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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XF926

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys off the Coast of Massachusetts

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

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from Orsted (U.S.) LLC/Bay State Wind LLC (Bay State Wind) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to high-resolution geophysical (HRG) survey investigations associated with marine site characterization activities off the coast of Massachusetts in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0500) (the Lease Area). Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to Bay State Wind to incidentally take, by Level A and Level B harassment, small numbers of marine mammals during the specified activities. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorizations and agency responses will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than [*insert date 30 days after date of publication in the FEDERAL REGISTER*].

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service.

Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Youngkin@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted online at *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-construction-activities* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Dale Youngkin, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-construction-activities*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

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 and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

NMFS has defined "negligible impact" in 50 CFR 216.103 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.

The MMPA states that the term "take" means to harass, hunt, capture, kill or attempt to harass, hunt, capture, or kill any marine mammal.

Except with respect to certain activities not pertinent here, 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).

National Environmental Policy Act (NEPA)

The U.S. Bureau of Ocean Energy Management (BOEM) prepared an Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), to evaluate the issuance of wind energy leases covering the entirety of the Massachusetts Wind Energy Area (including the OCS-A 0500 Lease Area), and the approval of site assessment

activities within those leases (BOEM, 2014). NMFS previously adopted BOEM's EA and issued a Finding of No Significant Effect (FONSI) for similar work in 2016 (81 FR 56589, August 22, 2016).

NMFS has reviewed the BOEM EA and our previous FONSI and has preliminarily determined that this action is consistent with categories of activities identified in CE B4 of the Companion Manual for NOAA Administrative Order 216-6A, which do not individually or cumulatively have the potential for significant impacts on the quality of the human environment and for which we have not identified any extraordinary circumstances that would preclude this categorical exclusion. Accordingly, NMFS has preliminarily determined that the issuance of the proposed IHA qualifies to be categorically excluded from further NEPA review. We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On October 20, 2017 NMFS received an application from Bay State Wind for the taking of marine mammals incidental to HRG and geotechnical survey investigations off the coast of Massachusetts in the OCS-A 0500 Lease Area, designated and offered by the BOEM, to support the development of an offshore wind project. Bay State Wind's request is for take, by Level A and Level B harassment, of a small number of 10 species or stocks of marine mammals. Neither the applicant nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

NMFS previously issued an IHA to Bay State Wind (then operating under DONG Energy) for similar work (FR 81 56589, August 22, 2016). Bay State Wind complied with all

the requirements (*e.g.*, mitigation, monitoring, and reporting) of the previous IHA and information regarding their monitoring results may be found in the Estimated Take section.

Description of the Specified Activity

Overview

Bay State Wind proposes to conduct HRG surveys in the Lease Area to support the characterization of the existing seabed and subsurface geological conditions in the Lease Area. This information is necessary to support the final siting, design, and installation of offshore project facilities, turbines and subsea cables within the project area as well as to collect the data necessary to support the review requirements associated with Section 106 of the National Historic Preservation Act of 1966, as amended. Underwater sound resulting from Bay State Wind's proposed site characterization surveys has the potential to result in incidental take of marine mammals. This take of marine mammals is anticipated to be in the form of harassment and no serious injury or mortality is anticipated, nor is any authorized in this IHA.

Dates and Duration

HRG surveys of the wind turbine generator (WTG) and offshore substation (OSS) areas are anticipated to commence no earlier than June 1, 2018 and will last for approximately 60 days, including estimated weather down time. Likewise, the Export Cable Route HRG surveys are anticipated to commence no earlier than June 1, 2018 and will last approximately 40 days (including estimated weather down time). Offshore and near coastal shallow water regions of the HRG survey will occur within the same 40-day timeframe. Surveys are anticipated to commence upon issuance of the requested IHA, if appropriate.

Specified Geographic Region

Bay State Wind's survey activities will occur in the approximately 187,532-acre Lease Area designated and offered by BOEM, located approximately 14 miles (mi) south of Martha's Vineyard, Massachusetts at its closest point, as well as within 2 potential export cable routes to Somerset, MA and to Falmouth, MA (see Figure 1-1 of the IHA application). The Lease Area falls within the Massachusetts Wind Energy Area (MA WEA).

Detailed Description of Specified Activities

Marine site characterization surveys will include the following HRG survey activities:

- Depth sounding (multibeam depth sounder) to determine water depths and general bottom topography;
- Magnetic intensity measurements for detecting local variations in regional magnetic field from geological strata and potential ferrous objects on and below the bottom;
- Seafloor imaging (sidescan sonar survey) for seabed sediment classification purposes, to identify natural and man-made acoustic targets resting on the bottom as well as any anomalous features;
- Shallow penetration sub-bottom profiler (pinger/chirp) to map the near surface stratigraphy (top 0-5 meter (m) soils below seabed); and
- Medium penetration sub-bottom profiler (sparker) to map deeper subsurface stratigraphy as needed (soils down to 75-100 m below seabed).

Table 1 identifies the representative survey equipment that is being considered in support of the HRG survey activities. The make and model of the listed HRG equipment will vary depending on availability, but will be finalized as part of the survey preparations and contract negotiations with the survey contractor, and therefore the final selection of the survey equipment will be confirmed prior to the start of the HRG survey program. Only the make and model of the HRG equipment may change, not the types of equipment or the addition of equipment with

characteristics that might have effects beyond (*i.e.*, resulting in larger ensonified areas) those considered in this proposed IHA. None of the proposed HRG survey activities will result in the disturbance of bottom habitat in the Lease Area.

Table 1. Summary of representative Bay State Wind HRG survey equipment.

HRG Equipment	Operating Frequencies	Source Level reported by Manufacturer	Beamwidth (degree)	Pulse Duration (millisec)	Pulse Repetition Rate (Hz)
USBL & GAPS Transceiver					
Sonardyne Ranger 2 USBL HPT 5/7000	19 - 34 kHz	206 dB_{pk}/ 200 dB_{RMS}	180	8 - 16	1
Sonardyne Ranger 2 USBL HPT 5/7000	19 – 34 kHz	194 dB_{pk}/ 188 dB_{RMS}	180	8 - 16	3
Easytrak Nexus 2 USBL	18 – 32 kHz	198 dB_{pk}/ 192 dB_{RMS}	180	10	1
IxSea GAPS System	20 – 30 kHz	191 dB_{pk}/ 188 dB_{RMS}	200	10	10
Sidescan Sonar (SSS)					
EdgeTech 4200 dual frequency SSS	300 or 600 kHz	208-213 dB_{pk}/ 205-210 dB_{RMS}	0.5 – 0.26 X 50	2.8 - 12	5 - 55
Multibeam Sonar (MBS)					
R2 Sonic 2024 Multipbeam Echosounder	200 – 400 kHz	229 dB_{pk}/ 162 dB_{RMS}	0.5 X 1 256 beams	0.15 – 0.5	60
Kongsberg EM2040C Dual Head	200 – 400 kHz	210 dB_{pk}/ 204.5 dB_{RMS}	1 X 1	3 or 12	Up to 50
Sub-Bottom Profilers (SBP)					
Edgetech 3200 XS 216 Shallow SBP	2 – 16 kHz	208-213 dB_{pk}/ 205-210 dB_{RMS}	17	20	10
Innomar SES-2000 Medium SBP	85 – 115 kHz	250 dB_{pk}/ 243 dB_{RMS}	1	0.07 - 2	40
Innomar SES-2000 Standard SBP	85 – 115 kHz	243 dB_{pk}/ 236 dB_{RMS}	1	0.07 - 2	60
Sparkers					
GeoMarine Geo-Source	0.2 - 5 kHz	220 dB_{pk}/ 205 dB_{RMS}	30	3.8	2
Boomers					
Applied Acoustics S-Boom Triple Plate Boomer	0.250 - 8 Hz	220 dB_{pk}/ 216 dB_{RMS}	25 - 35	0.3 – 0.5	3
Applied	0.1 - 5 kHz	209 dB_{pk}/	30	0.3 – 0.5	3

Acoustics S-Boom Boomer		203 dB_{peak}			

The deployment of HRG survey equipment, including the use of intermittent, impulsive sound-producing equipment operating below 200 kilohertz (kHz), has the potential to cause acoustic harassment to marine mammals. Based on the frequency ranges of the equipment to be used in support of the HRG survey activities (Table 1) and the hearing ranges of the marine mammals that have the potential to occur in the Lease Area during survey activities (Table 2), the noise produced by the ultra short baseline (USBL) and global acoustic positioning system (GAPS) transceiver systems; sub-bottom profilers; sparkers; and boomers fall within the established marine mammal hearing ranges and have the potential to result in harassment of marine mammals.

The equipment positioning systems use vessel-based underwater acoustic positioning to track equipment in very shallow to very deep water. Using pulsed acoustic signals, the systems calculate the position of a subsea target by measuring the range (distance) and bearing from a vessel-mounted transceiver to a small acoustic transponder (the acoustic beacon, or pinger) fitted to the target. Equipment positioning systems will be operational at all times during HRG survey data acquisition (*i.e*, concurrent with the sub-bottom profiler operation). Sub-bottom profiling systems identify and measure various marine sediment layers that exist below the sediment/water interface. A sound source emits an acoustic signal vertically downwards into the water and a receiver monitors the return signal that has been reflected off the sea floor. Some of the acoustic signal will penetrate the seabed and be reflected when it encounters a boundary between two layers that have different acoustic impedance. The system uses this reflected energy to provide information on sediment layers beneath the sediment-water interface. A shallow penetration sub-bottom profiler will be used to map the near surface stratigraphy of the Lease Area. The

shallow penetration sub-bottom profiler is a precisely controlled hull/pole mounted "chirp" system that emits high-energy sounds used to penetrate and profile the shallow (top 0-5 m soils below seabed) sediments of the seafloor. A Geo-Source 600/800, or similar model, medium-penetration sub-bottom profiler (sparker) will be used to map deeper subsurface stratigraphy in the Lease Area as needed (soils down to 75-100 m below seabed).

Given the size of the Lease Area (187,532 acres), to minimize cost, the duration of survey activities, and the period of potential impact on marine species, Bay State Wind has proposed conducting survey operations 24 hours per day in the offshore areas. Based on 24-hour operations, the estimated duration of the survey activities would be approximately 60 days (including estimated weather down time). For the nearshore/landfall area, a small vessel with a draft sufficient to survey shallow waters will be needed. Only daylight operations will be used to survey the nearshore/landfall, and will require an estimated 40 days to complete (including estimated weather down time). Offshore and near coastal shallow water regions of the HRG survey will occur within the same 40-day timeframe.

The survey area consists of several sections (Lots) as described below:

- Export Cable Route to Somerset, MA – This export cable route will be split into two Lots reflecting the boundary between State and Federal waters, which also coincides with the 3 nautical mile maritime boundary:
    - Lot 1 consists of a 1,640-ft (500 m) wide survey corridor from the 3-nautical mile maritime boundary near coastal shallow water, at which point the corridor splits into three extensions toward potential landfall locations (Extensions 1a, 1b, and 1c; see Figure 1-1 inset in the

application). Each extension is 820 ft (250 m) wide. The total estimated trackline miles are approximately 350 mile (mi) (563 km); and

- Lot 2 consists of a 3,281-ft (1,000 m) wide survey corridor in the offshore region of the export cable route. The total estimated trackline miles are approximately 678 mi (1,091 km);

- Phase I Development Area – This area comprises Lot 3, which consists of the locations for the WTG and OSS as well as inter-array cable segments. The trackline is estimated to be approximately 1,768 mi (2,845 km) and would be comprised of:
  - 656-ft (200 m) radius around the planned locations for OSS;
  - 492-ft (150 m) radius around the planned locations for WTGs;
  - 246-ft (75 m) radius around planned locations for inter-array cable segments; and
- Export Cable Route to Falmouth, MA – This area will be split into two Lots reflecting the boundary between State and Federal waters and coinciding with the 3-nautical mile boundary:
  - Lot 4 consists of a 3,281-ft (1,000 m) wide survey corridor in the offshore region of the cable route. The estimated trackline would be approximately 1,400 mi (2.253 km);
  - Lot 5 consists of a 1,640-ft (500 m) wide survey corridor in the near coastal shallow water region of the cable route. The total estimated trackline would be approximately 67 mi (108 km).

Multiple vessels will be utilized to conduct site characterization survey activities in the locations of the WTG and OSS, two offshore segments of the export cable route, and nearshore/cable landfall area. For the near coastal shallow water regions of the Export Cable Routes (Lots 1 and 5; Refer to Figure 1 and Pages 3-4 of the application for description of Lots), up to two small vessels with a draft sufficient to survey shallow waters (up to 72 feet (ft) (22 m)) are planned to be used. For the WTG and OSS and offshore regions of the two Export Cable Routes (Lots 3, 2, and 4, respectively), up to three large vessels (approximately 170 ft (52 m) in length) will conduct survey operations. In Lots 3 and 4 (WTG and OSS locations and offshore portion of the Export Cable Route to Falmouth), one large vessel will serve as a "mother vessel" to a smaller (41 ft (12.5 m)) autonomous surface vessel (ASV) that may be used to 'force multiply' survey production. Additionally, the ASV will also capture data in water depths shallower than 26 ft (8 m)), increasing the shallow end reach of the larger vessel. The ASV can be used for nearshore operations and shallow work (20 ft (6 m) and less) in a "manned" configuration.

The ASV and mother vessel will acquire survey data in tandem and the ASV will be kept within sight of the mother vessel at all times. The ASV will operate autonomously along a parallel track to, and slightly ahead of, the mother vessel at a distance set to prevent crossed signaling of survey equipment (within 2,625 ft (800 m)). During data acquisition surveyors have full control of the data being acquired and have the ability to make changes to settings such as power, gain, range scale etc. in real time. Surveyors will also be able to monitor the data as it is acquired by the ASV utilizing a real time IP radio link. For each 12 hour shift, an ASV technician will be assigned to manage the vessel during his or her shift to ensure the vehicle is operating properly and to take over control of the vehicle should the need arise. The ASV is

outfitted with an array of cameras, radars, thermal equipment and AIS, all of which is monitored in real time by the ASV technician. This includes a forward-facing dual thermal/HD camera installed on the mother vessel to provide a field of view ahead of the vessel and around the ASV, forward-facing thermal camera on the ASV itself with a real-time monitor display installed on the mother vessel bridge, and use of night-vision goggles with thermal clip-ons for monitoring around the mother vessel and ASV. Additionally, there will be 2 survey technicians per shift assigned to acquire the ASV survey data.

Proposed mitigation, monitoring, and reporting measures are described in detail later in this document (please see "Proposed Mitigation" and "Proposed Monitoring and Reporting").

Description of Marine Mammals in the Area of the Specified Activity

Sections 3 and 4 of Bay State Wind's IHA application summarize available information regarding the status and trends, distribution and habitat preferences, and behavior and life history of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS's Stock Assessment Reports (SAR; *http://www.nmfs.noaa.gov/pr/sars/species.htm*) and more general information can be found about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' website (*http://www.nmfs.noaa.gov/pr/species/mammals/*).

Table 2 lists all marine mammal species with expected occurrence in the Northwest Atlantic Outer Continental Shelf (OCS) and summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) as well as potential biological removal (PBR), where known. For taxonomy, we follow the Committee on Taxonomy (2016). PBR is defined by the MMPA 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 (as described in NMFS' SARs). While no mortality is anticipated or authorized here, 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' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprise that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Atlantic Ocean SARs (*e.g.*, Hayes *et al.*, 2017). All values presented in Table 2 are the most recent available at the time of publication and are available in the 2016 SARs (Hayes *et al.*, 2017) and draft 2017 SARs (available online at: *http://www.nmfs.noaa.gov/pr/sars/draft.htm*).

Table 2. Marine mammals known to occur in the waters of Southern New England.

Common Name	Scientific Name	ESA/MMPA Status[1]	Stock Abundance (CV; N_{min})[2]	Stock	PBR	Annual M/SI3
Toothed Whales (Odontoceti)						
Atlantic white-sided dolphin	***Lagenorhynchus acutus***	***N/A***	***48,819 (0.61; 30,403)***	***W. North Atlantic***	***304***	***74***
Atlantic spotted dolphin	*Stenella frontalis*	N/A	44,715 (0.43; 31,610)	W. North Atlantic	316	0
Bottlenose dolphin	***Tursiops truncatus***	***Northern coastal stock is Strategic***	***11,548 (0.36; 8,620)***	***W. North Atlantic, Northern Migratory Coastal***	***86***	***1 – 7.5***
Clymene dolphin	*Stenella clymene*	N/A	Unknown	W. North Atlantic	Unknown	0
Fraser's dolphin	*Lagenodelphis hosei*	N/A	Unknown	W. North Atlantic	Unknown	0
Pan-tropical spotted dolphin	*Stenella attenuata*	N/A	3,333 (0.91; 1,733)	W. North Atlantic	17	0
Risso's dolphin	*Grampus griseus*	N/A	18,250	W. North	126	53.6

			(0.46; 12,619)	Atlantic		
Rough-toothed dolphin	*Steno bredanensis*	N/A	271 (1.0; 134)	W. North Atlantic	1.3	0
Short-beaked common dolphin	***Delphinus delphis***	***N/A***	***70,184 (0.28; 55,690)***	***W. North Atlantic***	***557***	***409***
Striped dolphin	*Stenella coeruleoalba*	N/A	54,807 (0.3; 42,804)	W. North Atlantic	428	0
Spinner dolphin	*Stenella longirostris*	N/A	Unknown	W. North Atlantic	Unknown	0
White-beaked dolphin	*Lagenorhynchus albirostris*	N/A	2,003 (0.94; 1,023)	W. North Atlantic	10	0
Harbor porpoise	***Phocoena phocoena***	***N/A***	***79,833 (0.32; 61,415)***	***Gulf of Maine/Bay of Fundy***	***706***	***437***
Killer whale	*Orcinus orca*	N/A	Unknown	W. North Atlantic	Unknown	0
Pygmy killer whale	*Feresa attenuata*	N/A	Unknown	W. North Atlantic	Unknown	0
False killer whale	*Pseudorca crassidens*	Strategic	442 (1.06; 212)	W. North Atlantic	2.1	Unknown
Long-finned pilot whale	*Globicephala melas*	N/A	5,636 (0.63; 3,464)	W. North Atlantic	35	38
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	21,515 (0.37; 15,913)	W. North Atlantic	159	192
Sperm whale	***Physeter macrocephalus***	***Endangered***	***2,288 (0.28; 1,815)***	***North Atlantic***	***3.6***	***0.8***
Pigmy sperm whale	*Kogia breviceps*	N/A	3,785 [4] (0.47; 2,598)	W. North Atlantic	21	3.5
Dwarf sperm whale	*Kogia sima*	N/A	3,785 [4] (0.47; 2,598)	W. North Atlantic	21	3.5
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	6,532 (0.32; 5,021)	W. North Atlantic	50	0.4
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	7,092 [5] (0.54; 4,632)	W. North Atlantic	46	0.2
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	7,092 [5] (0.54; 4,632)	W. North Atlantic	46	0
True's beaked whale	*Mesoplodon mirus*	N/A	7,092 [5] (0.54; 4,632)	W. North Atlantic	46	0
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	7,092 [5] (0.54; 4,632)	W. North Atlantic	46	0
Northern bottlenose whale	*Hyperoodon ampullatus*	N/A	Unknown	W. North Atlantic	Unknown	0
Melon-headed whale	*Peponocephala electra*	N/A	Unknown	W. North Atlantic	Unknown	0
Baleen Whales (Mysticeti)						
Minke whale	***Balaenoptera***	***N/A***	***2,591 (0.81;***	***Canadian East***	***14***	***8.25***

	acutorostrata		***1,425)***	***Coast***		
Blue whale	*Balaenoptera musculus*	Endangered	Unknown (Unknown; 440)	W. North Atlantic	0.9	Unknown
Fin whale	***Balaenoptera physalus***	***Endangered***	***1,618 (0.33; 1,234)***	***W. North Atlantic***	***2.5***	***3.8***
Humpback whale	***Megaptera novaeangliae***	***N/A***	***823 (0; 823)***	***Gulf of Maine***	***13***	***9.05***
North Atlantic right whale	*Eubalaena glacialis*	Endangered	440 (0; 440)	W. North Atlantic	1	5.66
Sei whale	*Balaenoptera borealis*	Endangered	357 (0.52; 236)	Nova Scotia	0.5	0.8
Earless Seals (Phocidae)						
Gray seals	***Halichoerus grypus***	***N/A***	***424,300 (0.16; 371,444)***	***W. North Atlantic***	***Unknown***	***4,937***
Harbor seals	***Phoca vitulina***	***N/A***	***75,834 (0.15; 66,884)***	***W. North Atlantic***	***2,006***	***389***
Hooded seals	*Cystophora cristata*	N/A	Unknown	W. North Atlantic	Unknown	Unknown
Harp seal	*Phoca groenlandica*	N/A	8,300,000 (Unknown)	W. North Atlantic	Unknown	Unknown

NOTE: Species information in bold italics are species expected to be taken and proposed for authorization; others are not expected or proposed to be taken.

[1] A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal (PBR) level; 2) which is declining and likely to be listed as threatened under the Endangered Species Act (ESA); or 3) which is listed as threatened or endangered under the ESA or as depleted under the Marine Mammal Protection Act (MMPA)

[2] NMFS stock assessment reports online at: *www.nmfs.noaa.gov/pr/sars*. CV = coefficient of variarion; Nmin = minimum estimate of stock abundance.

[3] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury (M/SI) from all sources combined (*e.g.*, commercial fisheries, ship strike, etc.). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.

[4] This estimate may include both the dwarf and pygmy sperm whales.

[5] This estimate includes Gervais' and Blainville's beaked whales and undifferentiated *Mesoplodon* spp. beaked whales.

Sources: Hayes *et al.*, 2016, Waring *et al*., 2015; Waring *et al*., 2013; Waring *et al*., 2011; Warring *et al*., 2010; RI SAMP, 2011; Kenney and Vigness-Raposa, 2009; NMFS, 2012

There are 38 species of marine mammals that potentially occur in the Northwest Atlantic OCS region (BOEM, 2014) (Table 2). The majority of these species are pelagic and/or more northern species, or are so rarely sighted that their presence in the Lease Area is unlikely. Five marine mammal species are listed under the ESA and are known to be present, at least seasonally, in the waters of Southern New England: blue whale, fin whale, right whale, sei whale, and sperm whale. These species are highly migratory and do not spend extended periods

of time in a localized area; the waters of Southern New England (including the Lease Area) are primarily used as a stopover point for these species during seasonal movements north or south between important feeding and breeding grounds. While the fin and right whales have the potential to occur within the Lease Area, the sperm, blue, and sei whales are more pelagic and/or northern species, and though their presence within the Lease Area is possible, they are considered less common with regards to sightings. Because the potential for blue whales and sei whales to occur within the Lease Area during the marine survey period is unlikely, these species will not be described further in this analysis. Sperm whales are known to occur occasionally in the region, but their sightings are considered rare and thus their presence in the Lease Area at the time of the proposed activities is considered unlikely. However, based on a recent increase in sightings, they are included in the discussion below.

The following species are both common in the waters of the OCS south of Massachusetts and have the highest likelihood of occurring, at least seasonally, in the Lease Area: humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), harbor porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin (*Delphinus delphis*), harbor seal (*Phoca vitulina*), and gray seal (*Halichorus grypus*). In general, the remaining non-ESA listed marine mammal species listed in Table 2 range outside the survey area, usually in more pelagic waters, or are so rarely sighted that their presence in the survey area is unlikely. For example, while white-beaked dolphins (*Lagenorhynchus albirostris*) are likely to occur in the nearby waters surrounding the survey area (*i.e.*, within 40 nautical miles (74 kilometers (km)), they are not likely to occur within the survey area, and beaked whales are likely to occur in the region to the south of the survey area, but not within 40 nautical miles (74 km) (Right Whale Consortium, 2014). Therefore, only north Atlantic right whales, humpback

whales, fin whales, sperm whales, minke whales, bottlenose dolphins, short-beaked common dolphins, Atlantic white-sided dolphins, harbor porpoises, harbor seals, and gray seals are considered in this analysis.

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 (2016) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibels (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. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): generalized hearing is estimated to occur between approximately 7 Hertz (Hz) and 35 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera Kogia and Cephalorhynchus; including two members of the genus Lagenorhynchus, on the basis of recent echolocation data and genetic data): generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.
- Pinnipeds in water; Phocidae (true seals): generalized hearing is estimated to occur between approximately 50 Hz to 86 kHz;
- Pinnipeds in water; Otariidae (eared seals): generalized hearing is estimated to occur between 60 Hz and 39 kHz.

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 (2016) for a review of available information. Eleven marine mammal species (nine cetacean and two pinniped (both phocid) species) have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 2. Of the cetacean species that may be present, five are classified as low-frequency cetaceans (*i.e*., all mysticete species), four are

classified as mid-frequency cetaceans (*i.e.*, all delphinid and ziphiid species and the sperm whale), and one is classified as high-frequency cetacean (*i.e.*, harbor porpoise).

Potential Effects of the Specified Activity on 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 by Incidental Harassment" 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 by Incidental Harassment" 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.

Background on Sound

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and is generally characterized by several variables. Frequency describes the sound's pitch and is measured in Hz or kHz, while sound level describes the sound's intensity and is measured in dB. Sound level increases or decreases exponentially with each dB of change. The logarithmic nature of the scale means that each 10-dB increase is a 10-fold increase in acoustic power (and a 20-dB increase is then a 100-fold increase in power). A 10-fold increase in acoustic power does not mean that the sound is perceived as being 10 times louder, however. Sound levels are compared to a reference sound pressure (micro-Pascal) to identify the medium. For air and water, these reference pressures are "re: 20 micro pascals (µPa)" and "re: 1 µPa," respectively. Root mean square (RMS) is the quadratic mean sound

pressure over the duration of an impulse. RMS is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1975). RMS 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. 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 rather than by peak pressures.

Acoustic Impacts

HRG survey equipment use during the geophysical surveys may temporarily impact marine mammals in the area due to elevated in-water sound levels. Marine mammals are continually exposed to many sources of sound. Naturally occurring sounds such as lightning, rain, sub-sea earthquakes, and biological sounds (*e.g.*, snapping shrimp, whale songs) are widespread throughout the world's oceans. Marine mammals produce sounds in various contexts and use sound for various biological functions including, but not limited to: (1) social interactions; (2) foraging; (3) orientation; and (4) predator detection. Interference with producing or receiving these sounds may result in adverse impacts. Audible distance, or received levels of sound depend on the nature of the sound source, ambient noise conditions, and the sensitivity of the receptor to the sound (Richardson *et al.*, 1995). Type and significance of marine mammal reactions to sound are likely dependent on a variety of factors including, but not limited to, (1) the behavioral state of the animal (*e.g.*, feeding, traveling, etc.); (2) frequency of the sound; (3) distance between the animal and the source; and (4) the level of the sound relative to ambient conditions (Southall *et al.*, 2007).

When sound travels (propagates) from its source, its loudness decreases as the distance traveled by the sound increases. Thus, the loudness of a sound at its source is higher than the loudness of that same sound a kilometer away. Acousticians often refer to the loudness of a sound at its source (typically referenced to one meter from the source) as the source level and the loudness of sound elsewhere as the received level (*i.e.*, typically the receiver). For example, a humpback whale 3 km from a device that has a source level of 230 dB may only be exposed to sound that is 160 dB loud, depending on how the sound travels through water (*e.g.*, spherical spreading (6 dB reduction with doubling of distance) was used in this example). As a result, it is important to understand the difference between source levels and received levels when discussing the loudness of sound in the ocean or its impacts on the marine environment.

As sound travels from a source, its propagation in water is influenced by various physical characteristics, including water temperature, depth, salinity, and surface and bottom properties that cause refraction, reflection, absorption, and scattering of sound waves. Oceans are not homogeneous and the contribution of each of these individual factors is extremely complex and interrelated. The physical characteristics that determine the sound's speed through the water will change with depth, season, geographic location, and with time of day (as a result, in actual active sonar operations, crews will measure oceanic conditions, such as sea water temperature and depth, to calibrate models that determine the path the sonar signal will take as it travels through the ocean and how strong the sound signal will be at a given range along a particular transmission path). As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity is referred to as propagation loss, also commonly called transmission loss.

Hearing Impairment

Marine mammals may experience temporary or permanent hearing impairment when exposed to loud sounds. Hearing impairment is classified by temporary threshold shift (TTS) and permanent threshold shift (PTS). There are no empirical data for onset of PTS in any marine mammal; therefore, PTS-onset must be estimated from TTS-onset measurements and from the rate of TTS growth with increasing exposure levels above the level eliciting TTS-onset. PTS is considered auditory injury (Southall *et al*., 2007) and occurs in a specific frequency range and amount. Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.*, 2007). Given the higher level of sound, longer durations of exposure necessary to cause PTS as compared with TTS, and the small zone within which sound levels would exceed criteria for onset of PTS, it is considerably less likely that PTS would occur during the proposed HRG surveys.

Temporary Threshold Shift

TTS is the mildest form of hearing impairment that can occur during exposure to a loud sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days, can be limited to a particular frequency range, and can occur to varying degrees (*i.e*., a loss of a certain number of dBs of sensitivity). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends.

Marine mammal hearing plays a critical role in communication with conspecifics and in 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. 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 takes place during a time when the animals is traveling through the open ocean, 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 a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that it impeded communication. The fact that animals exposed to levels and durations of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is also notable and potentially of more importance than the simple existence of a TTS.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale, harbor porpoise, and Yangtze finless porpoise) and three species of pinnipeds (northern elephant seal, harbor seal, and California sea lion) exposed to a limited number of sound sources (*i.e.*, mostly tones and octave-band noise) in laboratory settings (*e.g.*, Finneran *et al.*, 2002 and 2010; Nachtigall *et al.*, 2004; Kastak *et al.*, 2005; Lucke *et al.*, 2009; Mooney *et al.*, 2009; Popov *et al.*, 2011; Finneran and Schlundt, 2010). In general, harbor seals (Kastak *et al.*, 2005; Kastelein *et al.*, 2012a) and harbor porpoises (Lucke *et al.*, 2009; Kastelein *et al.*, 2012b) have a lower TTS onset than other measured pinniped or cetacean species. However, even for these animals, which are better able to hear higher frequencies and may be more sensitive to higher frequencies, exposures on the order of approximately 170 dB_{RMS} or higher for brief transient

signals are likely required for even temporary (recoverable) changes in hearing sensitivity that would likely not be categorized as physiologically damaging (Lucke *et al*., 2009). Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes (of note, the source operating characteristics of some of Bay State Wind's proposed HRG survey equipment—*i.e.*, the equipment positioning systems—are unlikely to be audible to mysticetes). For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see NMFS (2016), Southall *et al*. (2007), Finneran and Jenkins (2012), and Finneran (2015).

Scientific literature highlights the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts (Mooney *et al.*, 2009a, 2009b; Kastak *et al.*, 2007). Generally, with sound exposures of equal energy, quieter sounds (lower sound pressure level (SPL)) of longer duration were found to induce TTS onset more than louder sounds (higher SPL) of shorter duration (more similar to sub-bottom profilers). For intermittent sounds, less threshold shift will occur than from a continuous exposure with the same energy (some recovery will occur between intermittent exposures) (Kryter *et al.*, 1966; Ward, 1997). For sound exposures at or somewhat above the TTS-onset threshold, hearing sensitivity recovers rapidly after exposure to the sound ends; intermittent exposures recover faster in comparison with continuous exposures of the same duration (Finneran *et al*., 2010). NMFS considers TTS as Level B harassment that is mediated by physiological effects on the auditory system; however, NMFS does not consider TTS-onset to be the lowest level at which Level B harassment may occur.

Marine mammals in the Lease Area during the HRG survey are unlikely to incur TTS hearing impairment due to the characteristics of the sound sources, which include low source levels (208 to 221 dB re 1 µPa-m) and generally very short pulses and duration of the sound. Even for high-frequency cetacean species (*e.g*., harbor porpoises), which may have increased sensitivity to TTS (Lucke *et al*., 2009; Kastelein *et al*., 2012b), individuals would have to make a very close approach and also remain very close to vessels operating these sources in order to receive multiple exposures at relatively high levels, as would be necessary to cause TTS. Intermittent exposures—as would occur due to the brief, transient signals produced by these sources—require a higher cumulative SEL to induce TTS than would continuous exposures of the same duration (*i.e*., intermittent exposure results in lower levels of TTS) (Mooney *et al*., 2009a; Finneran *et al*., 2010). Moreover, most marine mammals would more likely avoid a loud sound source rather than swim in such close proximity as to result in TTS. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a sub-bottom profiler emits a pulse is small—because if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause temporary threshold shift and would likely exhibit avoidance behavior to the area near the transducer rather than swim through at such a close range. Further, the restricted beam shape of the sub-bottom profiler and other HRG survey equipment makes it unlikely that an animal would be exposed more than briefly during the passage of the vessel. Boebel *et al*. (2005) concluded similarly for single and multibeam echosounders, and more recently, Lurton (2016) conducted a modeling exercise and concluded similarly that likely potential for acoustic injury from these types of systems is negligible, but that behavioral response cannot be ruled out. Animals may avoid the area around the survey vessels, thereby reducing exposure. Any disturbance to marine

mammals is likely to be in the form of temporary avoidance or alteration of opportunistic foraging behavior near the survey location.

Masking

Masking is the obscuring of sounds of interest to an animal by other sounds, typically at similar frequencies. Marine mammals are highly dependent on sound, and their ability to recognize sound signals amid other sound is important in communication and detection of both predators and prey (Tyack, 2000). Background ambient sound may interfere with or mask the ability of an animal to detect a sound signal even when that signal is above its absolute hearing threshold. Even in the absence of anthropogenic sound, the marine environment is often loud. Natural ambient sound includes contributions from wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal sound resulting from molecular agitation (Richardson *et al*., 1995).

Background sound may also include anthropogenic sound, and masking of natural sounds can result when human activities produce high levels of background sound. Conversely, if the background level of underwater sound is high (*e.g*., on a day with strong wind and high waves), an anthropogenic sound source would not be detectable as far away as would be possible under quieter conditions and would itself be masked. Ambient sound is highly variable on continental shelves (Thompson, 1965; Myrberg, 1978; Desharnais *et al*., 1999). This results in a high degree of variability in the range at which marine mammals can detect anthropogenic sounds.

Although masking is a phenomenon which may occur naturally, the introduction of loud anthropogenic sounds into the marine environment at frequencies important to marine mammals increases the severity and frequency of occurrence of masking. For example, if a baleen whale is exposed to continuous low-frequency sound from an industrial source, this would reduce the size

of the area around that whale within which it can hear the calls of another whale. The components of background noise that are similar in frequency to the signal in question primarily determine the degree of masking of that signal. In general, little is known about the degree to which marine mammals rely upon detection of sounds from conspecifics, predators, prey, or other natural sources. In the absence of specific information about the importance of detecting these natural sounds, it is not possible to predict the impact of masking on marine mammals (Richardson *et al.*, 1995). In general, masking effects are expected to be less severe when sounds are transient than when they are continuous. Masking is typically of greater concern for those marine mammals that utilize low-frequency communications, such as baleen whales, because of how far low-frequency sounds propagate.

Marine mammal communications would not likely be masked appreciably by the sub-profiler or pingers' signals given the directionality of the signal and the brief period when an individual mammal is likely to be within its beam.

Non-auditory Physical Effects (Stress)

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses.

In the case of many stressors, an animal's first and sometimes most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of

continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical "fight or flight" response which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with "stress." These responses have a relatively short duration and may or may not have significant long-term effect on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine systems; the system that has received the most study has been the hypothalamus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine 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 (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al*., 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al*., 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic 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 a risk to the animal's welfare. 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 biotic function, which impairs

those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and its fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called "distress" (Seyle, 1950) or "allostatic loading" (McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al*., 1996; Hood *et al*., 1998; Jessop *et al*., 2003; Krausman *et al*., 2004; Lankford *et al*., 2005; Reneerkens *et al*., 2002; Thompson and Hamer, 2000). Information has also been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds (Fair and Becker, 2000; Romano *et al*., 2002). 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. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality.

Studies of other marine animals and terrestrial animals would also lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological

responses that would be classified as "distress" upon exposure to high frequency, mid-frequency and low-frequency sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (for example, elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al*. (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al*. (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al*. (2004a, 2004b), for example, identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and to communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), we also assume that stress

responses are likely to persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

In general, there are few data on the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007). There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to an anthropogenic sound source. In addition, marine mammals that show behavioral avoidance of survey vessels and related sound sources, are unlikely to incur non-auditory impairment or other physical effects. NMFS does not expect that the generally short-term, intermittent, and transitory HRG surveys would create conditions of long-term, continuous noise and chronic acoustic exposure leading to long-term physiological stress responses in marine mammals.

Behavioral Disturbance

Behavioral responses to sound are highly variable and context-specific. An animal's perception of and response to (in both nature and magnitude) an acoustic event can be influenced by prior experience, perceived proximity, bearing of the sound, familiarity of the sound, etc. (Southall *et al*., 2007; DeRuiter *et al.*, 2013a and 2013b). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, l*et al*one the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding

area for a prolonged period, impacts on individuals and populations could be significant (*e.g.*, Lusseau and Bejder, 2007; Weilgart, 2007).

Southall *et al*. (2007) reports the results of the efforts of a panel of experts in acoustic research from behavioral, physiological, and physical disciplines that convened and reviewed the available literature on marine mammal hearing and physiological and behavioral responses to human-made sound with the goal of proposing exposure criteria for certain effects. This peer-reviewed compilation of literature is very valuable, though Southall *et al*. (2007) note that not all data are equal, some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables – such data were reviewed and sometimes used for qualitative illustration but were not included in the quantitative analysis for the criteria recommendations. All of the studies considered, however, contain an estimate of the received sound level when the animal exhibited the indicated response.

For purposes of analyzing responses of marine mammals to anthropogenic sound and developing criteria, NMFS (2016) differentiates between pulse (impulsive) sounds (single and multiple) and non-pulse sounds. For purposes of evaluating the potential for take of marine mammals resulting from underwater noise due to the conduct of the proposed HRG surveys (operation of USBL positioning system and the sub-bottom profilers), the criteria for Level A harassment (PTS onset) from impulsive noise was used as prescribed in NMFS (2016) and the threshold level for Level B harassment (160 dB_{RMS} re 1 µPa) was used to evaluate takes from behavioral harassment.

Studies that address responses of low-frequency cetaceans to sounds include data gathered in the field and related to several types of sound sources, including: vessel noise, drilling and machinery playback, low-frequency M-sequences (sine wave with multiple phase

reversals) playback, tactical low-frequency active sonar playback, drill ships, and non-pulse playbacks. These studies generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1µPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB range. As mentioned earlier, though, contextual variables play a very important role in the reported responses and the severity of effects do not increase linearly with received levels. Also, few of the laboratory or field datasets had common conditions, behavioral contexts, or sound sources, so it is not surprising that responses differ.

The studies that address responses of mid-frequency cetaceans to sounds include data gathered both in the field and the laboratory and related to several different sound sources, including: pingers, drilling playbacks, ship and ice-breaking noise, vessel noise, Acoustic harassment devices (AHDs), Acoustic Deterrent Devices (ADDs), mid-frequency active sonar, and non-pulse bands and tones. Southall *et al*. (2007) were unable to come to a clear conclusion regarding the results of these studies. In some cases animals in the field showed significant responses to received levels between 90 and 120 dB, while in other cases these responses were not seen in the 120 to 150 dB range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals typically responded at lower levels in the field). The studies that address the responses of mid-frequency cetaceans to impulse sounds include data gathered both in the field and the laboratory and related to several different sound sources, including: small explosives, airgun arrays, pulse sequences, and natural and artificial pulses. The data show no clear indication of increasing probability and severity of response with increasing received level. Behavioral responses seem to vary depending on species and stimuli.

The studies that address responses of high-frequency cetaceans to sounds include data gathered both in the field and the laboratory and related to several different sound sources, including: pingers, AHDs, and various laboratory non-pulse sounds. All of these data were collected from harbor porpoises. Southall *et al.* (2007) concluded that the existing data indicate that harbor porpoises are likely sensitive to a wide range of anthropogenic sounds at low received levels (around 90 to 120 dB), at least for initial exposures. All recorded exposures above 140 dB induced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.*, 2007). Rapid habituation was noted in some but not all studies.

The studies that address the responses of pinnipeds in water to sounds include data gathered both in the field and the laboratory and related to several different sound sources, including: AHDs, various non-pulse sounds used in underwater data communication, underwater drilling, and construction noise. Few studies exist with enough information to include them in the analysis. The limited data suggest that exposures to non-pulse sounds between 90 and 140 dB generally do not result in strong behavioral responses of pinnipeds in water, but no data exist at higher received levels (Southall *et al.*, 2007). The studies that address the responses of pinnipeds in water to impulse sounds include data gathered in the field and related to several different sources, including: small explosives, impact pile driving, and airgun arrays. Quantitative data on reactions of pinnipeds to impulse sounds is limited, but a general finding is that exposures in the 150 to 180 dB range generally have limited potential to induce avoidance behavior (Southall *et al.*, 2007).

Marine mammals are likely to avoid the HRG survey activity, especially harbor porpoises, while the harbor seals might be attracted to them out of curiosity. However, because the sub-bottom profilers and other HRG survey equipment operate from a moving vessel, and the

field-verified distance to the 160 dB_{RMS} re 1µPa isopleth (Level B harassment criteria) is 247 ft (75.28 m), the area and time that this equipment would be affecting a given location is very small. Further, once an area has been surveyed, it is not likely that it will be surveyed again, therefore reducing the likelihood of repeated HRG-related impacts within the survey area.

We have also considered the potential for severe behavioral responses such as stranding and associated indirect injury or mortality from Bay State Wind's use of HRG survey equipment, on the basis of a 2008 mass stranding of approximately one hundred melon-headed whales in a Madagascar lagoon system. An investigation of the event indicated that use of a high-frequency mapping system (12-kHz multibeam echosounder) was the most plausible and likely initial behavioral trigger of the event, while providing the caveat that there is no unequivocal and easily identifiable single cause (Southall *et al*., 2013). The investigatory panel's conclusion was based on (1) very close temporal and spatial association and directed movement of the survey with the stranding event; (2) the unusual nature of such an event coupled with previously documented apparent behavioral sensitivity of the species to other sound types (Southall *et al*., 2006; Brownell *et al*., 2009); and (3) the fact that all other possible factors considered were determined to be unlikely causes. Specifically, regarding survey patterns prior to the event and in relation to bathymetry, the vessel transited in a north-south direction on the shelf break parallel to the shore, ensonifying large areas of deep-water habitat prior to operating intermittently in a concentrated area offshore from the stranding site; this may have trapped the animals between the sound source and the shore, thus driving them towards the lagoon system. The investigatory panel systematically excluded or deemed highly unlikely nearly all potential reasons for these animals leaving their typical pelagic habitat for an area extremely atypical for the species (*i.e*., a shallow lagoon system). Notably, this was the first time that such a system has been associated with a

stranding event. The panel also noted several site- and situation-specific secondary factors that may have contributed to the avoidance responses that led to the eventual entrapment and mortality of the whales. Specifically, shoreward-directed surface currents and elevated chlorophyll levels in the area preceding the event may have played a role (Southall *et al*., 2013).

The report also notes that prior use of a similar system in the general area may have sensitized the animals and also concluded that, for odontocete cetaceans that hear well in higher frequency ranges where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts. It is, however, important to note that the relatively lower output frequency, higher output power, and complex nature of the system implicated in this event, in context of the other factors noted here, likely produced a fairly unusual set of circumstances that indicate that such events would likely remain rare and are not necessarily relevant to use of lower-power, higher-frequency systems more commonly used for HRG survey applications. The risk of similar events recurring may be very low, given the extensive use of active acoustic systems used for scientific and navigational purposes worldwide on a daily basis and the lack of direct evidence of such responses previously reported.

Tolerance

Numerous studies have shown that underwater sounds from industrial activities are often readily detectable by marine mammals in the water at distances of many kms. However, other studies have shown that marine mammals at distances more than a few kilometers away often show no apparent response to industrial activities of various types (Miller *et al*., 2005). This is often true even in cases when the sounds must be readily audible to the animals based on

measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound from sources such as airgun pulses or vessels under some conditions, at other times, mammals of all three types have shown no overt reactions (*e.g.*, Malme *et al*., 1986; Richardson *et al.*, 1995; Madsen and Mohl, 2000; Croll *et al*., 2001; Jacobs and Terhune, 2002; Madsen *et al*., 2002; Miller *et al*., 2005). In general, pinnipeds seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al*. (1995) found that vessel sound does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al*. (1995) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels, and Brueggeman *et al*. (1992) observed ringed seals (*Pusa hispida*) hauled out on ice pans displaying short-term escape reactions when a ship approached within 0.16-0.31 mi (0.25-0.5 km). Due to the relatively high vessel traffic in the Lease Area it is possible that marine mammals are habituated to noise from project vessels in the area.

Vessel Strike

Ship strikes of marine mammals can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel's propeller could injure an animal just below the surface. 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).

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, such as the North Atlantic right whale, 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. Smaller marine mammals (*e.g*., bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. 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 results in death (Knowlton and Kraus, 2001; Laist *et al*., 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records with known vessel speeds, 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 24.1 km/h (14.9 mph; 13 knots). Given the slow vessel speeds and predictable course necessary for data acquisition, ship strike is unlikely to occur during the geophysical and geotechnical surveys. Marine mammals would be able to easily avoid vessels and are likely already habituated to the presence of numerous vessels in the area. Further, Bay State Wind shall implement measures (*e.g*., vessel speed restrictions and separation distances; see *Proposed Mitigation Measures*) set forth in the BOEM Lease to reduce the risk of a vessel strike to marine mammal species in the Lease Area.

Effects on Marine Mammal Habitat

There are no feeding areas, rookeries, or mating grounds known to be biologically important to marine mammals within the proposed project area. There is also no designated critical habitat for any ESA-listed marine mammals. NMFS' regulations at 50 CFR part 224 designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal

Management Area (SMA) for right whales in 2008. Mandatory vessel speed restrictions are in place in that SMA from November 1 through April 30 to reduce the threat of collisions between ships and right whales around their migratory route and calving grounds.

Because of the temporary nature of the disturbance, the availability of similar habitat and resources (*e.g.*, prey species) in the surrounding area, and the lack of important or unique marine mammal habitat, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, 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, 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 use of the HRG equipment (*i.e.*, USBL&GAPS systems, sub-bottom profilers, sparkers, and boomers) has the potential to result in disruption of behavioral patterns for individual marine mammals. However, there is also some potential for auditory injury (Level A harassment) to result, primarily for high

frequency species (*i.e.*, harbor porpoise) due to larger predicted auditory injury zones. Auditory injury is unlikely to occur for low or mid-frequency cetaceans or pinnipeds. The proposed mitigation and monitoring measures are expected to avoid, or minimize the severity of such taking, to the extent practicable.

Project activities that have the potential to harass marine mammals, as defined by the MMPA, include underwater noise from operation of the HRG survey sub-bottom profilers, boomers, sparkers, and equipment positioning systems. Harassment could take the form of temporary threshold shift, avoidance, or other changes in marine mammal behavior. NMFS anticipates that impacts to marine mammals would be mainly in the form of behavioral harassment (Level B harassment), but we have evaluated a small number of PTS takes (Level A harassment) for high frequency species (harbor porpoise) to be precautionary. No take by serious injury, or mortality is proposed. NMFS does not anticipate take resulting from the movement of vessels associated with construction because there will be a limited number of vessels moving at slow speeds and the BOEM lease agreement requires measures to ensure vessel strike avoidance.

Described in the most basic way, we estimate take by estimating: 1) acoustic thresholds above which NMFS believes the best available science 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. Below we describe these components in more detail and present the proposed take estimate.

Acoustic Thresholds

Using the best available science, NMFS has developed 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).

Level B Harassment for non-explosive sources – 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 (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.*, 2011). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (*e.g.* vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, seismic airguns) or intermittent (*e.g.*, scientific sonar) sources. Bay State Wind's proposed activity includes the use of intermittent impulsive (HRG Equipment) sources, and therefore the 160 dB re 1 μPa (rms) threshold is applicable.

Level A harassment for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Technical Guidance, 2016) 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).

These thresholds are provided in Table 4 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: *http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm*.

Table 4. Thresholds identifying the onset of Permanent Threshold Shift.

	PTS Onset Acoustic Thresholds* (Received Level)	
Hearing Group	**Impulsive**	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB

* Dual metric acoustic 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 should also be considered.

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 1μPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI 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 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 and OW 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.

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds.

When NMFS' Acoustic Technical Guidance (2016) was published, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component of the new thresholds, NMFS developed an optional User Spreadsheet that includes tools to help predict takes. We note that because of some of the assumptions included in the methods used for these tools, we anticipate that isopleths produced are typically going to be overestimates of some degree, which will result in some degree of overestimate of Level A take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For mobile sources such as the HRG survey equipment proposed for use in Bay State Wind's activity, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed. Inputs used in the User Spreadsheet, and the resulting isopleths for the various HRG equipment types are reported in Appendix A of Bay State Wind's IHA application, and distances to the acoustic exposure criteria discussed above are shown in Tables 5 and 6.

Table 5. Distances to Thresholds for Level A Harassment (PTS Onset).

Generalized Hearing Group	Marine Mammal Level A Harassment (PTS Onset)	Distance (m)
USBL/GAPS Positioning Systems[1]		
LF cetaceans	219 dB_{peak}/ 183 dB SEL_{cum}	--- ---
MF cetaceans	230 dB_{peak}/ 185 dB SEL_{cum}	--- ---
HF cetaceans	202 dB_{peak}/ 155 dB SEL_{cum}	--- ---
Phocid pinnipeds	218 dB_{peak}/ 185 dB SEL_{cum}	--- ---
Sub-bottom Profiler[1]		

LF cetaceans	219 dB_{peak}/ 183 dB SEL_{cum}	--- ---
MF cetaceans	230 dB_{peak}/ 185 dB SEL_{cum}	--- ---
HF cetaceans	202 dB_{peak}/ 155 dB SEL_{cum}	--- < 6
Phocid pinnipeds	218 dB_{peak}/ 185 dB SEL_{cum}	--- ---
Innomar SES-2000 Medium Sub-Bottom Profiler		
LF cetaceans	219 dB_{peak}/ 183 dB SEL_{cum}	< 1 N/A
MF cetaceans	230 dB_{peak}/ 185 dB SEL_{cum}	< 1 ---
HF cetaceans	202 dB_{peak}/ 155 dB SEL_{cum}	< 5 <75
Phocid pinnipeds	218 dB_{peak}/ 185 dB SEL_{cum}	< 1 N/A
Sparker[1]		
LF cetaceans	219 dB_{peak}/ 183 dB SEL_{cum}	--- ---
MF cetaceans	230 dB_{peak}/ 185 dB SEL_{cum}	--- ---
HF cetaceans	202 dB_{peak}/ 155 dB SEL_{cum}	< 3 ---
Phocid pinnipeds	218 dB_{peak}/ 185 dB SEL_{cum}	--- ---
Boomer		
LF cetaceans	219 dB_{peak}/ 183 dB SEL_{cum}	< 2 <15
MF cetaceans	230 dB_{peak}/ 185 dB SEL_{cum}	--- ---
HF cetaceans	202 dB_{peak}/ 155 dB SEL_{cum}	< 10 <1
Phocid pinnipeds	218 dB_{peak}/ 185 dB SEL_{cum}	< 2 <1

Notes:
Peak SPL criterion is unweighted, whereas the cumulative SEL criterion is M-weighted for the given marine mammal hearing group;
Calculated sound levels and results are based on NMFS Acoustic Technical Guidance companion User Spreadsheet except as indicated (refer to Appendix A of the IHA application, which includes all spreadsheets);
[1] Indicates distances for this equipment type have been field verified;
--- Indicates not expected

Table 6. Distances to Level B Harassment Thresholds (160 $dB_{RMS\ 90\%}$).

Survey Equipment	Marine Mammal Level B Harassment 160 dB_{RMS} re 1 µPa (m)
USBL & GAPS Positioning Systems	
Sonardyne Ranger 2 USBL HPT 5/7000	6
Sonardyne Ranger 2 USBL HPT 3000	1
Easytrak Nexus 2 USBL	2

IxSea GAPS System	1
Sidescan Sonar	
EdgeTech 4200 dual frequency Side Scan Sonar	N/A
Multibeam Sonar	
R2 Sonic 2024 Multibeam Echosounder	N/A
Kongsberg EM2040C Dual Band Head	N/A
Shallow Sub-Bottom Profilers	
Edgetech 3200 XS 216	9
Innomar SES-2000 Sub Bottom Profiler	135[1]
Sparkers	
GeoMarine Geo-Source 400tip	54
Boomers	
Applied Acoustics S-Boom Triple Plate Boomer	400[1]
Notes: [1] The calculated sound levels and results are based on NMFS Acoustic Technical Guidance (NMFS 2016) except as indicated The Level B criterion is unweighted. N/A indicates the operating frequencies are above all relevant marine mammal hearing thresholds and these systems were not directly assessed in this IHA.	

Bay State Wind completed an underwater noise monitoring program for field verification at the project site prior to commencement of the HRG survey that took place in 2016. One of the main objectives of this program was to determine the apparent sound source levels of HRG activities. Results from field verification studies during previously authorized activities were used where applicable and manufacturer source levels were adjusted to reflect the field verified levels. However, not all equipment proposed for use in the 2018 season was used in the 2016 activities. As no field data currently exists for the Innomar sub-bottom profiler or Applied Acoustics boomer, acoustic modeling was completed using a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM) and BELLHOP Gaussian beam ray-trace propagation model (Porter and Liu 1994). Calculations of the ensonified area are conservative due to the directionality of the sound sources. For the various HRG transducers Bay State Wind proposes to use for these activities, the beamwidth varies from 200° (almost omnidirectional) to

1 ^{o}. The modeled directional sound levels were then used as the input for the acoustic propagation models, which do not take the directionality of the source into account. Therefore, the volume of area affected would be much lower than modeled in cases with narrow beamwidths such as the Innomar SES-2000 sub-bottom profiler, which has a 1 ^{o} beamwidth.

Marine Mammal Occurrence

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

The data used as the basis for estimating species density ("D") for the Lease Area are derived from data provided by Duke University's Marine Geospatial Ecology Lab and the Marine Life Data and Analysis Team. This data set is a compilation of the best available marine mammal data (1994-2014) and was prepared in a collaboration between Duke University, Northeast Regional Planning Body, University of Carolina, the Virginia Aquarium and Marine Science Center, and NOAA (Roberts *et al.*, 2016; MDAT 2016).

Northeast Navy Operations Area (OPAREA) Density Estimates (DoN, 2007) were used in support for estimating take for seals, which represents the only available comprehensive data for seal abundance. NODEs utilized vessel-based and aerial survey data collected by NMFS from 1998-2005 during broad-scale abundance studies. Modeling methodology is detailed in DoN (2007). Therefore, for the purposes of the take calculations, NODEs Density Estimates (DoN, 2007) as reported for the summer and fall seasons were used to estimate harbor seal and gray seal densities.

Take Calculation and Estimation

Here we describe how the information provided above is brought together to produce a quantitative take estimate. In order to estimate the number of marine mammals predicted to be

exposed to sound levels that would result in harassment, radial distances to predicted isopleths corresponding to harassment thresholds are calculated, as described above. Those distances are then used to calculate the area(s) around the HRG survey equipment predicted to be ensonified to sound levels that exceed harassment thresholds. The area estimated to be ensonified to relevant thresholds in a single day of the survey is then calculated, based on areas predicted to be ensonified around the HRG survey equipment and the estimated trackline distance traveled per day by the survey vessel.

The estimated distance of the daily vessel trackline was determined using the estimated average speed of the vessel and the 24-hour or daylight-only operational period within each of the corresponding survey segments. All noise producing survey equipment are assumed to be operating concurrently. Using the distance of 400 m (1,312 ft) to the Level B isopleth and 75 m (246.1 ft) for the Level A isopleth (for harbor porpoise), and the estimated daily vessel track of approximately 177.8 km (110.5 miles) for 24-hour operations and 43 km (26.7 miles) for daylight-only operations, areas of ensonification (zone of influence, or ZOI) were calculated and used as a basis for calculating takes of marine mammals. The ZOI is based on the worst case (since it assumes the equipment with the larger ZOI will be operating all the time), and are presented in Table 7. Take calculations were based on the highest seasonal species density as derived from Duke University density data (Roberts *et al.*, 2016) for cetaceans and seasonal OPAREA density estimates (DoN, 2007) for pinnipeds. The resulting take calculations and number of requested takes (rounded to the nearest whole number) are presented in Table 8.

Table 7. Survey Segment Distances and Zones of Influence.

Survey Segment	Total Track Line (km)	# Active Survey Days	Estimated Distance/ Day (km)	Calculated Level A ZOI (km^2) – (harbor porpoise)	Calculated Level B ZOI (km^2)
Lot 3 (WSG/OSS	2,845	60	177.8	26.69	142.74

Location-Offshore)					
Export Cable Route, Somerset					
Lot 1 (nearshore)	1,091	18	177.8	6.46	34.88
Lot 2 (offshore)	563	15	43.0	26.69	142.74
Export Cable Route, Falmouth					
Lot 4 (offshore)	2,253	37	177.8	26.69	142.74
Lot 5 (nearshore)	108	5	43.0	6.46	34.88

Table 8. Estimated Level B harassment takes for HRG survey activities.

Species	Lot 3 (WSG/OSS Location-Offshore)		Lot 2 (Somerset Export-Offshore)		Lot 1 (Somerset Export - Nearshore)		Lot 4 (Falmouth Export-Offshore)		Lot 5 (Falmouth Export - Nearshore)		Totals	
	Highest Seasonal Avg. Density[a] (#/100 km^2)	Calc. take	Highest Seasonal Avg. Density[a] (#/100 km^2)	Calc. take	Highest Seasonal Avg. Density[a] (#/100 km^2)	Calc. take	Highest Seasonal Avg. Density[a] (#/100 km^2)	Calc. take	Highest Seasonal Avg. Density[a] (#/100 km^2)	Calc. take	Requested take	% of population
Level A												
Harbor porpoise	6.67	106.75	4.89	19.56			1.1	10.95			137	0.17
Level B												
North Atlantic right whale	0.96	82.22 (0.00)	1.25	26.76 (0.00)	-	-	0.79	41.72 (0.00)	-	-	0.00[b]	0.00
Humpback whale	0.15	12.44	0.12	2.46	-	-	0.04	2.30	-	-	18	2.18
Fin whale	0.27	23.24	0.19	4.15	-	-	0.07	3.64	-	-	32	1.98
Sperm whale	0.01	0.71	0.01	0.15	-	-	0.00	0.22	-	-	5[c]	0.22
Minke whale	0.08	7.00	0.05	1.14	-	-	0.03	1.82	-	-	20[d]	0.77
Bottlenose dolphin	1.72	147.34	0.46	9.85	-	-	9.00	475.06	-	-	1,000[c]	8.66
Short-beaked common dolphin	6.26	535.71	2.74	58.67	-	-	0.46	24.34	-	-	2,000[d]	2.85
Atlantic white-sided dolphin	1.90	162.75	1.07	22.98	-	-	0.21	10.85	-	-	500[c]	1.02
Harbor porpoise	6.67	570.94	4.89	104.61	-	-	1.11	58.57	-	-	755	0.95
Harbor seal[e]	9.74	834.41	9.74	208.60	9.74	61.15	9.74	514.55	9.74	16.99	1,654	2.18

Gray seal[e]	14.12	1,209.26	14.12	302.32	14.12	88.65	14.12	745.71	14.12	24.62	2,397	0.56

Notes:
[a] Density values from Duke University (Roberts *et al.*, 2016) except for pinnipeds
[b] Exclusion zone exceeds Level B isopleth; take adjusted to 0 given mitigation to prevent take
[c] Value increased to reflect typical group size
[d] Adjusted to account for actual take sighting data in the Survey Area to date (Smultea Environmental Sciences, 2016; Gardline, 2016)
[e] Density from NODEs (DoN, 2007)

As noted in Table 8, requested take estimates were adjusted to account for typical group size for sperm whales, bottlenose dolphins, and Atlantic white-sided dolphins. Requested take numbers were also adjusted to account for recent sightings data (Smultea Environmental Sciences, 2016; Gardline, 2016) for minke whales and short-beaked common dolphins. In addition, requested Level A take numbers for harbor porpoise were adjusted to account for the fact that a Level A shutdown zone encompassing the Level A harassment zone will be implemented to avoid Level A takes of this species. Finally, requested take numbers were adjusted for north Atlantic right whales due to the implementation of a 500 m shutdown zone, which is greater than the 400 m Level B behavioral harassment zone, to avoid Level B takes of this species.

Bay State Wind's calculations do not take into account whether a single animal is harassed multiple times or whether each exposure is a different animal. Therefore, the numbers in Tables 6 are the maximum number of animals that may be harassed during the HRG surveys (*i.e.*, Bay State Wind assumes that each exposure event is a different animal). With exception of north Atlantic right whales and Level A takes of harbor porpoises, these estimates do not account for prescribed mitigation measures that Bay State Wind would implement during the specified activities and the fact that other mitigation measures may be imposed as part of other agreements that Bay State Wind must adhere to, such as their lease agreement with BOEM.

NMFS proposes to authorize a small number of Level A takes of harbor porpoises even though NMFS has also proposed a 75 m shut down zone to avoid Level A take of this species.

This is warranted due to the small size of the species in combination with some higher sea states and weather conditions that could make harbor porpoises more cryptic and difficult to observe at the 75 m shut down zone. For reasons discussed above (short pulse duration and highly directional sound pulse transmission of these mobile sources), PTS (Level A take) is unlikely to occur even if harbor porpoises were within the 75 m isopleth. However, out of an abundance of caution, NMFS proposes to authorize Level A take of harbor porpoises.

No take of north Atlantic right whale is requested, nor is any take proposed for authorization. The modeled Level B behavioral harassment (400 m) is well within the 500 m mitigation shut down for this species and, based on the described monitoring measures, information from previous monitoring reports, and in consideration of the size of this species, it is reasonable to expect that north Atlantic right whales will be able to be observed such that shut down would occur well beyond the threshold for potential behavioral harassment.

Finally, as stated above, calculation of the ensonified area does not take directionality of the sound source into account and results in a conservative estimate for the ZOI. The equipment with the largest radial distance to Level A (for harbor porpoise) and Level B harassment thresholds was used to calculate the ZOI under the assumption that this equipment would be in use for the entirety of the survey activities. The Innomar SES-2000 sub-bottom profiler resulted in the largest isopleth for Level A harassment for HF cetaceans (harbor porpoise), so the ZOI was calculated based on this 75 m isopleth. However, as also described above, this equipment has a 1^{o} beamwidth, so the actual ensonified volume would be much less than the calculated area. Similarly, the Applied Acoustics S-Boom triple plate boomer resulted in the largest isopleth for Level B harassment, so the ZOI was calculated using this 400 m isopleth and, as described above, this equipment has a beamwidth of $25^{o} – 35^{o}$ and is also not omnidirectional so

the actual ensonified volume would be less than the calculated area. Therefore, the resulting number of calculated marine mammal incidental takes are very conservative due to the assumption that the equipment with the largest isopleths are in use for the duration of activities and the calculated ZOIs do not take directionality of these sound sources into account. Further, the calculated takes are conservative because these HRG sound sources have very short pulse durations that are also not taken into account in calculations of take, but would lessen the potential for marine mammals to be exposed to the sound source for long enough periods to result in the potential for take as described above.

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such 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 such 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) and 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.

With NMFS' input during the application process, Bay State Wind is proposing the following mitigation measures during site characterization surveys utilizing HRG survey equipment. The mitigation measures outlined in this section are based on protocols and procedures that have been successfully implemented and resulted in no observed take of marine mammals for similar offshore projects and previously approved by NMFS (DONG Energy, 2016, ESS, 2013; Dominion, 2013 and 2014), as well as results of sound source verification (SSV) studies implemented by Bay State Wind during past activities in the proposed project area.

Marine Mammal Exclusion and Monitoring Zones

Protected species observers (PSOs) will monitor the following exclusion/monitoring zones for the presence of marine mammals:

- A 1,640 ft (500-m) exclusion zone for North Atlantic right whales, which encompasses the largest Level B harassment isopleth of 400 m for the Applied Acoustics S-Boom Triple Plate Boomer;

- A 328 ft (100-m) exclusion zone for non-delphinoid large cetacean and ESA-listed marine mammals, which is consistent with vessel strike avoidance measures stipulated in the BOEM lease;
- A 1,312 ft (400-m) Level B monitoring zone for all marine mammals except for North Atlantic right whales, which is the extent of the largest Level B harassment isopleth for the Applied Acoustics S-Boom Triple Plate Boomer; and
- A 246 ft (75-m) exclusion zone for harbor porpoise, which is the extent of the largest Level A harassment isopleth for the Innomar SES-2000 medium sub-bottom profiler.

The distances from the sound sources for these exclusion/monitoring zones are based on distances to NMFS harassment criteria or requirements of the BOEM lease stipulations for vessel strike avoidance (discussed below). The representative area ensonified to the MMPA Level B threshold for each of the pieces of HRG survey equipment represents the zone within which take of a marine mammal could occur. The distances to the Level A and Level B harassment criteria were used to support the estimate of take as well as the development of the monitoring and/or mitigation measures. Radial distance to NMFS' Level A and Level B harassment thresholds are summarized in Tables 5 and 6 above.

Visual monitoring of the established exclusion zone(s) for the HRG surveys will be performed by qualified and NMFS-approved PSOs, the resumes of whom will be provided to NMFS for review and approval prior to the start of survey activities. Observer qualifications will include direct field experience on a marine mammal observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. An observer team comprising a minimum of four NMFS-approved PSOs and two certified Passive Acoustic Monitoring (PAM) operators (PAM operators will not function as PSOs), operating in shifts, will be stationed aboard either the survey vessel

or a dedicated PSO-vessel. PSOs and PAM operators will work in shifts such that no one monitor will work more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period. During daylight hours the PSOs will rotate in shifts of 1 on and 3 off, while during nighttime operations PSOs will work in pairs. The PAM operators will also be on call as necessary during daytime operations should visual observations become impaired. Each PSO will monitor 360 degrees of the field of vision.

PSOs will be responsible for visually monitoring and identifying marine mammals approaching or within the established exclusion zone(s) during survey activities. It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and ensure the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate. PAM operators will communicate detected vocalizations to the Lead PSO on duty, who will then be responsible for implementing the necessary mitigation procedures. A mitigation and monitoring communications flow diagram has been included as Appendix A in the IHA application.

PSOs will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to the vessel and/or exclusion zone using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the sighting and monitoring of marine species. Digital single-lens reflex camera equipment will be used to record sightings and verify species identification. During night operations, PAM (see *Passive Acoustic Monitoring* requirements below) and night-vision equipment in combination with infrared video monitoring will be used (Additional details and specifications of the night-vision devices and infrared video monitoring technology will be provided under separate cover by the Bay State Wind Survey Contractor once selected.).

Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.

For monitoring around the ASV, a dual thermal/HD camera will be installed on the mother vessel, facing forward, angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. The ASV will be kept in sight of the mother vessel at all times (within 2,625 ft (800 m)). PSOs will be able to monitor the real time output of the camera on hand-held iPads. Images from the cameras can be captured for review and to assist in verifying species identification. A monitor will also be installed on the bridge displaying the real-time picture from the thermal/HD camera installed on the front of the ASV itself, providing a further forward field of view of the craft. In addition, night-vision goggles with thermal clip-ons, as mentioned above, and a hand-held spotlight will be provided such that PSOs can focus observations in any direction, around the mother vessel and/or the ASV. PSOs will also be able to monitor the data as it is acquired by the ASV utilizing a real time IP radio link. For each 12 hour shift, an ASV technician will be assigned to manage the vessel and monitor the array of cameras, radars, and thermal equipment during their shift to ensure the vehicle is operating properly and to take over control of the vessel should the need arise. Additionally, there will be 2 survey technicians per shift assigned to acquire the ASV survey data.

The PSOs will begin observation of the exclusion zone(s) at least 60 minutes prior to ramp-up of HRG survey equipment. Use of noise-producing equipment will not begin until the exclusion zone is clear of all marine mammals for at least 60 minutes, as per the requirements of the BOEM Lease.

If a marine mammal is detected approaching or entering the exclusion zones during the HRG survey, the vessel operator would adhere to the shutdown procedures described below to minimize noise impacts on the animals.

At all times, the vessel operator will maintain a separation distance of 500 m from any sighted North Atlantic right whale as stipulated in the *Vessel Strike Avoidance* procedures described below. These stated requirements will be included in the site-specific training to be provided to the survey team.

Vessel Strike Avoidance

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds and slow down or stop their vessels to avoid striking these species. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal and sea turtle sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include the following, except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk:

- All vessel operators will comply with 10 knot (<18.5 km per hour (km/h)) speed restrictions in any Dynamic Management Area (DMA). In addition, all vessels operating from November 1 through July 31 will operate at speeds of 10 knots (<18.5 km/h) or less;
- All vessel operators will reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or larger assemblages of non-delphinoid cetaceans are observed near an underway vessel;
- All survey vessels will maintain a separation distance of 1,640 ft (500 m) or greater from any sighted North Atlantic right whale;

- If underway, vessels must steer a course away from any sighted North Atlantic right whale at 10 knots (<18.5 km/h) or less until the 1,640 ft (500 m) minimum separation distance has been established. If a North Atlantic right whale is sighted in a vessel's path, or within 330 ft (100 m) to an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 330 ft (100 m). If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 330 ft (100 m);
- All vessels will maintain a separation distance of 330 ft (100 m) or greater from any sighted non-delphinoid (*i.e.*, mysticetes and sperm whales) cetaceans. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved outside of the vessel's path and beyond 330 ft (100 m). If a survey vessel is stationary, the vessel will not engage engines until the non-delphinoid cetacean has moved out of the vessel's path and beyond 330 ft (100 m);
- All underway vessels will avoid excessive speed or abrupt changes in direction to avoid injury to any sighted delphinoid cetacean or pinniped; and
- All vessels will maintain a separation distance of 164 ft (50 m) or greater from any sighted pinniped.

The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.

Seasonal Operating Requirements

Between watch shifts, members of the monitoring team will consult the NMFS North Atlantic right whale reporting systems for the presence of North Atlantic right whales throughout survey operations. However, the proposed survey activities will occur outside of the seasonal management area (SMA) located off the coast of Massachusetts and Rhode Island. The proposed survey activities will occur in June through September, which is outside of the seasonal mandatory speed restriction period for this SMA (November 1 through April 30).

Throughout all survey operations, the Applicant will monitor the NMFS North Atlantic right whale reporting systems for the establishment of a DMA. If NMFS should establish a DMA in the Lease Area under survey, within 24 hours of the establishment of the DMA the Applicant will work with NMFS to shut down and/or alter the survey activities to avoid the DMA.

Passive Acoustic Monitoring

As per the BOEM Lease, alternative monitoring technologies (*e.g.*, active or passive acoustic monitoring) are required if a Lessee intends to conduct geophysical surveys at night or when visual observation is otherwise impaired. To support 24-hour HRG survey operations, Bay State Wind will use certified PAM operators with experience reviewing and identifying recorded marine mammal vocalizations, as part of the project monitoring during nighttime operations to provide for optimal acquisition of species detections at night, or as needed during periods when visual observations may be impaired. In addition, PAM systems shall be employed during daylight hours to support system calibration and PSO and PAM team coordination, as well as in support of efforts to evaluate the effectiveness of the various mitigation techniques (*i.e.*, visual observations during day and night, compared to the PAM detections/operations).

Given the range of species that could occur in the Lease Area, the PAM system will consist of an array of hydrophones with both broadband (sampling mid-range frequencies of 2 kHz to 200 kHz) and at least one low-frequency hydrophone (sampling range frequencies of 10 Hz to 30 kHz). Monitoring of the PAM system will be conducted from a customized processing station aboard the HRG survey vessel. The on-board processing station provides the interface between the PAM system and the operator. The PAM operator(s) will monitor the hydrophone signals in real time both aurally (using headphones) and visually (via the monitor screen displays). Bay State Wind proposes the use of PAMGuard software for 'target motion analysis' to support localization in relation to the identified exclusion zone. PAMGuard is an open source software/hardware interface to enable flexibility in the configuration of in-sea equipment (number of hydrophones, sensitivities, spacing, and geometry). PAM operators will immediately communicate detections/vocalizations to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measure (*e.g.*, shutdown) even if visual observations by PSOs have not been made.

Ramp-Up

As per the BOEM Lease, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or re-start of HRG survey activities. A ramp-up procedure will be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the Lease Area by allowing them to vacate the area prior to the commencement of survey equipment use. The ramp-up procedure will not be initiated during daytime, night time, or periods of inclement weather if the exclusion zone cannot be adequately monitored by the PSOs using the appropriate visual technology (*e.g.*, reticulated binoculars, night vision equipment) and/or PAM for a 60-minute period. A ramp-up would begin with the

power of the smallest acoustic HRG equipment at its lowest practical power output appropriate for the survey. The power would then be gradually turned up and other acoustic sources added such that the source level would increase in steps not exceeding 6 dB per 5-minute period. If marine mammals are detected within the HRG survey exclusion zone prior to or during the ramp-up, activities will be delayed until the animal(s) has moved outside the monitoring zone and no marine mammals are detected for a period of 60 minutes.

Shutdown Procedures

The exclusion zone(s) around the noise-producing activities HRG survey equipment will be monitored, as previously described, by PSOs and at night by PAM operators for the presence of marine mammals before, during, and after any noise-producing activity. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown.

As per the BOEM Lease, if a non-delphinoid (*i.e.*, mysticetes and sperm whales) cetacean is detected at or within the established Level A exclusion zone, an immediate shutdown of the HRG survey equipment is required. Subsequent restart of the electromechanical survey equipment must use the ramp-up procedures described above and may only occur following clearance of the exclusion zone for 60 minutes. Subsequent power up of the survey equipment must use the ramp-up procedures described above and may occur after (1) the exclusion zone is clear of a delphinoid cetacean and/or pinniped for 60 minutes.

If the HRG sound source (including the sub-bottom profiler) shuts down for reasons other than encroachment into the exclusion zone by a marine mammal including but not limited to a mechanical or electronic failure, resulting in in the cessation of sound source for a period greater than 20 minutes, a restart for the HRG survey equipment (including the sub-bottom profiler) is

required using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and pinnipeds for 60 minutes. If the pause is less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the exclusion zone remained clear of cetaceans and pinnipeds. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart of the HRG survey equipment (including the sub-bottom profiler) is required using the full ramp-up procedures and clearance of the exclusion zone for all cetaceans and pinnipeds for 60 minutes.

The proposed mitigation measures are designed to avoid the already low potential for injury (Level A harassment) in addition to some Level B harassment, and to minimize the potential for vessel strikes. There are no known marine mammal rookeries or mating grounds in the survey area that would otherwise potentially warrant increased mitigation measures for marine mammals or their habitat (or both). The proposed survey would occur in an area that has been identified as a biologically important area (BIA) for migration for North Atlantic right whales. However, given the small spatial extent of the survey area relative to the substantially larger spatial extent of the right whale migratory area, the survey is not expected to appreciably reduce migratory habitat nor to negatively impact the migration of North Atlantic right whales. In addition, the timing of importance for migration in this biologically important area BIA is March-April and November-December, and Bay State Wind's proposed activities are anticipated to occur outside of the timing of importance. Thus, mitigation to address the proposed survey's occurrence in North Atlantic right whale migratory habitat is not warranted. The proposed survey area would partially overlap spatially with a biologically important feeding area for fin whales. However, the fin whale feeding area is sufficiently large (2,933 km^2), and the acoustic footprint

of the proposed survey is sufficiently small that the survey is not expected to appreciably reduce fin whale feeding habitat nor to negatively impact the feeding of fin whales, thus mitigation to address the proposed survey's occurrence in fin whale feeding habitat is not warranted. Further, we believe the proposed mitigation measures are practicable for the applicant to implement

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 provide the means of effecting the least practicable impact on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) 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 ITAs 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.

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
- Mitigation and monitoring effectiveness.

Proposed Monitoring Measures

Bay State Wind submitted a marine mammal monitoring and reporting plan as part of the IHA application. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period.

Visual Monitoring - Visual monitoring of the established Level B harassment zones will be performed by qualified and NMFS-approved PSOs (see discussion of PSO qualifications and requirements in *Marine Mammal Exclusion Zones* above).

The PSOs will begin observation of the monitoring zone during all HRG survey activities and all geotechnical operations where DP thrusters are employed. Observations of the monitoring zone will continue throughout the survey activity. PSOs will be responsible for visually monitoring and identifying marine mammals approaching or entering the established monitoring zone during survey activities.

Observations will take place from the highest available vantage point on the survey vessel. General 360-degree scanning will occur during the monitoring periods, and target scanning by the PSO will occur when alerted of a marine mammal presence.

Data on all PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of construction operations; time of observation, location and weather; details of the sightings (*e.g.*, species, age classification [if known], numbers, behavior); and details of any observed "taking" (behavioral disturbances or injury/mortality). The data sheet will be provided to both NMFS and BOEM for review and approval prior to the start of survey activities. In addition, prior to initiation of survey work, all crew members will undergo environmental training, a component of which will focus on the procedures for sighting and protection of marine mammals. A briefing will also be conducted between the survey supervisors and crews, the PSOs, and the Applicant. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures.

Proposed Reporting Measures

The Applicant will provide the following reports as necessary during survey activities:

- The Applicant will contact NMFS and BOEM within 24 hours of the commencement of survey activities and again within 24 hours of the completion of the activity.
- As per the BOEM Lease: Any observed significant behavioral reactions (*e.g.*, animals departing the area) or injury or mortality to any marine mammals must be reported to NMFS and BOEM within 24 hours of observation. Dead or injured protected species are reported to the NMFS Greater Atlantic Regional Fisheries Office Stranding Hotline (800-900-

3622) within 24 hours of sighting, regardless of whether the injury is caused by a vessel. In addition, if the injury of death was caused by a collision with a project related vessel, the Applicant must ensure that NMFS and BOEM are notified of the strike within 24 hours. The Applicant must use the form included as Appendix A to Addendum C of the Lease to report the sighting or incident. If The Applicant is responsible for the injury or death, the vessel must assist with any salvage effort as requested by NMFS. Additional reporting requirements for injured or dead animals are described below (*Notification of Injured or Dead Marine Mammals*).

Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified HRG and geotechnical activities lead to an unauthorized injury of a marine mammal (Level A harassment) or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), Bay State Wind would immediately cease the specified activities and report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources and the NOAA Greater Atlantic Regional Fisheries Office (GARFO) Stranding Coordinator. The report would include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);

- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the event. NMFS would work with Bay State Wind to minimize reoccurrence of such an event in the future. Bay State Wind would not resume activities until notified by NMFS.

In the event that Bay State Wind discovers an injured or dead marine mammal and determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition), Bay State Wind would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources and the GARFO Stranding Coordinator. The report would include the same information identified in the paragraph above. Activities would be allowed to continue while NMFS reviews the circumstances of the incident. NMFS would work with the Applicant to determine if modifications in the activities are appropriate.

In the event that Bay State Wind discovers an injured or dead marine mammal and determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Bay State Wind would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Greater Atlantic Regional Fisheries Office Regional Stranding Coordinator, within 24 hours of the discovery. Bay State Wind would provide photographs or video footage (if available) or other

documentation of the stranded animal sighting to NMFS. Bay State Wind can continue its operations in such a case.

Within 90 days after completion of the marine site characterization survey activities, a technical report will be provided to NMFS and BOEM that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of marine mammals that may have been taken during survey activities, and provides an interpretation of the results and effectiveness of all monitoring tasks. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS.

In addition to the Applicant's reporting requirements outlined above, the Applicant will provide an assessment report of the effectiveness of the various mitigation techniques, *i.e.* visual observations during day and night, compared to the PAM detections/operations. This will be submitted as a draft to NMFS and BOEM 30 days after the completion of the HRG surveys and as a final version 60 days after completion of the surveys.

Negligible Impact Analysis and Determination

Negligible impact is 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, as the severity of harassment may vary greatly depending on the context and duration of the behavioral response, many of which would not be expected to have deleterious impacts on the fitness of any individuals. In determining whether the expected takes will have a negligible impact, in addition to considering estimates of

the number of marine mammals that might be "taken," NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, and the status of the species.

As discussed in the "Potential Effects of the Specified Activity on Marine Mammals and Their Habitat" section, PTS, masking, non-auditory physical effects, and vessel strike are not expected to occur. However, a small number of PTS takes of harbor porpoise are analyzed here out of an abundance of caution even though the potential is low. There is also some potential for limited TTS. Animals in the area would likely incur no more than brief hearing impairment (*i.e.*, TTS) due to generally low SPLs—and in the case of the HRG survey equipment use, directional beam pattern, transient signals, and moving sound sources—and the fact that most marine mammals would more likely avoid a loud sound source rather than swim in such close proximity for an amount of time as to result in TTS or PTS. Further, once an area has been surveyed, it is not likely that it will be surveyed again, therefore reducing the likelihood of repeated impacts within the project area.

Potential impacts to marine mammal habitat were discussed previously in this document (see the "Potential Effects of the Specified Activity on Marine Mammals and their Habitat" section). Marine mammal habitat may be impacted by elevated sound levels and some sediment disturbance, but these impacts would be temporary and relatively short term. Feeding behavior is not likely to be significantly impacted, as marine mammals appear to be less likely to exhibit behavioral reactions or avoidance responses while engaged in feeding activities (Richardson *et al.*, 1995). Prey species are mobile, and are broadly distributed throughout the Lease Area;

therefore, marine mammals that may be temporarily displaced during survey activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Because of the temporary nature of the disturbance, the availability of similar habitat and resources in the surrounding area, and the lack of important or unique marine mammal habitat, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. Furthermore, there are no feeding areas, rookeries, or mating grounds known to be biologically important to marine mammals within the proposed project area. A small portion of a BIA for fin whale feeding is within the survey area and a BIA for North Atlantic right whale migration encompasses the Lease Area. However, there is no temporal overlap between the north Atlantic right whale BIA (effective March-April and November-December) and the proposed survey activities (April-June; October). The portion of the fin whale feeding BIA within the HRG survey area is a very small portion of the overall BIA, and HRG activities would ensonify such a small area that fin whale foraging is not anticipated to be substantially impacted. ESA-listed species for which takes are proposed are sperm whales and fin whales, and these effects are anticipated to be limited to lower level behavioral effects.

Examination of the minimum number alive population index calculated from the individual sightings database for the years 1990-2010 suggested a positive and slowly accelerating trend in North Atlantic right whale population size (Waring *et al*., 2015); however, since June 7, 2017, an unusual mortality event has been declared for this species due to a high number of mortalities with human interactions (*i.e.*, fishery-related entanglements and vessel strikes) identified as the most likely cause. There are currently insufficient data to determine population trends for fin whale (Waring *et al*., 2015). There is no designated critical habitat for

any ESA-listed marine mammals within the Lease Area, and none of the stocks for non-listed species proposed to be taken are considered "depleted" or "strategic" by NMFS under the MMPA.

The proposed mitigation measures are expected to reduce the number and/or severity of takes by giving animals the opportunity to move away from the sound source before HRG survey equipment reaches full energy and preventing animals from being exposed to sound levels reaching 180 dB during HRG survey activities. Additional vessel strike avoidance requirements will further mitigate potential impacts to marine mammals during vessel transit to and within the Study Area.

Bay State Wind did not request, and NMFS is not proposing, take of marine mammals by serious injury, or mortality. NMFS expects that most takes would primarily be in the form of short-term Level B behavioral harassment in the form of brief startling reaction and/or temporary vacating of the area, or decreased foraging (if such activity were occurring)—reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al.*, 2007). This is largely due to the short time scale of the proposed activities, the low source levels and intermittent nature of many of the technologies proposed to be used, as well as the required mitigation. However, Bay State Wind has requested a small number of Level A takes for harbor porpoises in an abundance of caution. NMFS is proposing to authorize Level A take of harbor porpoises due to the fact that their small size may make it difficult to observe all individuals in certain sea states or weather conditions, so some Level A take may occur even with implementation of the 75 m shut down zone.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No mortality or serious is anticipated or authorized;
- Take is anticipated to be primarily Level B behavioral harassment consisting of brief startling reactions and/or temporary avoidance of the survey area due to the intermittent and short term nature of the activities as well as the directionality of the sound sources;
- While the survey area is within areas noted as biologically important for north Atlantic right whale migration, the activities will take place outside of the timeframe of noted importance for migration, and would occur in such a comparatively small area such that any avoidance of the survey area due to activities would not affect migration. In addition, mitigation measures to shut down at 500 m to avoid potential for Level B behavioral harassment due to animals that may occur inside that isopleth (400 m) will avoid any take of the species. Similarly, due to the small footprint of the survey activities in relation to the size of a biologically important area for fin whales foraging, the survey activities would not affect foraging behavior of this species.
- For most species, the percentage of stocks affected are less than 3 percent of the stock. This represents the total number of exposures and does not consider that there are likely repeat exposures of the same individuals. In addition, these takes are anticipated to be mainly Level B behavioral takes in the form of short-term startle or avoidance reactions that would not affect the species or stock.

NMFS concludes that exposures to marine mammal species and stocks due to Bay State Wind's HRG survey activities would result in only short-term (temporary and short in duration)

and relatively infrequent effects to individuals exposed, and not of the type or severity that would be expected to be additive for the very small portion of the stocks and species likely to be exposed. NMFS does not anticipate the proposed take estimates to impact annual rates of recruitment or survival. Animals may temporarily avoid the immediate area, but are not expected to permanently abandon the area. Major shifts in habitat use, distribution, or foraging success, are not expected.

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 total marine mammal take from Bay State Wind's proposed HRG survey activities will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

The requested takes proposed to be authorized for the HRG represent 2.18 percent of the Gulf of Maine stock of humpback whale (West Indies Distinct Population Segment); 1.98 percent of the WNA stock of fin whale; 0.77 percent of the Canadian East Coast stock of minke whale; 0.22 percent of the North Atlantic stock of sperm whales; 8.66 percent of the Western North Atlantic stock of bottlenose dolphins; 2.85 percent of the WNA stock of short-beaked common dolphin, 1.02 percent of the WNA stock of Atlantic white-sided dolphin, 0.95 percent of the Gulf of Maine/Bay of Fundy stock of harbor porpoise, 2.18 percent of the WNA stock of harbor seal, and 0.56 percent of the North Atlantic stock of gray seal. These take estimates represent the percentage of each species or stock that could be taken and for most stocks are small numbers (less than 3 percent for most stocks) relative to the affected species or stock sizes. Further, the proposed take numbers are the maximum numbers of animals that are expected to be

harassed during the project; it is possible that some of these exposures may occur to the same individual, which would mean the percentage of stock taken would be very conservative as it would not take into account these multiple exposures of the same individual(s). Therefore, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals 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

Within the project area, fin, humpback, and North Atlantic right whale are listed as endangered under the ESA. Under section 7 of the ESA, BOEM consulted with NMFS on commercial wind lease issuance and site assessment activities on the Atlantic Outer Continental Shelf in Massachusetts, Rhode Island, New York and New Jersey Wind Energy Areas. NOAA's GARFO issued a Biological Opinion concluding that these activities may adversely affect but are not likely to jeopardize the continued existence of fin whale or North Atlantic right whale. NMFS is also consulting internally on the issuance of an IHA under section 101(a)(5)(D) of the MMPA for this activity and the existing Biological Opinion may be amended to include an incidental take exemption for these marine mammal species, as appropriate.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to Bay State Wind for HRG survey activities during geophysical survey activities from April 2018

through March 2019, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

Orsted/US Wind Power/Bay State Wind (Bay State Wind) (One International Place, 100 Oliver Street, Suite 2610, Boston, MA 02110) is hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1371(a)(5)(D)) and 50 CFR 216.107, to harass marine mammals incidental to high-resolution geophysical (HRG) and geotechnical survey investigations associated with marine site characterization activities off the coast of Massachusetts in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0500) (the Lease Area).

1. This incidental harassment authorization (IHA) is valid for a period of one year from the date of issuance.

2. This IHA is valid only for marine site characterization survey activity, as specified in the IHA application, in the Atlantic Ocean.

3. General Conditions

(a) A copy of this IHA must be in the possession of Bay State Wind, the vessel operator and other relevant personnel, the lead protected species observer (PSO), and any other relevant designees of Bay State Wind operating under the authority of this IHA.

(b) The species authorized for taking are listed in Table 7. The taking, by harassment only, is limited to the species and numbers listed in Table 7. Any taking of species not listed in

Table 7, or exceeding the authorized amounts listed in Table 7, is prohibited and may result in the modification, suspension, or revocation of this IHA.

(c) The taking by serious injury or death of any species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) Bay State Wind shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocols, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations.

4. Mitigation Requirements – the holder of this Authorization is required to implement the following mitigation measures:

(a) Bay State Wind shall use at least four (4) NMFS-approved PSOs during HRG surveys. The PSOs must have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements.

(b) Visual monitoring must begin no less than 30 minutes prior to initiation of survey equipment and must continue until 30 minutes after use of survey equipment ceases.

(c) Exclusion Zones and Watch Zone – PSOs shall establish and monitor marine mammal Exclusion Zones and Watch Zones. The Watch Zone shall represent the extent of the maximum Level B harassment zone (1,166 m) or, as far as possible if the extent of the Zone is not fully visible. The Exclusion Zones are as follows:

(i) a 75 m Exclusion Zone for harbor porpoises;

(ii) a 100 m Exclusion Zone for large whales including sperm whales and mysticetes

(except North Atlantic right whales);

(iii) a 500 m Exclusion Zone for North Atlantic right whales;

(iv) a 400 m Level B harassment monitoring zone for all marine mammals.

(d) Shutdown requirements – If a marine mammal is observed within, entering, or approaching the relevant Exclusion Zones as described under 4(c) while geophysical survey equipment is operational, the geophysical survey equipment must be immediately shut down.

(i) Any PSO on duty has the authority to call for shutdown of survey equipment. When there is certainty regarding the need for mitigation action on the basis of visual detection, the relevant PSO(s) must call for such action immediately.

(ii) When a shutdown is called for by a PSO, the shutdown must occur and any dispute resolved only following shutdown.

(iii) Shutdown of HRG survey equipment is also required upon confirmed passive acoustic monitoring (PAM) detection of a North Atlantic right whale at night, except in instances when the PAM detection of a North Atlantic right whale can be localized and the whale is confirmed as being beyond the 500 m EZ for right whales. The PAM operator on duty has the authority to call for shutdown of survey equipment based on confirmed acoustic detection of a North Atlantic right whale at night even in the absence of visual confirmation. When shutdown occurs based on confirmed PAM detection of a North Atlantic right whale at night, survey equipment may be re-started no sooner than 30 minutes after the last confirmed acoustic detection.

(iv) Upon implementation of a shutdown, survey equipment may be reactivated when all marine mammals have been confirmed by visual observation to have exited the relevant

Exclusion Zone or an additional time period has elapsed with no further sighting of the animal that triggered the shutdown (15 minutes for small delphinoid cetaceans and pinnipeds and 30 minutes for all other species).

(v) If geophysical equipment shuts down for reasons other than mitigation (*i.e.*, mechanical or electronic failure) resulting in the cessation of the survey equipment for a period of less than 20 minutes, the equipment may be restarted as soon as practicable if visual surveys were continued diligently throughout the silent period and the relevant Exclusion Zones are confirmed by PSOs to have remained clear of marine mammals during the entire 20 minute period. If visual surveys were not continued diligently during the pause of 20 minutes or less, a 30 minute pre-clearance period shall precede the restart of the geophysical survey equipment as described in 4(e). If the period of shutdown for reasons other than mitigation is greater than 20 minutes, a pre-clearance period shall precede the restart of the geophysical survey equipment as described in 4(e).

(e) Pre-clearance observation – 30 minutes of pre-clearance observation shall be conducted prior to initiation of geophysical survey equipment. Geophysical survey equipment shall not be initiated if marine mammals are observed within or approaching the relevant Exclusion Zones as described under 4(c) during the pre-clearance period. If a marine mammal is observed within or approaching the relevant Exclusion Zone during the pre-clearance period, geophysical survey equipment shall not be initiated until the animal(s) is confirmed by visual observation to have exited the relevant Exclusion Zone or until an additional time period has elapsed with no further sighting of the animal (15 minutes for small delphinoid cetaceans and pinnipeds and 30 minutes for all other species).

(f) Ramp-up – when technically feasible, survey equipment shall be ramped up at the

start or re-start of survey activities. Ramp-up will begin with the power of the smallest acoustic equipment at its lowest practical power output appropriate for the survey. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.

(g) Vessel Strike Avoidance – Vessel operator and crew must maintain a vigilant watch for all marine mammals and slow down or stop the vessel or alter course, as appropriate, to avoid striking any marine mammal, unless such action represents a human safety concern. Survey vessel crew members responsible for navigation duties shall receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures shall include the following, except under circumstances when complying with these requirements would put the safety of the vessel or crew at risk:

(i) The vessel operator and crew shall maintain vigilant watch for cetaceans and pinnipeds, and slow down or stop the vessel to avoid striking marine mammals;

(ii) The vessel operator will reduce vessel speed to 10 knots (18.5 km/hr) or less when any large whale, any mother/calf pairs, whale or dolphin pods, or larger assemblages of non-delphinoid cetaceans are observed near (within 100 m (330 ft)) an underway vessel;

(iii) The survey vessel will maintain a separation distance of 500 m (1640 ft) or greater from any sighted North Atlantic right whale;

(iv) If underway, the vessel must steer a course away from any sighted North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 m (1640 ft) minimum separation distance has been established. If a North Atlantic right whale is sighted in a vessel's path, or within 500 m (330 ft) to an underway vessel, the underway vessel must reduce speed and shift

the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 500 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 500 m;

(v) The vessel will maintain a separation distance of 100 m (330 ft) or greater from any sighted non-delphinoid cetacean. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved outside of the vessel's path and beyond 100 m. If a survey vessel is stationary, the vessel will not engage engines until the non-delphinoid cetacean has moved out of the vessel's path and beyond 100 m;

(vi) The vessel will maintain a separation distance of 50 m (164 ft) or greater from any sighted delphinoid cetacean. Any vessel underway shall remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Any vessel underway shall reduce vessel speed to 10 knots (18.5 km/hr) or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. Vessels may not adjust course and speed until the delphinoid cetaceans have moved beyond 50 m and/or the abeam of the underway vessel;

(vii) All vessels underway will not divert or alter course in order to approach any whale, delphinoid cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and

(viii) All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped.

(ix) The vessel operator will comply with 10 knot (18.5 km/hr) or less speed

restrictions in any Seasonal Management Area per NMFS guidance.

(x) If NMFS should establish a Dynamic Management Area (DMA) in the area of the survey, within 24 hours of the establishment of the DMA Bay State Wind shall work with NMFS to shut down and/or alter survey activities to avoid the DMA as appropriate.

5. Monitoring Requirements – The Holder of this Authorization is required to conduct marine mammal visual monitoring and PAM during geophysical survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) A minimum of four NMFS-approved PSOs and a minimum of two certified PAM operator(s), operating in shifts, shall be employed by Bay State Wind during geophysical surveys.

(b) Observations shall take place from the highest available vantage point on the survey vessel. General 360-degree scanning shall occur during the monitoring periods, and target scanning by PSOs shall occur when alerted of a marine mammal presence.

(c) For monitoring around the autonomous surface vessel (ASV), a dual thermal/HD camera shall be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. PSOs shall be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras shall be able to be captured and reviewed to assist in verifying species identification. A monitor shall also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a hand-held spotlight shall be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

(d) PSOs shall be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to the vessel and/or Exclusion Zones using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the sighting and monitoring of marine species.

(e) PAM shall be used during nighttime geophysical survey operations. The PAM system shall consist of an array of hydrophones with both broadband (sampling mid-range frequencies of 2 kHz to 200 kHz) and at least one low-frequency hydrophone (sampling range frequencies of 75 Hz to 30 kHz). PAM operators shall communicate detections or vocalizations to the Lead PSO on duty who shall ensure the implementation of the appropriate mitigation measure.

(f) During night surveys, night-vision equipment and infrared technology (as described in 5 (c) above) shall be used in addition to PAM.

(g) PSOs and PAM operators shall work in shifts such that no one monitor will work more than 4 consecutive hours without a 2 hour break or longer than 12 hours during any 24-hour period. During daylight hours the PSOs shall rotate in shifts of 1 on and 3 off, and during nighttime operations PSOs shall work in pairs.

(h) PAM operators shall also be on call as necessary during daytime operations should visual observations become impaired.

(i) Position data shall be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.

(j) A briefing shall be conducted between survey supervisors and crews, PSOs, and Bay State Wind to establish responsibilities of each party, define chains of command, discuss

communication procedures, provide an overview of monitoring purposes, and review operational procedures.

(k) PSO qualifications shall include direct field experience on a marine mammal observation vessel and/or aerial surveys.

(l) Data on all PAM/PSO observations shall be recorded based on standard PSO collection requirements. PSOs must use standardized data forms, whether hard copy or electronic. The following information shall be reported:

(i) PSO names and affiliations

(ii) Dates of departures and returns to port with port name

(iii) Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort

(iv) Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts

(v) Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change

(vi) Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon

(vii) Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.*, vessel traffic, equipment malfunctions)

(viii) Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (*i.e.*, pre-clearance survey, ramp-up, shutdown, end of operations, etc.)

(ix) If a marine mammal is sighted, the following information should be recorded:

(A) Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

(B) PSO who sighted the animal;

(C) Time of sighting;

(D) Vessel location at time of sighting;

(E) Water depth;

(F) Direction of vessel's travel (compass direction);

(G) Direction of animal's travel relative to the vessel;

(H) Pace of the animal;

(I) Estimated distance to the animal and its heading relative to vessel at initial sighting;

(J) Identification of the animal (*e.g.*, genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;

(K) Estimated number of animals (high/low/best) ;

(L) Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);

(M) Description (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);

(N) Detailed behavior observations (*e.g.*, number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);

(O) Animal's closest point of approach and/or closest distance from the center point of the acoustic source;

(P) Platform activity at time of sighting (*e.g.*, deploying, recovering, testing, data acquisition, other); and

(Q) Description of any actions implemented in response to the sighting (*e.g.*, delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.

6. Reporting – a technical report shall be provided to NMFS within 90 days after completion of survey activities that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of marine mammals that may have been taken during survey activities, describes the effectiveness of the various mitigation techniques (*i.e.* visual observations during day and night compared to PAM detections/operations), provides an interpretation of the results and effectiveness of all monitoring tasks, and includes an assessment of the effectiveness of night vision equipment used during nighttime surveys, including comparisons of relative effectiveness among the different types of night vision equipment used. Any recommendations made by NMFS shall be addressed in the final report prior to acceptance by NMFS.

(a) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not authorized by this IHA, such as serious injury or mortality, Bay State Wind shall immediately cease the specified activities and immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8400) and the NMFS Northeast Stranding Coordinator ((866) 755-6622). The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the incident;

(B) Vessel's speed during and leading up to the incident;

(C) Description of the incident;

(D) Status of all sound source use in the 24 hours preceding the incident;

(E) Water depth;

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

(G) Description of all marine mammal observations in the 24 hours preceding the incident;

(H) Species identification or description of the animal(s) involved;

(I) Fate of the animal(s); and

(J) Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with Bay State Wind to determine what measures are

necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Bay State Wind may not resume their activities until notified by NMFS.

(ii) In the event that Bay State Wind discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), Bay State Wind shall immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8400) and the NMFS Northeast Stranding Coordinator ((866) 755-6622). The report must include the same information identified in condition 6(b)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Bay State Wind to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that Bay State Wind discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the specified activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Bay State Wind shall report the incident to the NMFS Office of Protected Resources ((301) 427-8400) and the NMFS Northeast Stranding Coordinator ((866) 755-6622), within 24 hours of the discovery. Bay State Wind shall provide photographs or video footage or other documentation of the sighting to NMFS.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Request for Public Comments

We request comment on our analyses, the draft authorization, and any other aspect of this Notice of Proposed IHA for the proposed marine site characterization surveys. Please include with your comments any supporting data or literature citations to help inform our final decision on the request for MMPA authorization.

On a case-by-case basis, NMFS may issue a one-year renewal IHA without additional notice when 1) another year of identical or nearly identical activities as described in the Specified Activities section is planned, or 2) the activities would not be completed by the time the IHA expires and renewal would allow completion of the activities beyond that described in the Dates and Duration section, provided all of the following conditions are met:

- A request for renewal is received no later than 60 days prior to expiration of the current IHA.
- The request for renewal must include the following:

(1) An explanation that the activities to be conducted beyond the initial dates either are identical to the previously analyzed activities or include changes so minor (*e.g.*, reduction in pile size) that the changes do not affect the previous analyses, take estimates, or mitigation and monitoring requirements; and

(2) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized;

- Upon review of the request for renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures remain the same and

appropriate, and the original findings remain valid.

Dated: May 10, 2018.

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Elaine T. Saiz,

Acting Deputy Director, Office of Protected Resources,

National Marine Fisheries Service.

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