13,500	11,800	437
Mid-frequency cetaceans	Site S4	2,730	2,480	19.3
High-frequency cetaceans	Site S4	15,600	13,700	589
Phocid pinnipeds (in water)	Site S4	7,820	7,020	155

Regarding the marine mammal density and occurrence data used in the take estimates for UXO/MECs, to avoid any *in situ* detonations of UXO/MECs during periods when North Atlantic right whale densities are highest in and near the SWEC corridor and Lease Area, Sunrise Wind has opted for a seasonal temporal restriction to not detonate in Federal waters from December 1 through April 30 annually. Accordingly, for each species they selected the highest average monthly marine mammal density between May and November from Roberts and Halpin (2022) to conservatively estimate exposures from UXO/MEC detonation for a given species in any given year (*i.e.,* assumed all three UXO/MECs would be detonated in the month with the greatest average monthly density). Furthermore, given that UXOs/MECs detonations have the potential to occur anywhere within the Lease Area, a 10 km (6.21 mi) perimeter was applied around the Lease Area. In some cases where monthly densities were unavailable, annual densities were used instead for some species (*i.e.,* blue whales, pilot whale *spp.*).

Table 29 provides those densities and the associated months in which the species-specific densities are highest for the Sunrise Wind Lease Area.

TABLE 29—MAXIMUM AVERAGE MONTHLY MARINE MAMMAL DENSITIES (INDIVIDUALS/km^2) WITHIN 10 km OF THE SUNRISE WIND WIND FARM LEASE AREA FROM MAY THROUGH NOVEMBER, AND THE MONTH IN WHICH THE MAXIMUM DENSITY OCCURS

Marine mammal species	Maximum average monthly density (individual/km^2)	Maximum density month
Mysticetes:		
Blue whale *	0.0000	Annual.
Fin whale *	0.0042	July.
Humpback whale	0.0025	May.
Minke whale	0.0178	May.
North Atlantic right whale *	0.0018	May.
Sei whale *	0.0017	May.
Odontocetes:		
Atlantic spotted dolphin	0.0033	October.
Atlantic white-sided dolphin	0.0268	May.
Bottlenose dolphin	0.0160	August.
Common dolphin	0.1824	September.
Harbor porpoise	0.0517	May.
Pilot whales	0.0018	Annual.
Risso's dolphin	0.0020	December.
Sperm whale *	0.0006	August.
Phocid Pinnipeds:		
Seals (Harbor and Gray)	0.1730	May.

* Denotes species listed under the Endangered Species Act.

To estimate take incidental to UXO/MEC detonations in the Sunrise Wind Lease Area, the maximum ensonified areas based on the largest $R_{95percent}$ to Level A harassment (PTS) and Level B harassment (TTS) thresholds (assuming 10 dB attenuation) from a single detonation (assuming the largest UXO/MEC charge weight) in the Lease Area, as shown in Tables 27 and 28, were multiplied by three (the maximum number of UXOs/MECs that are expected to be detonated in the Sunrise Wind Lease Area) and then multiplied by the marine mammal densities shown in Table 29, resulting in the take estimates in Table 30. As described above, Sunrise Wind based the amount of requested take on the number of exposures estimated assuming 10 dB attenuation using a NAS because they believe consistent, successful implementation of this mitigation measure would be possible.

As shown below in Table 30, the likelihood of marine mammal exposures above the PTS threshold is low, especially considering the instantaneous nature of the acoustic signal and the fact that there will be no more than three. Further, Sunrise Wind has proposed mitigation and monitoring measures intended to avoid the potential for PTS for most marine mammal species, and the extent and severity of Level B harassment (see Proposed Mitigation and Proposed Monitoring and Reporting sections below). However, given the relatively large distances to the high-frequency cetacean Level A harassment (PTS, SEL_{cum}) isopleth applicable to harbor porpoises and the difficulty detecting this species at sea, Sunrise Wind is requesting and NMFS is proposing to authorize 19 Level A harassment takes of harbor porpoise from UXO/MEC detonations. Similarly, seals are difficult to detect at longer ranges, and although the distance to the phocid hearing group SEL PTS threshold is not as large as those for high-frequency cetaceans, it may not be possible to detect all seals within the PTS threshold distances even with the proposed monitoring measures. Therefore, Sunrise Wind requested and NMFS is proposing to authorize take by Level A harassment of 2 gray seals and 3 harbor seals incidental to UXO/MEC detonation.

TABLE 30—ESTIMATED LEVEL A HARASSMENT (PTS) AND LEVEL B HARASSMENT (TTS, BEHAVIOR) TAKES PROPOSED TO BE AUTHORIZED FROM ALL POTENTIAL UXO/MEC DETONATIONS [1] ASSUMING 10 dB NOISE ATTENUATION FOR THE SUNRISE WIND PROJECT

Marine mammal species	Total Level A density-based take estimate	Total Level B density-based take estimate	PSO data take estimate	Mean group size	Requested Level A take	Requested Level B take
Mysticetes:						
Blue whale *	0.0	0.0		1.0	0	1
Fin whale *	0.5	5.5	0.6	1.8	0	6
Humpback whale	0.3	3.3	1.7	2.0	0	4
Minke whale	2.2	23.4	0.2	1.2	0	24
North Atlantic right whale *	0.2	2.3	0.1	2.4	0	3
Sei whale *	0.2	2.2	0.0	1.6	0	3
Odontocetes:						
Atlantic spotted dolphin	0.0	0.2		29.0	0	29
Atlantic white-sided dolphin	0.0	1.6	0.2	27.9	0	28
Bottlenose dolphin	0.0	0.9	1.9	7.8	0	8
Common dolphin	0.3	10.6	48.5	34.9	0	49
Harbor porpoise	18.7	91.4	0.0	2.7	19	92
Pilot whales	0.0	0.1		8.4	0	9
Risso's dolphin	0.0	0.1	0.1	5.4	0	6
Sperm whale *	0.0	0.0		1.5	0	2
Phocid Pinnipeds:						
Gray seal	1.1	24.8	0.1	0.4	2	25
Harbor seal	2.5	55.6	0.2	1.0	3	56

* Denotes species listed under the Endangered Species Act.
[1] 1 Sunrise Wind only expects up to three UXO/MECs to necessitate high-order removal (detonation) and only expects that these would be found in the Lease Area, not the export cable corridor.

HRG Surveys

Sunrise Wind's proposed HRG survey activity includes the use of impulsive (*i.e.,* boomers and sparkers) and non-impulsive (*e.g.,* CHIRP SBPs) sources (Table 31).

TABLE 31—REPRESENTATIVE HRG SURVEY EQUIPMENT AND OPERATING FREQUENCIES

Equipment type	Representative equipment model	Operating frequency (kHz)
Sub-bottom profiler	EdgeTech 216	2–16
	EdgeTech 424	4–24
	EdgeTech 512	0.7–12
	GeoPulse 5430A	2–17
	Teledyne Benthos Chirp III—TTV 170	2–7
Sparker	Applied Acoustics Dura-spark UHD (400 tip, 500 J)	0.3–1.2
Boomer	Applied Acoustics triple plate S-Boom (700–1,000 J)	0.1–5

Authorized takes would be by Level B harassment only in the form of disruption of behavioral patterns for individual marine mammals resulting from exposure to noise from certain HRG acoustic sources. Based primarily on the characteristics of the signals produced by the acoustic sources planned for use, Level A harassment is neither anticipated, even absent mitigation, nor proposed to be authorized. Therefore, the potential for Level A harassment is not evaluated further in this document. Sunrise Wind did not request, and NMFS is not proposing to authorize, take by Level A harassment incidental to HRG surveys. Please see Sunrise Wind's application for details of a quantitative exposure analysis (*i.e.,* calculated distances to Level A harassment isopleths and Level A harassment exposures). No serious injury or mortality is anticipated to result from HRG survey activities.

Specific to HRG surveys, in order to better consider the narrower and directional beams of the sources, NMFS has developed a tool for determining the sound pressure level (SPL_{rms}) at the 160 dB isopleth for the purposes of estimating the extent of Level B harassment isopleths associated with HRG survey equipment (NMFS, 2020). This methodology incorporates frequency-dependent absorption and some directionality to refine estimated ensonified zones. Sunrise Wind used NMFS' methodology with additional modifications to incorporate a seawater absorption formula and account for energy emitted outside of the primary beam of the source. For sources that operate with different beamwidths, the maximum beam width was used, and the lowest frequency of the source was used when calculating the frequency-dependent absorption coefficient.

NMFS considers the data provided by Crocker and Fratantonio (2016) to represent the best scientific information available on source levels associated with HRG equipment and therefore, recommends that source levels provided by Crocker and Fratantonio (2016) be incorporated in the method described above to estimate ranges to the Level A harassment and Level B harassment isopleths. In cases when the source level for a specific type of HRG equipment is not provided in Crocker and Fratantonio (2016), NMFS recommends that either the source levels provided by the manufacturer be used or in instances where source levels provided by the manufacturer are unavailable or unreliable, a proxy from Crocker and Fratantonio (2016) be used instead. Sunrise Wind utilized the following criteria for selecting the appropriate inputs into the NMFS User Spreadsheet Tool (NMFS, 2018):

(1) For equipment that was measured in Crocker and Fratantonio (2016), the reported SL for the most likely operational parameters was selected.

(2) For equipment not measured in Crocker and Fratantonio (2016), the best available manufacturer specifications were selected. Use of manufacturer specifications represent the absolute maximum output of any source and do not adequately represent the operational source. Therefore, they should be considered an overestimate of the sound propagation range for that equipment.

(3) For equipment that was not measured in Crocker and Fratantonio (2016) and did not have sufficient manufacturer information, the closest proxy source measured in Crocker and Fratantonio (2016) was used.

The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the HRG surveys. These included variants of the Dura-spark sparker system and various configurations of the GeoMarine Geo-Source sparker system. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available. Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP–D700 and CSP–N). The CSP–D700 power source was used in the 700 joules (J) measurements but not in the 1,000 J measurements. The CSP–N source was measured for both 700 J and 1,000 J operations but resulted in a lower source level; therefore, the single maximum source level value was used for both operational levels of the S-Boom.

Table 32 identifies all the representative survey equipment that operates below 180 kHz (*i.e.,* at frequencies that are audible and have the potential to disturb marine mammals) that may be used in support of planned survey activities and are likely to be detected by marine mammals given the source level, frequency, and beamwidth of the equipment. This table also provides all operating parameters used to calculate the distances to threshold for marine mammals.

TABLE 32—SUMMARY OF REPRESENTATIVE HRG SURVEY EQUIPMENT AND OPERATING PARAMETERS

Equipment type	Representative equipment model	Operating frequency (kHz)	Source level SPL rms (dB)	Source level 0-pk (dB)	Pulse duration (rms)	Repetition rate (Hz)	Beamwidth (degrees)	Information source
Sub-bottom Profiler	EdgeTech 216	2–16	195	-	20	6	24	MAN.
	EdgeTech 424	4–24	176	-	3.4	2	71	CF.
	EdgeTech 512	0.7–12	179	-	9	8	80	CF.
	GeoPulse 5430A	2–17	196	-	50	10	55	MAN.
	Teledyn Benthos Chirp III—TTV 170	2–17	197	-	60	15	100	MAN.
Sparker	Applied Acoustics DuraSpark UHD (400 tips, 500 J).	0.3–1.2	203	211	1.1	4	Omni	CF.
Boomer	Applied Acoustics triple plate S-Boom (700–1,000 J).	0.1–5	205	211	0.6	4	80	CF.

- = not applicable; CF = Crocker and Fratantonio (2016); MAN = Manufactures Specifications.
Source Levels are given in dB re 1 µPa @1m.

Results of modeling using the methodology described above indicated that, of the HRG equipment planned for use by Sunrise Wind that has the potential to result in Level B harassment of marine mammals, sound produced by the Applied Acoustics sparkers and Applied Acoustics triple-plate S-boom would propagate furthest to the Level B harassment isopleth (141 m; Table 33). For the purposes of take estimation, it was conservatively assumed that sparkers and/or boomers would be the dominant acoustic source for all survey days (although, again, this may not always be the case). Thus, the range to the isopleth corresponding to the threshold for Level B harassment for and the boomer and sparkers (141 m) was used as the basis of take calculations for all marine mammals. This is a conservative approach as the actual sources used on individual survey days or during a portion of a survey day may produce smaller distances to the Level B harassment isopleth.

TABLE 33—DISTANCES TO THE LEVEL B HARASSMENT THRESHOLDS FOR EACH HRG SOUND SOURCE OR COMPARABLE SOUND SOURCE CATEGORY FOR EACH MARINE MAMMAL HEARING GROUP

Equipment type	Representative model	Level B harassment threshold (m)
		All (SPL_{rms})
Sub-bottom profiler	EdgeTech 216	9
	EdgeTech 424	4
	EdgeTech 512	6
	GeoPulse 5430A	21
	Teledyn Benthos Chirp III—TTV 170	48
Sparker	Applied Acoustics Dura-Spark UHD (700 tips, 1,000 J)	34
	Applied Acoustics Dura-Spark UHD (400 tips, 500 J)	141
Boomer	Applied Acoustics triple plate S-Boom (700–1,000 J)	141

To estimate densities for the HRG surveys occurring both within the lease area and within the SWEC based on Roberts and Halpin (2022), a 5-km (3.11 mi) perimeter was applied around each area (see Figures 34 and 35 of the Updated Density and Take Estimation Memo for Sunrise Wind) using GIS (ESRI, 2017). Given that HRG surveys could occur at any point year-round, the annual average density for each species was calculated using average monthly densities from January through December (Table 34).

TABLE 34—ANNUAL AVERAGE MARINE MAMMAL DENSITIES ALONG THE EXPORT CABLE CORRIDOR AND SUNRISE WIND LEASE AREA [1]

Marine mammal species	SWEC corridor annual average density (individual per km^2)	Lease area annual average density (individual per km^2)
Mysticetes:		
Blue whale *	0.0000	0.0000
Fin Whale *	0.0022	0.0020
Humpback Whale	0.0011	0.0012
Minke Whale	0.0052	0.0051
North Atlantic Right Whale *	0.0004	0.0016
Sei Whale *	0.0004	0.0005
Odontocetes:		
Atlantic Spotted Dolphin	0.0006	0.0005
Atlantic White-sided Dolphin	0.0117	0.0144
Bottlenose Dolphin	0.0127	0.0091
Common Dolphin	0.0827	0.0802
Harbor Porpoise	0.0297	0.0372
Pilot Whales	0.0011	0.0021
Risso's Dolphin	0.0005	0.0005
Sperm Whale *	0.0001	0.0002
Phocid (pinnipeds):		
Seals (Harbor and Gray)	0.0910	0.0917

* Denotes species listed under the Endangered Species Act.
[1] Values presented in this table are from the Sunrise Wind Updated Density and Take Estimation Memo, which can be found on NMFS' website.

The maximum range (141 m) to the Level B harassment threshold and the estimated trackline distance traveled per day by a given survey vessel (*i.e.,* 70 km) were then used to calculate the daily ensonified area or zone of influence (ZOI) around the survey vessel.

The ZOI is a representation of the maximum extent of the ensonified area around a HRG sound source over a 24-hr period. The ZOI for each piece of equipment operating at or below 180 kHz was calculated per the following formula:

$$ZOI = (Distance/day \times 2r) + pi \ x \ r^2$$

Where *r* is the linear distance from the source to the harassment isopleth.

The largest daily ZOI (19.8 km² (7.64 mi²)), associated with the proposed use of boomers, was applied to all planned survey days.

Overally, Sunrise Wind estimated approximately a length of 12,604 km (7,831.76 mi) of surveys will occur within the Lease Area and 11,946 km (7,422.9 mi) would occur within the SWEC corridor. Potential Level B density-based harassment exposures are estimated by multiplying the average annual density of each species within the survey area by the daily ZOI. That product was then multiplied by the number of planned survey days in each sector during the approximately 2-year construction timeframe (171 days in the SWEC corridor and 180 days in the Lease Area), and the product was rounded to the nearest whole number. This assumed a total ensonified area of 3,566 km² (1,376.84 mi²) in the Lease Area and 3,380 km² (1,305.03 mi²) along the SWEC corridor. Given that the HRG surveys are anticipated to occur over 2 years of construction activities, the total survey effort and associated ensonified areas were split equally across 2 years. These results can be found in Table 35.

TABLE 35—ESTIMATE TAKE, BY LEVEL B HARASSMENT, INCIDENTAL TO HRG SURVEYS DURING THE 2-YEAR CONSTRUCTION PERIOD (WITH INFORMATION PRESENTED FOR BOTH YEARS OF CONSTRUCTION ACTIVITIES)

Marine mammal species	Year 1 construction phase take by survey		Year 2 construction phase take by survey		Total density-based take estimate	PSO data take estimate	Mean group size	Highest annual level B take for year 1	Highest annual level B take for year 2
	SRWF lease area	SRWF EC corridor	SRWF lease area	SRWF EC corridor					
Mysticetes:									
Blue Whale *	0.0	0.0	0.0	0.0	0.0	....	1.0	1	1
Fin Whale *	3.6	3.7	3.6	3.7	7.3	5.3	1.8	8	8
Humpback Whale	2.1	1.9	2.1	1.9	4.0	13.2	2.0	14	14
Minke Whale	9.0	8.7	9.0	8.7	17.8	4.8	1.2	18	18
North Atlantic Right Whale *	2.8	0.7	2.8	0.7	3.5	....	2.4	4	4
Sei Whale *	0.9	0.7	0.9	0.7	1.5	....	1.6	2	2
Odontocetes:									
Atlantic Spotted Dolphin	0.9	1.1	0.9	1.1	2.0	....	29.0	29	29
Atlantic White-sided Dolphin	25.6	19.8	25.6	19.8	45.4	....	27.9	46	46
Bottlenose Dolphin	16.2	21.5	16.2	21.5	37.8	80.3	7.8	81	81
Common Dolphin	143.0	139.8	143.0	139.8	282.8	1,887.3	34.9	1,888	1,888
Harbor Porpoise	66.3	50.1	66.3	50.1	116.4	....	2.7	117	117
Pilot Whales	3.7	1.9	3.7	1.9	5.6	....	8.4	9	9
Risso's Dolphin	1.0	0.9	1.0	0.9	1.8	1.9	5.4	6	6
Sperm Whale *	0.4	0.2	0.4	0.2	0.6	....	1.5	2	2
Phocid (pinnipeds):									
Gray Seal	50.3	47.4	50.3	47.4	97.7	5.7	1.4	98	98
Harbor Seal	113.1	106.4	113.1	106.4	219.5	9.0	0.0	220	220

* Denotes species listed under the Endangered Species Act.

As mentioned previously, HRG surveys would also routinely be carried out during the period of time following construction of the Sunrise Wind Lease Area and SWEC corridor, which, for the purposes of exposure modeling, Sunrise Wind assumed to be 3 years. Generally, Sunrise followed the same approach as described above for HRG surveys occurring during the 2 years of construction activities with the only modification during the 3-year operations years being a difference in the survey effort. During the 3 years of operations, Sunrise Wind estimates that HRG surveys would cover 2,898 km (1,800.73 mi) within the Lease Area and 3,413 km (2,120.74 mi) along the SRWEC corridor annually. Maintaining that 70 km (43.5 mi) are surveyed per day, this amounts to 41.4 days of survey activity in the Lease Area and 48.8 days of survey activity along the SRWEC corridor each year or 270.6 days total for the three-year timeframe following the 2 years of construction activities. Density-based take was estimated using the same approach outlined above by multiplying the daily ZOI by the annual average densities and separately by the number of survey days planned for the SWEC and Sunrise Wind Lease Area. Using the same approach described above, Sunrise Wind estimated a conservative amount of annual take by Level B harassment based on the highest exposures predicted by the density-based, PSO based, or average group size-based estimates. The highest predicted exposure value was multiplied by three to yield the amount of take Sunrise Wind requested and that is proposed for authorization, as shown in Table 36 below.

TABLE 36—ESTIMATE TAKE, BY LEVEL B HARASSMENT, INCIDENTAL TO HRG SURVEYS DURING THE 3-YEAR OPERATIONS PERIOD

Marine mammal species	Annual operations phase take by survey area		Annual total density-based take estimate	Annual PSO Data take estimate	Mean group size	Highest annual Level B take	Total Level B take over 3 years of HRG surveys
	SRWF lease area	SRWF EC corridor					
Mysticetes:							
Blue Whale *	0.0	0.0	0.0	....	1.0	1	3
Fin Whale *	1.6	2.1	3.7	2.7	1.8	4	12
Humpback Whale	1.0	1.1	2.0	6.8	2.0	7	21
Minke Whale	4.2	5.0	9.1	2.4	1.2	10	30
North Atlantic Right Whale *	1.3	0.4	1.7	....	2.4	3	9
Sei Whale *	0.4	0.4	0.8	....	1.6	2	6
Odontocetes:							
Atlantic Spotted Dolphin	0.4	0.6	1.0	....	29.0	29	87
Atlantic White-sided Dolphin	11.8	11.3	23.1	....	27.9	28	84

TABLE 36—ESTIMATE TAKE, BY LEVEL B HARASSMENT, INCIDENTAL TO HRG SURVEYS DURING THE 3-YEAR OPERATIONS PERIOD—Continued

Marine mammal species	Annual operations phase take by survey area		Annual total density-based take estimate	Annual PSO Data take estimate	Mean group size	Highest annual Level B take	Total Level B take over 3 years of HRG surveys
	SRWF lease area	SRWF EC corridor					
Bottlenose Dolphin	7.5	12.3	19.8	41.3	7.8	42	126
Common Dolphin	65.8	79.9	145.7	970.4	34.9	971	2,913
Harbor Porpoise	30.5	28.6	59.1		2.7	60	180
Pilot Whales	1.7	1.1	2.8		8.4	9	27
Risso's Dolphin	0.4	0.5	0.9	1.0	5.4	6	18
Sperm Whale *	0.2	0.1	0.3		1.5	2	6
Phocid (pinnipeds):							
Gray Seal	23.3	27.1	50.2	2.9	1.4	51	153
Harbor Seal	52.0	60.8	112.8	4.6	1.4	113	339

* Denotes species listed under the Endangered Species Act.

Total Proposed Take Across All Activities

Level A harassment and Level B harassment proposed take numbers for the combined activities of impact pile driving (assuming 10 dB of sound attenuation) during the impact installation of monopile, OCS–DC foundations, and casing pipe installation; vibratory pile driving for sheet pile installation and removal; HRG surveys; and potential UXO/MEC detonations are provided by year in Table 37. NMFS also presents the 5-year total amount of take for each species in Table 38. The mitigation and monitoring measures provided in the Proposed Mitigation and Proposed Monitoring and Reporting sections are activity-specific and are designed to minimize acoustic exposures to marine mammal species.

Table 37 below depicts the proposed annual take for authorization, given that specific activities are expected to occur within specific years. Sunrise Wind is currently planning for all construction activities related to permanent structures (*i.e.,* WTG foundations, OCS–DC foundation installation, cable landfall structures) to occur within the first year of the project. HRG surveys are expected to occur, with varying effort, across all 5-years of the proposed rulemaking's effective duration. More specifically, as a conservative assumption, the Year 1 proposed take includes the installation of all WTGs and OCS–DC foundations, cable landfall construction, one year of HRG surveys, and up to three high-order detonations of UXOs/MECs (at a rate of one per day for up to three days). Take for years 2–5 accounts for HRG surveys. NMFS notes that while HRG surveys are expected to occur across all 5years (2023–2028) of the effective period of the rulemaking (a total of 621 days across all 5 years), survey effort will vary. As such, during the first 2 years, up to 180 days of survey effort in the Lease Area and 171 days in the export cable corridor would occur and during the three post-construction/operation years of Sunrise Wind, up to 41.4 days of survey activity in the Lease Area and 48.8 days of survey activity along the SWEC corridor would occur annually, equating to a total of 270.6 days during the last 3 years of the rulemaking. All activities are expected to be completed by early 2028, equating to the 5 years of activities as described in this preamble.

Based on the distribution of activities over the five-year period described above and the annual take estimates shown in Tables 21, 25, 30, 35, and 36 above, Tables 37 and 38 below summarize the total (across all activities) yearly and five-year take proposed for authorization.

TABLE 37—PROPOSED LEVEL A HARASSMENT AND LEVEL B HARASSMENT TAKES FOR ALL ACTIVITIES PROPOSED TO BE CONDUCTED DURING THE CONSTRUCTION AND DEVELOPMENT OF THE SUNRISE WIND OFFSHORE WIND ENERGY FACILITY OVER 5 YEARS. YEAR 1 REPRESENTS THE MAXIMUM AMOUNT OF TAKE THAT WOULD BE AUTHORIZED ANNUALLY

Marine mammal species	NMFS stock abundance	Year 1		Year 2		Year 3		Year 4		Year 5	
		Level A harassment	Level B harassment	Level A harassment	Level B harassment	Level A harassment	Level B harassment	Level A harassment	Level B harassment	Level A harassment	Level B harassment
Mysticetes:											
Blue whale *	[a] 412	0	4	0	1	0	1	0	1	0	1
Fin whale *	6,802	4	78	0	8	0	4	0	4	0	4
Humpback whale	1,396	3	89	0	14	0	7	0	7	0	7
Minke whale	21,968	27	419	0	18	0	10	0	10	0	10
North Atlantic Right whale *	368	0	35	0	4	0	3	0	3	0	3
Sei whale *	6,292	2	31	0	2	0	2	0	2	0	2
Odontocetes:											
Atlantic spotted dolphin	39,921	0	114	0	15	0	29	0	29	0	29
Atlantic white-sided dolphin	93,221	0	639	0	46	0	28	0	28	0	28
Bottlenose dolphin	62,851	0	425	0	81	0	42	0	42	0	42
Common dolphin	172,974	0	7,393	0	1,888	0	971	0	971	0	971
Harbor porpoise	95,543	20	1,008	0	117	0	60	0	60	0	60
Pilot whales	68,139	0	58	0	6	0	9	0	9	0	9
Risso's dolphin	35,215	0	47	0	3	0	6	0	6	0	6
Sperm whale *	4,349	0	14	0	1	0	2	0	2	0	2
Phocid (pinnipeds):											
Gray seal	27,300	3	1,099	0	98	0	51	0	51	0	51
Harbor Seal	61,336	5	2,468	0	220	0	113	0	113	0	113

* Denotes species listed under the Endangered Species Act.

[a] The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination.

TABLE 38—TOTAL 5-YEAR PROPOSED TAKES OF MARINE MAMMALS (BY LEVEL A HARASSMENT AND LEVEL B HARASSMENT) FOR ALL ACTIVITIES PROPOSED TO BE CONDUCTED DURING THE CONSTRUCTION AND DEVELOPMENT OF THE SUNRISE WIND OFFSHORE WIND ENERGY PROJECT

Marine mammal species	NMFS stock abundance	5-Year totals		
		Proposed Level A harassment	Proposed Level B harassment	5-Year sum (Level A + Level B)
Mysticetes:				
Blue whale *	[a] 402	0	7	7
Fin whale *	6,802	4	97	101
Humpback whale	1,396	3	123	126
Minke whale	21,968	27	467	494
North Atlantic Right whale *	368	0	47	47
Sei whale *	6,292	2	39	41
Odontocetes:				
Atlantic Spotted dolphin	39,921	0	215	215
Atlantic White-sided dolphin	93,221	0	768	768
Bottlenose dolphin	62,851	0	631	631
Common dolphin	172,974	0	12,193	12,193
Harbor porpoise	95,543	20	1,304	1,324
Pilot whales	68,139	0	91	91
Risso's dolphin	35,215	0	68	68
Sperm whale *	4,349	0	21	21
Phocid (pinnipeds):				
Gray seal	27,300	3	1,350	1,353
Harbor seal	61,336	5	3,027	3,032

* Denotes species listed under the Endangered Species Act.
[a] The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination.

To inform both the negligible impact analysis and the small numbers determination, NMFS assesses the greatest amount of proposed take of marine mammals that could occur within any given year (which in the case of this rule is based on the predicted Year 1 for all species). In this calculation, the maximum estimated number of Level A harassment takes in any one year is summed with the maximum estimated number of Level B harassment takes in any one year for each species to yield the highest number of estimated take that could occur in any year. Table 39 also depicts the amount of take proposed relative to each stock assuming that each individual is taken only once, which specifically informs the small numbers determination.

TABLE 39—MAXIMUM NUMBER OF PROPOSED TAKES (LEVEL A HARASSMENT AND LEVEL B HARASSMENT) THAT COULD OCCUR IN ANY ONE YEAR OF THE PROJECT RELATIVE TO STOCK POPULATION SIZE ASSUMING EACH TAKE IS OF A DIFFERENT INDIVIDUAL

Marine mammal species	NMFS stock abundance	Maximum annual take proposed for authorization			
		Maximum Level A harassment [b]	Maximum Level B harassment [c]	Maximum annual take [d]	Total percent stock taken based on maximum annual take [e]
Mysticetes:					
Blue Whale *	[a] 412	0	4	4	0.97
Fin Whale *	6,802	4	78	82	1.21
Humpback Whale	1,396	3	89	92	6.59
Minke Whale	21,968	27	419	446	2.03
North Atlantic Right Whale *	368	0	35	35	9.51
Sei Whale *	6,292	2	31	33	0.52
Odontocetes:					
Atlantic Spotted Dolphin	39,921	0	114	114	0.29
Atlantic White-sided Dolphin	93,221	0	639	639	0.69
Bottlenose Dolphin	62,851	0	425	425	0.68
Common Dolphin	172,974	0	7,393	7,393	4.27
Harbor Porpoise	95,543	20	1,008	1,028	1.08
Pilot Whales	68,139	0	58	58	0.09
Risso's Dolphin	35,215	0	47	47	0.13
Sperm Whale *	4,349	0	14	14	0.32
Phocid (pinnipeds):					
Gray Seal	27,300	3	1,099	1,102	4.04
Harbor Seal	61,336	5	2,468	2,473	4.03

* Denotes species listed under the Endangered Species Act.

[a] The minimum blue whale population is estimated at 412, although the exact value is not known. NMFS is utilizing this value for our preliminary small numbers determination.
[b] These values are based on the activities occurring in Year 1 of the project, as these are conservatively estimated to cause the highest numbers of Level A harassment takes of marine mammals.
[c] These values are based on the activities occurring in Year 1 of the project, as these are conservatively estimated to cause the highest numbers of Level C harassment takes of marine mammals.
[d] Calculations of the maximum annual take are based on the maximum requested Level A harassment take in any one year + the total requested Level B harassment take in any one year.
[e] Calculations of percentage of stock taken are based on the maximum requested Level A harassment take in any one year + the total requested Level B harassment take in any one year and then compared against the best available abundance estimate as shown in Table 5. For this proposed action, the best available abundance estimates are derived from the NMFS Stock Assessment Reports (Hayes *et al.,* 2022).

Proposed Mitigation

In order to promulgate a rulemaking under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to the activity, and other means of effecting the least practicable impact on the species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS' regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting the activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned), the likelihood of effective implementation (probability implemented as planned), and;

(2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The mitigation strategies described below are consistent with those required and successfully implemented under previous incidental take authorizations issued in association with in-water construction activities (*e.g.,* soft-start, establishing shutdown zones). Additional measures have also been incorporated to account for the fact that the proposed construction activities would occur offshore. Modeling was performed to estimate harassment zones, which were used to inform mitigation measures for pile driving activities to minimize Level A harassment and Level B harassment to the extent practicable while providing estimates of the areas within which Level B harassment might occur.

Generally speaking, the measures considered and proposed here fall into three categories: temporal (seasonal and daily) work restrictions, real-time measures (shutdown, clearance zones, and vessel strike avoidance), and noise abatement/reduction measures. Seasonal work restrictions are designed to avoid or minimize operations when marine mammals are concentrated or engaged in behaviors that make them more susceptible, or make impacts more likely) in order to reduce both the number and severity of potential takes, and are effective in reducing both chronic (longer-term) and acute effects. Real-time measures, such as shutdown and pre-clearance zones, and vessel strike avoidance measures are intended to reduce the probability or scope of near-term acute impacts by taking steps in real time once a higher-risk scenario is identified (*i.e.,* once animals are detected within an impact zone). Noise abatement measures, such as bubble curtains, are intended to reduce the noise at the source, which reduces both acute impacts as well as the contribution to aggregate and cumulative noise that results in longer term chronic impacts.

Below, we describe training, coordination, and vessel strike avoidance measures that apply to all activity types, and then in the following subsections, we describe the measures that apply specifically to WTG and OCS–DC foundation installation, sheet pile or casing pipe scenario installation and removal, UXO/MEC detonations, HRG surveys, and fishery monitoring surveys.

Training and Coordination

Sunrise Wind would be required to instruct all project personnel regarding the authority of the marine mammal monitoring team(s). For example, the HRG acoustic equipment operator, pile driving personnel, *etc.,* would be required to immediately comply with any call for a delay or shutdown by the Lead PSO. Any disagreement between the Lead PSO and the project personnel would only be discussed after delay or shutdown has occurred. All relevant personnel and the marine mammal monitoring team would be required to participate in joint, onboard briefings that would be led by Sunrise Wind project personnel and the Lead PSO prior to the beginning of project activities. This would serve to ensure that all relevant responsibilities, communication procedures, marine mammal monitoring and mitigation protocols, reporting protocols, safety, operational procedures, and ITA requirements are clearly understood by all involved parties. The briefing would be repeated whenever new relevant personnel (*e.g.,* new PSOs, acoustic source operators, relevant crew) join the operation before work commences.

More information on vessel crew training requirements can be found in the *Vessel Strike Avoidance Measures* section below.

North Atlantic Right Whale Awareness Monitoring

Sunrise Wind must use available sources of information on North Atlantic right whale presence, including daily monitoring of the Right Whale Sightings Advisory System, monitoring of Coast Guard VHF Channel 16 throughout each day to receive notifications of any sightings, and information associated with any regulatory management actions (*e.g.,* establishment of a zone identifying the need to reduce vessel speeds). Maintaining daily awareness and coordination affords increased protection of North Atlantic right whales by understanding North Atlantic right whale presence in the area through ongoing visual and passive acoustic monitoring efforts and opportunities (outside of Sunrise Wind's efforts) and allows for planning of construction activities, when practicable, to minimize potential impacts on North Atlantic right whales.

Protected Species Observers and PAM Operator Training

Sunrise Wind would employ NMFS-approved PSOs and PAM operators. The PSO field team and PAM team would have a lead member (designated as the ''Lead PSO'' or ''PAM Lead'') who would have prior experience observing mysticetes, odontocetes and pinnipeds in the Northwestern Atlantic Ocean on other offshore projects requiring PSOs. Any remaining PSOs and PAM operators must have previous experience observing marine mammals during projects and must have the ability to work with all required and relevant software and equipment. New and/or inexperienced PSOs would be paired with an experienced PSO to ensure that the quality of marine mammal observations and data recording is kept consistent.

All PSOs and PAM operators would be required to complete a Permits and Environmental Compliance Plan (PECP) training as well as a 2-day training and refresher session on monitoring protocols. These trainings would be held with the PSO provider and project compliance representatives and would occur before the start of project activities related to the construction and development of the Sunrise Wind Offshore Wind Farm Project. PSOs would be required during all foundation installations, sheet pile or casing pipe installation/removal activities, UXO/MEC detonations, and HRG surveys. More information on requirements during each activity can be found in the Proposed Monitoring and Reporting section.

Vessel Strike Avoidance Measures

This proposed rule contains numerous vessel strike avoidance measures. Sunrise Wind will be required to comply with these measures except under circumstances when doing so would create an imminent and serious threat to a person or vessel or to the extent that a vessel is unable to maneuver and because of the inability to maneuver, the vessel cannot comply (*e.g.,* due to towing, *etc.*). Vessel operators and crews will receive protected species identification training prior to the start of in-water construction activities. This training will cover information about marine mammals and other protected species known to occur or which have the potential to occur in the project area. It will include training on making observations in both good weather conditions (*i.e.,* clear visibility, low wind, and low sea state) and bad weather conditions (*i.e.,* fog, high winds and high sea states, in glare). Training will not only include identification skills but will also include information and resources available regarding applicable Federal laws and regulations for protected species.

Sunrise Wind will abide by the following vessel strike avoidance measures:

- All vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course (as appropriate) to avoid striking any marine mammal.
- During any vessel transits within or to/from the Sunrise Wind project area, such as for crew transfers, an observer would be stationed at the best vantage point of the vessel(s) to ensure that the vessel(s) are maintaining the appropriate separation distance from marine mammals.
- Year-round and when a vessel is in transit, all vessel operators will continuously monitor U.S. Coast Guard VHF Channel 16 over which North Atlantic right whale sightings are broadcasted.
- At the onset of transiting and at least once every four hours, vessel operators and/or trained crew members will monitor the project's Situational Awareness System, WhaleAlert, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales Any observations of any large whale by any Sunrise Wind staff or contractors, including vessel crew, must be communicated immediately to PSOs, PAM operator, and all vessel captains to increase situational awareness. Conversely, any large whale observation or detection via a sighting network (*e.g.,* Mysticetus) by PSOs or PAM operators will be conveyed to vessel operators and crew.
- All vessels would comply with existing NMFS regulations and speed restrictions and state regulations, as applicable, for North Atlantic right whales.
- In the event that any Slow Zone (designated as a DMA) is established that overlaps with an area where a project-associated vessel would operate, that vessel, regardless of size, will transit that area at 10 knots or less.
- Between November 1st and April 30th, all vessels, regardless of size, would operate port to port (specifically from ports in New Jersey, New York, Maryland, Delaware, and Virginia) at 10 knots or less, except for vessels while transiting in Narragansett Bay or Long Island Sound (which have not been demonstrated by best available science to provide consistent habitat for North Atlantic right whales).
- All vessels, regardless of size, would immediately reduce speed to 10 knots or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed near (within 100 m) an underway vessel.
- All vessels, regardless of size, would immediately reduce speed to 10 knots or less when a North Atlantic right whale is sighted, at any distance, by an observer or anyone else on the vessel.
- If a vessel is traveling at greater than 10 knots, in addition to the required dedicated visual observer, real-time PAM of transit corridors must be conducted prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 knots or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 12 hours.
- All underway vessels (*e.g.,* transiting, surveying) must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this proposed action. Visual observers may be third-party observers (*i.e.,* NMFS-approved PSOs) or crew members and must not have any other duties other than observing for marine mammals. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine

mammal. Confirmation of the observers' training and understanding of the ITA requirements must be documented on a training course log sheet and reported to NMFS.

- All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action.
- If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 knots or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale or a large whale that cannot be confirmed as a species other than a North Atlantic right whale is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action.
- All vessels must maintain a minimum separation distance of 100 m from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 100 m.
- All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinoid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral (again, with an exception made for those that approach the vessel). Engines will not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m.
- When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.,* any situation where the vessel is navigationally constrained).
- All vessels underway must not divert or alter course in order to approach any marine mammal.
- For in-water construction heavy machinery activities, other than impact or vibratory pile driving, if a marine mammal is on a path towards or comes within 10 m of equipment, Sunrise Wind must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment.
- Sunrise Wind must submit a North Atlantic right whale vessel strike avoidance plan 180 days prior to commencement of vessel use. The plan would, at minimum, describe how PAM, in combination with visual observations, would be conducted to ensure the transit corridor is clear of right whales. The plan would also provide details on the vessel-based observer protocols on transiting vessels.

WTG and OCS–DC Foundation Installation

For WTG and OCS–DC foundation installation, NMFS is proposing to include the following mitigation requirements, which are described in detail below: seasonal and daily restrictions; the use of noise abatement systems; the use of PSOs and PAM operators; the implementation of clearance and shutdown zones, and the use of soft-start.

Seasonal and Daily Restrictions

No foundation impact pile driving activities would occur January 1 through April 30. Based on the best scientific information available (Roberts and Halpin, 2022), the highest densities of North Atlantic right whales in the project area are expected during the months of January through April. NMFS is requiring this seasonal work restriction to minimize the potential for North Atlantic right whales to be exposed to noise incidental to impact pile driving of monopiles, which is expected to greatly reduce the number of takes of North Atlantic right whales.

No more than three foundation monopiles would be installed per day. Monopiles would be no larger than 15-m in diameter, representing the larger end of the tapered 7/15-m monopile design. For all monopiles, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,000 kJ.

Sunrise Wind has requested authorization to initiate pile driving during nighttime when detection of marine mammals is visually challenging. To date, Sunrise Wind has not submitted a plan containing the information necessary, including evidence, that their proposed systems are capable of detecting marine mammals, particularly large whales, at night and at distances necessary to ensure mitigation measures are effective. The available information on traditional night vision technologies demonstrates that there is a high degree of uncertainty in reliably detecting marine mammals at night at the distances necessary for this project (Smultea *et al.,* 2021). Therefore, at this time, NMFS plans to only allow Sunrise Wind to initiate pile driving during daylight hours and prohibit Sunrise Wind from initiating pile driving earlier than one hour after civil sunrise or later than 1.5 hours before civil sunset. We are, however, proposing to encourage and allow Sunrise Wind the opportunity to further investigate and test advanced technology and detection systems to support their request. NMFS is proposing to condition the LOA such that nighttime pile driving would only be allowed if Sunrise Wind submits an Alternative Monitoring Plan (as part of the Pile Driving and Marine Mammal Monitoring Plan) to NMFS for approval that proves the efficacy of their night vision devices (*e.g.,* mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting protected marine mammals prior to making a determination in the final rule. The plan must include a full description of the proposed technology, monitoring methodology, and supporting data demonstrating the reliability and effectiveness of the proposed technology in detecting marine mammal(s) within the clearance and shutdown zones for monopiles before and during impact pile driving. The Plan should identify the efficacy of the technology at detecting marine mammals in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting.

Noise Abatement Systems

Sunrise Wind would employ noise abatement systems (NAS), also known as noise attenuation systems, during all impact pile driving of monopiles to reduce the sound pressure levels that are transmitted through the water in an effort to reduce ranges to acoustic thresholds and minimize any acoustic impacts resulting from impact pile driving. Sunrise Wind would be required to employ a big double bubble curtain or a combination of two or more NAS during these activities as well as the adjustment of operational protocols to minimize noise levels.

Two categories of NAS exist: primary and secondary. A primary NAS would be used to reduce the level of noise produced by the pile driving activities at the source, typically through adjustments on to the equipment (*e.g.,* hammer strike parameters). Primary NAS are still evolving and will be considered for use during mitigation efforts when the NAS has been demonstrated as effective in commercial projects. However, as primary NAS are not fully effective at eliminating noise, a secondary NAS would be employed. The secondary NAS is a device or group of devices that would reduce noise as it was transmitted through the water away from the pile, typically through a physical barrier that would reflect or absorb sound waves and therefore, reduce the distance the higher energy sound propagates through the water column. Together, these systems must reduce noise levels to the lowest level practicable with the goal of not exceeding measured ranges to Level A harassment and Level B harassment isopleths corresponding to those modeled assuming 10 dB sound attenuation, pending results of SFV (see the *Acoustic Monitoring for Sound Field and Harassment Isopleth Verification* section).

Noise abatement systems, such as bubble curtains, are used to decrease the sound levels radiated from a source. Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the bubbles determines their effective frequency band, with larger bubbles needed for lower frequencies. There are a variety of bubble curtain systems, confined or unconfined bubbles, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. Small bubble curtains have been measured to reduce sound levels but effective attenuation is highly dependent on depth of water, current, and configuration and operation of the curtain (Austin *et al.,* 2016; Koschinski and Lüdemann, 2013). Bubble curtains vary in terms of the sizes of the bubbles and those with larger bubbles tend to perform a bit better and more reliably, particularly when deployed with two separate rings (Bellmann, 2014; Koschinski and Lüdemann, 2013; Nehls *et al.,* 2016). Encapsulated bubble systems (*e.g.,* Hydro Sound Dampers (HSDs)), can be effective within their targeted frequency ranges (*e.g.,* 100–800 Hz), and when used in conjunction with a bubble curtain appear to create the greatest attenuation. The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Secondary NAS that may be used by Sunrise Wind include a big bubble curtain (BBC), a hydro-sound damper (HSD), or an AdBm Helmholz resonator (Elzinga *et al.,* 2019). See Appendix B (Protected Species Mitigation and Monitoring Plan (PSMMP) of the ITA application for more information on these systems (Sunrise Wind, 2022b). If a single system is used, it must be a double big bubble curtain (dBBC). Other systems (*e.g.,* noise mitigation screens) are not considered feasible for the Sunrise Wind project as they are in their early stages of development and field tests to evaluate performance and effectiveness have not been completed. Should the research and development phase of these newer systems demonstrate effectiveness, as part of adaptive management, Sunrise Wind may submit data on the effectiveness of these systems and request approval from NMFS to use them during pile driving.

If a bubble curtain is used (single or double), Sunrise Wind would be required to maintain the following operational parameters: the bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 $m^3/(min*m)$ and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; no parts of the ring or other objects should prevent full seafloor contact. Sunrise Wind must require that construction contractors train personnel in the proper balancing of airflow to the bubble ring and must require that construction contractors submit an inspection/performance report for approval by Sunrise Wind within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving of monopiles. If Sunrise Wind uses a noise mitigation device in addition to a BBC, similar quality control measures would be required.

The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design as well as differences in site conditions and difficulty in properly installing and operating in-water attenuation devices. Dähne *et al.* (2017) found that single bubble curtains that reduce sound levels by 7 to 10 dB reduced the overall sound level by approximately 12 dB when combined as a double bubble curtain for 6-m steel monopiles in the North Sea. During installation of monopiles (~8 m) for more than 150 WTGs in comparable water depths (>25 m) and conditions in Europe indicate that attenuation of 10 dB is readily achieved (Bellmann, 2019; Bellmann *et al.,* 2020) using single BBCs for noise attenuation. Designed to gather additional data regarding the efficacy of BBCs, the Coastal Virginia Offshore Wind (CVOW) pilot project systematically measured noise resulting from the impact driven installation of two 7.8-m monopiles, one installation using a dBBC and the other installation using no noise abatement system (CVOW, unpublished data). Although many factors contributed to variability in received levels throughout the installation of the piles (*e.g.,* hammer energy, technical challenges during operation of the dBBC), reduction in broadband SEL using the dBBC (comparing measurements derived from the mitigated and the unmitigated monopiles) ranged from approximately 9–15 dB. Again, NMFS would require Sunrise Wind to apply a dBBC or a single BBC coupled with an additional noise mitigation device to ensure sound generated from the project does not exceed that modeled (assuming 10 dB reduction) at given ranges to harassment isopleths and to minimize noise levels to the lowest level practicable. Double BBCs are successfully and widely applied across European wind development efforts and are known to reduce noise levels more than single BBC alone (*e.g.,* Bellman *et al.,* 2020). Sunrise Wind anticipates and NMFS agrees that the use of a noise abatement system would likely produce field measurements of the isopleth distances to the Level A harassment and Level B harassment thresholds that accord with those modeled assuming 10 dB of attenuation for impact pile driving of monopiles (refer back to the Estimated Take, Proposed Mitigation, and

Proposed Monitoring and Reporting sections).

Use of PSOs and PAM Operators

As described above, Sunrise Wind would be required to use PSOs and acoustic PSOs (*i.e.,* PAM operators) during all foundation installation activities. At minimum, four PSOs would be actively observing marine mammals before, during, and after pile driving. At least two PSOs would be stationed on the pile driving vessel and at least two PSOs would be stationed on a secondary, dedicated PSO vessel. The dedicated PSO vessel would be located at the outer edge of the 2.3 km (in the summer; 4.4 km in the winter) large whale clearance zone (unless modified by NMFS based on SFV). Concurrently, at least one PAM operator would be actively monitoring for marine mammals before, during, and after pile driving. More details on PSO and PAM operator requirements can be found in the Proposed Monitoring and Reporting section.

Furthermore, all crew and personnel working on the Sunrise Wind project would be required to maintain situational awareness of marine mammal presence (discussed further above) and would be required to report any sightings to the PSOs.

Clearance and Shutdown Zones

NMFS is proposing to require the establishment of both clearance and shutdown zones during all impact pile driving of WTG and OCS–DC foundation piles, which would be monitored by visual PSOs and PAM operators before, during and after pile driving. Prior to the start of impact pile driving activities, Sunrise Wind would clear the area of marine mammals, per the clearance zones in Table 40, to minimize the potential for and degree of harassment.

The purpose of ''clearance'' of a particular zone is to prevent potential instances of auditory injury and more severe behavioral disturbance or in the case of North Atlantic right whales, avoid and minimize behavioral disturbance to the maximum extent practicable (for North Atlantic right whales, the clearance and shutdown zones are set to any distance; see Table 40) by delaying the commencement of impact pile driving if marine mammals are detected within certain pre-defined distances from the pile being installed.

PSOs would visually monitor for marine mammals for a minimum of 60 minutes immediately prior to commencement of pile driving while PAM operators would review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes immediately prior to pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes immediately prior to starting a soft-start of pile driving. If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and will not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone or when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species).

Mitigation zones related to impact pile driving activities were created around two different seasonal periods in consideration of the different seasonal sound speed profiles that were used in JASCO's underwater sound propagation modeling, including summer (May through November) and winter (December) (Table 40). In addition to the clearance and shutdown zones that would be monitored both visually and acoustically, NMFS is proposing to establish a minimum visibility zone to ensure that marine mammals are visually detected prior to commencement of pile driving. The minimum visibility zone would extend 2,300 m from the pile during summer months and 4,400 m during December (Table 40). These values correspond to the maximum low-frequency cetacean (*i.e.,* baleen whale) distances to the Level A harassment isopleths assuming three monopiles are driven in a day, rounded up to the nearest hundred. The entire minimum visibility zone must be visible (*i.e.,* not obscured by dark, rain, fog, *etc.*) for a full 30 minutes immediately prior to commencing impact pile driving. For North Atlantic right whales, there is an additional requirement that the clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred during the 60-minute monitoring period. Any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a non-North Atlantic right whale must be treated as if it were a North Atlantic right whale.

The purpose of a shutdown is to prevent a specific acute impact, such as auditory injury or severe behavioral disturbance of sensitive species, by halting the activity. If a marine mammal is observed entering or within the respective shutdown zone (Table 40) after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving. In situations when shutdown is called for but Sunrise Wind determines shutdown is not practicable due to imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy must be implemented when the lead engineer determines it is practicable. Specifically, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal, and a shut-down would lead to a stuck pile which then poses an imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk for individuals. Pile instability occurs when the pile is unstable and unable to stay standing if the piling vessel were to ''let go.'' During these periods of instability, the lead engineer may determine a shutdown is not feasible because the shutdown combined with impending weather conditions may require the piling vessel to ''let go'', which then poses an imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk for individuals. In these situations, Sunrise Wind must reduce hammer energy to the lowest level practicable.

After shutdown, impact pile driving may be reinitiated once all clearance zones are clear of marine mammals for the minimum species-specific periods (15 minutes for small odontocetes and 30 minutes for all other marine mammal species). If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability, at which time Sunrise Wind must use the lowest hammer energy practicable to maintain stability. Upon re-starting pile driving, soft-start protocols must be followed.

The clearance and shutdown zone sizes vary by species and are shown in Tables 40, 41, and 42. All distances to the perimeter of clearance zones are the radii from the center of the pile. Pursuant to the proposed adaptive management provisions, Sunrise Wind may request modification to these zone sizes pending results of sound field verification (see Proposed Monitoring and Reporting section). Any changes to zone size would require NMFS' approval.

TABLE 40—RANGES AND MITIGATION ZONES [a f g] TO THE LEVEL A AND LEVEL B HARASSMENT THRESHOLDS DURING IMPACT PILE DRIVING OF WTG FOUNDATIONS IN SUMMER AND WINTER

Marine mammal species	WTG foundation impact installation							
	Level A harassment zone (m; SEL_{cum}) [c]	Level B harassment zone (m) [f]	Clearance zone (m) [d f h]	Shutdown zone (m) [d f h]	Level A harassment zone (m; SEL_{cum}) [c]	Level B harassment zone (m) [f]	Clearance zone (m) [d f h]	Shutdown zone (m) [d f h]
	Summer (May through November)				Winter (December only)			
Low-frequency cetaceans:								
Fin whale *	3,680	6,490	3,700	3,700	4,240	6,970	4,300	4,300
Minke whale	1,860	6,490	3,700	3,700	2,020	6,970	4,300	4,300
Sei whale *	2,670	6,490	3,700	3,700	3,010	6,970	4,300	4,300
Humpback whale	3,400	6,490	3,700	3,700	3,820	6,970	4,300	4,300
North Atlantic right whale *	2,510	6,490	See Table 42	See Table 42	2,900	6,970	See Table 42	See Table 42
Blue whale * [e]	3,680	6,490	3,700	3,700	4,240	6,970	4,300	4,300
Mid-frequency cetaceans:								
Sperm whale *	....	6,490	3,700	3,700	....	6,970	4,300	4,300
Atlantic spotted dolphin	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
Atlantic white-sided dolphin	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
Common dolphin	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
Risso's dolphin	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
Bottlenose dolphin	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
Long-finned pilot whale	....	6,490	[b] NAS	[b] NAS	....	6,970	[b] NAS	[b] NAS
High-frequency cetaceans:								
Harbor porpoise	....	6,490	200	200	....	6,970	[b] NAS	[b] NAS
Phocid Pinnipeds:								
Gray seal	30	6,490	100	100	30	6,970	100	100
Harbor seal	80	6,490	100	100	80	6,970	100	100

* Denotes species listed under the Endangered Species Act.
[a] Zones were made on the assumptions that 7/12-m tapered monopiles would be installed at a rate of 3 monopiles per day with 10 dB of noise attenuation from a noise attenuation system.
[b] NAS (noise abatement system) means the perimeter of the NAS will serve as the clearance and shutdown zone for species where NAS is indicated.
[c] The Level A zone represents the exposure ranges of species derived from animal movement modeling.
[d] The pre-start clearance and shutdown zone for large whales, porpoise, and seals is based upon the maximum Level A zone rounded up for PSO clarity.
[e] As no Level A exposures were calculated for blue whales (meaning no Level A exposure ranges were calculated), the exposure range for fin whales was used as a proxy.
[f] All zone monitoring would be achieved through visual observations and passive acoustic monitoring.
[g] Sunrise Wind's proposed mitigation and monitoring distances are found in Tables 7 and 8 in Sunrise Wind's Protected Species Mitigation and Monitoring Plan; however, NMFS has slightly rounded/modified some of these ranges for PSO clarity.
[h] The minimum visibility zone would extend 2,300 m from the pile during summer months and 4,400 m during December.

TABLE 41—RANGES AND MITIGATION ZONES [a f g] TO THE LEVEL A AND LEVEL B HARASSMENT THRESHOLDS DURING IMPACT PILE DRIVING OF PILES FOR THE OCS–DC IN SUMMER AND WINTER

Marine mammal species	OCS–DC impact installation							
	Level A harassment zone (m; SEL_{cum}) [c]	Level B harassment zone (m) [f]	Clearance zone (m) [d f]	Shutdown zone (m) [d f]	Level A harassment zone (m; SEL_{cum}) [c]	Level B harassment zone (m) [f]	Clearance zone (m) [d f]	Shutdown zone (m) [d f]
	Summer (May through November)				Winter (December only)			
Low-frequency cetaceans:								
Fin whale *	5,550	6,470	5,600	5,600	6,420	6,630	6,500	6,500
Minke whale	2,880	6,470	5,600	5,600	3,200	6,630	6,500	6,500
Sei whale *	4,220	6,470	5,600	5,600	4,730	6,630	6,500	6,500
Humpback whale	5,130	6,470	5,600	5,600	6,030	6,630	6,500	6,500
North Atlantic right whale *	3,620	6,470	See Table 42	See Table 42	4,060	6,630	See Table 42	See Table 42
Blue whale *	5,550	6,470	5,600	5,600	6,420	6,630	6,500	6,500
Mid-frequency cetaceans:								
Sperm whale *	....	6,470	5,600	5,600	....	6,630	6,500	6,500
Atlantic spotted dolphin	....	6,470	[b] NAS	[b] NAS	....	6,630	[b] NAS	[b] NAS
Atlantic white-sided dolphin	....	6,470	[b] NAS	[b] NAS	....	6,630	[b] NAS	[b] NAS

Common dolphin	....	6,470	[b] NAS	[b] NAS	....	6,630	[b] NAS	[b] NAS
Bottlenose dolphin	....	6,470	[b] NAS	[b] NAS	....	6,630	[b] NAS	[b] NAS
Long-finned pilot whale	....	6,470	[b] NAS	[b] NAS	....	6,630	[b] NAS	[b] NAS
High-frequency cetaceans:								
Harbor porpoise	810	6,470	900	900	590	6,630	600	600
Phocid Pinnipeds:								
Gray seal	1,720	6,470	1,800	1,800	1,730	6,630	1,800	1,800
Harbor seal	690	6,470	1,800	1,800	690	6,630	1,800	1,800

* Denotes species listed under the Endangered Species Act.
[a] Zones were made on the assumptions that 4-m piled jackets would be installed at a rate of four pin piles per day with 10 dB of noise attenuation from a noise attenuation system.
[b] NAS (noise abatement system) means that the zone is small enough that it would be encompassed by the bubble curtain.
[c] The Level A zone represents the exposure ranges of species derived from animal movement modeling.
[d] The pre-start clearance and shutdown zone for large whales, porpoise, and seals is based upon the maximum Level A zone rounded up for PSO clarity.
[e] As no Level A exposures were calculated for blue whales (meaning no Level A exposure ranges were calculated), the exposure range for fin whales was used as a proxy.
[f] All zone monitoring would be achieved through visual observations and passive acoustic monitoring.
[g] The original mitigation and monitoring distances are found in Tables 9 and 10 in Sunrise Wind's PSMMP; however, NMFS has slightly rounded/modified some of these ranges for PSO clarity.

TABLE 42—CLEARANCE, SHUTDOWN, AND REAL-TIME PAM MONITORING ZONES [a] DURING IMPACT PILE DRIVING ACTIVITIES (WTG FOUNDATIONS AND OCS–DC) FOR NORTH ATLANTIC RIGHT WHALES IN THE SUMMER AND WINTER

Marine mammal species	Minimum visibility zone (m) [b]	Visual clearance and shutdown zones (m)	PAM monitoring zone (m)	PAM clearance zone (m) [c]	PAM shutdown zone (m)	Minimum visibility zone (m) [b]	Visual clearance and shutdown zones (m)	PAM monitoring zone (m)	PAM clearance zone (m) [c]	PAM shutdown zone (m)
	Summer (May through November)					Winter (December only)				
WTG Foundation Impact Installation:										
North Atlantic right whale *	3,700	Any distance	10,000	6,500	3,700	4,300	Any distance	10,000	[d] 7,000	4,300
OCS–DC Impact Installation:										
North Atlantic right whale *	5,600	Any distance	10,000	6,500	5,600	6,500	Any distance	10,000	6,700	6,500

* Denotes species listed under the Endangered Species Act.
[a] Sunrise Wind may request modification of these zones based on the results of sound field verification.
[b] The minimum visibility zone is based upon the maximum non-humpback whale Level A harassment zone for the group and rounded up for PSO clarity.
[c] The PAM clearance zone is equal to the Level B harassment zone.
[d] As the Level A harassment zone for North Atlantic right whales was less than the Level B harassment zone, the Level B harassment zone was used instead for all distances.

Soft-Start

The use of a soft-start procedure is believed to provide additional protection to marine mammals by warning them or providing them with a chance to leave the area prior to the hammer operating at full capacity. Soft-start typically involves initiating hammer operation at a reduced energy level (relative to full operating capacity) followed by a waiting period. Sunrise Wind must utilize a soft-start protocol for impact pile driving of monopiles by performing 4–6 strikes per minute at 10 to 20 percent of the maximum hammer energy for a minimum of 20 minutes. NMFS notes that it is difficult to specify a reduction in energy for any given hammer because of variation across drivers. For impact hammers, the actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in ''bouncing'' of the hammer as it strikes the pile, resulting in multiple ''strikes''; however, as mentioned previously, Sunrise Wind will target less than 20 percent of the total hammer energy for the initial hammer strikes during soft-start. A soft-start will be required at the beginning of each day's monopile installation and at any time following a cessation of impact pile driving of 30 minutes or longer. If a marine mammal is detected within or about to enter the applicable clearance zones prior to the beginning of soft-start procedures, impact pile driving would be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species).

Cable Landfall Construction

For sheet pile or casing pipe installation and removal, NMFS is proposing to include the following mitigation requirements, which are described in detail below: daily restrictions; the use of PSOs; the implementation of clearance and shutdown zones; and the use of soft-start if a pneumatic impact hammer is used. Given the short duration of work, relatively small harassment zones if a pneumatic hammer is used, and lower noise levels during vibratory driving, NMFS is not proposing to require PAM or noise abatement system use during these activities.

Seasonal and Daily Restrictions

Sunrise Wind has proposed to install and remove the sheet piles or casing pipe scenario within the first year of the effective period of the regulations and LOA. NMFS is not requiring any seasonal work restrictions for landfall construction in this proposed rule due to the relatively short duration of work (*i.e.,* low associated impacts). Sunrise Wind would be required, however, to conduct vibratory pile driving associated with sheet pile installation and pneumatic hammering of casing pipes during daylight hours only. Although North Atlantic right whales do migrate in coastal waters, they are not expected to occur in Narragansett Bay where work would be occurring. The distance to the Level B harassment isopleth (9.74 km) for installation of steel sheet piles and the maximum distance to the Level A isopleth (3.95 km) for installation of a casing pipe do not extend beyond the mouth of Narragansett Bay; thus, it is unlikely that right whales (or most species of marine mammals considered here) would be exposed to vibratory pile driving during sheet pile installation at levels close to the 120 dB Level B harassment threshold or pneumatic hammering at Level A harassment thresholds.

Use of PSOs

Prior to the start of vibratory pile driving or pneumatic hammering activities, at least two PSOs located at the best vantage points would monitor the clearance zone for 30 minutes, continue monitoring during pile driving or pneumatic hammering, and for 30 minutes following cessation of either activity. The clearance zones must be fully visible for at least 30 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes immediately prior to initiation of either activity.

Clearance and Shutdown Zones

Sunrise Wind would establish clearance and shutdown zones for vibratory pile driving activities associated with sheet pile installation (Table 43.) and pneumatic hammering for casing pipe installation (Table 44.). If a marine mammal is observed entering or is observed within the respective zones, activities will not commence until the animal has exited the zone or a specific amount of time has elapsed since the last sighting (*i.e.,* 30 minutes for large whales and 15 minutes for dolphins, porpoises, and pinnipeds). If a marine mammal is observed entering or within the respective shutdown zone after vibratory pile driving or pneumatic hammering has begun, the PSO will call for a temporary cessation of the activity. Pile driving or hammering must not be restarted until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually confirmed beyond that clearance zone or when specific time periods have elapsed with no further sightings or acoustic detections have occurred (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other marine mammal species). Because a vibratory hammer can grip a pile without operating, pile instability should not be a concern and no caveat for re-starting pile driving due to pile instability is proposed.

TABLE 43—DISTANCES TO HARASSMENT THRESHOLDS AND MITIGATION ZONES [a] DURING VIBRATORY SHEET PILE DRIVING

Marine mammal species	Level A harassment (SEL_{cum}) (m)	Level B harassment (m)	Clearance zone (m)	Shutdown zone (m)
Low-frequency cetaceans:				
Fin whale *	5	9,740	200	50
Minke whale	5	9,740	200	50
Sei whale *	5	9,740	200	50
Humpback whale	5	9,740	200	50
North Atlantic right whale *	5	9,740	200	50
Blue whale *	5	9,740	200	50
Mid-frequency cetaceans:				
Sperm whale *	....	9,740	200	50
Atlantic white-sided dolphin	....	9,740	200	50
Atlantic spotted dolphin	....	9,740	200	50
Common dolphin	....	9,740	200	50
Risso's dolphin	....	9,740	200	50

TABLE 43—DISTANCES TO HARASSMENT THRESHOLDS AND MITIGATION ZONES [a] DURING VIBRATORY SHEET PILE DRIVING—Continued

Marine mammal species	Level A harassment (SEL_{cum}) (m)	Level B harassment (m)	Clearance zone (m)	Shutdown zone (m)
Bottlenose dolphin		9,740	200	50
Pilot whales		9,740	200	50
High-frequency cetaceans:				
Harbor porpoise	190	9,740	200	200
Phocid Pinnipeds (in water):				
Gray seal	10	9,740	200	10
Harbor seal	10	9,740	200	10

* Denotes species listed under the Endangered Species Act.
[a] The original mitigation and monitoring distances are found in Table 18 in Sunrise Wind's PSMMP; however, NMFS has slightly rounded/modified some of these ranges for PSO clarity.

TABLE 44—DISTANCES TO HARASSMENT THRESHOLDS AND MITIGATION ZONES [a] DURING IMPACT INSTALLATION OF THE CASING PIPE

Marine mammal species	Level A harassment (SEL_{cum}) (m)	Level B harassment (m)	Clearance zone (m)	Shutdown zone (m)
Low-frequency cetaceans:				
Fin whale *	3,870	920	500	500
Minke whale	3,870	920	500	500
Sei whale *	3,870	920	500	500
Humpback whale	3,870	920	500	500
North Atlantic right whale *	3,870	920	500	500
Blue whale *	3,870	920	500	500
Mid-frequency cetaceans:				
Sperm whale *	230	920	100	100
Atlantic white-sided dolphin	230	920	100	100
Atlantic spotted dolphin	230	920	100	100
Common dolphin	230	920	100	100
Risso's dolphin	230	920	100	100
Bottlenose dolphin	230	920	100	100
Pilot whales	230	920	100	100
High-frequency cetaceans:				
Harbor porpoise	3,950	920	500	500
Phocid Pinnipeds (in water):				
Gray seal	1,290	920	100	100
Harbor seal	1,290	920	100	100

* Denotes species listed under the Endangered Species Act.

UXO/MEC Detonations

For UXO/MEC detonations, NMFS is proposing to include the following mitigation requirements, which are described in detail below: As Low as Reasonably Practical Approach (ALARP); seasonal and daily restrictions; the use of noise abatement systems; the use of PSOs and PAM operators to visually and acoustically monitor for marine mammals; and the implementation of clearance zones.

As Low as Reasonably Practicable (ALARP) Approach

For any UXOs/MECs that require removal, Sunrise Wind would be required to implement the As Low as Reasonably Practicable (ALARP) process. This process would require Sunrise Wind to undertake ''lift-and-shift'' (*i.e.,* physical removal) and then lead up to *in situ* disposal, which could include low-order (deflagration) to high-order (detonation) methods of removal. Another potential approach involves the cutting of the UXO/MEC to extract any explosive components. Implementing the ALARP approach would minimize potential impacts to marine mammals as UXOs/MECs would only be detonated as a last resort.

Seasonal and Daily Restrictions

Sunrise Wind would be limited to detonating a total of three UXOs/MECs between May 1 and November 31 to reduce impacts to North Atlantic right whales during peak occurrence periods. Furthermore, UXO/MEC detonation would be limited to daylight hours only to ensure that visual PSOs can confirm appropriate clearance of the site prior to detonation events.

Noise Abatement Systems

Sunrise Wind would be required to use a noise abatement system during all UXO/MEC detonations, should detonations be determined to be necessary. Although the exact level of noise attenuation that can be achieved by noise abatement systems is unknown, available data from Bellmann *et al.* (2020) and Bellmann and Betke (2021) provide a reasonable expectation that the noise abatement systems would be able to achieve at least 10 dB attenuation. SFV would be required for all detonation events to verify the modeled distances, assuming 10 dB attenuation, are representative of the sound fields generated during detonations. This level of noise reduction would provide substantial reductions in impact zones for low-frequency cetaceans, such as the North Atlantic right whale. For example, assuming the largest UXO/MEC charge weight (454 kg; E12) at a depth of 45 m, 10 dB of attenuation reduces the Level A harassment (PTS) zone from 243 km² to approximately 45 km². The Level B harassment zone, given the same parameters, would be decreased from 1,158 km² to 445 km². However, and as previously stated in this proposed rule, Sunrise Wind does not expect that all 3 of the potential UXOs/MECs would be of the largest charge weight; this weight was used as a conservative option in estimating exposures and take of marine mammals.

Use of PSOs and PAM Operators

PSOs would monitor clearance zones in vessels and when the clearance zone is larger than 5 km, aircraft. Prior to the UXO/MEC detonation, at least two PSOs per observing platform (*i.e.,* vessels, plane) located at the best vantage points would monitor the clearance zone for 60 minutes, continue monitoring during the detonation, and for 30 minutes following the event. The clearance zones must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes immediately prior to initiation of either activity.

In addition to visual monitoring, real-time PAM monitoring is also proposed. A PAM operator would be stationed on at least one of the dedicated monitoring vessels in addition to the PSOs or located remotely/onshore to acoustically monitor a zone that encompasses a minimum of a 10 km radius around the source. PAM would be conducted for at least 60 minutes prior to detonation and the zone must be acoustically clear during this time.

In the case of visual or acoustic detection, the Lead PSO will be responsible for requesting the designated crewmember to implement a delay in UXO detonation.

Clearance Zones

Sunrise Wind proposed to clear a 3.78-km radius zone around the detonation site prior to detonations using both visual and acoustic monitoring methods. This distance represents the modeled Level A (PTS) harassment zone for low-frequency cetaceans (*i.e.,* large whales) assuming the largest 454-kg charge weight and use of a bubble curtain (Table 45.). However, NMFS is proposing to require more protective zone sizes in order to ensure the least practicable adverse impact, which includes minimizing the potential for TTS. As stated above, it is not currently known how easily Sunrise Wind will be able to identify UXO/MEC charge weights in the field. For this reason, NMFS proposes to require Sunrise Wind to clear a zone extending 10 km for large whales, 2 km for delphinids, 10 km for harbor porpoises, and 5 km for seals (Table 45.). These zones are based on (but not equal to) the largest TTS threshold distances for a 454-kg charge at any site modeled. However, NMFS notes that these zone sizes may be adjusted based on SFV and confirmation of UXO/MEC/doner charge sizes. Moreover, if Sunrise Wind indicates to NMFS they will be able to easily and reliably identify charge weights in the field, NMFS would develop clearance zones in the final rule for each charge weight analyzed.

If a marine mammal is observed entering or within the clearance zone prior to denotation, the activity would be delayed. Only when the marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales (including the North Atlantic right whale) or 30 minutes have elapsed without any subsequent detections of delphinids, harbor porpoises, or seals may detonation of UXOs/MECs occur.

TABLE 45—LARGEST MODELED HARASSMENT AND CLEARANCE ZONES FOR UXO/MEC DETONATION OF E12 (454 kg) CHARGE ASSUMING 10 dB NOISE ABATEMENT

Marine mammal species	Distances to zones for E12 (454 kg) UXO/MEC charge weight [a b]		
	Level A harassment zone (m)	Level B harassment zone (m)	Clearance zones (m)
Mysticetes:			
Fin whale *	3,700	11,800	10,000
Minke whale.			
Sei whale *.			
Humpback whale.			
North Atlantic right whale *.			
Blue whale *.			
Odontocetes:			
Sperm whale *	[b] 500	2,500	2,000
Atlantic white-sided dolphin.			
Atlantic spotted dolphin.			
Common dolphin.			
Risso's dolphin.			
Bottlenose dolphin.			
Long-finned pilot whale.			
Harbor porpoise	6,200	13,700	10,000
Phocid Pinnipeds (in water):			
Gray seal	1,500	[b] 7,100	5,000
Harbor seal.			

* Denotes species listed under the Endangered Species Act.

[a] At time of preparing this proposed rule, Sunrise Wind has not provided NMFS evidence they will be able to reliably determine the charge weight of any UXO/MEC that must be detonated; therefore, NMFS assumes all UXO/MECs could be of the largest size modeled. If Sunrise Wind provides information they can detect charge weights in the field prior to issuance of the final rule, if issued, NMFS may modify the clearance zone to ones based on charge weights distances to PTS and TTS. Distances to PTS and TTS thresholds have been identified by Sunrise Wind in Appendix B of their application.

[b] The original mitigation and monitoring distances are found in Sunrise Wind's UXO/MEC modeling report (Hannay and Zykov, 2022); however, NMFS has rounded these ranges for PSO clarity.

HRG Surveys

For HRG surveys, NMFS is proposing to include the following mitigation requirements, which are described in detail below, for all HRG survey activities using boomers, sparkers, and CHIRPs: the use of PSOs; the implementation of clearance, shutdown, and vessel separation zones; and ramp-up of survey equipment.

There are no mitigation measures prescribed for sound sources operating at frequencies greater than 180 kHz as these would be expected to fall outside of marine mammal hearing ranges and not result in harassment; however, all HRG survey vessels would be subject to the aforementioned vessel strike avoidance measures described earlier in this section. Furthermore, due to the frequency range and characteristics of some of the sound sources, shutdown, clearance, and ramp-up procedures are not proposed to be conducted during HRG surveys utilizing only non-impulsive sources (*e.g.,* Ultra-Short BaseLine (USBL) and other parametric sub-bottom profilers) with exception to usage of CHIRPS and other non-parametric sub-bottom profilers. PAM would not be required during HRG surveys. While NMFS agrees that PAM can be an important tool for augmenting detection capabilities in certain circumstances, its utility in further reducing impacts during HRG survey activities is limited. We have provided a thorough description of our reasoning for not requiring PAM during HRG surveys in several **Federal Register** notices (*e.g.,* 87 FR 40796, July 8, 2022; 87 FR 52913, August 3, 2022; 87 FR 51356, August 22, 2022).

Seasonal and Daily Restrictions

Given the potential impacts to marine mammals from exposure to HRG survey noise sources are relatively minor (*e.g.,* limited to Level B harassment) and that the distances to the Level B harassment isopleth is very small (maximum distance is 141 m), NMFS is not proposing to implement any seasonal or time-of-day restrictions for HRG surveys.

Although no temporal restrictions are proposed, NMFS would require Sunrise Wind to deactivate acoustic sources during periods where no data is being collected except as determined necessary for testing. Any unnecessary use of the acoustic source would be avoided.

Use of PSOs

During all HRG survey activities using boomers, sparkers, and CHIRPS, one PSO would be required to monitor during daylight hours and two would be required to monitor during nighttime hours per vessel. PSOs would begin visually monitoring 30 minutes prior to the initiation of the specified acoustic source (*i.e.,* ramp-up, if applicable) through 30 minutes after the use of the specified acoustic source has ceased. PSOs would be required to monitor the appropriate clearance and shutdown zones. These zones would be based around the radial distance from the acoustic source and not from the vessel.

Clearance, Shutdown, and Vessel Separation Zones

Sunrise Wind would be required to implement a 30-minute clearance period of the clearance zones (Table 46) immediately prior to the commencing of the survey or when there is more than a 30-minute break in survey activities and PSOs have not been actively monitoring. The clearance zones would be monitored by PSOs using the appropriate visual technology. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up (described below) may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species). In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (*i.e.,* no delay is required) despite periods of inclement weather and/or loss of daylight.

Once the survey has commenced, Sunrise Wind would be required to shut down boomers, sparkers, and CHIRPs if a marine mammal enters a respective shutdown zone (Table 46). In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.,* no shutdown is required) so long as no marine mammals have been detected. The use of boomers, sparkers, and CHIRPS would not be allowed to commence or resume until the animal(s) has been confirmed to have left the shutdown zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting. Any large whale sighted by a PSO within 1,000 m of the boomers, sparkers, and CHIRPs that cannot be identified as a non-North Atlantic right whale would be treated as if it were a North Atlantic right whale.

The shutdown requirement would be waived for small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus,* and *Tursiops.* Specifically, if a delphinid from the specified genera is visually detected approaching the vessel (*i.e.,* to bow-ride) or towed equipment, shutdown would not be required. Furthermore, if there is uncertainty regarding identification of a marine mammal species (*i.e.,* whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), the PSOs would use their best professional judgment in making the decision to call for a shutdown. Shutdown would be required if a delphinid that belongs to a genus other than those specified is detected in the shutdown zone.

If a boomer, sparker, or CHIRP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if (1) PSOs have maintained constant observation, and (2) no additional detections of any marine mammal occurred within the respective shutdown zones. If a boomer, sparker, or CHIRP was shut down for a period longer than 30 minutes, then all clearance and ramp-up procedures would be required, as previously described.

TABLE 46—HARASSMENT THRESHOLD RANGES AND MITIGATION ZONES DURING HRG SURVEYS

Marine mammal species	Level B harassment zone (m)		Clearance zone (m)	Shutdown zone (m)
	Boomer/ sparker	CHIRPs		
Low-frequency cetaceans:				
Fin whale *	141	48	100	100

TABLE 46—HARASSMENT THRESHOLD RANGES AND MITIGATION ZONES DURING HRG SURVEYS—Continued

Marine mammal species	Level B harassment zone (m)		Clearance zone (m)	Shutdown zone (m)
	Boomer/sparker	CHIRPs		
Minke whale			100	100
Sei whale *			100	100
Humpback whale			100	100
North Atlantic right whale *			500	500
Blue whale *			100	100
Mid-frequency cetaceans:				
Sperm whale *	141	48	100	100
Atlantic white-sided dolphin			100	n/a
Atlantic spotted dolphin			100	n/a
Common dolphin			100	n/a
Risso's dolphin			100	100
Bottlenose dolphin			100	n/a
Long-finned pilot whale			100	100
High-frequency cetaceans:				
Harbor porpoise	141	48	100	100
Phocid Pinnipeds (in water):				
Gray seal	141	48	100	100
Harbor seal.				

Note: n/a = no shutdown zone mitigation will be applied as these species are known to bow-ride.
* Denotes species is listed under the Endangered Species Act.

Ramp-Up

At the start or restart of the use of boomers, sparkers, and/or CHIRPs, a ramp-up procedure would be required unless the equipment operates on a binary on/off switch. A ramp-up procedure, involving a gradual increase in source level output, is required at all times as part of the activation of the acoustic source when technically feasible. Operators would ramp up sources to half power for 5 minutes and then proceed to full power. Prior to a ramp-up procedure starting, the operator would have to notify the Lead PSO of the planned start of the ramp-up. This notification time would not be less than 60 minutes prior to the planned ramp-up activities as all relevant PSOs would need the appropriate 30 minute period to monitor prior to the initiation of ramp-up. Prior to ramp-up beginning, the operator must receive confirmation from the PSO that the clearance zone is clear of any marine mammals. All ramp-ups would be scheduled to minimize the overall time spent with the source being activated. The ramp-up procedure must be used at the beginning of HRG survey activities or after more than a 30-minute break in survey activities using the specified HRG equipment to provide additional protection to marine mammals in or near the survey area by allowing them to vacate the area prior to operation of survey equipment at full power.

Sunrise Wind would not initiate ramp-up until the clearance process has been completed (see Clearance and Shutdown Zones section above). Ramp-up activities would be delayed if a marine mammal(s) enters its respective clearance zone. Ramp-up would only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until additional time has elapsed with no further sighting (*i.e.,* 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

ASV Use

Should Sunrise Wind use an ASV for HRG survey operations, the following measures would be implemented:

• When in use, the ASV would be within 800 m (2,625 ft) of the primary vessel while conducting survey operations;

• Two PSOs would be stationed aboard the mother vessel at the best vantage points to monitor the clearance and shutdown zones around the ASV;

• A dual thermal/high definition camera would be installed on the mother vessel, facing forward and angled in a direction to provide a field of view ahead of the vessel and around the ASV. PSOs would monitor the real-time camera output on hand-held tablets. A monitor would also be installed on the bridge, displaying the real-time image from the thermal/HD camera installed on the ASV itself, providing an additional forward field of view from the ASV;

• Night-vision goggles with thermal clip-ons, and a hand-held spotlight would be used to monitor the ASV during survey operations during periods of reduced visibility (*e.g.,* darkness, rain, fog).

Fishery Monitoring Surveys

Training

All crew undertaking the fishery survey activities would be required to receive protected species identification training prior to activities occurring. Marine mammal monitoring must occur prior to, during, and after haul-back and gear must not be deployed if a marine mammal is observed in the area. Trawl operations must only start after 15 minutes of no marine mammal sightings within 1 nm of the sampling station.

Gear-Specific Best Management Practices (BMPs)

Sunrise Wind would be required to undertake BMPs to reduce risks to marine mammals during trawl surveys. These include:

• All captains and crew conducting trawl surveys will be trained in marine mammal detection and identification;

• Survey vessels will adhere to all vessel mitigation measures (see Proposed Mitigation section);

• Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before (15 minutes prior to within 1 nm), during, and after haul back;

• Trawl operations will commence as soon as possible once the vessel arrives on station;

• If a marine mammal (other than dolphins and porpoises) is sighted within 1 nm of the planned location in the 15 minutes before gear deployment, Sunrise Wind will delay setting the trawl until marine mammals have not been resighted for 15 minutes or Sunrise Wind may move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, Sunrise Wind may decide to move again or to skip the station;

- Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk of interaction, all gear will be immediately removed;
- Sunrise Wind will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (*i.e.,* throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, Sunrise Wind will take the most appropriate action to avoid marine mammal interaction;
- Limit tow time to 20 minutes and monitoring for marine mammals throughout gear deployment, fishing, and retrieval;
- Sunrise Wind will open the codend of the net close to the deck/sorting area to avoid damage to animals that may be caught in gear;
- Trawl nets will be fully cleaned and repaired (if damaged) before setting again.

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures would provide the means of affecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to promulgate a rulemaking for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.,* presence, abundance, distribution, density);
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving or feeding areas);
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors;
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks;
- Effects on marine mammal habitat (*e.g.,* marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat); and/or
- Mitigation and monitoring effectiveness.

Separately, monitoring is also regularly used to support mitigation implementation, which is referred to as mitigation monitoring, and monitoring plans typically include measures that both support mitigation implementation and increase our understanding of the impacts of the activity on marine mammals.

During Sunrise Wind's construction activities, visual monitoring by NMFS-approved PSOs would be conducted before, during, and after impact pile driving, vibratory pile driving and pneumatic hammering, any UXO/MEC detonations, and HRG surveys. PAM would also be conducted during all impact pile driving and UXO/MEC detonations. Observations and acoustic detections by PSOs would be used to support the activity-specific mitigation measures described above. Also, to increase understanding of the impacts of the activity on marine mammals, observers would record all incidents of marine mammal occurrence at any distance from the piling and pneumatic hammering locations, UXO/MEC detonation site, and during active HRG acoustic sources, and monitors would document all behaviors and behavioral changes, in concert with distance from an acoustic source. The required monitoring is described below, beginning with PSO measures that are applicable to all activities or monitoring and followed by activity-specific monitoring requirements.

Protected Species Observer Requirements

Sunrise Wind would be required to collect sighting data and behavioral response data related to construction activities for marine mammal species observed in the region of the activity during the period in which the activities occur using NMFS-approved visual and acoustic PSOs (see Proposed Mitigation section). All observers must be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. PSOs would monitor all clearance and shutdown zones prior to, during, and following impact pile driving, vibratory pile driving, pneumatic hammering, UXO/MEC detonation, and during HRG surveys using boomers, sparkers, and CHIRPs (with monitoring durations specified further below). PSOs will also monitor the Level B harassment zones and will document any marine mammals observed within these zones, to the extent practicable (noting that some zones are too large to fully observe). Observers would be located at the best practicable vantage points on the pile driving vessel and, where required, on an aerial platform. Full details regarding all marine mammal monitoring must be included in relevant Plans (*e.g.,* Pile Driving and Marine Mammal Monitoring Plan) that, under this proposed action, Sunrise Wind would be required to submit to NMFS for approval at least 180 days in advance of the commencement of any construction activities.

The following measures apply to all visual monitoring efforts:

1. Monitoring must be conducted by NMFS-approved, trained PSOs who would be placed at the primary location relevant to the activity (*i.e.,* pile driving vessel, pneumatic hammering location, UXO/MEC vessel, HRG survey vessel), dedicated PSO vessels (*e.g.,* additional UXO/MEC vessel(s) when the detonation area is larger than 2 km), and aerial survey plane and must be in positions that allow for the best vantage point to monitor for marine mammals and implement the relevant clearance and shutdown procedures, when determined to be applicable;

2. PSO must be independent third-party observers and must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct the relevant vessel crew with regard to the presence of protected species and mitigation requirements;

3. During all observation periods related to pile driving (impact and vibratory), pneumatic hammering, UXO/MEC detonations, and HRG surveys, PSOs would be located at the best vantage point(s) in order to ensure 360° visual coverage of the entire clearance and shutdown zones around the observing platform and as much of the Level B harassment zone as possible while still maintaining a safe work environment;

4. PSOs may not exceed 4 consecutive watch hours, must have a minimum 2-hour break between watches, and may not exceed a combined watch schedule of more than 12 hours in a single 24-hour period;

5. PSOs would be required to use appropriate equipment (specified below) to monitor for marine mammals. During periods of low visibility (*e.g.,* darkness, rain, fog, poor weather conditions, *etc.*), PSOs would be required to use alternative technologies (*i.e.,* infrared or thermal cameras) to monitor the shutdown and clearance zones.

6. PSOs should have the following minimum qualifications:

a. Visual acuity in both eyes (corrected is permissible) sufficient for discernment of moving targets at the water's surface with the ability to estimate the target size and distance. The use of binoculars is permitted and may be necessary to correctly identify the target(s);

b. Ability to conduct field observations and collect data according to the assigned protocols;

c. Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;

d. Writing skills sufficient to document observations, including but not limited to: the number and species of marine mammals observed, the dates and times of when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior.

e. Ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area, as necessary.

Observer teams employed by Sunrise Wind, in satisfaction of the mitigation and monitoring requirements described herein, must meet the following additional requirements:

7. At least one observer must have prior experience working as an observer.

8. Other observers may substitute education (a degree in biological science or a related field) or training for experience;

9. One observer will be designated as lead observer or monitoring coordinator (''Lead PSO''). This Lead PSO would be required to have a minimum of 90 days of at-sea experience working in this role in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience;

10. At least one PSO located on platforms (either vessel-based or aerial) would be required to have a minimum of 90 days of at-sea experience working in this role in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience; and

11. All PSOs must be approved by NMFS. Sunrise Wind would be required to submit resumes of the initial set of PSOs necessary to commence the project to NMFS OPR for approval at least 60 days prior to the first day of in-water construction activities requiring PSOs. Resumes would need to include the dates of training and any prior NMFS approval as well as the dates and description of their last PSO experience and must be accompanied by information documenting their successful completion of an acceptable training course. NMFS would allow three weeks to approve PSOs from the time that the necessary information is received by NMFS after which any PSOs that meet the minimum requirements would automatically be considered approved.

Some Sunrise Wind activities may require the use of PAM, which would necessitate the employment of at least one acoustic PSO (aka PAM operator) on duty at any given time. PAM operators would be required to meet several of the specified requirements described above for PSOs, including: 2, 4, 6b–e, 8, 9, 10, and 11. Furthermore, PAM operators would be required to complete a specialized training for operating PAM systems and must demonstrate familiarity with the PAM system on which they would be working.

PSOs would be able to act as both acoustic and visual observers for the project if the individual(s) demonstrates that they have had the required level and appropriate training and experience to perform each task. However, a single individual would not be allowed to concurrently act in both roles or exceed work hours specified in #4 above.

Sunrise Wind's personnel and PSOs would also be required to use available sources of information on North Atlantic right whale presence to aid in monitoring efforts. This includes:

1. Daily monitoring of the Right Whale Sightings Advisory System;

2. Consulting of the WhaleAlert app; and,

3. Monitoring of the Coast Guard's VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with North Atlantic right whales.

Additionally, whenever multiple project-associated vessels (of any size; *e.g.,* construction survey, crew transfer) are operating concurrently, any visual observations of ESA-listed marine mammals must be communicated to PSOs and vessel captains associated with other vessels to increase situational awareness.

The following are proposed monitoring and reporting measures that NMFS would require specific to each construction activity:

WTG and OCS–DC Foundation Installation

Sunrise Wind would be required to implement the following monitoring procedures during all impact pile driving of WTG and OCS–DC foundations.

During all observations associated with impact pile driving, PSOs would use high magnification (7x) binoculars and the naked eye to search continuously for marine mammals. At least one PSO on the foundation pile driving vessel and secondary dedicated-PSO vessel must be equipped with Big Eye binoculars (*e.g.,* 25 x 50; 2,7 view angle; individual ocular focus; height control) of appropriate quality. These would be pedestal-mounted on the deck at the most appropriate vantage point that provides optimal sea surface observation and PSO safety.

Sunrise Wind would be required to have a minimum of four PSOs actively observing marine mammals before, during, and after (specific times described below) the installation of foundation piles (monopiles). At least two PSOs must be actively observing on the pile driving vessel while at least two

PSOs are actively observing on a secondary, PSO-dedicated vessel. Concurrently, at least one acoustic PSO (*i.e.,* PAM operator) must be actively monitoring for marine mammals before, during and after impact pile driving.

As described in the Proposed Mitigation section, if the minimum visibility zone cannot be visually monitored at all times, pile driving operations may not commence or, if active, must shutdown, unless Sunrise Wind determines shutdown is not practicable due to imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk of injury or loss of life for individuals.

To supplement visual observation efforts, Sunrise Wind would utilize at least one PAM operator before, during, and after pile installation. This PAM operator would assist the PSOs in ensuring full coverage of the clearance and shutdown zones. All on-duty visual PSOs would remain in contact with the on-duty PAM operator, who would monitor the PAM systems for acoustic detections of marine mammals in the area. In some cases, the PAM operator and workstation may be located onshore or they may be located on a vessel. In either situation, PAM operators would maintain constant and clear communication with visual PSOs on duty regarding detections of marine mammals that are approaching or within the applicable zones related to impact pile driving. Sunrise Wind would utilize PAM to acoustically monitor the clearance and shutdown zones (and beyond for situational awareness), and would record all detections of marine mammals and estimated distance, when possible, to the activity (noting whether they are in the Level A harassment or Level B harassment zones). To effectively utilize PAM, Sunrise Wind would implement the following protocols:

- PAM operators would be stationed on at least one of the dedicated monitoring vessels in addition to the PSOs, or located remotely/onshore.
- PAM operators would have completed specialized training for operating PAM systems prior to the start of monitoring activities, including identification of species-specific mysticete vocalizations (*e.g.,* North Atlantic right whales).
- The PAM operator(s) on-duty would monitor the PAM systems for acoustic detections of marine mammals that are vocalizing in the area.
- Any detections would be conveyed to the PSO team and any PSO sightings would be conveyed to the PAM operator for awareness purposes, and to identify if mitigation is to be triggered.
- For real-time PAM systems, at least one PAM operator would be designated to monitor each system by viewing data or data products that are streamed in real-time or near real-time to a computer workstation and monitor located on a project vessel or onshore.
- The PAM operator would inform the Lead PSO on duty of marine mammal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.,* Mysticetus or similar system), who would be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.,* delay or shutdown).
- Acoustic monitoring during nighttime and low visibility conditions during the day would complement visual monitoring (*e.g.,* PSOs and thermal cameras) and would cover an area of at least the Level B harassment zone around each foundation.

All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to and during all impact pile driving and for 30 minutes after impact driving. However, PAM operators must review acoustic data from the previous 24 hours as well. As described in the Proposed Mitigation section, impact pile driving of monopiles would only commence when the minimum visibility zone (extending 2.3 km from the pile during summer months and 4.4 km during December for WTG foundation installations, and 1.6 km during summer months and 2.7 km during December for OCS–DC foundation installations) is fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of impact pile driving.

For North Atlantic right whales, any visual (regardless of distance) or acoustic detection would trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale species, it must be treated as if it were a North Atlantic right whale. Following a shutdown, monopile installation may not recommence until the minimum visibility zone is fully visible and the clearance zone is clear of marine mammals for 30 minutes and no marine mammals have been detected acoustically within the PAM clearance zone for 30 minutes.

Sunrise Wind must prepare and submit a Pile Driving and Marine Mammal Monitoring Plan to NMFS for review and approval at least 180 days before the start of any pile driving. The plans must include final pile driving project design (*e.g.,* number and type of piles, hammer type, noise abatement systems, anticipated start date, *etc.*) and all information related to PAM PSO monitoring protocols for pile-driving and visual PSO protocols for all activities.

Cable Landfall Construction

Sunrise Wind would be required to implement the following procedures during all vibratory pile driving activities associated with sheet pile installation and removal and pneumatic hammering installation and removal of casing pipes.

During all observation periods related to vibratory pile driving or pneumatic hammering, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals.

Sunrise Wind would be required to have a minimum of two PSOs on active duty during any installation and removal of the temporary sheet piles or casing pipe. These PSOs would always be located at the best vantage point(s) on the vibratory pile driving or pneumatic hammering platform or secondary platform in the immediate vicinity of the primary platforms in order to ensure that appropriate visual coverage is available of the entire visual clearance zone and as much of the Level B harassment zone as possible. NMFS would not require the use of PAM for these activities.

PSOs would monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles or casing pipes, and for 30 minutes after the activities have ceased. Sheet pile or casing pipe installation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving.

UXO/MEC Detonations

Sunrise Wind would be required to implement the following procedures during all UXO/MEC detonations.

During all observation periods related to UXO/MEC detonation, PSOs must use high-magnification (25x), standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. PSOs located on the UXO/MEC monitoring vessel((s) would also be equipped with ''Big Eye'' binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control). These would be mounted on a pedestal on the deck of the vessel(s) at the most appropriate vantage to provide for optimal sea surface observation, as well as safety of the PSOs.

For detonation zones (based on UXO/MEC charge weight) larger than 2 km, a secondary vessel would be used for marine mammal monitoring. In the event a secondary vessel is needed, two PSOs would be located at an appropriate vantage point on this vessel and would maintain watch during the same time period as the PSOs on the primary monitoring vessel. For detonation zones larger than 5 km, Sunrise Wind would also be required to perform an aerial survey. At least two PSOs must be deployed on the plane during the aerial survey that would occur before, during, and after UXO/detonation events. Sunrise Wind would be required to ensure that the clearance zones are fully (100 percent) monitored prior to, during, and after detonations.

As UXO/MEC detonation would only occur during daylight hours, PSOs would only need to monitor during the period between civil twilight rise and set. All PSOs and PAM operators would be required to begin monitoring 60 minutes prior to the UXO/MEC detonation event, during the event, and after for 30 minutes. Detonation may only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to detonation.

The PAM operator(s) would be stationed on one of the dedicated monitoring vessels but may also potentially be located remotely onshore, although the latter alternative is subject to approval by NMFS. When real-time PAM is used, at least one PAM operator would be designated to monitor each system by viewing the data or data products that would be streamed in real-time or near real-time to a computer workstation and monitor, which would be located either on an Sunrise Wind vessel or onshore. The PAM operator would work in coordination with the visual PSOs to ensure the clearance zone is clear of marine mammals (both visually and acoustically) prior to the detonation. The PAM operator would inform the Lead PSO on-duty of any marine mammal detections approaching or within the clearance zones via the data collection software (*i.e.,* Mysticetus or a similar system), who would then be responsible for requesting the necessary mitigation procedure (*i.e.,* delay). The PAM operator would monitor the clearance zone for large whales and beyond the zone as possible (dependent on the detection radius of the PAM monitoring equipment).

Sunrise Wind must prepare and submit a UXO/MEC and Marine Mammal Monitoring Plan to NMFS for review and approval at least 180 days before the start of any UXO/MEC. The plans must include final project design and all information related to visual and PAM PSO monitoring protocols for UXO/MEC detonations.

HRG Surveys

Sunrise Wind would be required to implement the following procedures during all HRG surveys.

During all observation periods, PSOs must use standard handheld (7x) binoculars and the naked eye to search continuously for marine mammals.

Between four and six PSOs would be present on every 24-hour survey vessel, and two to three PSOs would be present on every 12-hour survey vessel. Sunrise Wind would be required to have at least one PSO on active duty during HRG surveys that are conducted during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and at least two PSOs during HRG surveys that are conducted during nighttime hours.

All PSOs would begin monitoring 30 minutes prior to the activation of boomers, sparkers, or CHIRPs; throughout use of these acoustic sources, and for 30 minutes after the use of the acoustic sources has ceased.

Given that multiple HRG vessels may be operating concurrently, any observations of marine mammals would be required to be communicated to PSOs on all nearby survey vessels.

Ramp-up of boomers, sparkers, and CHIRPs would only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of survey activities utilizing the specified acoustic sources.

During daylight hours when survey equipment is not operating, Sunrise Wind would ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports.

Marine Mammal Passive Acoustic Monitoring

As described previously, Sunrise Wind would be required to utilize a PAM system to supplement visual monitoring for all monopile installations as well as during all UXO/MEC detonations. PAM operators may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches. Again, PSOs can act as PAM operators or visual PSOs (but not simultaneously) as long as they demonstrate that their training and experience are sufficient to perform each task.

The PAM system must be monitored by a minimum of one PAM operator beginning at least 60 minutes prior to soft-start of impact pile driving of monopiles and UXO/MEC detonation, at all times during monopile installation and UXO/MEC detonation and 30 minutes post-completion of both activities. PAM operators must immediately communicate all detections of marine mammals at any distance (*i.e.,* not limited to the Level B harassment zones) to visual PSOs, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination.

PAM systems may be used for real-time mitigation monitoring. The requirement for real-time detection and localization limits the types of PAM technologies that can be used to those systems that are either cabled, satellite, or radio-linked. It is most likely that Sunrise Wind would deploy autonomous or moored-remote PAM devices, including sonobuoy arrays or similar retrievable buoy systems. The system chosen will dictate the design and protocols of the PAM operations. Sunrise Wind is not considering seafloor cabled PAM systems, in part due to high installation and maintenance costs, environmental issues related to cable laying, and the associated permitting complexities. For a review of the PAM systems Sunrise Wind is considering, see Appendix 4 of the Protected Species Mitigation and Monitoring Plan included in Sunrise Wind's ITA application.

Towed PAM systems may be utilized for the Sunrise Wind project only if additional PAM systems are necessary. Towed systems consist of cabled hydrophone arrays that would be deployed from a vessel and then typically monitored from the tow vessel. Notably, several challenges exist when using a towed PAM system (*i.e.,* the tow vessel may not be fit for the purpose as it may be towing other equipment, operating sound sources, or working in patterns not conducive to effective PAM). Furthermore, detection and localization capabilities for low-frequency cetacean calls (*i.e.,* mysticete species) can be difficult in a commercial deployment setting. Alternatively, these systems have many advantages, as they are often low cost to operate, have high mobility, and are fairly easy and reliable to operate. These types of systems also work well in conjunction with visual monitoring efforts.

Sunrise Wind plans to deploy PAM arrays specific for mitigation and monitoring of marine mammals outside of the shutdown zone to optimize the PAM system's capabilities to monitor for the presence of animals potentially entering these zones. The exact configuration and number of PAM devices would depend on the size of the zone(s) being monitored, the amount of noise expected in the area, and the characteristics of the signals being monitored. More closely spaced hydrophones would allow for more directionality and, perhaps, range to the vocalizing marine mammals; however, this approach would add additional costs and greater levels of complexity to the project. Mysticetes, which would produce relatively loud and lower-frequency vocalizations, may be able to be heard with fewer hydrophones spaced at greater distances. However, detecting smaller cetaceans (such as mid-frequency delphinids; odontocetes) may necessitate that more hydrophones be spaced closer together given the shorter propagation range of the shorter, mid-frequency acoustic signals (*e.g.,* whistles and echolocation clicks). As there are no ''perfect fit'' single optimal array configurations, these set-ups would need to be considered on a case-by-case basis.

A Passive Acoustic Monitoring (PAM) Plan must be submitted to NMFS for review and approval at least 180 days prior to the planned start of monopile installations. PAM should follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.,* 2021). The plan must describe all proposed PAM equipment, procedures, and protocols. However, NMFS considers PAM usage for every project on a case-by-case basis and would continue discussions with Sunrise Wind regarding selection of the PAM system that is most appropriate for the proposed project. The authorization to take marine mammals would be contingent upon NMFS' approval of the PAM Plan.

Acoustic Monitoring for Sound Field and Harassment Isopleth Verification (SFV)

During the installation of the first three monopile foundations and during all UXO/MEC detonations, Sunrise Wind must empirically determine source levels, the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds, and the transmission loss coefficient(s). Sunrise Wind may also estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from *in situ* measurements conducted at several distances from the monopile being driven and UXO/MEC being detonated. Sunrise Wind must measure received levels at a standard distance of 750 m from the monopiles and at both the presumed modeled Level A harassment and Level B harassment isopleth ranges or an alternative distance(s) as agreed to in the SFV Plan.

If acoustic field measurements collected during installation of foundation piles or UXO detonation indicate ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds are greater than the ranges predicted by modeling (assuming 10 dB attenuation), Sunrise Wind must implement additional noise mitigation measures prior to installing the next monopile or detonating any additional UXOs/MECs. Initial additional measures may include improving the efficacy of the implemented noise mitigation technology (*e.g.,* BBC, DBBC) and/or modifying the piling schedule to reduce the sound source. Each sequential modification would be evaluated empirically by acoustic field measurements. In the event that field measurements indicate ranges to isopleths corresponding to Level A harassment and Level B harassment thresholds are greater than the ranges predicted by modeling (assuming 10 dB attenuation), NMFS may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols. 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.

If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Sunrise Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles and for detonation of UXOs/MECs. For NMFS to consider a modification request, Sunrise Wind would have had to conduct SFV on three or more monopiles and on all detonated UXOs/MECs thus far to verify that zone sizes are consistently smaller than those predicted by modeling (assuming 10 dB attenuation). In addition, if a subsequent monopile installation location is selected that was not represented by previous three locations (*i.e.,* substrate composition, water depth), SFV would be required. Furthermore, if a subsequent UXO/MEC charge weight is encountered and/or detonation location is selected that was not representative of the previous locations (*i.e.,* substrate composition, water depth), SFV would also be required. Upon receipt of an interim SFV report, NMFS may adjust zones (*i.e.,* Level A harassment, Level B harassment, clearance, shutdown, and/or minimum visibility zone) to reflect SFV measurements. The shutdown and clearance zones for pile driving would be equivalent to the measured range to the Level A harassment isopleths plus 10 percent (shutdown zone) and 20 percent (clearance zone), rounded up to the nearest 100 m for PSO clarity. The minimum visibility zone would be based on the largest measured distance to the Level A harassment isopleth for large whales. Regardless of SFV, a North Atlantic right whale detected at any distance by PSOs would continue to result in a delay to the start of pile driving. Similarly, if pile driving has commenced, shutdown would be called for in the event a right whale is observed at any distance. That is, the visual clearance and shutdown criteria for North Atlantic right whales would not change, regardless of field acoustic measurements. The Level B harassment zone would be equal to the largest measured range to the Level B harassment isopleth.

The SFV plan must also include how operational noise would be monitored. Sunrise Wind would be required to estimate source levels (at 10 m from the operating foundation) based on received levels measured at 50 m, 100 m, and 250 m from each foundation monitored (minimum of 3 WTG and the OCS–DC). These data must be used to identify estimated transmission loss rates. Operational parameters (*e.g.,* direct drive/gearbox information, turbine rotation rate) as well as sea state conditions and information on nearby anthropogenic activities (*e.g.,* vessels transiting or operating in the area) must be reported.

Sunrise Wind must submit a SFV Plan at least 180 days prior to the planned start of impact pile driving and any UXO/MEC detonation activities. The plan must describe how Sunrise Wind would ensure that the first three monopile foundation installation sites selected and each UXO/MEC detonation scenario (*i.e.,* charge weight, location) selected for SFV are representative of the rest of the monopile installation sites and UXO/MEC scenarios. Sunrise Wind must include information on how additional sites/scenarios would be selected for SFV should it be determined that these sites/scenarios are not representative of all other monopile installation sites and UXO/MEC detonations. The plan must also include the methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Sunrise Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first three piles and after each UXO/MEC detonation.

In addition to the aforementioned monitoring requirements, Sunrise Wind proposes to conduct a long-term ecological monitoring project using bottom-mounted passive acoustic monitoring equipment during the effective period of the proposed rule to better understand the long term distribution of marine mammals in the project area with a focus on detecting North Atlantic right whales. This long-term study will contribute to the understanding of the potential impacts of the project and inform any potential adaptive management strategies.

Reporting

Prior to any construction activities occurring, Sunrise Wind would provide a report to NMFS (at *itp.daly@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) documenting that all required training for Sunrise Wind personnel (*i.e.,* vessel crews, vessel captains, PSOs, and PAM operators) has been completed.

NMFS would require standardized and frequent reporting from Sunrise Wind during the life of the proposed regulations and LOA. All data collected relating to the Sunrise Wind project would be recorded using industry-standard software (*e.g.,* Mysticetus or a similar software) installed on field laptops and/or tablets. Sunrise Wind would be required to submit weekly, monthly and annual reports as described below. During activities requiring PSOs, the following information would be collected and reported related to the activity being conducted:

- Date and time that monitored activity begins or ends;
- Construction activities occurring during each observation period;
- Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
- PSO who sighted the animal;
- Time of sighting;
- Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility);
- Water conditions (*e.g.,* sea state, tide state, water depth);
- All marine mammal sightings, regardless of distance from the construction activity;
- Species (or lowest possible taxonomic level possible)
- Pace of the animal(s);
- Estimated number of animals (minimum/maximum/high/low/best);
- Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*);
- Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
- Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity;
- Animal's closest distance and bearing from the pile being driven, UXO/MEC, or specified HRG equipment and estimated time spent within the Level A harassment and/or Level B harassment zones;
- Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, UXO/MEC detonation, HRG survey), use of any noise abatement device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft-start for pile driving, active pile driving, post-UXO/MEC detonation, *etc.*);
- Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action; and
- Other human activity in the area.

For all real-time acoustic detections of marine mammals, the following must be recorded and included in weekly, monthly, annual, and final reports:

1. Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name;
2. Bottom depth and depth of recording unit (in meters);
3. Recorder (model & manufacturer) and platform type (*i.e.,* bottom-mounted, electric glider, *etc.*), and instrument ID of the hydrophone and recording platform (if applicable);
4. Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. *i.e.,* EST time zone is UTC–5);
5. Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ);
6. Deployment/retrieval dates and times (in ISO 8601 format);
7. Recording schedule (must be continuous);
8. Hydrophone and recorder sensitivity (in dB *re. 1* μPa);
9. Calibration curve for each recorder;
10. Bandwidth/sampling rate (in Hz);
11. Sample bit-rate of recordings; and
12. Detection range of equipment for relevant frequency bands (in meters).

For each detection the following information must be noted:

13. Species identification (if possible);
14. Call type and number of calls (if known);
15. Temporal aspects of vocalization (date, time, duration, *etc.,* date times in ISO 8601 format);
16. Confidence of detection (detected, or possibly detected);
17. Comparison with any concurrent visual sightings;
18. Location and/or directionality of call (if determined) relative to acoustic rLocation of recorder and construction activities at time of call;
19. Name and version of detection or sound analysis software used, with protocol reference;
20. Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and
21. Name of PAM operator(s) on duty.

If a North Atlantic right whale is detected via Sunrise Wind's PAM, the date, time, and location (*i.e.,* latitude and longitude of recorder) of the detection as well as the recording platform that had the detection must be reported to *nmfs.pacmdata@noaa.gov* as soon as feasible, no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*).

If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any impact or vibratory pile-driving vessel, dedicated PSO vessel, construction survey vessel, during vessel transit, or during an aerial survey, Sunrise Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755–6622, to the U.S. Coast Guard via channel 16, and through the WhaleAlert app (*http://www.whalealert/org/*) as soon as feasible but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed.

SFV Interim Report—Sunrise Wind would be required to provide, as soon as they are available but no later than 48 hours after each installation, the initial results of SFV measurements to NMFS in an interim report after each monopile for the first three piles and any subsequent piles monitored. An SFV interim report must also be submitted within 48 hours after each UXO/MEC detonation.

Weekly Report—Sunrise Wind would be required to compile and submit weekly PSO, PAM, and SFV reports to NMFS (*PR.ITP.monitoringreports@noaa.gov*) that document the daily start and stop of all pile driving, pneumatic hammering, HRG survey, or UXO/MEC detonation activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals (acoustic and visual), any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise abatement system(s) used and its performance. Weekly reports would be due on Wednesday for the previous week (Sunday–Saturday). The weekly report would also identify which turbines become operational and when (a map must be provided). Once all foundation pile installation is complete, weekly reports would no longer be required.

Monthly Report—Sunrise Wind would be required to compile and submit monthly reports to NMFS (at *itp.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, number of UXO/MEC detonations, all detections of marine mammals, and any mitigative actions taken. Monthly reports would be due on the 15th of the month for the previous month. The monthly report would also identify which turbines become operational and when (a map must be provided). Once foundation pile installation is complete, monthly reports would no longer be required.

Annual Report—Sunrise Wind would be required to submit an annual PSO, PAM, and SFV summary report to NMFS (at *itp.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) no later than 90 days following the end of a given calendar year describing, in detail, all of the information required in the monitoring section above. A final annual report would be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments were received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report would be considered final.

Final Report—Sunrise Wind must submit its draft final report(s) to NMFS (at *itp.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) on all visual and acoustic monitoring conducted under the LOA within 90 calendar days of the completion of activities occurring under the LOA. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of NMFS' receipt of the draft report, the report shall be considered final.

Situational Reporting

Specific situations encountered during the development of the Sunrise Wind project would require reporting. These situations and the relevant procedures are described in paragraphs (d)(10)(i) through (v) of this section:

• If a large whale is detected during vessel transit, the following information must be recorded and reported:

a. Time, date, and location;
b. The vessel's activity, heading, and speed;
c. Sea state, water depth, and visibility;
d. Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal);
e. Initial distance and bearing to marine mammal from vessel and closest point of approach; and,
f. Any avoidance measures taken in response to the marine mammal sighting.

• If a sighting of a stranded, entangled, injured, or dead marine mammal occurs, the sighting would be reported to NMFS OPR, the NMFS Greater Atlantic Regional Fisheries Office (GARFO) Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866–755–6622), and the U.S. Coast Guard within 24 hours. If the injury or death was caused by a project activity, Sunrise Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Sunrise Wind may not resume their activities until notified by NMFS. The report must include the following information:

a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
b. Species identification (if known) or description of the animal(s) involved;
c. Condition of the animal(s) (including carcass condition if the animal is dead);
d. Observed behaviors of the animal(s), if alive;
e. If available, photographs or video footage of the animal(s); and
f. General circumstances under which the animal was discovered.

• In the event of a vessel strike of a marine mammal by any vessel associated with the Sunrise Wind project, Sunrise Wind shall immediately report the strike incident to the NMFS OPR and the GARFO within and no later than 24 hours. Sunrise Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Sunrise Wind may not resume their activities until notified by NMFS. The report must include the following information:

a. Time, date, and location (latitude/longitude) of the incident;
b. Species identification (if known) or description of the animal(s) involved;
c. Vessel's speed during and leading up to the incident;
d. Vessel's course/heading and what operations were being conducted (if applicable);
e. Status of all sound sources in use;
f. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

g. Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

h. Estimated size and length of animal that was struck;

i. Description of the behavior of the marine mammal immediately preceding and following the strike;

j. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

k. Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and

l. To the extent practicable, photographs or video footage of the animal(s).

Sound Monitoring Reporting

As described previously, Sunrise Wind would be required to provide the initial results of SFV (including measurements) to NMFS in interim reports after each monopile installation for the first three piles (and any subsequent piles) as soon as they are available, but no later than 48 hours after each installation. Sunrise Wind would also have to provide interim reports after every UXO/MEC detonation as soon as they are available but no later than 48 hours after each detonation. In addition to *in situ* measured ranges to the Level A harassment and Level B harassment isopleths, the acoustic monitoring report must include: hammer energies (pile driving), UXO/MEC weight (including donor charge weight), SPL_{peak}, SPL_{rms} that contains 90 percent of the acoustic energy, single strike sound exposure level, integration time for SPL_{rms}, and 24-hour cumulative SEL extrapolated from measurements. The sound levels reported must be in median and linear average (*i.e.,* average in linear space), and in dB. All these levels must be reported in the form of median, mean, max, and minimum. The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported. The acoustic monitoring report must also include: a description of the SFV PAM hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, a description of the hydrophones used, hydrophone and water depth, distance to the pile driven, sediment type at the recording location, and local environmental conditions (*e.g.,* wind speed). In addition, pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern) should be reported. Finally, the report must include a description of the noise abatement system and operational parameters (*e.g.,* bubble flow rate, distance deployed from the pile or UXO/MEC location, *etc.*), and any action taken to adjust the noise abatement system. Final results of SFV must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of monopiles and UXOs/MECs detonations.

Adaptive Management

The regulations governing the take of marine mammals incidental to Sunrise Wind's construction activities would contain an adaptive management component. The monitoring and reporting requirements in this proposed rule are designed to provide NMFS with information that helps us better understand the impacts of the specified activities on marine mammals and informs our consideration of whether any changes to mitigation or monitoring are appropriate. The use of adaptive management allows NMFS to consider new information from different sources to determine (with input from Sunrise Wind regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammals and if the measures are practicable.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: (1) Results from monitoring reports, as required by MMPA authorizations; (2) results from general marine mammal and sound research; and (3) any information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOA. During the course of the rule, Sunrise Wind (and other LOA-holders conducting offshore wind development activities) would be required to participate in one or more adaptive management meetings convened by NMFS and/or BOEM, in which the above information would be summarized and discussed in the context of potential changes to the mitigation or monitoring measures.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' by mortality, serious injury, and Level A harassment or Level B harassment, we consider other factors, such as the likely nature of any behavioral responses (*e.g.,* intensity, duration), the context of any such responses (*e.g.,* critical reproductive time or location, migration) as well as effects on habitat and the likely effectiveness of mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

In the Estimated Take section, we identified the subset of potential effects that would be expected to qualify as takes under the MMPA and then identified the maximum number of takes by Level A harassment and Level B harassment that we estimate are reasonably expected to occur based on the methods described. The impact that any given take would have is dependent on many case-specific factors that need to be considered in the negligible impact analysis (*e.g.,* the context of behavioral exposures such as duration or intensity of a disturbance, the health of impacted animals, the status of a species that incurs fitness-level impacts to individuals, *etc.*). In this rule, we evaluate the likely impacts of the enumerated harassment takes that are proposed for authorization in the context of the specific circumstances surrounding these predicted takes. We also collectively evaluate this information as well as other more taxa-specific information and mitigation measure effectiveness in group-specific discussions that support our negligible impact conclusions for each stock. As also described above, no serious injury or mortality is expected or proposed for authorization for any species or stock.

The Description of the Specified Activities section describes the specified activities proposed by Sunrise Wind that may result in take of marine mammals and an estimated schedule for conducting those activities. Sunrise Wind has provided a realistic construction schedule (*e.g.,* Sunrise Wind's schedule reflects the maximum number of piles they anticipate to be able to drive each month in which pile driving is authorized to occur), although, we recognize schedules may shift for a variety of reasons (*e.g.,* weather or supply delays). However, the total amount of take would not exceed the 5 year totals and maximum annual total in any given year indicated in Tables 38 and 39, respectively.

We base our analysis and negligible impact determination (NID) on the maximum number of takes that would be reasonably expected to occur and are proposed to be authorized in the 5-year LOA, if issued, and extensive qualitative consideration of other contextual factors that influence the degree of impact of the takes on the affected individuals and the number and context of the individuals affected. As stated before, the number of takes, both annual and 5-year total, alone are only a part of the analysis. To avoid repetition, we provide some general analysis in this Negligible Impact Analysis and Determination section that applies to all the species listed in Table 4, given that some of the anticipated effects of Sunrise Wind's construction activities on marine mammals are expected to be relatively similar in nature. Then, we subdivide into more detailed discussions for mysticetes, odontocetes, and pinnipeds, which have broad life history traits that support an overarching discussion of some factors considered within the analysis for those groups (*e.g.,* habitat-use patterns, high-level differences in feeding strategies).

Last, we provide a negligible impact determination for each species or stock, providing species or stock-specific information or analysis, where appropriate, for example, for North Atlantic right whales given their population status. Organizing our analysis by grouping species or stocks that share common traits or that would respond similarly to effects of Sunrise Wind's proposed activities and then providing species- or stock-specific information allows us to avoid duplication while ensuring that we have analyzed the effects of the specified activities on each affected species or stock. It is important to note that in the group or species sections, we base our negligible impact analysis on the maximum annual take that is predicted under the 5-year rule; however, the majority of the impacts are associated with WTG and OCS–DC foundation installation, which would occur largely within a 1-year period. The estimated take in the other years is expected to be notably less, which is reflected in the total take that would be allowable under the rule.

As described previously, no serious injury or mortality is anticipated or proposed for authorization in this rule. The amount of harassment Sunrise Wind has requested and NMFS is proposing to authorize is based on exposure models that consider the outputs of acoustic source and propagation models. Several conservative parameters and assumptions are ingrained into these models, such as assuming forcing functions that consider direct contact with piles (*i.e.,* no cushion allowances) and application of the highest monthly sound speed profile to all months within a given season. The exposure model results do not reflect any mitigation measures or avoidance response. The amount of take proposed to be authorized reflects careful consideration of other data (*e.g,* PSO data, group size data) and for large whales and Level A harassment potential, the consideration of mitigation measures. For all species, the amount of take proposed to be authorized represents the amount of Level A harassment and Level B harassment that is reasonably expected to occur.

Behavioral Disturbance

In general, NMFS anticipates that impacts on an individual that has been harassed are likely to be more intense when exposed to higher received levels and for a longer duration (though this is in no way a strictly linear relationship for behavioral effects across species, individuals, or circumstances) and less severe impacts result when exposed to lower received levels and for a brief duration. However, there is also growing evidence of the importance of contextual factors, such as distance from a source in predicting marine mammal behavioral response to sound—*i.e.,* sounds of a similar level emanating from a more distant source have been shown to be less likely to evoke a response of equal magnitude (*e.g.,* DeRuiter, 2012; Falcone *et al.,* 2017). As described in the Potential Effects to Marine Mammals and their Habitat section, the intensity and duration of any impact resulting from exposure to Sunrise Wind's activities is dependent upon a number of contextual factors including, but not limited to, sound source frequencies, whether the sound source is moving towards the animal, hearing ranges of marine mammals, behavioral state at time of exposure, status of individual exposed (*e.g.,* reproductive status, age class, health) and an individual's experience with similar sound sources. Ellison *et al.* (2012) and Moore and Barlow (2013), among others, emphasize the importance of context (*e.g.,* behavioral state of the animals, distance from the sound source) in evaluating behavioral responses of marine mammals to acoustic sources. Harassment of marine mammals may result in behavioral modifications (*e.g.,* avoidance, temporary cessation of foraging or communicating, changes in respiration or group dynamics, masking) or may result in auditory impacts such as hearing loss. In addition, some of the lower level physiological stress responses (*e.g.,* orientation or startle response, change in respiration, change in heart rate) discussed previously would likely co-occur with the behavioral modifications, although these physiological responses are more difficult to detect and fewer data exist relating these responses to specific received levels of sound. Takes by Level B harassment, then, may have a stress-related physiological component as well; however, we would not expect Sunrise Wind's activities to produce conditions of long-term and continuous exposure to noise leading to long-term physiological stress responses in marine mammals that could affect reproduction or survival.

In the range of potential behavioral effects that might be expected to be part of a response that qualifies as an instance of Level B harassment by behavioral disturbance (which by nature of the way it is modeled/counted, occurs within 1 day), the less severe end might include exposure to comparatively lower levels of a sound, at a greater distance from the animal, for a few or several minutes. A less severe exposure of this nature could result in a behavioral response such as avoiding an area that an animal would otherwise have chosen to move through or feed in for some amount of time, or breaking off one or a few feeding bouts. More severe effects could occur if an animal gets close enough to the source to receive a comparatively higher level, is exposed continuously to one source for a longer time, or is exposed intermittently to different sources throughout a day. Such effects might result in an animal having a more severe flight response and leaving a larger area for a day or more or potentially losing feeding opportunities for a day. However, such severe behavioral effects are expected to occur infrequently.

Many species perform vital functions, such as feeding, resting, traveling, and socializing on a diel cycle (24-hour cycle). Behavioral reactions to noise exposure, when taking place in a biologically important context, such as disruption of critical life functions, displacement, or avoidance of important habitat, are more likely to be significant if they last more than 1 day or recur on subsequent days (Southall *et al.,* 2007) due to diel and lunar patterns in diving and foraging behaviors observed in many cetaceans (Baird *et al.,* 2008, Barlow *et al.,* 2020, Henderson *et al.,* 2016, Schorr *et al.,* 2014). It is important to note the water depth in the Sunrise Wind project area is shallow (5 to 50 m) and deep diving species, such as sperm whales, are not expected to be engaging in deep foraging dives when exposed to noise above NMFS harassment thresholds during the specified activities. Therefore, we do not anticipate impacts to deep foraging behavior to be impacted by the specified activities.

It is also important to identify that the estimated number of takes does not necessarily equate to the number of individual animals Sunrise Wind expects to harass (which is lower) but rather, to the instances of take (*i.e.,* exposures above the Level B harassment thresholds) that are anticipated to occur. These instances may represent either brief exposures (*e.g.,* seconds for UXO/MEC detonation or seconds to minutes for HRG surveys) or in some cases, longer durations of exposure within a day (*e.g.,* pile driving). Some individuals of a species may experience recurring instances of take over multiple days throughout the year while some members of a species or stock may experience one exposure as they move through an area, which means that the number of individuals taken is smaller than the total estimated takes. In short, for species that are more likely to be migrating through the area and/or for which only a comparatively smaller number of takes are predicted (*e.g.,* some of the mysticetes), it is more likely that each take represents a different individual whereas for non-migrating species with larger amounts of predicted take, we expect that the total anticipated takes represent exposures of a smaller number of individuals of which some would be exposed multiple times.

For the Sunrise Wind project, impact pile driving is most likely to result in a higher magnitude and severity of behavioral disturbance than other activities (*i.e.,* vibratory pile driving, UXO/MEC detonation, and HRG surveys). Impact pile driving has higher source levels than vibratory pile driving and HRG sources. HRG survey equipment also produces much higher frequencies than pile driving, resulting in minimal sound propagation. While UXO/MEC detonations may have higher source levels, impact pile driving is planned for longer durations (*i.e.,* a maximum of three UXO/MEC detonations are planned, which would result in only instantaneous exposures). While impact pile driving is anticipated to be most impactful for these reasons, impacts are minimized through implementation of mitigation measures, including soft-start, use of a sound attenuation system, and the implementation of clearance zones that would facilitate a delay of pile driving if marine mammals were observed approaching or within areas that could be ensonified above sound levels that could result in Level B harassment. Given sufficient notice through the use of soft-start, marine mammals are expected to move away from a sound source prior to becoming exposed to very loud noise levels. The requirement that pile driving can only commence when the full extent of all clearance zones are fully visible to visual PSOs would ensure a higher marine mammal detection, enabling a high rate of success in implementation of clearance zones. Furthermore, Sunrise Wind would be required to utilize PAM prior to and during all clearance periods, during impact pile driving, and after pile driving has ended during the post-piling period. PAM has been shown to be particularly effective when used in conjunction with visual observations, increasing the overall capability to detect marine mammals (Van Parijs *et al.,* 2021). These measures also apply to UXO/MEC detonation(s), which also have the potential to elicit more severe behavioral reactions in the unlikely event that an animal is relatively close to the explosion in the instant that it occurs; hence, severity of behavioral responses are expected to be lower than would be the case without mitigation.

Occasional, milder behavioral reactions are unlikely to cause long-term consequences for individual animals or populations, and even if some smaller subset of the takes are in the form of a longer (several hours or a day) and more severe response, if they are not expected to be repeated over sequential days, impacts to individual fitness are not anticipated. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer *et al.,* 2018; Harris *et al.,* 2017; King *et al.,* 2015; NAS 2017; New *et al.,* 2014; Southall *et al.,* 2007; Villegas-Amtmann *et al.,* 2015).

Temporary Threshold Shift (TTS)

TTS is one form of Level B harassment that marine mammals may incur through exposure to Sunrise Wind's activities and, as described earlier, the proposed takes by Level B harassment may represent takes in the form of behavioral disturbance, TTS, or both. As discussed in the Potential Effects to Marine Mammals and their Habitat section, in general, TTS can last from a few minutes to days, be of varying degree, and occur across different frequency bandwidths, all of which determine the severity of the impacts on the affected individual, which can range from minor to more severe. Impact and vibratory pile driving generate sounds in the lower frequency ranges (with most of the energy below 1–2 kHz, but with a small amount energy ranging up to 20 kHz); therefore, in general and all else being equal, we would anticipate the potential for TTS is higher in low-frequency cetaceans (*i.e.,* mysticetes) than other marine mammal hearing groups and would be more likely to occur in frequency bands in which they communicate. However, we would not expect the TTS to span the entire communication or hearing range of any species given the frequencies produced by pile driving do not span entire hearing ranges for any particular species. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalizations, the frequency range of TTS from Sunrise Wind's pile driving and UXO/MEC detonation activities would not typically span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. However, the mitigation measures proposed by Sunrise Wind and proposed by NMFS, further reduce the potential for TTS in mysticetes.

Generally, both the degree of TTS and the duration of TTS would be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). The threshold for the onset of TTS was discussed previously (refer back to Table 8). However, source level alone is not a predictor of TTS. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which would be difficult considering the proposed mitigation and the nominal speed of the receiving animal relative to the stationary sources such as impact pile driving. The recovery time of TTS is also of importance when considering the potential impacts from TTS. In TTS laboratory studies (as discussed in the Potential Effects to Marine Mammals and their Habitat section), some using exposures of almost an hour in duration or up to 217 SEL, almost all individuals recovered within 1 day (or less, often in minutes) and we note that while the pile driving activities last for hours a day, it is unlikely that most marine mammals would stay in the close vicinity of the source long enough to incur more severe TTS. UXO/MEC detonation also has the potential to result in TTS; however, given the duration of exposure is extremely short (milliseconds), the degree of TTS (*i.e.,* the amount of dB shift) is expected to be small and TTS duration is expected to be short (minutes to hours). Overall, given the small number of times that any individual might incur TTS, the low degree of TTS and the short anticipated duration, and the unlikely scenario that any TTS overlapped the entirety of a critical hearing range, it is unlikely that TTS of the nature expected to result from Sunrise Wind's activities would result in behavioral changes or other impacts that would impact any individual's (of any hearing sensitivity) reproduction or survival.

Permanent Threshold Shift (PTS)

Sunrise Wind has requested and NMFS proposed to authorize a very small amount of take by PTS to some marine mammal individuals. The numbers of proposed annual takes by Level A harassment are relatively low for all marine mammal stocks and species: humpback whales (7 takes), harbor porpoises (49 takes), gray seals (7 takes), and harbor seals (16 takes). The only activities we anticipate PTS may result from are exposure to impact pile driving and UXO/MEC detonations, which produce sounds that are both impulsive and primarily concentrated in the lower frequency ranges (below 1 kHz) (David, 2006; Krumpel *et al.,* 2021).

There are no PTS data on cetaceans and only one instance of PTS being induced in an older harbor seals (Reichmuth *et al.,* 2019); however, available TTS data (of mid-frequency hearing specialists exposed to mid- or high-frequency sounds (Southall *et al.,* 2007; NMFS 2018; Southall *et al.,* 2019)) suggest that most threshold shifts occur in the frequency range of the source up to one octave higher than the source. We would anticipate a similar result for PTS. Further, no more than a small degree of PTS is expected to be associated with any of the incurred Level A harassment given it is unlikely that animals would stay in the close vicinity of a source for a duration long enough to produce more than a small degree of PTS.

PTS would consist of minor degradation of hearing capabilities occurring predominantly at frequencies one-half to one octave above the frequency of the energy produced by pile driving or instantaneous UXO/MEC detonation (*i.e.,* the low-frequency region below 2 kHz) (Cody and Johnstone, 1981; McFadden, 1986; Finneran, 2015), not severe hearing impairment. If hearing impairment occurs from either impact pile driving or UXO/MEC detonation, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics. However, given sufficient notice through use of soft-start prior to implementation of full hammer energy during impact pile driving, marine mammals are expected to move away from a sound source prior to it resulting in severe PTS. Sunrise estimates up to three UXOs/MECs may be detonated and the exposure analysis assumes the worst-case scenario that all of the UXOs/MECs found would consist of the largest charge weight of UXO/MEC (E12; 454 kg). However, it is highly unlikely that all charges would be this maximum size; thus, the amount of Level A harassment that may occur incidental to the detonation of the three UXOs/MECs would likely be less than what is estimated here. Nonetheless, this negligible impact analysis considers the effects of the takes that are conservatively proposed for authorization.

Auditory Masking or Communication Impairment

The ultimate potential impacts of masking on an individual are similar to those discussed for TTS (*e.g.,* decreased ability to communicate, forage effectively, or detect predators), but an important difference is that masking only occurs during the time of the signal versus TTS, which continues beyond the duration of the signal. Also, though, masking can result from the sum of exposure to multiple signals, none of which might individually cause TTS. Fundamentally, masking is referred to as a chronic effect because one of the key potential harmful components of masking is its duration—the fact that an animal would have reduced ability to hear or interpret critical cues becomes much more likely to cause a problem the longer it is occurring. Also inherent in the concept of masking is the fact that the potential for the effect is only present during the times that the animal and the source are in close enough proximity for the effect to occur (and further, this time period would need to coincide with a time that the animal was utilizing sounds at the masked frequency). As our analysis has indicated, for this project we expect that impact pile driving foundations have the greatest potential to mask marine mammal signals, and this pile driving may occur for several, albeit intermittent, hours per day. Masking is fundamentally more of a concern at lower frequencies (which are pile driving dominant frequencies) because low frequency signals propagate significantly further than higher frequencies and because they are more likely to overlap both the narrower low frequency calls of mysticetes, as well as many non-communication cues related to fish and invertebrate prey, and geologic sounds that inform navigation. However, the area in which masking would occur for all marine mammal species and stocks (*e.g.,* predominantly in the vicinity of the foundation pile being driven) is small relative to the extent of habitat used by each species and stock. In summary, the nature of Sunrise Wind's activities, paired with habitat use patterns by marine mammals, does not support the likelihood that the level of masking that could occur would have the potential to affect reproductive success or survival.

Impacts on Habitat and Prey

Construction activities or UXO/MEC detonation may result in fish and invertebrate mortality or injury very close to the source, and all activities (including HRG surveys) may cause some fish to leave the area of disturbance. It is anticipated that any mortality or injury would be limited to a very small subset of available prey and the implementation of mitigation measures, such as the use of a noise attenuation system during impact pile driving and UXO/MEC detonation, would further limit the degree of impact (again noting UXO/MEC detonation would be limited to 3 events over 5 years). Behavioral changes in prey in response to construction activities could temporarily impact marine mammals' foraging opportunities in a limited portion of the foraging range but because of the relatively small area of the habitat that may be affected at any given time (*e.g.,* around a pile being driven), the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences.

Cable presence and operation are not anticipated to impact marine mammal habitat as these would be buried, and any electromagnetic fields emanating from the cables are not anticipated to result in consequences that would impact marine mammals prey to the extent they would be unavailable for consumption.

The presence and operation of wind turbines within the lease area could have longer-term impacts on marine mammal habitat, as the project would result in the persistence of the structures within marine mammal habitat for more than 30 years. The presence and operation of an extensive number of structures, such as wind turbines, are, in general, likely to result in local and broader oceanographic effects in the marine environment and may disrupt dense aggregations and distribution of marine mammal zooplankton prey through altering the strength of tidal currents and associated fronts, changes in stratification, primary production, the degree of mixing, and stratification in the water column (Chen *et al.,* 2021, Johnson *et al.,* 2021, Christiansen *et al.,* 2022, Dorrell *et al.,* 2022). However, the scale of impacts is difficult to predict and may vary from hundreds of meters for local individual turbine impacts (Schultze *et al.,* 2020) to large-scale dipoles of surface elevation changes stretching hundreds of kilometers (Christiansen *et al.,* 2022). In 2022, NMFS hosted a workshop to better understand the current scientific knowledge and data gaps around the potential long-term impacts of offshore wind farm operations in the Atlantic Ocean. The report from that workshop is pending, and NMFS will consider its findings in development of the final rule for this action.

As discussed in the Potential Effects to Marine Mammals and Their Habitat section, the SRWF would consist of no more than 94 WTGs (scheduled to be operational by the end of Year 1 of the effective period of the rule) in coastal waters off New York, an area dominated by physical oceanographic patterns of strong seasonal stratification (summer) and turbulence-driven mixing (winter). While there are likely to be local oceanographic impacts from the presence and operation of the SRWF, meaningful oceanographic impacts relative to stratification and mixing that would significantly affect marine mammal habitat and prey over large areas in key foraging habitats are not anticipated from the Sunrise Wind project. Although this area supports aggregations of zooplankton (baleen whale prey) that could be impacted if long-term oceanographic changes occurred, prey densities are typically significantly less in the Sunrise Wind project area than in known baleen whale foraging habitats to the east and north (*e.g.,* south of Nantucket and Martha's Vineyard, Great South Channel). For these reasons, if oceanographic features are affected by wind farm operation during the course of the proposed rule (approximately end of Year 1 through Year 5), the impact on marine mammal habitat and their prey is likely to be comparatively minor.

Mitigation To Reduce Impacts on All Species

This proposed rulemaking includes a variety of mitigation measures designed to minimize impacts on all marine mammals, with a focus on North Atlantic right whales (the latter is described in more detail below). For impact pile driving of foundation piles, eight overarching mitigation measures are proposed, which are intended to reduce both the number and intensity of marine mammal takes: (1) seasonal/time of day work restrictions; (2) use of multiple PSOs to visually observe for marine mammals (with any detection within designated zones triggering delay or shutdown); (3) use of PAM to acoustically detect marine mammals, with a focus on detecting baleen whales (with any detection within designated zones triggering delay or shutdown); (4) implementation of clearance zones; (5) implementation of shutdown zones; (6) use of soft-start; (7) use of noise abatement technology; and, (8) maintaining situational awareness of marine mammal presence through the requirement that any marine mammal sighting(s) by Sunrise Wind project personnel must be reported to PSOs.

When monopile foundation installation does occur, Sunrise Wind is committed to reducing the noise levels generated by impact pile driving to the lowest levels practicable and ensuring that they do not exceed a noise footprint above that which was modeled, assuming a 10 dB attenuation. Use of a soft-start would allow animals to move away from (*i.e.,* avoid) the sound source prior to the elevation of the hammer energy to the level maximally needed to install the pile (Sunrise Wind would not use a hammer energy greater than necessary to install piles). Clearance zone and shutdown zone implementation, required when marine mammals are within given distances associated with certain impact thresholds, would reduce the magnitude and severity of marine mammal take.

Sunrise proposed and NMFS would require use a noise attenuation device (likely a big bubble curtain and another technology, such as a hydro-sound damper) during all foundation pile driving to ensure sound generated from the project does not exceed that modeled (assuming 10 dB reduction) distances to harassment isopleths and to minimize noise levels to the lowest level practicable. Double big bubble curtains are successfully and widely applied across European wind development efforts, and are known to reduce noise levels more than a single big bubble curtain alone (*e.g.,* see Bellman *et al.,* 2020).

Mysticetes

Six mysticete species (comprising six stocks) of cetaceans (North Atlantic right whale, humpback whale, fin whale, blue whale, sei whale, and minke whale) are proposed to be taken by harassment. These species, to varying extents, utilize coastal New England waters, including the project area, for the purposes of migration and foraging.

Behavioral data on mysticete reactions to pile driving noise is scant. Kraus *et al.* (2019) predicted that the three main impacts of offshore wind farms on marine mammals would consist of displacement, behavioral disruptions, and stress. Broadly, we can look to studies that have focused on other noise sources such as seismic surveys and military training exercises, which suggest that exposure to loud signals can result in avoidance of the sound source (or displacement if the activity continues for a longer duration in a place where individuals would otherwise have been staying, which is less likely for mysticetes in this area), disruption of foraging activities (if they are occurring in the area), local masking around the source, associated stress responses, and impacts to prey as well as TTS or PTS in some cases.

Mysticetes encountered in the Sunrise Wind project area are expected to be migrating through and/or foraging within the project area; the extent to which an animal engages in these behaviors in the area is species-specific and varies seasonally. Given that extensive feeding BIAs for the North Atlantic right whale, humpback whale, fin whale, sei whale, and minke whale exist to the east and north of the project area (LaBrecque *et al.,* 2015; Van Parijs *et al,* 2015), many mysticetes are expected to predominantly be migrating through the project area towards or from these feeding habitats. However, the extent to which particular species are utilizing the project area and nearby habitats (*i.e,,* south of Martha's Vineyard and Nantucket) for foraging or other activities is changing, particularly right whales (*e.g.,* O'Brien *et al.,* 2021; Quintana-Rizzo *et al.,* 2021), thus our understanding of the temporal and spatial occurrence of right whales and other mysticete species is continuing to be informed by ongoing monitoring efforts. While we have acknowledged above that mortality, hearing impairment, or displacement of mysticete prey species may result locally from impact pile driving or UXO/MEC detonation, given the very short duration of UXO/MEC detonation and limited amount over 5 years, and broad availability of prey species in the area and the availability of alternative suitable foraging habitat for the mysticete species most likely to be affected, any impacts on mysticete foraging would be expected to be minor. Whales temporarily displaced from the proposed project area would be expected to have sufficient remaining feeding habitat available to them and would not be prevented from feeding in other areas within the biologically important feeding habitats. In addition, any displacement of whales or interruption of foraging bouts would be expected to be temporary in nature.

The potential for repeated exposures is dependent upon the residency time of whales, with migratory animals unlikely to be exposed on repeated occasions and animals remaining in the area to be more likely exposed repeatedly. Where relatively low amounts of species-specific proposed Level B harassment are predicted (compared to the abundance of each mysticete species or stock, such as is indicated in Table 4) and movement patterns suggest that individuals would not necessarily linger in a particular area for multiple days, each predicted take likely represents an exposure of a different individual. The behavioral impacts would, therefore, be expected to occur within a single day within a year—an amount that would not be expected to impact reproduction or survival. Alternatively, species with longer residence time in the project area may be subject to repeated exposures. In general, for this project, the duration of exposures would not be continuous throughout any given day and pile driving would not occur on all consecutive days within a given year due to weather delays or any number of logistical constraints Sunrise Wind has identified. Species-specific analysis regarding potential for repeated exposures and impacts is provided below. Overall, we do not expect impacts to whales within project area habitat, including fin whales foraging in the fin whale feeding BIA, to affect the fitness of any large whales.

NMFS is proposing to authorize Level A harassment (in the form of PTS) of fin, minke, humpback, and sei whales incidental to installation of SFWF foundations. As described previously, PTS for mysticetes from impact pile driving may overlap frequencies used for communication, navigation, or detecting prey. However, given the nature and duration of the activity, the mitigation measures, and likely avoidance behavior, any PTS is expected to be of a small degree, would be limited to frequencies where pile driving noise is concentrated (*i.e.,* only a small subset of their expected hearing range) and would not be expected to impact reproductive success or survival.

North Atlantic Right Whales

North Atlantic right whales are listed as endangered under the ESA and as described in the Effects to Marine Mammals and Their Habitat section, are threatened by a low population abundance, higher than average mortality rates, and lower than average reproductive rates. Recent studies have reported individuals showing high stress levels (*e.g.,* Corkeron *et al.,* 2017) and poor health, which has further implications on reproductive success and calf survival (Christiansen *et al.,* 2020; Stewart *et al.,* 2021; Stewart *et al.,* 2022). Given this, the status of the North Atlantic right whale population is of heightened concern and therefore, merits additional analysis and consideration. NMFS proposes to authorize a maximum of 35 takes of North Atlantic right whales by Level B harassment only in any given year (likely Year 1) with no more than 47 takes incidental to all construction activities over the 5-year period of effectiveness of this proposed rule.

As described above, the project area represents part of an important migratory and potential feeding area for right whales. Quintana-Rizzo *et al.* (2021) noted different degrees of residency (*i.e.,* the minimum number of days an individual remained in southern New England) for right whales with individual sighting frequency ranging from 1 to 10 days. The study results indicate that southern New England may, in part, be a stopover site for migrating right whales moving to or from southeastern calving grounds. The right whales observed during the study period were primarily concentrated in the northeastern and southeastern sections of the MA WEA during the summer (June–August) and winter (December–February) rather than in OCS–A 0487, which is to the west in the RI/MA WEA (see Figure 5 in Quintano-Rizzo *et al.,* 2021). Right whale distribution did shift to the west into the RI/MA WEA in the spring (March–May), although sightings within the Sunrise Wind project area were few compared to other portions of the WEA during this time. Overall, the Sunrise Wind project area contains habitat less frequently utilized by North Atlantic right whales than the more easterly Southern New England region.

In general, North Atlantic right whales in southern New England are expected to be engaging in migratory or foraging behavior (Quintano-Rizzo *et al.,* 2021). Model outputs suggest that 23 percent of the species' population is present in this region from December through May, and the mean residence time has tripled to an average of 13 days during these months. Given the species' migratory behavior in the project area, we anticipate individual whales would be typically migrating through the area during most months when foundation installation and UXO/MEC detonation would occur (given the seasonal restrictions on foundation installation from January through April and UXO/MEC detonation from December through April) rather than lingering for extended periods of time. Other work that involves either much smaller harassment zones (*e.g.,* HRG surveys) or is limited in amount (cable landfall construction) may occur during periods when North Atlantic right whales are using the habitat for both migration and foraging. Therefore, it is likely that many of the exposures would occur to individual whales; however, some may be repeat takes of the same animal across multiple days for some short period of time given residency data (*e.g.,* 13 days during December through May). It is important to note the activities occurring from December through May that may impact North Atlantic right whale would be primarily HRG surveys and cable landfall construction, neither of which would result in very high received levels. Across all years, while it is possible an animal could have been exposed during a previous year, the low amount of take proposed to be authorized during the 5-year period of the proposed rule makes this scenario possible but unlikely. However, if an individual were to be exposed during a subsequent year, the impact of that exposure is likely independent of the previous exposure given the duration between exposures.

North Atlantic right whales are presently experiencing an ongoing UME (beginning in June 2017). Preliminary findings support human interactions, specifically vessel strikes and entanglements, as the cause of death for the majority of North Atlantic right whales. Given the current status of the North Atlantic right whale, the loss of even one individual could significantly impact the population. No mortality, serious injury, or injury of North Atlantic right whales as a result of the project is expected or proposed to be authorized. Any disturbance to North Atlantic right whales due to Sunrise Wind's activities is expected to result in temporary avoidance of the immediate area of construction. As no injury, serious injury, or mortality is expected or authorized, and Level B harassment of North Atlantic right whales will be reduced to the level of least practicable adverse impact through use of mitigation measures, the authorized number of takes of North Atlantic right whales would not exacerbate or compound the effects of the ongoing UME in any way.

As described in the general *Mysticetes* section above, impact pile driving of foundation piles has the potential to result in the highest amount of annual take (44 Level B harassment takes) and is of greatest concern given loud source levels. This activity would likely be limited to 1 year, during times when North Atlantic right whales are not present in high numbers and are likely to be primarily migrating to more northern foraging grounds with the potential for some foraging occurring in or near the project area. The potential types, severity, and magnitude of impacts are also anticipated to mirror that described in the general *Mysticetes* section above, including avoidance (the most likely outcome), changes in foraging or vocalization behavior, masking, a small amount of TTS, and temporary physiological impacts (*e.g.,* change in respiration, change in heart rate). Importantly, the effects of the activities proposed by Sunrise Wind are expected to be sufficiently low-level and localized to specific areas as to not meaningfully impact important behaviors such as migratory or foraging behavior of North Atlantic right whales. As described above, no more than 35 takes would occur in any given year (likely Year 1 if all foundations are installed in Year 1) with no more than 47 takes occurring across the 5 years the proposed rule would be effective. If this number of exposures results in temporary behavioral reactions, such as slight displacement (but not abandonment) of migratory habitat or temporary cessation of feeding, it is unlikely to result in energetic consequences that could affect reproduction or survival of any individuals. As described above, North Atlantic right whales are primarily foraging during December through May when the vast majority of take from impact pile driving would not occur (given the seasonal restriction from January 1–April 30). Overall, NMFS expects that any harassment of North Atlantic right whales incidental to the specified activities would not result in changes to their migration patterns or foraging behavior as only temporary avoidance of an area during construction is expected to occur. As described previously, right whales migrating through and/or foraging in these areas are not expected to remain in this habitat for extensive durations, relative to nearby habitats such as south of Nantucket and Martha's Vineyard or the Great South Channel (known core foraging habitats) (Quintana-Rizzo *et al.,* 2021) and that any temporarily displaced animals would be able to return to or continue to travel through and forage in these areas once activities have ceased.

Although acoustic masking may occur, based on the acoustic characteristics of noise associated with pile driving (*e.g.,* frequency spectra, short duration of exposure) and construction surveys (*e.g.,* intermittent signals), NMFS expects masking effects to be minimal (*e.g.,* impact or vibratory pile driving) to none (*e.g.,* construction surveys). In addition, masking would likely only occur during the period of time that a North Atlantic right whale is in the relatively close vicinity of pile driving, which is expected to be infrequent and brief given time of year restrictions, anticipated mitigation effectiveness, and likely avoidance behaviors. TTS is another potential form of Level B harassment that could result in brief periods of slightly reduced hearing sensitivity affecting behavioral patterns by making it more difficult to hear or interpret acoustic cues within the frequency range (and slightly above) of sound produced during impact pile driving. However, any TTS would likely be of low amount and limited to frequencies where most construction noise is centered (below 2 kHz). NMFS expects that right whale hearing sensitivity would return to pre-exposure levels shortly after migrating through the area or moving away from the sound source.

As described in the Potential Effects to Marine Mammals and Their Habitat section, the distance of the receiver to the source influences the severity of response with greater distances typically eliciting less severe responses. Additionally, NMFS recognizes North Atlantic right whales migrating could be pregnant females (in the fall) and cows with older calves (in spring) and that these animals may slightly alter their migration course in response to any foundation pile driving. However, as described in the Potential Effects to Marine Mammals and Their Habitat section, we anticipate that course diversion would be of small magnitude. Hence, while some avoidance of the pile driving activities may occur, we anticipate any avoidance behavior of migratory right whales would be similar to that of gray whales (Tyack and Clark, 1983), on the order of hundreds of meters up to 1 to 2 km. This diversion from a migratory path otherwise uninterrupted by Sunrise Wind activities or from lower quality foraging habitat (relative to nearby areas) is not expected to result in meaningful energetic costs that would impact annual rates of recruitment of survival. NMFS expects that North Atlantic right whales would be able to avoid areas during periods of active noise production while not being forced out of this portion of their habitat.

North Atlantic right whale presence in the Sunrise Wind project area is year-round; however, abundance during summer months is lower compared to the winter months with spring and fall serving as ''shoulder seasons'' wherein abundance waxes (fall) or wanes (spring). Given this year-round habitat usage, in recognition that where and when whales may actually occur during project activities is unknown as it depends on the annual migratory behaviors, Sunrise Wind has proposed and NMFS is proposing to require a suite of mitigation measures designed to reduce impacts to North Atlantic right whales to the maximum extent practicable. These mitigation measures (*e.g.,* seasonal/daily work restrictions, vessel separation distances, reduced vessel speed) would not only avoid the likelihood of ship strikes but also would minimize the severity of behavioral disruptions by minimizing impacts (*e.g.,* through sound reduction using abatement systems and reduced temporal overlap of project activities and North Atlantic right whales). This would further ensure that the number of takes by Level B harassment that are estimated to occur are not expected to affect reproductive success or survivorship via detrimental impacts to energy intake or cow/calf interactions during migratory transit. However, even in consideration of recent habitat-use and distribution shifts, Sunrise Wind would still be installing monopiles when the presence of North Atlantic right whales is expected to be lower.

As described in the Description of Marine Mammals in the Area of Specified Activities section, Sunrise Wind would be constructed within the North Atlantic right whale migratory corridor BIA, which represent areas and months within which a substantial portion of a species or population is known to migrate. Off the south coast of Massachusetts and Rhode Island, this BIA extends from the coast to beyond the shelf break. The Sunrise Wind lease area is relatively small compared with the migratory BIA area (approximately 351 km^2 versus the size of the full North Atlantic right whale migratory BIA, 269,448 km^2). Because of this, overall North Atlantic right whale migration is not expected to be impacted by the proposed activities. There are no known North Atlantic right whale mating or calving areas within the project area. Impact pile driving, which is responsible for the majority of North Atlantic right whale impacts, would be limited to a maximum of 12 hours per day (three intermittent 4-hour events); therefore, if foraging activity is disrupted due to pile driving, any disruption would be brief as North Atlantic right whales would likely resume foraging after pile driving ceases or when animals move to another nearby location to forage. Prey species are mobile (*e.g.,* calanoid copepods can initiate rapid and directed escape responses) and are broadly distributed throughout the project area (noting again that North Atlantic right whale prey is not particularly concentrated in the project area relative to nearby habitats). Therefore, any impacts to prey that may occur are also unlikely to impact marine mammals.

The most significant measure to minimize impacts to individual North Atlantic right whales during monopile installations is the seasonal moratorium on impact pile driving of monopiles from January 1 through April 30 when North Atlantic right whale abundance in the project area is expected to be highest. NMFS also expects this measure to greatly reduce the potential for mother-calf pairs to be exposed to impact pile driving noise above the Level B harassment threshold during their annual spring migration through the project area from calving grounds to primary foraging grounds (*e.g.,* Cape Cod Bay). Further, NMFS expects that exposures to North Atlantic right whales would be reduced due to the additional proposed mitigation measures that would ensure that any exposures above the Level B harassment threshold would result in only short-term effects to individuals exposed. Impact pile driving may only begin in the absence of North Atlantic right whales (based on visual and passive acoustic monitoring). If impact pile driving has commenced, NMFS anticipates North Atlantic right whales would avoid the area, utilizing nearby waters to carry on pre-exposure behaviors. However, impact pile driving must be shut down if a North Atlantic right whale is sighted at any distance unless a shutdown is not feasible due to risk of injury or loss of life. Shutdown may occur anywhere if right whales are seen within or beyond the Level B harassment zone, further minimizing the duration and intensity of exposure. NMFS anticipates that if North Atlantic right whales go undetected and they are exposed to impact pile driving noise, it is unlikely a North Atlantic right whale would approach the impact pile driving locations to the degree that they would purposely expose themselves to very high noise levels. These measures are designed to avoid PTS and also reduce the severity of Level B harassment, including the potential for TTS. While some TTS could occur, given the proposed mitigation measures (*e.g.,* delay pile driving upon a sighting or acoustic detection and shutting down upon a sighting or acoustic detection), the potential for TTS to occur is low.

The proposed clearance and shutdown measures are most effective when detection efficiency is maximized, as the measures are triggered by a sighting or acoustic detection. To maximize detection efficiency, Sunrise Wind proposed, and NMFS is proposed to require, the combination of PAM and visual observers (as well as communication protocols with other Sunrise Wind vessels, and other heightened awareness efforts such as daily monitoring of North Atlantic right whale sighting databases) such that as a North Atlantic right whale approaches the source (and thereby could be exposed to higher noise energy levels), PSO detection efficacy would increase, the whale would be detected, and a delay to commencing pile driving or shutdown (if feasible) would occur. In addition, the implementation of a soft-start would provide an opportunity for whales to move away from the source if they are undetected, reducing received levels. Further, Sunrise Wind has committed to not installing two WTG or OCS–DC foundations simultaneously. North Atlantic right whales would, therefore, not be exposed to concurrent impact pile driving on any given day and the area ensonified at any given time would be limited. We note that Sunrise Wind has requested to install foundation piles at night which does raise concern over detection capabilities. Sunrise Wind is currently conducting detection capability studies using alternative technology and intends to submit the results of these studies to NMFS. In consultation with BOEM, NMFS will review the results and determine whether Sunrise Wind's proposed monitoring plan will be effective at detecting marine mammals in order to implement mitigation.

Although the temporary sheet pile Level B harassment zone is large (9,740 km to the unweighted Level B harassment threshold; Table 27 in the ITA application), the sheet piles would be installed within Narragansett Bay over a short timeframe (56 hours total; 28 hours for installation and 28 hours for removal). Therefore, it is also unlikely that any North Atlantic right whales would be exposed to concurrent vibratory and impact pile installation noises. Any UXO/MEC detonations, if determined to be necessary, would only occur in daylight and if all other low-order methods or removal of the explosive equipment of the device are determined to not be possible. Given that specific locations for the three UXOs/MECs detonations, if they occur, are not presently known, Sunrise Wind has agreed to undertake specific mitigation measures to reduce impacts on any North Atlantic right whales, including the use of a sound attenuation device (*i.e.,* likely a bubble curtain and another device) to achieve a minimum of 10 dB attenuation, and not detonating a UXO/MEC if a North Atlantic right whale is observed within the large whale clearance zone (10 km). Finally, for HRG surveys, the maximum distance to the Level B harassment isopleth is 141 m. The estimated take, by Level B harassment only, associated with HRG surveys is to account for any North Atlantic right whale sightings PSOs may miss when HRG acoustic sources are active. However, because of the short maximum distance to the Level B harassment isopleth (141 m), the requirement that vessels maintain a distance of 500 m from any North Atlantic right whales, the fact whales are unlikely to remain in close proximity to an HRG survey vessel for any length of time, and that the acoustic source would be shutdown if a North Atlantic right whale is observed within

500 m of the source, any exposure to noise levels above the harassment threshold (if any) would be very brief. To further minimize exposures, ramp-up of boomers, sparkers, and CHIRPs must be delayed during the clearance period if PSOs detect a North Atlantic right whale (or any other ESA-listed species) within 500 m of the acoustic source. With implementation of the proposed mitigation requirements, take by Level A harassment is unlikely and, therefore, not proposed for authorization. Potential impacts associated with Level B harassment would include low-level, temporary behavioral modifications, most likely in the form of avoidance behavior. Given the high level of precautions taken to minimize both the amount and intensity of Level B harassment on North Atlantic right whales, it is unlikely that the anticipated low-level exposures would lead to reduced reproductive success or survival.

North Atlantic right whales are listed as endangered under the ESA with a declining population primarily due to vessel strike and entanglement. Again, NMFS is proposing to authorize no more than 35 instances of take, by Level B harassment only, within the a given year with no more than 47 instances of take could occur over the 5-year effective period of the proposed rule, with the likely scenario that each instance of exposure occurs to a different individual (a small portion of the stock), and any individual North Atlantic right whale is likely to be disturbed at a low-moderate level. The magnitude and severity of harassment are not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality, serious injury, or Level A harassment is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the proposed authorized take would have a negligible impact on the North Atlantic stock of North Atlantic right whales.

Humpback Whales

Humpback whales potentially impacted by Sunrise Wind's activities do not belong to a DPS that is listed as threatened or endangered under the ESA. However, humpback whales along the Atlantic Coast have been experiencing an active UME as elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through Florida since January 2016. Of the cases examined, approximately half had evidence of human interaction (ship strike or entanglement). The UME does not yet provide cause for concern regarding population-level impacts, and take from ship strike and entanglement is not proposed to be authorized. Despite the UME, the relevant population of humpback whales (the West Indies breeding population, or DPS of which the Gulf of Maine stock is a part) remains stable at approximately 12,000 individuals.

Sunrise Wind has requested, and NMFS has proposed to authorize, a limited amount of humpback whale harassment, by Level A harassment and Level B harassment. No mortality or serious injury is anticipated or proposed for authorization. Among the activities analyzed, impact pile driving has the potential to result in the highest amount of annual take of humpback whales (3 takes by Level A harassment and 89 takes by Level B harassment) and is of greatest concern, given the associated loud source levels. Kraus *et al.* (2016) reported humpback whale sightings in the RI–MA WEA during all seasons, with peak abundance during the spring and early summer, but their presence within the region varies between years. Increased presence of sand lance (*Ammodytes* spp.) appears to correlate with the years in which most whales were observed, suggesting that humpback whale distribution and occurrence could largely be influenced by prey availability (Kenney and Vigness-Raposa 2010, 2016). Seasonal abundance estimates of humpback whales in the RI–MA WEA range from 0 to 41 (Kraus *et al.,* 2016), with higher estimates observed during the spring and summer. Davis *et al.* (2020) found the greatest number of acoustic detections in southern New England in the winter and spring, with a noticeable decrease in acoustic detections during most summer and fall months. These data suggest that the 3 and 89 maximum annual instances of predicted take by Level A harassment and Level B harassment, respectively, could consist of individuals exposed to noise levels above the harassment thresholds once during migration through the project area and/or individuals exposed on multiple days if they are utilizing the area as foraging habitat. Based on the observed peaks in humpback whale seasonal distribution in the RI/MA WEA, it is likely that these individuals would primarily be exposed to HRG survey activities, landfall construction activities, and to a lesser extent, impact pile driving and UXO/MEC detonations (given the seasonal restrictions on the latter two activities). Any such exposures would occur either singly, or intermittently, but not continuously throughout a day.

For all the reasons described in the *Mysticetes* section above, we anticipate any potential PTS or TTS would be small (limited to a few dB) and concentrated at half or one octave above the frequency band of pile driving noise (most sound is below 2 kHz) which does not include the full predicted hearing range of baleen whales. If TTS is incurred, hearing sensitivity would likely return to pre-exposure levels shortly after exposure ends. Any masking or physiological responses would also be of low magnitude and severity for reasons described above.

Altogether, the low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the proposed authorized take would have a negligible impact on the Gulf of Maine stock of humpback whales.

Fin Whale

The western North Atlantic stock of fin whales is listed as endangered under the ESA. The 5-year total amount of take, by Level A harassment and Level B harassment, of fin whales (n= 4 and 97, respectively) that NMFS proposes to authorize is low relative to the stock abundance. Any Level B harassment is expected to be in the form of behavioral disturbance, primarily resulting in avoidance of the project area where pile driving is occurring, and some low-level TTS and masking that may limit the detection of acoustic cues for relatively brief periods of time. Any potential PTS or TTS would be small (limited to a few dB) and concentrated at half or one octave above the frequency band of pile driving noise (most sound is below 2 kHz) which does not include the full predicted hearing range of fin whales. No serious injury or mortality is anticipated or proposed for authorization. As described previously, the project area overlaps approximately 12 percent of a small fin whale feeding BIA (March–October; 2,933 km²) located east of Montauk Point, New York (Figure 2.3 in LaBrecque *et al.,* 2015). Although the SRWF and a portion of the SRWEC would be constructed within the fin whale foraging BIA, the BIA is considerably larger than the relatively small area within which impacts from monopile installations or UXO/MEC detonations may occur; this difference in scale would provide ample access to foraging opportunities for fin whales within the remaining area of the BIA. In addition, monopile installations and UXO/MEC detonations have seasonal/daily work restrictions, such that the temporal overlap between these project activities and the BIA timeframe does not include the months of March or April. Acoustic impacts from landfall construction would be limited to Narragansett Bay, within which fin whales are not expected to occur. A second larger yearlong feeding BIA (18,015 km^2) extends from the Great South Channel (east of the smaller fin whale feeding BIA) north to southern Maine. Any disruption of feeding behavior or avoidance of the western BIA by fin whales from May to October is expected to be temporary, with habitat utilization by fin whales returning to baseline once the construction activities cease. The larger fin whale feeding BIA would provide suitable alternate habitat and ample foraging opportunities consistently throughout the year, rather than seasonally like the smaller, western BIA.

Because of the relatively low magnitude and severity of take proposed for authorization, the fact that no serious injury or mortality is anticipated, the temporary nature of the disturbance, and the availability of similar habitat and resources in the surrounding area, NMFS has preliminarily determined that the impacts of Sunrise Wind's activities on fin whales and the food sources that they utilize are not expected to cause significant impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock.

Blue and Sei Whales

The Western North Atlantic stock of blue whales and the Nova Scotia stock of sei whales are also listed under the ESA. There are no known areas of specific biological importance in or around the project area, nor are there any UMEs. For both species, the actual abundance of each stock is likely significantly greater than what is reflected in each SAR because, as noted in the SARs, the most recent population estimates are primarily based on surveys conducted in U.S. waters and both stocks' range extends well beyond the U.S. EEZ.

The 5-year total amount of take, by Level B harassment, proposed for authorization for blue whales (n=7) and the 5-year total amount of take, by Level A harassment and Level B harassment proposed for authorization for sei whales (n=2 and 26, respectively) is low. NMFS is not proposing to authorize take by Level A harassment for blue whales. Similar to other mysticetes, we would anticipate the number of takes to represent individuals taken only once or, in rare cases, an individual taken a very small number of times as most whales in the project area would be migrating. To a small degree, sei whales may forage in the project area, although the currently identified foraging habitats (BIAs) are to the east and north of the area in which Sunrise Wind's activities would occur (LaBrecque *et al.* 2015). With respect to the severity of those individual takes by behavioral Level B harassment, we would anticipate impacts to be limited to low-level, temporary behavioral responses with avoidance and potential masking impacts in the vicinity of the turbine installation to be the most likely type of response. Any potential PTS or TTS would be small (limited to a few dB) and concentrated at half or one octave above the frequency band of pile driving noise (most sound is below 2 kHz) which does not include the full predicted hearing range of blue or sei whales. Any avoidance of the project area due to Sunrise Wind's activities would be expected to be temporary.

Overall, the take by harassment proposed for authorization is of a low magnitude and severity and is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the proposed authorized take would have a negligible impact on the Western North Atlantic blue whale stock and the Nova Scotia sei whale stock.

Minke Whales

The Canadian East Coast stock of minke whales is not listed under the ESA. There are no known areas of specific biological importance in or around the project area. Beginning in January 2017, elevated minke whale strandings have occurred along the Atlantic coast from Maine through South Carolina, with highest numbers in Massachusetts, Maine, and New York. This event does not provide cause for concern regarding population level impacts, as the likely population abundance is greater than 21,000 whales. No mortality or serious injury of this stock is anticipated or proposed for authorization.

The 5-year total amount of take, by Level A harassment and Level B harassment proposed for authorization for minke whales (n=27 and 467, respectively) is relatively low. We anticipate the impacts of this harassment to follow those described in the general Mysticete section above. In summary, Level B harassment would be temporary, with primary impacts being temporary displacement of the project area but not abandonment of any migratory or foraging behavior. Overall, the amount of take proposed to be authorized is small and the low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, let alone have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. Any potential PTS or TTS would be small (limited to a few dB) and concentrated at half or one octave above the frequency band of pile driving noise (most sound is below 2 kHz) which does not include the full predicted hearing range of minke whales. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the proposed authorized take would have a negligible impact on the Canadian East Coast stock of minke whales.

Odontocetes

In this section, we include information here that applies to all of the odontocete species and stocks addressed below, which are further divided into the following subsections: sperm whales, dolphins and small whales; and harbor porpoises. These sub-sections include more specific information, as well as conclusions for each stock represented.

The majority of takes by harassment of odontocetes incidental to Sunrise Wind's specified activities are by Level B harassment incidental to pile driving and HRG surveys. We anticipate that, given ranges of individuals (*i.e.,* that some individuals remain within a small area for some period of time), and non-migratory nature of some odontocetes in general (especially as compared to mysticetes), these takes are more likely to represent multiple exposures of a smaller number of individuals than is the case for mysticetes, though some takes may also represent one-time exposures to an individual.

Pile driving, particularly impact pile driving foundation piles, has the potential to disturb odontocetes to the greatest extent, compared to HRG surveys and UXO/MEC detonations. While we do expect animals to avoid the area during pile driving, their habitat range is extensive compared to the area ensonified during pile driving.

As described earlier, Level B harassment may manifest as changes to behavior (*e.g.,* avoidance, changes in vocalizations (from masking) or foraging), physiological responses, or TTS. Odontocetes are highly mobile species and, similar to mysticetes, NMFS expects any avoidance behavior to be limited to the area near the pile being driven. While masking could occur during pile driving, it would only occur in the vicinity of and during the duration of the pile driving, and would not generally occur in a frequency range that overlaps most odontocete communication or echolocation signals. The mitigation measures (*e.g.,* use of sound abatement systems, implementation of clearance and shutdown zones) would also minimize received levels such that the severity of any behavioral response would be expected to be less than exposure to unmitigated noise exposure.

Any masking or TTS effects are anticipated to be of low-severity. First, the frequency range of pile driving, the most impactful activity conducted by Sunrise Wind in terms of response severity, falls within a portion of the frequency range of most odontocete vocalizations. However, odontocete vocalizations span a much wider range than the low frequency construction activities proposed by Sunrise Wind. Further, as described above, recent studies suggest odontocetes have a mechanism to self-mitigate (*i.e.,* reduce hearing sensitivity) the impacts of noise exposure, which could potentially reduce TTS impacts. Any masking or TTS is anticipated to be limited and would typically only interfere with communication within a portion of an odontocete's range and as discussed earlier, the effects would only be expected to be of a short duration and, for TTS, a relatively small degree. Furthermore, odontocete echolocation occurs predominantly at frequencies significantly higher than low frequency construction activities; therefore, there is little likelihood that threshold shift, either temporary or permanent, would interfere with feeding behaviors (noting that take by Level A harassment (PTS) is proposed for only harbor porpoises). For HRG surveys, the sources operate at higher frequencies than pile driving and UXO/MEC detonations; however, sounds from these sources attenuate very quickly in the water column, as described above; therefore, any potential for TTS and masking is very limited. Further, odontocetes (*e.g.,* common dolphins, spotted dolphins, bottlenose dolphins) have demonstrated an affinity to bow-ride actively surveying HRG surveys; therefore, the severity of any harassment, if it does occur, is anticipated to be minimal based on the lack of avoidance previously demonstrated by these species.

The waters off the coast of New York are used by several odontocete species; however, none (except the sperm whale) are listed under the ESA and there are no known habitats of particular importance. In general, odontocete habitat ranges are far-reaching along the Atlantic coast of the UNITED STATES, and the waters off New York, including the project area, do not contain any particularly unique odontocete habitat features.

Sperm Whale

The Western North Atlantic stock of sperm whales spans the East Coast out into oceanic waters well beyond the U.S. EEZ. Although listed as endangered, the primary threat faced by the sperm whale (*i.e.,* commercial whaling) has been eliminated and, further, sperm whales in the western North Atlantic were little affected by modern whaling (Taylor *et al.,* 2008). Current potential threats to the species globally include vessel strikes, entanglement in fishing gear, anthropogenic noise, exposure to contaminants, climate change, and marine debris. There is no currently reported trend for the stock and, although the species is listed as endangered under the ESA, there are no specific issues with the status of the stock that cause particular concern *(e.g.,* no UMEs). There are no known areas of biological importance (*e.g.,* critical habitat or BIAs) in or near the project area.

No mortality, serious injury or Level A harassment is anticipated or proposed to be authorized for this species. Impacts would be limited to Level B harassment and would occur to only a very small number of individuals (maximum of 14 in any given year (likely year 1) and 21 across all 5 years) incidental to pile driving, UXO/MEC detonation(s), and HRG surveys. Sperm whales are not common within the project area due to the shallow waters, and it is not expected that any noise levels would reach habitat in which sperm whales are common, including deep-water foraging habitat. If sperm whales do happen to be present in the project area during any activities related to the Sunrise Wind project, they would likely be only transient visitors and not engaging in any significant behaviors. This very low magnitude and severity of effects is not expected to result in impacts on the reproduction or survival of individuals, much less impact annual rates of recruitment or survival. For these reasons, we have determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the take proposed to be authorized would have a negligible impact on sperm whales.

Dolphins and Small Whales (Including Delphinids, Pilot Whales, and Harbor Porpoises)

There are no specific issues with the status of odontocete stocks that cause particular concern (*e.g.,* no recent UMEs). No mortality or serious injury is expected or proposed to be authorized for these stocks. Only Level B harassment is anticipated or proposed for authorization for any dolphin or small whale. A small amount (n= 20) of Level A harassment (in the form of PTS) is proposed to be authorized for harbor porpoises.

The maximum amount of take, by Level B harassment, proposed for authorization within any one year for all odontocetes cetacean stocks ranges from 21 to 12,193 instances, which is less than a maximum of 4.3 percent as compared to the population size for all stocks. As described above for odontocetes broadly, we anticipate that a fair number of these instances of take in a day represent multiple exposures of a smaller number of individuals, meaning the actual number of individuals taken is lower. Although some amount of repeated exposure to some individuals is likely given the duration of activity proposed by Sunrise Wind, the intensity of any Level B harassment combined with the availability of alternate nearby foraging habitat suggests that the likely impacts would not impact the reproduction or survival of any individuals.

Overall, the populations of all dolphins and small whale species and stocks for which we propose to authorize take are stable (no declining population trends), not facing existing UMEs, and the small amount, magnitude and severity of effects is not expected to result in impacts on the reproduction or survival of any individuals, much less affect annual rates of recruitment or survival. For these reasons, we have determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the take proposed to be authorized would have a negligible impact on all dolphin and small whale species and stocks considered in this analysis.

Harbor Porpoises

The Gulf of Maine/Bay of Fundy stock of harbor porpoises is found predominantly in northern U.S. coastal waters (less than 150 m depth) and up into Canada's Bay of Fundy. Although the population trend is not known, there are no UMEs or other factors that cause particular concern for this stock. No mortality or non-auditory injury by UXO/MEC detonations are anticipated or authorized for this stock. NMFS proposes to authorize 49 takes by Level A harassment (PTS; incidental to UXO/MEC detonations) and 1,237 takes by Level B harassment (incidental to multiple activities).

Regarding the severity of takes by behavioral Level B harassment, because harbor porpoises are particularly sensitive to noise, it is likely that a fair number of the responses could be of a moderate nature, particularly to pile driving. In response to pile driving, harbor porpoises are likely to avoid the area during construction, as previously demonstrated in Tougaard *et al.* (2009) in Denmark, in Dahne *et al.* (2013) in Germany, and in Vallejo *et al.* (2017) in the United Kingdom, although a study by Graham *et al.* (2019) may indicate that the avoidance distance could decrease over time. However, pile driving is scheduled to occur when harbor porpoise abundance is low off the coast of New York and, given alternative foraging areas, any avoidance of the area by individuals is not likely to impact the reproduction or survival of any individuals. Given only one UXO/MEC would be detonated on any given day and up to only three UXO/MEC would be detonated over the 5-year effective period of the LOA, any behavioral response would be brief and of a low severity.

With respect to PTS and TTS, the effects on an individual are likely relatively low given the frequency bands of pile driving (most energy below 2 kHz) compared to harbor porpoise hearing (150 Hz to 160 kHz peaking around 40 kHz). Specifically, PTS or TTS is unlikely to impact hearing ability in their more sensitive hearing ranges, or the frequencies in which they communicate and echolocate. Regardless, we have authorized a limited amount of PTS, but expect any PTS that may occur to be within the very low end of their hearing range where harbor porpoises are not particularly sensitive, and any PTS would be of small magnitude. As such, any PTS would not interfere with key foraging or reproductive strategies necessary for reproduction or survival.

In summary, the amount of take proposed to be authorized across all 5 years is 20 and 1,304 by Level A harassment and Level B harassment, respectively. While harbor porpoises are likely to avoid the area during any construction activity discussed herein, as demonstrated during European wind farm construction, the time of year in which work would occur is when harbor porpoises are not in high abundance, and any work that does occur would not result in the species' abandonment of the waters off New York. The low magnitude and severity of harassment effects is not expected to result in impacts on the reproduction or survival of any individuals, l*et al*one have impacts on annual rates of recruitment or survival of this stock. No mortality or serious injury is anticipated or proposed to be authorized. For these reasons, we have preliminarily determined, in consideration of all of the effects of the Sunrise Wind's activities combined, that the proposed authorized take would have a negligible impact on the Gulf of Maine/Bay of Fundy stock of harbor porpoises.

Phocids (Harbor Seals and Gray Seals)

Neither the harbor seal nor gray seal are listed under the ESA. Sunrise Wind requested, and NMFS proposes to authorize that no more than 5 and 2,468 harbor seals and 3 and 1,099 gray seals may be taken by Level A harassment and Level B harassment, respectively, within any one year. These species occur in New Yorkwaters most often in winter, when impact pile driving and UXO/MEC detonations would not occur. Seals are also more likely to be close to shore such that exposure to impact pile driving would be expected to be at lower levels generally (but still above NMFS behavioral harassment threshold). The majority of takes of these species is from monopile installations, vibratory pile driving associated with temporary sheet pile installation and removal, and HRG surveys. Research and observations show that pinnipeds in the water may be tolerant of anthropogenic noise and activity (a review of behavioral reactions by pinnipeds to impulsive and non-impulsive noise can be found in Richardson *et al.* (1995) and Southall *et al.* (2007)). Available data, though limited, suggest that exposures between approximately 90 and 140 dB SPL do not appear to induce strong behavioral responses in pinnipeds exposed to non-pulse sounds in water (Costa *et al.,* 2003; Jacobs and Terhune, 2002; Kastelein *et al.,* 2006c). Although there was no significant displacement during construction as a whole, Russell *et al.* (2016) found that displacement did occur during active pile driving at predicted received levels between 168 and 178 dB re 1μPa$_{(p-p)}$; however seal distribution returned to the pre-piling condition within two hours of cessation of pile driving. Pinnipeds may not react at all until the sound source is approaching (or they approach the sound source) within a few hundred meters and then may alert, ignore the stimulus, change their behaviors, or avoid the immediate area by swimming away or diving. Effects on pinnipeds that are taken by Level B harassment in the project area would likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals would simply move away from the sound source and be temporarily displaced from those areas (see Lucke *et al.,* 2006; Edren *et al.,* 2010; Skeate *et al.,* 2012; Russell *et al.,* 2016). Given their documented tolerance of anthropogenic sound (Richardson *et al.,* 1995; Southall *et al.,* 2007), repeated exposures of individuals of either of these species to levels of sound that may cause Level B harassment are unlikely to significantly disrupt foraging behavior. Given the low anticipated magnitude of impacts from any given exposure, even repeated Level B harassment across a few days of some small subset of individuals, which could occur, is unlikely to result in impacts on the reproduction or survival of any individuals. Moreover, pinnipeds would benefit from the mitigation measures described in the Proposed Mitigation section.

Sunrise Wind requested, and NMFS is proposing to authorize, a small amount of take by PTS (16 harbor seals and 7 gray seals) incidental to UXO/MEC detonations over the 5-year effective period of the proposed rule. As described above, noise from UXO/MEC detonation is low frequency and, while any PTS that does occur would fall within the lower end of pinniped hearing ranges (50 Hz to 86 kHz), PTS would not occur at frequencies where pinniped hearing is most sensitive. In summary, any PTS, would be of small degree and not occur across the entire, or even most sensitive, hearing range. Hence, any impacts from PTS are likely to be of low severity and not interfere with behaviors critical to reproduction or survival.

Elevated numbers of harbor seal and gray seal mortalities were first observed in July 2018 and occurred across Maine, New Hampshire, and Massachusetts until 2020. Based on tests conducted so far, the main pathogen found in the seals belonging to that UME was phocine distemper virus, although additional testing to identify other factors that may be involved in this UME are underway. Currently, the only active UME is occurring in Maine with some harbor and gray seals testing positive for highly pathogenic avian influenza (HPAI) H5N1. Although elevated strandings continue, neither UME (alone or in combination) provide cause for concern regarding population-level impacts to any of these stocks. For harbor seals, the population abundance is over 75,000 and annual M/SI (350) is well below PBR (2,006) (Hayes *et al.,* 2020). The population abundance for gray seals in the United States is over 27,000, with an estimated overall abundance, including seals in Canada, of approximately 450,000. In addition, the abundance of gray seals is likely increasing in the U.S. Atlantic, as well as in Canada (Hayes *et al.,* 2020).

Overall, impacts from the Level B harassment take proposed for authorization incidental to Sunrise Wind's specified activities would be of relatively low magnitude and a low severity. Similarly, while some individuals may incur PTS overlapping some frequencies that are used for foraging and communication, given the low degree, the impacts would not be expected to impact reproduction or survival of any individuals. In consideration of all of the effects of Sunrise Wind's activities combined, we have preliminarily determined that the authorized take will have a negligible impact on harbor seals and gray seals.

Preliminary Negligible Impact Determination

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the marine mammal take from all of Sunrise Wind's specified activities combined will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. When the predicted number of individuals to be taken is less than one-third of the species or stock abundance, the take is considered to be of small numbers. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

NMFS proposes to authorize incidental take (by Level A harassment and Level B harassment) of 16 species of marine mammal (with 16 managed stocks). The maximum number of takes possible within any one year and proposed for authorization relative to the best available population abundance is less than one-third for all species and stocks potentially impacted (*i.e.,* less than 1 percent for 8 stocks and less than 10 percent for the remaining 8 stocks; see Table 39).

Based on the analysis contained herein of the proposed activities (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals would be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. 1531 *et seq.*) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the promulgation of rulemakings, NMFS consults internally whenever we propose to authorize take for endangered or threatened species, in this case with the NMFS Greater Atlantic Regional Field Office (GARFO).

NMFS is proposing to authorize the take of five marine mammal species which are listed under the ESA: the North Atlantic right, sei, fin, blue, and sperm whale. The Permit and Conservation Division will request initiation of Section 7 consultation with GARFO for the issuance of this proposed rulemaking. NMFS will conclude ESA consultation prior to reaching a determination regarding the proposed issuance of the authorization. The proposed regulations and any subsequent LOA(s) would be conditioned such that, in addition to measures included in those documents, the applicant would also be required to abide by the reasonable and prudent measures and terms and conditions of a Biological Opinion and Incidental Take Statement, issued by NMFS, pursuant to Section 7 of the Endangered Species Act.

Proposed Promulgation

As a result of these preliminary determinations, NMFS proposes to promulgate an ITA for Sunrise Wind authorizing take, by Level A and B harassment, incidental to construction activities associated with the Sunrise Wind Offshore Wind Farm project offshore of New York for a 5-year period from November 20, 2023 through November 19, 2028, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed rulemaking can be found at *https://www.fisheries.noaa.gov/action/incidental-take-authorization-Sunrise-wind-llc-construction-Sunrise-wind-energy.*

Request for Additional Information and Public Comments

NMFS requests interested persons to submit comments, information, and suggestions concerning Sunrise Wind's request and the proposed regulations (see **ADDRESSES**). All comments will be reviewed and evaluated as we prepare the final rule and make final determinations on whether to issue the requested authorization. This proposed rule and referenced documents provide all environmental information relating to our proposed action for public review.

Recognizing, as a general matter, that this action is one of many current and future wind energy actions, we invite comment on the relative merits of the IHA, single-action rule/LOA, and programmatic multi-action rule/LOA approaches, including potential marine mammal take impacts resulting from this and other related wind energy actions and possible benefits resulting from regulatory certainty and efficiency.

Classification

Pursuant to the procedures established to implement Executive Order 12866, the Office of Management and Budget has determined that this proposed rule is not significant.

Pursuant to section 605(b) of the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. Sunrise Wind is the sole entity that would be subject to the requirements in these proposed regulations, and Sunrise Wind is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Under the RFA, governmental jurisdictions are considered to be small if they are governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than 50,000. Because of this certification, a regulatory flexibility analysis is not required and none has been prepared.

Notwithstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act (PRA) unless that collection of information displays a currently valid OMB control number. These requirements have been approved by OMB under control number 0648–0151 and include applications for regulations, subsequent LOA, and reports. Send comments regarding any aspect of this data collection, including suggestions for reducing the burden, to NMFS.

The Coastal Zone Management Act (CZMA) requires Federal actions within and outside the coastal zone that have reasonably foreseeable effects on any coastal use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. 16 U.S.C. 1456(c). Additionally, regulations implementing the CZMA require non-Federal applicants for Federal licenses or permits to submit a consistency certification to the state that declares that the proposed activity complies with the enforceable policies of the state's approved management program and will be conducted in a manner consistent with such program. As required, on September 1, 2021, Sunrise Wind submitted a Federal consistency certification to the New York State Department of State (NYSDOS), Rhode Island Coastal Resources Management Council (RICRMC), Massachusetts Office of Coastal Zone Management (MACZM) for approval of the Construction and Operations Plan (COP) by BOEM and the issuance of an Individual Permit by United States Army Corps of Engineers, under section 10 and 14 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (15 CFR part 930, subpart E). Sunrise Wind expects a decision from NYSDOS on June 13, 2023, RICRMC on April 27, 2023, and MACZM on March 30, 2023.

NMFS has determined that Sunrise Wind's application for an authorization to allow the incidental, but not intentional, take of small numbers of marine mammals on the outer continental shelf is an unlisted activity and, thus, is not, at this time, subject to Federal consistency requirements in the absence of the receipt and prior approval of an unlisted activity review request from the state by the Director of NOAA's Office for Coastal Management.

List of Subjects in 50 CFR Part 217

Administrative practice and procedure, Endangered and threatened species, Exports, Fish, Fisheries, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation, Wildlife.

Dated: February 1, 2023.

Samuel D. Rauch, III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, NMFS proposed to amend 50 CFR part 217 as follows:

PART 217—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

■ 1. The authority citation for part 217 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.,* unless otherwise noted.

■ 2. Add subpart FF, consisting of §§ 217.310 through 217.319, to read as follows:

Subpart FF—Taking Marine Mammals Incidental to the Sunrise Wind Offshore Wind Farm Project Offshore Rhode Island

Sec.

Subpart AF—Taking Marine Mammals Incidental to the Sunrise Wind Offshore Wind Farm Project Offshore New York

§ 217.310 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the taking of marine mammals that occurs incidental to activities associated with construction of the Sunrise Wind Offshore Wind Farm Project by Sunrise Wind, LLC (Sunrise Wind) and those persons it authorizes or funds to conduct activities on its behalf in the area outlined in paragraph (b) of this section.

(b) The taking of marine mammals by Sunrise Wind may be authorized in a Letter of Authorization (LOA) only if it occurs in the Bureau of Ocean Energy Management (BOEM) lease area Outer Continental Shelf (OCS)–A–0486 Commercial Lease of Submerged Lands for Renewable Energy Development and along export cable route at sea-to-shore transition points at Quonset Point in North Kingstown, Rhode Island.

(c) The taking of marine mammals by Sunrise Wind is only authorized if it occurs incidental to the following activities associated with the Sunrise Wind Offshore Wind Farm Project:

(1) Installation of wind turbine generators (WTG) and offshore converter substation (OCS–DC) foundations by impact pile driving;

(2) Installation of temporary cofferdams by vibratory pile driving;

(3) High-resolution geophysical (HRG) site characterization surveys; and,

(4) Detonation of unexploded ordnances (UXOs) or munitions and explosives of concern (MECs).

§ 217.311 Effective dates.

Regulations in this subpart are effective from November 20, 2023–November 19, 2028.

§ 217.312 Permissible methods of taking.

Under an LOA, issued pursuant to §§ 216.106 of this chapter and 217.316, Sunrise Wind, and those persons it authorizes or funds to conduct activities on its behalf, may incidentally, but not intentionally, take marine mammals within the area described in § 217.310(b) in the following ways, provided Sunrise Wind is in complete compliance with all terms, conditions, and requirements of the regulations in this subpart and the appropriate LOA.

(a) By Level B harassment associated with the acoustic disturbance of marine mammals by impact pile driving (WTG and OCS–DC monopile foundation installation), vibratory pile installation and removal of temporary cofferdams, the detonation of UXOs/MECs, and through HRG site characterization surveys.

(b) By Level A harassment, provided take is associated with impact pile driving and UXO/MEC detonations.

(c) The incidental take of marine mammals by the activities listed in paragraphs (a) and (b) of this section is limited to the following species:

TABLE 1 TO PARAGRAPH (c)

Marine mammal species	Scientific name	Stock
Blue whale	*Balaenoptera musculus*	Western North Atlantic.
Fin whale	*Balaenoptera physalus*	Western North Atlantic.
Sei whale	*Balaenoptera borealis*	Nova Scotia.
Minke whale	*Balaenoptera acutorostrata*	Canadian East Stock.
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic.
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine.
Sperm whale	*Physeter macrocephalus*	North Atlantic.
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic.
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic.
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Offshore.
Common dolphin	*Delphinus delphis*	Western North Atlantic.
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy.
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic.
Risso's dolphin	*Grampus griseus*	Western North Atlantic.
Gray seal	*Halichoerus grypus*	Western North Atlantic.
Harbor seal	*Phoca vitulina*	Western North Atlantic.

§ 217.313 Prohibitions.

Except for the takings described in § 217.312 and authorized by an LOA issued under §§ 217.316 or 217.317, it is unlawful for any person to do any of the following in connection with the activities described in this subpart.

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or an LOA issued under §§ 217.316 and 217.317.

(b) Take any marine mammal not specified in § 217.312(c).

(c) Take any marine mammal specified in the LOA in any manner other than as specified in the LOA.

(d) Take any marine mammal, as specified in § 217.312(c), after NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammals.

§ 217.314 Mitigation requirements.

When conducting the activities identified in §§ 217.310(a) and 217.312, Sunrise Wind must implement the mitigation measures contained in this section and any LOA issued under §§ 217.316 or 217.317 of this subpart. These mitigation measures include, but are not limited to:

(a) *General Conditions.* (1) A copy of any issued LOA must be in the possession of Sunrise Wind and its designees, all vessel operators, visual protected species observers (PSOs), passive acoustic monitoring (PAM) operators, pile driver operators, and any other relevant designees operating under the authority of the issued LOA;

(2) Sunrise Wind must conduct briefings between construction supervisors, construction crews, and the PSO and PAM team prior to the start of all construction activities, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring and reporting protocols, and operational procedures. An informal guide must be included with the Marine Mammal Monitoring Plan to aid personnel in identifying species if they are observed in the vicinity of the project area;

(3) Sunrise Wind must instruct all vessel personnel regarding the authority of the PSO(s). For example, the vessel operator(s) would be required to immediately comply with any call for a shutdown by a PSO. Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred;

(4) Sunrise Wind must ensure that any visual observations of an ESA-listed marine mammal are communicated to PSOs and vessel captains during the concurrent use of multiple project-associated vessels (of any size; *e.g.,* construction surveys, crew/supply transfers, *etc*);

(5) If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone for each specified activity, pile driving and pneumatic hammering activities, and HRG acoustic sources must be shut down immediately, unless shutdown is not practicable, or be delayed if the activity has not commenced. Impact and vibratory pile driving, pneumatic hammering, UXO/MEC detonation, and initiation of HRG acoustic sources must not commence or resume until the animal(s) has been confirmed to have left the relevant clearance zone or the observation time has elapsed with no further sightings. UXO/MEC detonations may not occur until the animal(s) has been confirmed to have left the relevant clearance zone or the observation time has elapsed with no further sightings;

(6) Prior to and when conducting any in-water construction activities and vessel operations, Sunrise Wind personnel (*e.g.,* vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the project area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (*i.e.,* Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators and PSOs;

(7) Any marine mammals observed within a clearance or shutdown zone must be allowed to remain in the area (*i.e.,* must leave of their own volition) prior to commencing impact and vibratory pile driving activities, pneumatic hammering, or HRG surveys; and

(8) Sunrise Wind must treat any large whale sighted by a PSO or acoustically detected by a PAM operator as if it were a North Atlantic right whale, unless a

PSO or a PAM operator confirms it is another type of whale.

(b) *Vessel strike avoidance measures:* Sunrise Wind must implement the following vessel strike avoidance measures:

(1) Prior to the start of construction activities, all vessel operators and crew must receive a protected species training that covers, at a minimum:

(i) Identification of marine mammals and other protected species known to occur or which have the potential to occur in the Sunrise Wind project area;

(ii) Training on making observations in both good weather conditions (*i.e.,* clear visibility, low winds, low sea states) and bad weather conditions (*i.e.,* fog, high winds, high sea states, with glare);

(iii) Training on information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species;

(iv) Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities; and

(v) Confirmation of marine mammal observer training (including an understanding of the LOA requirements) must be documented on a training course log sheet and reported to NMFS.

(2) All vessels must abide by the following:

(i) All vessel operators and crews, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any marine mammal;

(ii) All vessels must have a visual observer on board who is responsible for monitoring the vessel strike avoidance zone for marine mammals. Visual observers may be PSO or crew members, but crew members responsible for these duties must be provided sufficient training by Sunrise Wind to distinguish marine mammals from other phenomena and must be able to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine mammal. Crew members serving as visual observers must not have duties other than observing for marine mammals while the vessel is operating over 10 knots (kns);

(iii) Year-round and when a vessel is in transit, all vessel operators must continuously monitor US Coast Guard VHF Channel 16, over which North Atlantic right whale sightings are broadcasted. At the onset of transiting and at least once every four hours, vessel operators and/or trained crew members must monitor the project's Situational Awareness System, WhaleAlert, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales Any observations of any large whale by any Sunrise Wind staff or contractors, including vessel crew, must be communicated immediately to PSOs, PAM operator, and all vessel captains to increase situational awareness. Conversely, any large whale observation or detection via a sighting network (*e.g.,* Mysticetus) by PSOs or PAM operators must be conveyed to vessel operators and crew;

(iv) Any observations of any large whale by any Sunrise Wind staff or contractor, including vessel crew, must be communicated immediately to PSOs and all vessel captains to increase situational awareness;

(v) All vessels must comply with existing NMFS vessel speed regulations in 50 CFR 224.105, as applicable, for North Atlantic right whales;

(vi) In the event that any Slow Zone (designated as a DMA) is established that overlaps with an area where a project-associated vessel would operate, that vessel, regardless of size, will transit that area at 10 kns or less;

(vii) Between November 1st and April 30th, all vessels, regardless of size, must operate port to port (specifically from ports in New Jersey, New York, Maryland, Delaware, and Virginia) at 10 kns or less, except for vessels while transiting in Narragansett Bay or Long Island Sound which have not been demonstrated by best scientific information available to provide consistent habitat for North Atlantic right whales;

(viii) All vessels, regardless of size, must immediately reduce speed to 10 kns or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed (within 100 m) of an underway vessel;

(ix) All vessels, regardless of size, must immediately reduce speed to 10 kns or less when a North Atlantic right whale is sighted, at any distance, by anyone on the vessel;

(x) If a vessel is traveling at greater than 10 kns, in addition to the required dedicated visual observer, Sunrise Wind must monitor the transit corridor in real-time with PAM prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kns or less for 12 hours following the detection. Each subsequent detection triggers an additional 12-hour period at 10 kns or less. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor for 12 hours;

(xi) All underway vessels (*e.g.,* transiting, surveying) operating at any speed must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard) located at an appropriate vantage point for ensuring vessels are maintaining appropriate separation distances. Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this proposed action. Visual observers may be third-party observers (*i.e.,* NMFS-approved PSOs) or crew members. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities;

(xii) All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kns or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take the vessel strike avoidance measures described in this paragraph (b)(2)(xii);

(xiii) All vessels must maintain a minimum separation distance of 100 m from sperm whales and baleen whales other than North Atlantic right whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 100 m;

(xiv) All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m;

(xv) When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.,* any situation where the vessel is navigationally constrained);

(xvi) All vessels underway must not divert or alter course to avoid approaching any marine mammal. Any vessel underway must avoid speed over 10 kns or abrupt changes in course direction until the animal is out of an on a path away from the separation distances;

(xvii) For in-water construction heavy machinery activities other than impact or vibratory pile driving, if a marine mammal is on a path towards or comes within 10 m of equipment, Sunrise Wind must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment; and

(xviii) Sunrise Wind must submit a North Atlantic right whale vessel strike avoidance plan 90 days prior to commencement of vessel use. The plan will, at minimum, describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of right whales. The plan will also provide details on the vessel-based observer protocols on transiting vessels.

(c) *Wind turbine generator (WTG) and offshore converter substation (OCS–DC) foundation installation.* Sunrise Wind must comply with the following measures during WTG and OCS–DC installation:

(1) *Seasonal and daily restrictions:* (i) Foundation impact pile driving activities may not occur January 1 through April 30;

(ii) No more than three monopiles may be installed per day;

(iii) Sunrise Wind must not initiate pile driving earlier than 1 hour after civil sunrise or later than 1.5 hours prior to civil sunset, unless Sunrise Wind submits and NMFS approves an Alternative Monitoring Plan as part of the Pile Driving and Marine Mammal Monitoring Plan that reliably demonstrates the efficacy of their night vision devices; and

(iv) Monopiles must be no larger than 15 m in diameter, representing the larger end of the tapered 7/15 m monopile design. The minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Maximum hammer energies must not exceed 4,000 kilojoules (kJ).

(2) *Noise abatement systems.* (i) Sunrise Wind must deploy dual noise abatement systems that are capable of achieving, at a minimum, 10 dB of sound attenuation, during all impact pile driving of foundation piles;

(A) A single big bubble curtain (BBC) must not be used unless paired with another noise attenuation device;

(B) A double big bubble curtain (dBBC) may be used without being paired with another noise attenuation device;

(ii) The bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 $m^3/(min*m)$. The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must make appropriate adjustments to the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved;

(iii) The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact;

(iv) No parts of the ring or other objects may prevent full seafloor contact; and

(v) Construction contractors must train personnel in the proper balancing of airflow to the ring. Construction contractors must submit an inspection/performance report for approval by Sunrise Wind within 72 hours following the performance test. Corrections to the bubble ring(s) to meet the performance standards must occur prior to impact pile driving of monopiles. If Sunrise Wind uses a noise mitigation device in addition to the BBC, Sunrise Wind must maintain similar quality control measures as described here.

(3) *Sound field verification.* (i) Sunrise Wind must perform sound field verification (SFV) during all impact pile driving of the first three monopiles and must empirically determine source levels (peak and cumulative sound exposure level), the ranges to the isopleths corresponding to the Level A harassment (PTS) and Level B harassment thresholds, and estimated transmission loss coefficients;

(ii) If a subsequent monopile installation location is selected that was not represented by previous three locations (*i.e.,* substrate composition, water depth), SFV must be conducted;

(iii) Sunrise Wind may estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from *in situ* measurements conducted at several distances from the monopiles, and must measure received levels at a standard distance of 750 m from the monopiles;

(iv) If SFV measurements on any of the first three piles indicate that the ranges to Level A harassment and Level B harassment isopleths are larger than those modeled, assuming 10 dB attenuation, Sunrise Wind must modify and/or apply additional noise attenuation measures (*e.g.,* improve efficiency of bubble curtain(s), modify the piling schedule to reduce the source sound, install an additional noise attenuation device) before the second pile is installed. Until SFV confirms the ranges to Level A harassment and Level B harassment isopleths are less than or equal to those modeled, assuming 10 dB attenuation, the shutdown and clearance zones must be expanded to match the ranges to the Level A harassment and Level B harassment isopleths based on the SFV measurements. If the application/use of additional noise attenuation measures still does not achieve ranges less than or equal to those modeled, assuming 10 dB attenuation, and no other actions can further reduce sound levels, Sunrise Wind must expand the clearance and shutdown zones according to those identified through SFV, in consultation with NMFS;

(v) If harassment zones are expanded beyond an additional 1,500 m, additional PSOs must 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;

(vi) If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Sunrise Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles and UXO/MEC detonations. For a modification request to be considered by NMFS, Sunrise Wind must have conducted SFV on three or more monopiles and on all detonated UXOs/MECs thus far to verify that zone sizes are consistently smaller than predicted by modeling (assuming 10 dB attenuation). Regardless of SFV measurements, the clearance and shutdown zones for North Atlantic right whales must not be decreased;

(vii) If a subsequent monopile installation location is selected that was not represented by previous locations (*i.e.,* substrate composition, water depth), SFV must be conducted. If a subsequent UXO/MEC charge weight is encountered and/or detonation location is selected that was not representative of the previous locations (*i.e.,* substrate composition, water depth), SFV must be conducted;

(vii) Sunrise Wind must submit a SFV Plan at least 180 days prior to the planned start of impact pile driving and any UXO/MEC detonation activities. The plan must describe how Sunrise Wind would ensure that the first three monopile foundation installation sites selected and each UXO/MEC detonation scenario (*i.e.,* charge weight, location) selected for SFV are representative of the rest of the monopile installation sites and UXO/MEC scenarios. In the case that these sites/scenarios are not determined to be representative of all other monopile installation sites and UXO/MEC detonations, Sunrise Wind must include information on how additional sites/scenarios would be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Sunrise Wind must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first three piles and after each UXO/MEC detonation; and

(viii) The SFV plan must also include how operational noise would be monitored. Sunrise Wind must estimate source levels (at 10 m from the operating foundation) based on received levels measured at 50 m, 100 m, and 250 m from the pile foundation. These data must be used to identify estimated transmission loss rates. Operational parameters (*e.g.,* direct drive/gearbox information, turbine rotation rate) as well as sea state conditions and information on nearby anthropogenic activities (*e.g.,* vessels transiting or operating in the area) must be reported.

(4) *Protected species observer and passive acoustic monitoring.* (i) Sunrise Wind must have a minimum of four PSOs actively observing marine mammals before, during, and after (specific times described below) the installation of monopiles. At least four PSOs must be actively observing for marine mammals. At least two PSOs must be actively observing on the pile driving vessel while at least two PSOs must be actively observing on a secondary, PSO-dedicated vessel;

(ii) At least one active PSO on each platform must have a minimum of 90 days at-sea experience working in those roles in offshore environments with no more than eighteen months elapsed since the conclusion of the at-sea experience;

(iii) At least one acoustic PSO (*i.e.,* passive acoustic monitoring (PAM) operator) must be actively monitoring for marine mammals before, during and after impact pile driving with PAM; and

(iv) All visual PSOs and PAM operators monitoring the Sunrise Wind project must meet the requirements and qualifications described in § 217.315(a) and (b), and (c), respectively and as applicable to the specified activity.

(5) *Clearance and shutdown zones.* (i) Sunrise Wind must establish and implement clearance and shutdown zones (all distances to the perimeter are the radii from the center of the pile being driven) as described in the LOA for all WTG and OSC–DC foundation installation;

(ii) Sunrise Wind must use visual PSOs and PAM operators to monitor the area around each foundation pile before, during and after pile driving. PSOs must visually monitor clearance zones for marine mammals for a minimum of 60 minutes prior to commencing pile driving. At least one PAM operator must review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes immediately prior to starting a soft-start of pile driving;

(iii) PSOs must be able to visually clear (*i.e.,* confirm no marine mammals are present) an area that extends around the pile being driven as described in the LOA. The entire minimum visibility zone must be visible (*i.e.,* not obscured by dark, rain, fog, *etc.*) for a full 30 minutes immediately prior to commencing impact pile driving (minimum visibility zone size dependent on season);

(iv) If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and must not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species;

(v) The clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred within the PAM clearance zone during the 60-minute monitoring period. Any large whale sighting by a PSO or detected by a PAM operator that cannot be identified by species must be treated as if it were a North Atlantic right whale;

(vi) If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after impact pile driving has begun, the PSO must call for a temporary shutdown of impact pile driving;

(vii) Sunrise Wind must immediately cease pile driving if a PSO calls for shutdown, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. In this situation, Sunrise Wind must reduce hammer energy to the lowest level practicable;

(viii) Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time Sunrise Wind must use the lowest hammer energy practicable to maintain stability;

(ix) If impact pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection;

(x) Upon re-starting pile driving, soft-start protocols must be followed.

(6) *Soft-start.* (i) Sunrise Wind must utilize a soft-start protocol for impact pile driving of monopiles by performing 4–6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes;

(ii) Soft-start must occur at the beginning of monopile installation and at any time following a cessation of impact pile driving of 30 minutes or longer; and

(iii) If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving must be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other species.

(d) *Cable landfall construction.* Sunrise Wind must comply with the following measures during cable landfall construction:

(1) *Daily restrictions.* (i) Sunrise Wind must conduct vibratory pile driving or pneumatic hammering during daylight hours only;

(ii) [Reserved].

(2) *PSO use.* (i) All visual PSOs monitoring the Sunrise Wind project must meet the requirements and qualifications described in § 217.315(a) and (b), as applicable to the specified activity; and

(ii) Sunrise Wind must have a minimum of two PSOs on active duty during any installation and removal of the temporary sheet piles, or casing pipes and goal posts. These PSOs must always be located at the best vantage point(s) on the vibratory pile driving platform or secondary platform in the immediate vicinity of the vibratory pile driving platform, in order to ensure that appropriate visual coverage is available for the entire visual clearance zone and as much of the Level B harassment zone, as possible.

(3) *Clearance and shutdown zones.* (i) Sunrise Wind must establish and implement clearance and shutdown zones as described in the LOA;

(ii) Prior to the start of pneumatic hammering or vibratory pile driving activities, at least two PSOs must monitor the clearance zone for 30 minutes, continue monitoring during pile driving and for 30 minutes post pile driving;

(iii) If a marine mammal is observed entering or is observed within the clearance zones, piling and hammering must not commence until the animal has exited the zone or a specific amount of time has elapsed since the last sighting. The specific amount of time is 30 minutes for large whales and 15 minutes for dolphins, porpoises, and pinnipeds;

(iv) If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after vibratory pile driving or hammering has begun, the PSO must call for a temporary shutdown of vibratory pile driving or hammering;

(v) Sunrise Wind must immediately cease pile driving or pneumatic hammering if a PSO calls for shutdown, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability; and

(vi) Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species.

(e) *UXO/MEC detonation.* Sunrise wind must comply with the following measures related to UXO/MEC detonation:

(1) *General.* (i) Sunrise Wind must only detonate a maximum of three UXO/MECs, of varying sizes;

(ii) Upon encountering a UXO/MEC of concern, Sunrise Wind may only resort to high-order removal (*i.e.,* detonation) if all other means of removal are impracticable;

(iii) Sunrise Wind must utilize a noise abatement system (*e.g.,* bubble curtain or similar noise abatement device) around all UXO/MEC detonations and operate that system in a manner that achieves the maximum noise attenuation levels practicable.

(2) *Seasonal and daily restrictions.* (i) Sunrise Wind must not detonate UXOs/MECs from December 1 through April 30, annually; and

(ii) Sunrise Wind must only detonate UXO/MECs during daylight hours.

(3) *PSO and PAM use.* (i) All visual PSOs and PAM operators used for the Sunrise Wind project must meet the requirements and qualifications described in § 217.315(a), (b), and (c), respectively and as applicable to the specified activity; and

(ii) Sunrise Wind must use at least 2 visual PSOs on each platform (*i.e.,* vessels, plane) and one PAM operator to monitor for marine mammals in the clearance zones prior to detonation. If the clearance zone is larger than 2 km (based on charge weight), Sunrise Wind must deploy a secondary PSO vessel. If the clearance is larger than 5 km (based on charge weight), an aerial survey must be conducted.

(4) *Clearance zones.* (i) Sunrise Wind must establish and implement clearance zones for UXO/MEC detonation using both visual and acoustic monitoring, as described in the LOA;

(ii) Clearance zones must be fully visible for at least 60 minutes and all marine mammal(s) must be confirmed to be outside of the clearance zone for at least 30 minutes prior to detonation. PAM must also be conducted for at least 60 minutes prior to detonation and the zone must be acoustically cleared during this time; and

(iii) If a marine mammal is observed entering or within the clearance zone prior to denotation, the activity must be delayed. Detonation may only commence if all marine mammals have been confirmed to have voluntarily left the clearance zones and been visually confirmed to be beyond the clearance zone, or when 60 minutes have elapsed without any redetections for whales (including the North Atlantic right whale) or 15 minutes have elapsed without any redetections of delphinids, harbor porpoises, or seals.

(5) *Sound field verification.* (i) During each UXO/MEC detonation, Sunrise Wind must empirically determine source levels (peak and cumulative sound exposure level), the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds, and estimated transmission loss coefficient(s); and

(ii) If SFV measurements on any of the detonations indicate that the ranges to Level A harassment and Level B harassment thresholds are larger than those modeled, assuming 10 dB attenuation, Sunrise Wind must modify the ranges, with approval from NMFS, and/or apply additional noise attenuation measures (*e.g.,* improve efficiency of bubble curtain(s), install an additional noise attenuation device) before the next detonation event.

(f) *HRG surveys.* Sunrise Wind must comply with the following measures during HRG Surveys:

(1) *General.* (i) All personnel with responsibilities for marine mammal monitoring must participate in joint, onboard briefings that would be led by the vessel operator and the Lead PSO, prior to the beginning of survey activities. The briefing must be repeated whenever new relevant personnel (*e.g.,* new PSOs, acoustic source operators,

relevant crew) join the survey operation before work commences;

(ii) Sunrise Wind must deactivate acoustic sources during periods where no data is being collected, except as determined to be necessary for testing. Unnecessary use of the acoustic source(s) is prohibited; and

(iii) Any large whale sighted by a PSO within 1 km of the boomer, sparker, or CHIRP that cannot be identified by species must be treated as if it were a North Atlantic right whale.

(2) *PSO use.* (i) Sunrise Wind must use at least one PSO during daylight hours and two PSOs during nighttime operations, per vessel;

(ii) PSOs must establish and monitor the appropriate clearance and shutdown zones (*i.e.,* radial distances from the acoustic source in-use and not from the vessel); and

(iii) PSOs must begin visually monitoring 30 minutes prior to the initiation of the specified acoustic source (*i.e.,* ramp-up, if applicable), through 30 minutes after the use of the specified acoustic source has ceased.

(3) *Ramp-up.* (i) Any ramp-up activities of boomers, sparkers, and CHIRPs must only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using a specified acoustic source;

(ii) Prior to a ramp-up procedure starting, the operator must notify the Lead PSO of the planned start of the ramp-up. This notification time must not be less than 60 minutes prior to the planned ramp-up activities as all relevant PSOs must monitor the clearance zone for 30 minutes prior to the initiation of ramp-up; and

(iii) Prior to starting the survey and after receiving confirmation from the PSOs that the clearance zone is clear of any marine mammals, Sunrise Wind must ramp-up sources to half power for five minutes and then proceed to full power, unless the source operates on a binary on/off switch in which case ramp-up is not feasible. Ramp-up activities would be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up would only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until additional time has elapsed with no further sighting. The specific time periods are 15 minutes for small odontocetes and seals, and 30 minutes for all other species.

(4) *Clearance and shutdown zones.* (i) Sunrise Wind must establish and implement clearance zones as described in the LOA;

(ii) Sunrise Wind must implement a 30-minute clearance period of the clearance zones immediately prior to the commencing of the survey or when there is more than a 30 minute break in survey activities and PSOs are not actively monitoring;

(iii) If a marine mammal is observed within a clearance zone during the clearance period, ramp-up may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sighting. The specific time period is 15 minutes for small odontocetes and seals, and 30 minutes for all other species;

(iv) In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (*i.e.,* no delay is required) despite periods of inclement weather and/or loss of daylight;

(v) Once the survey has commenced, Sunrise Wind must shut down boomers, sparkers, and CHIRPs if a marine mammal enters a respective shutdown zone;

(vi) In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.,* no shutdown is required) so long as no marine mammals have been detected;

(vii) The use of boomers, sparkers, and CHIRPS would not be allowed to commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting;

(viii) Sunrise Wind must immediately shutdown any boomer, sparker, or CHIRP acoustic source if a marine mammal is sighted entering or within its respective shutdown zones. The shutdown requirement does not apply to small delphinids of the following genera: *Delphinus, Stenella, Lagenorhynchus,* and *Tursiops.* If there is uncertainty regarding the identification of a marine mammal species (*i.e.,* whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified here is detected in the shutdown zone;

(ix) If a boomer, sparker, or CHIRP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it may be activated again without ramp-up only if:

(A) PSOs have maintained constant observation; and

(B) No additional detections of any marine mammal occurred within the respective shutdown zones; and

(x) If a boomer, sparker, or CHIRP was shut down for a period longer than 30 minutes, then all clearance and ramp-up procedures must be initiated.

(5) *Autonomous survey vehicle (ASV):* Sunrise Wind must use and ASV during HRG Surveys and comply with the following requirements:

(i) The ASV must remain with 800 m (2,635 ft) of the primary vessel while conducting survey operations;

(ii) Two PSOs must be stationed on the mother vessel at the best vantage points to monitor the clearance and shutdown zones around the ASV;

(iii) At least one PSO must monitor the output of a thermal.high-definition camera installed on the mother vessel to monitor the field-of-view around the ASV using a hand-held tablet; and

(iv) During periods of reduced visibility (*e.g.,* darkness, rain, or fog), PSOs must use night-vision goggles with thermal clip-ons and a hand-held spotlight to monitor the clearance and shutdown zones around the ASV.

(g) *Fisheries Monitoring.* (i) All captains and crew conducting trawl surveys will be trained in marine mammal detection and identification;

(ii) Survey vessels will adhere to all vessel mitigation measures (see Proposed Mitigation section);

(iii) Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before (15 minutes prior to within 1 nm), during, and after haul back;

(iv) Trawl operations will commence as soon as possible once the vessel arrives on station;

(v) If a marine mammal (other than dolphins and porpoises) is sighted within 1 nm of the planned location in the 15 minutes before gear deployment Sunrise Wind will delay setting the trawl until marine mammals have not been resighted for 15 minutes, or Sunrise Wind may move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, Sunrise Wind may decide to move again or to skip the station;

(vi) Gear will not be deployed if marine mammals are observed within the area and if a marine mammal is deemed to be at risk of interaction, all gear will be immediately removed;

(vii) Sunrise Wind will maintain visual monitoring effort during the entire period of time that trawl gear is in the water (*i.e.,*throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, Sunrise Wind will take the most appropriate action to avoid marine mammal interaction;

(viii) Limit tow time to 20 minutes and monitoring for marine mammals throughout gear deployment, fishing, and retrieval;

(ix) Sunrise Wind will open the codend of the net close to the deck/sorting area to avoid damage to animals that may be caught in gear; and

(x) Trawl nets will be fully cleaned and repaired (if damaged) before setting again.

§ 217.315 Requirements for monitoring and reporting.

(a) *PSO Qualifications.* (1) Sunrise Wind must employ qualified, trained visual and acoustic PSOs to conduct marine mammal monitoring during activities requiring PSO monitoring. PSO requirements are as follows:

(i) Sunrise Wind must use independent, dedicated, qualified PSOs, meaning that the PSOs must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements;

(ii) All PSOs must be approved by NMFS. Sunrise Wind must submit PSO resumes for NMFS' review and approval at least 60 days prior to commencement of in-water construction activities requiring PSOs. Resumes must include dates of training and any prior NMFS approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS shall be allowed three weeks to approve PSOs from the time that the necessary information is received by NMFS, after which PSOs meeting the minimum requirements will automatically be considered approved;

(iii) PSOs must have visual acuity in both eyes (with correction of vision being permissible) sufficient enough to discern moving targets on the water's surface with the ability to estimate the target size and distance (binocular use is allowable);

(iv) All PSOs must be trained in marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations;

(v) PSOs must have sufficient writing skills to document all observations, including but not limited to:

(A) The number and species of marine mammals observed;

(B) The dates and times when in-water construction activities were conducted;

(C) The dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone; and

(D) Marine mammal behavior.

(vi) All PSOs must be able to communicate orally, by radio, or in-person with Sunrise Wind project personnel;

(vii) PSOs must have sufficient training, orientation, or experience with construction operations to provide for their own personal safety during observations;

(A) All PSOs must complete a Permits and Environmental Compliance Plan training and a 2-day refresher session that will be held with the PSO provider and Project compliance representative(s) prior to the start of construction activities;

(B) [Reserved];

(viii) At least one PSO must have prior experience working as an observer. Other PSOs may substitute education (*i.e.,* degree in biological science or related field) or training for experience;

(ix) One PSO for each activity (*i.e.,* foundation installation, sheet piles or casing pipe installation and removal, HRG surveys, UXO/MEC detonation) must be designated as the Lead PSO. The Lead PSO must have a minimum of 90 days of at-sea experience working in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience;

(x) At a minimum, at least one PSO located on each observation platform (either vessel-based or aerial-based) must have a minimum of 90 days of at-sea experience working in an offshore environment and would be required to have no more than eighteen months elapsed since the conclusion of their last at-sea experiences. Any new and/or inexperienced PSOs would be paired with an experienced PSO;

(xi) PSOs must monitor all clearance and shutdown zones prior to, during, and following impact pile driving, vibratory pile driving, pneumatic hammering, UXO/MEC detonations, and during HRG surveys that use boomers, sparkers, and CHIRPs (with specific monitoring durations described in § 217.315(b)(2)(iii), § 217.315(b)(3)(iv), § 217.315(b)(4)(ii), and § 217.315(b)(5)(iii). PSOs must also monitor the Level B harassment zones and document any marine mammals observed within these zones, to the extent practicable;

(xii) PSOs must be located on the best available vantage point(s) on the primary vessel(s) (*i.e.,* pile driving vessel, UXO/MEC vessel, HRG survey vessel) and on other dedicated PSO vessels (*e.g.,* additional UXO/MEC vessels) or aerial platforms, as applicable and necessary, to allow them appropriate coverage of the entire visual shutdown zone(s), clearance zone(s), and as much of the Level B harassment zone as possible. These vantage points must maintain a safe work environment; and

(xiii) Acoustic PSOs must complete specialized training for operating passive acoustic monitoring (PAM) systems and must demonstrate familiarity with the PAM system on which they must be working. PSOs may act as both acoustic and visual observers (but not simultaneously), so long as they demonstrate that their training and experience are sufficient to perform each task.

(b) Other *PSO requirements.* (1) *General.*

(i) All PSOs must be located at the best vantage point(s) on the primary vessel, dedicated PSO vessels, and aerial platform in order to ensure 360° visual coverage of the entire clearance and shutdown zones around the vessels, and as much of the Level B harassment zone as possible;

(ii) During all observation periods, PSOs must use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During impact pile driving and UXO/MEC detonation events, at least one PSO on the primary pile driving or UXO/MEC vessels must be equipped with Big Eye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality. These must be pedestal mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation and PSO safety; and

(iii) PSOs must not exceed 4consecutive watch hours on duty at any time, must have a 2-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period.

(2) *WTG and OCS–DC foundation installation.* (i) At least four PSOs must be actively observing marine mammals before, during, and after installation of foundation piles (monopiles). At least two PSOs must be stationed and observing on the pile driving vessel and at least two PSOs must be stationed on a secondary, PSO-dedicated vessel. Concurrently, at least one acoustic PSO (*i.e.,* PAM operator) must be actively monitoring for marine mammals with PAM before, during and after impact pile driving;

(ii) If PSOs cannot visually monitor the minimum visibility zone at all times using the equipment described in paragraph (b)(1)(ii) of this section, impact pile driving operations must not commence or must shutdown if they are currently active;

(iii) All PSOs, including PAM operators, must begin monitoring 60 minutes prior to pile driving, during, and for 30 minutes after an activity. The impact pile driving of monopiles must only commence when the minimum visibility zone is fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of impact pile driving;

(iv) For North Atlantic right whales, any visual or acoustic detection must trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed by species, it must be treated as if it were a North Atlantic right whale; and

(v) Following a shutdown, monopile installation must not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes.

(3) *Cable landfall construction.* (i) At least two PSOs must be on active duty during all activities related to the installation and removal of sheet piles or casing pipe;

(ii) These PSOs must be located at appropriate vantage points on the vibratory pile driving or pneumatic hammering platform or secondary platform in the immediate vicinity of the vibratory pile driving or pneumatic hammering platforms;

(iii) PSOs must ensure that there is appropriate visual coverage for the entire clearance zone and as much of the Level B harassment zone as possible; and

(iv) PSOs must monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles and casing pipes, and for 30 minutes after all vibratory pile driving or pneumatic hammering activities have ceased. Sheet pile or casing pipe installation shall only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of vibratory pile driving or pneumatic hammering.

(4) *UXO/MEC detonation.* (i) At least two PSOs must be on active duty on each observing platform (*i.e.,* vessel, plane) prior to, during, and after UXO/MEC detonations. Concurrently, at least one acoustic PSO (*i.e.,* PAM operator) must be actively monitoring for marine mammals with PAM before, during and after UXO/MEC detonations;

(ii) All PSOs, including PAM operators, must begin monitoring 60 minutes prior to UXO/MEC detonation, during detonation, and for 30 minutes after detonation;

(iii) Sunrise Wind must ensure that clearance zones are fully (100 percent) monitored;

(iv) For detonation areas larger than 2 km, Sunrise Wind must use a secondary vessel to monitor. For any additional vessels determined to be necessary, two PSOs must be used and located at the appropriate vantage point on the vessel. These additional PSOs would maintain watch during the same time period as the PSOs on the primary monitoring vessel; and

(v) For detonation areas larger than 5 km, Sunrise Wind must use an aircraft, in addition to the primary monitoring vessel, to monitor for marine mammals. Two PSOs must be used and located at the appropriate vantage point on the aircraft. These additional PSOs would maintain watch during the same time period as the PSOs on the primary monitoring vessel.

(5) *HRG surveys.* (i) Between four and six PSOs must be present on every 24-hour survey vessel and two to three PSOs must be present on every 12-hour survey vessel. At least one PSO must be on active duty during HRG surveys conducted during daylight and at least two PSOs must be on activity duty during HRG surveys conducted at night;

(ii) During periods of low visibility (*e.g.,* darkness, rain, fog, *etc.*), PSOs must use alternative technology (*i.e.,* infrared/thermal camera) to monitor the clearance and shutdown zones;

(iii) PSOs on HRG vessels must begin monitoring 30 minutes prior to activating boomers, sparkers, or CHIRPs, during use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased;

(iv) Any observations of marine mammals must be communicated to PSOs on all nearby survey vessels during concurrent HRG surveys; and

(v) During daylight hours when survey equipment is not operating, Sunrise Wind must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports.

(c) *PAM operator requirements*—(1) *General.* (i) PAM operators must have completed specialized training for operating PAM systems prior to the start of monitoring activities, including identification of species-specific mysticete vocalizations (*e.g.,* North Atlantic right whales);

(ii) During use of any real-time PAM system, at least one PAM operator must be designated to monitor each system by viewing data or data products that would be streamed in real-time or in near real-time to a computer workstation and monitor;

(iii) PAM operators may be located on a vessel or remotely on-shore but must have the appropriate equipment (*i.e.,* computer station equipped with a data collection software system (*i.e.,* Mysticetus or similar system) and acoustic data analysis software) available wherever they are stationed;

(iv) Visual PSOs must remain in contact with the PAM operator currently on duty regarding any animal detection that would be approaching or found within the applicable zones no matter where the PAM operator is stationed (*i.e.,* onshore or on a vessel);

(v) The PAM operator must inform the Lead PSO on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (*i.e.,* Mysticetus or similar system) who will be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.,* delay or shutdown);

(vi) PAM operators must be on watch for a maximum of four consecutive hours, followed by a break of at least two hours between watches; and

(vii) A Passive Acoustic Monitoring Plan must be submitted to NMFS for review and approval at least 180 days prior to the planned start of monopile installation. The authorization to take marine mammals would be contingent upon NMFS' approval of the PAM Plan.

(2) *WTG and OCS–DC foundation installation.* (i) Sunrise Wind must use a minimum of one PAM operator before, during, and after impact pile driving activities. The PAM operator must assist visual PSOs in ensuring full coverage of the clearance and shutdown zones;

(ii) PAM operators must assist the visual PSOs in monitoring by conducting PAM activities 60 minutes prior to any impact pile driving, during, and after for 30 minutes for the appropriate size PAM clearance zone (dependent on season). The entire minimum visibility zone must be clear for at least 30 minutes, with no marine mammal detections within the visual or PAM clearance zones prior to the start of impact pile driving;

(iii) Any acoustic monitoring during low visibility conditions during the day would complement visual monitoring efforts and would cover an area of at least the Level B harassment zone around each monopile foundation;

(iv) Any visual or acoustic detection within the clearance zones must trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be identified by species, it must be treated as if it were a North Atlantic right whale. Following a shutdown, monopile installation shall not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes and no marine mammals have been detected acoustically within the PAM clearance zone for 30 minutes; and

(v) Sunrise Wind must submit a Pile Driving and Marine Mammal Monitoring Plan to NMFS for review and approval at least 180 days before the start of any pile driving. The plan must include final project design related to pile driving (*e.g.,* number and type of piles, hammer type, noise abatement systems, anticipated start date, *etc.*) and all information related to PAM PSO monitoring protocols for pile-driving and visual PSO protocols for all activities.

(3) *UXO/MEC detonation.* (i) Sunrise Wind must use a minimum of one PAM operator before, during, and after UXO/MEC detonations. The PAM operator must assist visual PSOs in ensuring full coverage of the clearance and shutdown zones;

(ii) PAM must be conducted for at least 60 minutes prior to detonation, during, and for 30 minutes after detonation;

(iii) The PAM operator must monitor to and beyond the clearance zone for large whales; and

(iv) Sunrise Wind must prepare and submit a UXO/MEC and Marine Mammal Monitoring Plan to NMFS for review and approval at least 180 days before the start of any UXO/MEC detonations. The plan must include final project design and all information related to visual and PAM PSO monitoring protocols for UXO/MEC detonations.

(d) *Data Collection and Reporting.* (1) Prior to initiation of project activities, Sunrise Wind must demonstrate in a report submitted to NMFS (at *jaclyn.daly@noaa.gov* and *pr.itp.monitoringreports@noaa.gov*) that all required training for Sunrise Wind personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed;

(2) Sunrise Wind must use a standardized reporting system from November 20, 2023 through November 19, 2028, the effective period of this subpart and the LOA. All data collected related to the Sunrise Wind project must be recorded using industry-standard softwares (*e.g.,* Mysticetus or a similar software) that is installed on field laptops and/or tablets. For all monitoring efforts and marine mammal sightings, Sunrise Wind must collect the following information and report it to NMFS:

(i) Date and time that monitored activity begins or ends;

(ii) Construction activities occurring during each observation period;

(iii) Watch status (*i.e.,* sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(iv) PSO who sighted the animal;

(v) Time of sighting;

(vi) Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility);

(vii) Water conditions (*e.g.,* sea state, tide state, water depth);

(viii) All marine mammal sightings, regardless of distance from the construction activity;

(xi) Species (or lowest possible taxonomic level possible);

(x) Pace of the animal(s);

(xi) Estimated number of animals (minimum/maximum/high/low/best);

(xii) Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition, *etc.*);

(xiii) Description (*i.e.,* as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

(xiv) Description of any marine mammal behavioral observations (*e.g.,* observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity;

(xv) Animal's closest distance and bearing from the pile being driven, UXO/MEC, or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zones;

(xvi) Construction activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, UXO/MEC detonation, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft-start for pile driving, active pile driving, post-UXO/MEC detonation, *etc.*);

(xvii) Marine mammal occurrence in Level A harassment or Level B harassment zones;

(xviii) Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown, *etc.*) and time and location of the action; and

(xix) Other human activity in the area.

(3) For all real-time acoustic detections of marine mammals, the following must be recorded and included in weekly, monthly, annual, and final reports:

(i) Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name;

(ii) Bottom depth and depth of recording unit (in meters);

(iii) Recorder (model & manufacturer) and platform type (*i.e.,* bottom-mounted, electric glider, *etc.*), and instrument ID of the hydrophone and recording platform (if applicable);

(iv) Time zone for sound files and recorded date/times in data and metadata (in relation to UTC. *i.e.,* EST time zone is UTC–5);

(v) Duration of recordings (start/end dates and times; in ISO 8601 format, yyyy-mm-ddTHH:MM:SS.sssZ);

(vi) Deployment/retrieval dates and times (in ISO 8601 format);

(vii) Recording schedule (must be continuous);

(viii) Hydrophone and recorder sensitivity (in dB *re. 1* μ*Pa*);

(ix) Calibration curve for each recorder;

(x) Bandwidth/sampling rate (in Hz);

(xi) Sample bit-rate of recordings; and,

(xii) Detection range of equipment for relevant frequency bands (in meters).

(4) For each detection, the following information must be noted:

(i) Species identification (if possible);

(ii) Call type and number of calls (if known);

(iii) Temporal aspects of vocalization (date, time, duration, *etc.;* date times in ISO 8601 format);

(iv) Confidence of detection (detected, or possibly detected);

(v) Comparison with any concurrent visual sightings;

(vi) Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities;

(vii) Location of recorder and construction activities at time of call;

(viii) Name and version of detection or sound analysis software used, with protocol reference;

(xi) Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and

(x) Name of PAM operator(s) on duty.

(5) Weekly reports are required from Sunrise Wind and must adhere to the following standards:

(i) Sunrise Wind must compile and submit weekly PSO, PAM, and sound field verification (SFV) reports to NMFS (at *jaclyn.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that document the daily start and stop of all pile driving, HRG survey, or UXO/MEC detonation activities, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals (acoustic and visual), any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise abatement system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday—Saturday) and must include the information required under this section. The weekly report will also identify which turbines become operational and when (a map must be provided). Once all foundation pile installation is completed, weekly reports are no longer required;

(ii) [Reserved].

(6) Monthly reports are required from Sunrise Wind and must adhere to the following standards:

(i) Sunrise Wind must compile and submit monthly reports to NMFS (at *itp.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, number of UXO/MEC detonations, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The monthly report must also identify which turbines become operational and when (a map must be provided). Once foundation installation is complete, monthly reports are no longer required;

(ii) [Reserved].

(7) Annual reports are required from Sunrise Wind and must adhere to the following standards*:*

(i) Sunrise Wind must submit an annual report to NMFS (at *itp.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) no later than 90 days following the end of a given calendar year. Sunrise Wind must provide a final report within 30 days following resolution of comments on the draft report. The report must detail the following information and the information specified in paragraphs (d)(2)(i) through (xix), (d)(3)(i) through (xii), and (d)(4)(i) through (x) of this section:

(A) The total number of marine mammals of each species/stock detected and how many were within the designated Level A harassment and Level B harassment zones with comparison to authorized take of marine mammals for the associated activity type;

(B) Marine mammal detections and behavioral observations before, during, and after each activity;

(C) What mitigation measures were implemented (*i.e.,* number of shutdowns or clearance zone delays, *etc.*) or, if no mitigative actions was taken, why not;

(D) Operational details (*i.e.,* days of impact and vibratory pile driving, days/amount of HRG survey effort, total number and charge weights related to UXO/MEC detonations, *etc.*);

(E) SFV results;

(F) Any PAM systems used;

(G) The results, effectiveness, and which noise abatement systems were used during relevant activities (*i.e.,* impact pile driving, UXO/MEC detonation);

(H) Summarized information related to Situational Reporting; and

(I) Any other important information relevant to the Sunrise Wind project, including additional information that may be identified through the adaptive management process.

(ii) The final annual report must be prepared and submitted within 30 calendar days following the receipt of any comments from NMFS on the draft report. If no comments are received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report must be considered final.

(8) Final reports are required from Sunrise Wind and must adhere to the following standards:

(i) Sunrise Wind must submit its draft final report to NMFS (at *jaclyn.daly@noaa.gov* and *PR.ITP.monitoringreports@noaa.gov*) on all visual and acoustic monitoring conducted under the LOA within 90 calendar days of the completion of activities occurring under the LOA. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of NMFS' receipt of the draft report, the report shall be considered final.

(ii) [Reserved].

(9) Sound field verification reports are required from Sunrise Wind and must adhere to the following standards*:*

(i) Sunrise Wind must provide the initial results of the SFV measurements to NMFS in an interim report after each monopile foundation installation for the first three monopiles piles, and for each UXO/MEC detonation as soon as they are available, but no later than 48 hours after each installation or detonation. Sunrise Wind must also provide interim reports on any subsequent SFV on foundation piles within 48 hours. The interim report must include hammer energies used during pile driving or UXO/MEC weight (including donor charge weight), peak sound pressure level (SPL_{pk}) and median, mean, maximum, and minimum root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}) and single strike sound exposure level (SEL_{ss});

(ii) The final results of SFV of monopile installations must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of monopiles and UXO/MEC detonations. The final report must include, at minimum, the following:

(A) Peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), single strike sound exposure level (SEL_{ss}), integration time for SPL_{rms}, spectrum, and 24-hour cumulative SEL extrapolated from measurements at specified distances (*e.g.,* 750 m).

(*1*) All these levels must be reported in the form of:

(*i*) Median;

(*ii*) Mean;

(*iii*) Maximum; and

(*iv*) Minimum.

(*2*) The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported;

(B) The sound levels reported must be in median and linear average (*i.e.,* average in linear space), and in dB;

(C) A description of depth and sediment type, as documented in the

Construction and Operation Plan, at the recording and pile driving locations;

(D) Hammer energies required for pile installation and the number of strikes per pile;

(E) Hydrophone equipment and methods (*i.e.,* recording device, bandwidth/sampling rate, distance from the pile where recordings were made; depth of recording device(s));

(F) Description of the SFV PAM hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information;

(G) Description of UXO/MEC, weight, including donor charge weight, and why detonation was necessary;

(H) Local environmental conditions, such as wind speed, transmission loss data collected on-site (or the sound velocity profile), baseline pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern);

(I) Spatial configuration of the noise attenuation device(s) relative to the pile;

(J) The extents of the Level A harassment and Level B harassment zones; and

(K) A description of the noise abatement system and operational parameters (*e.g.,* bubble flow rate, distance deployed from the pile, *etc.*) and any action taken to adjust the noise abatement system.

(10) Situational reports are required from Sunrise Wind and must adhere to the following standards:

(i) If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any project vessel, or during vessel transit, Sunrise Wind must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755–6622, through the WhaleAlert app (*https://www.whalealert/org/*), and to the U.S. Coast Guard via channel 16, as soon as feasible but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed.

(ii) When an observation of a marine mammal occurs during vessel transit, the following information must be recorded:

(A) Time, date, and location;

(B) The vessel's activity, heading, and speed;

(C) Sea state, water depth, and visibility;

(D) Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal);

(E) Initial distance and bearing to marine mammal from vessel and closest point of approach; and

(F) Any avoidance measures taken in response to the marine mammal sighting.

(iii) If a North Atlantic right whale is detected via PAM, the date, time, location (*i.e.,* latitude and longitude of recorder) of the detection as well as the recording platform that had the detection must be reported to *nmfs.pacmdata@noaa.gov* as soon as feasible, but no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*);

(iv) In the event that the personnel involved in the activities defined in § 217.310(a) discover a stranded, entangled, injured, or dead marine mammal, Sunrise Wind must immediately report the observation to the NMFS Office of Protected Resources (OPR), the NMFS Greater Atlantic Stranding Coordinator for the New England/Mid-Atlantic area (866–755–6622), and the U.S. Coast Guard within 24 hours. If the injury or death was caused by a project activity, Sunrise Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Sunrise Wind may not resume their activities until notified by NMFS. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(B) Species identification (if known) or description of the animal(s) involved;

(C) Condition of the animal(s) (including carcass condition if the animal is dead);

(D) Observed behaviors of the animal(s), if alive;

(E) If available, photographs or video footage of the animal(s); and

(F) General circumstances under which the animal was discovered.

(v) In the event of a vessel strike of a marine mammal by any vessel associated with the Sunrise Wind Offshore Wind Farm Project, Sunrise Wind must immediately report the strike incident to the NMFS OPR and the GARFO within and no later than 24 hours. Sunrise Wind must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. Sunrise Wind may not resume their activities until notified by NMFS and additional measures, if any, to ensure compliance with the terms of the LOA are implemented. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the incident;

(B) Species identification (if known) or description of the animal(s) involved;

(C) Vessel's speed leading up to and during the incident;

(D) Vessel's course/heading and what operations were being conducted (if applicable);

(E) Status of all sound sources in use;

(F) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

(G) Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;

(H) Estimated size and length of animal that was struck;

(I) Description of the behavior of the marine mammal immediately preceding and following the strike;

(J) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;

(K) Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and

(L) To the extent practicable, photographs or video footage of the animal(s).

§ 217.316 Letter of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, Sunrise Wind must apply for and obtain an LOA.

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed November 20, 2023 through November 19, 2028 of this subpart.

(c) If an LOA expires prior to the expiration date of these regulations, Sunrise Wind may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, Sunrise Wind must apply for and obtain a modification of the LOA as described in § 217.317.

(e) The LOA must set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact (*i.e.,* mitigation) on the species, its habitat, and on the availability of the species for subsistence uses; and

(3) Requirements for monitoring and reporting.

(f) Issuance of the LOA must be based on a determination that the level of taking must be consistent with the findings made for the total taking allowable under this subpart.

(g) Notice of issuance or denial of an LOA must be published in the **Federal Register** within 30 days of a determination.

§ 217.317 Modifications of Letter of Authorization.

(a) An LOA issued under §§ 217.312 and 217.316 or § 217.317 for the activity identified in § 217.310(a) shall be modified upon request by the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for this subpart (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section), and

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For a LOA modification request by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that do not change the findings made for this subpart or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis of the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under §§ 217.312 and 217.316 or § 217.317 for the activities identified in § 217.310(a) may be modified by NMFS under the following circumstances:

(1) *Adaptive Management.* NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with Sunrise Wind regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in this subpart;

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA:

(A) Results from Sunrise Wind's monitoring from the previous year(s);

(B) Results from other marine mammals and/or sound research or studies;

(C) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by this subpart or subsequent LOA; and

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS shall publish a notice of proposed LOA in the **Federal Register** and solicit public comment.

(2) *Emergencies.* If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in the LOA issued pursuant to §§ 217.312 and 217.316 or § 217.317, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within 30 days of the action.

§§ 217.318–217.319 [Reserved]

[FR Doc. 2023–02497 Filed 2–8–23; 8:45 am]

BILLING CODE 3510–22–P