REPORT

Ocean Wind Project – Request for the Taking of Marine Mammals Incidental to the Site Characterization of the Ocean Wind Offshore Wind Farm Lease Area (OCS-A 0498)

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Acronyms and Abbreviations

µPa	microPascal
Applicant	Ocean Wind LLC
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetacean and Turtles Assessment Program
CFR	Code of Federal Regulations
cm	centimeter
CPT	cone penetration test
dB	decibel
DMA	Dynamic Management Area
DoN	U.S. Department of the Navy
DP	dynamically positioned
DPS	distinct population segments
EA	Environmental Assessment
ESA	Endangered Species Act
FLIDAR	floating light and detection ranging buoy
ft	foot
GPS	global positioning system
HRG	high-resolution geophysical
Hz	hertz
IHA	Incidental Harassment Authorization
in	inch
IUCN	World Conservation Union
IWC	International Whaling Commission
km	kilometer
km^2	square kilometer
km/h	kilometer per hour
kHz	kilohertz
knot	nautical mile per hour
m	meter
MA	Massachusetts
mi	mile
MMPA	Marine Mammal Protection Act
NJ	New Jersey
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
OCS	Outer Continental Shelf
OPAREA	Operations Area
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
PTS	permanent threshold shift
RMS	root mean square
SELcum	cumulative SEL
SMA	Seasonal Management Area

SPUE	sightings per unit effort
TTS	temporary threshold shift
WEA	Wind Energy Area
ZOI	Zone of Influence

1. Description of Specified Activity

Ocean Wind LLC (the Applicant) is proposing to conduct marine site characterization surveys off the coast of New Jersey in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0498) (the Lease Area; Figure 1-1). The Applicant submits this request for Incidental Harassment Authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) and 50 Code of Federal Regulations (CFR) § 216 Subpart I to allow for the incidental harassment of small numbers of marine mammals resulting from the execution of marine site characterization surveys in the Lease Area specifically associated with the operation of high-resolution geophysical (HRG) and geotechnical survey equipment during upcoming field activities. Both the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) have advised that sound-producing survey equipment operating below 200 kilohertz (kHz) (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz.

The regulations set forth in Section 101(a) (5) of the MMPA and 50 CFR § 216 Subpart I allow for the incidental taking of marine mammals by a specific activity if the activity is found to have a negligible impact on the species or stock(s) of marine mammals and will not result in immitigable adverse impact on the availability of the marine mammal species or stock(s) for certain subsistence uses. In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. Such a request is detailed in the following sections.

1.1 Survey Activities

The Applicant will conduct marine site characterization surveys in the marine environment of the approximately 160,480-acre Lease Area located approximately 9 nautical miles (nm) southeast of Atlantic City, New Jersey (see Figure 1-1). Marine site characterization surveys will consist of both HRG and geotechnical survey activities. The purpose of the marine site characterization surveys are to:

- Support the siting, design, and deployment of up to two meteorological data collection buoys referred to as floating light and detection ranging buoys (FLIDARs) and up to two metocean and current buoys; and
- Obtain a baseline assessment of seabed/sub-surface soil conditions in the Ocean Wind LLC Lease Area to support the siting of the proposed wind farm.

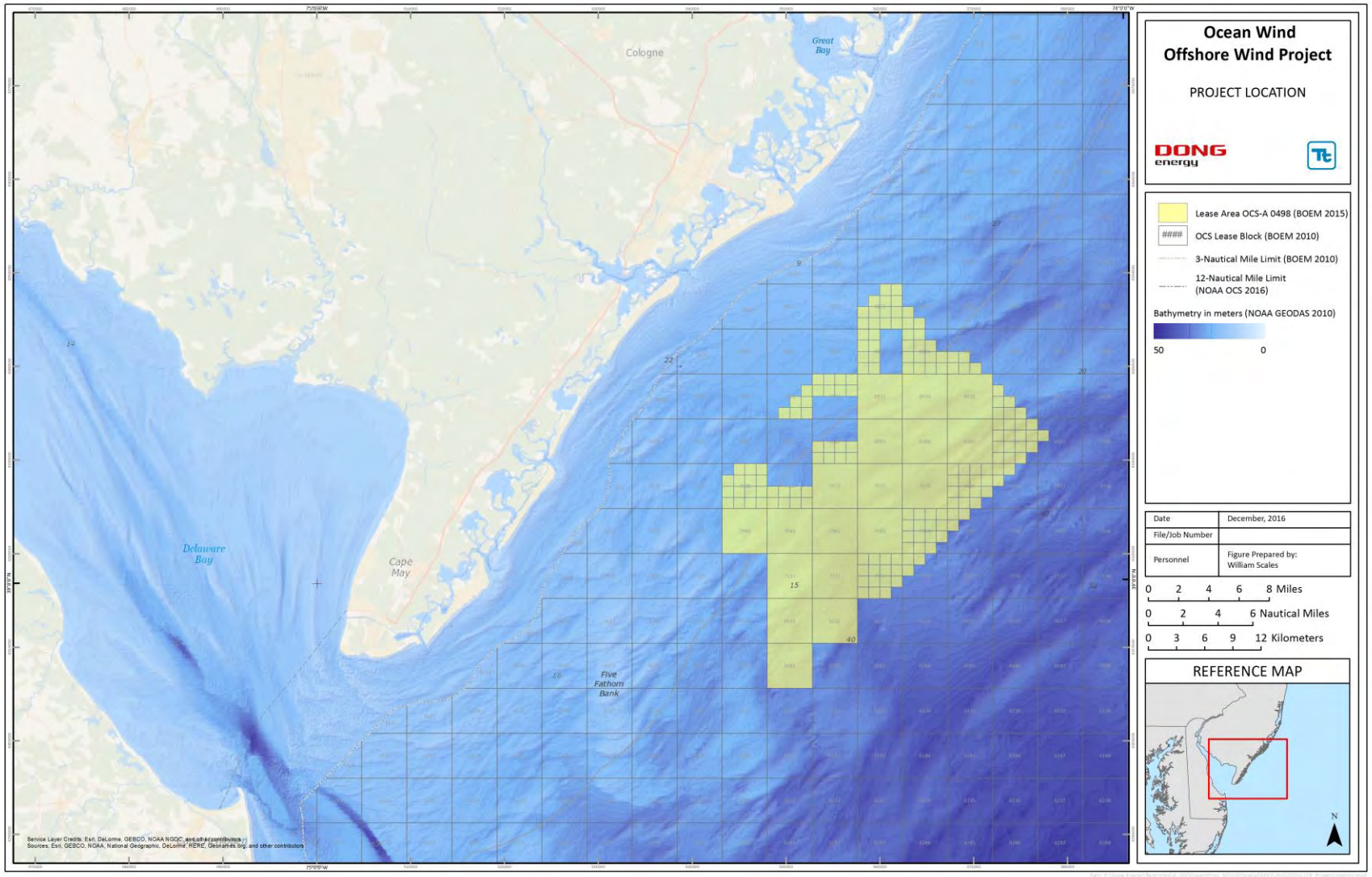

Figure 1-1 Project Location

The HRG survey activities will include the following:

- Depth sounding (multibeam depth sounder) to determine water depths and general bottom topography (currently estimated to range from approximately 15 to 40 meters [m], 50 to 120 feet [ft], in depth);
- 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 to 5 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).

The geotechnical survey activities will include the following:

- Sample boreholes to determine geological and geotechnical characteristics of sediments;
- Deep cone penetration tests (CPTs) to determine stratigraphy and in-situ conditions of the deep surface sediments; and
- Shallow CPTs to determine stratigraphy and in-situ conditions of the near surface sediments.

1.1.1 HRG Survey Activities

The HRG surveys are scheduled to begin no earlier than June 1st of 2017. The survey equipment to be utilized in the Ocean Wind Lease Area will be equivalent to the equipment utilized during the Bay State Wind HRG survey (NOAA 2016). Table 1-1 identifies the representative survey equipment that is being considered in support the HRG survey activities. The make and model of the listed HRG equipment may 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. None of the proposed HRG survey activities will result in the disturbance of bottom habitat in the Lease Area.

Table 1-1 Summary of Proposed HRG Survey Data Acquisition Equipment

Representative HRG Survey Equipment	Operating Frequencies	Source Level Reported by Manufacturer	Source Level Measured During Bay State Wind Survey /a	Beamwidth (degree)	Pulse Duration (millisec)
Sonardyne Ranger 2 USBL	35-50 kHz	200 dB_{Peak}	194 dB_{Peak}	180	1
Klein 3000H Sidescan Sonar	445/900 kHz	245 dB_{Peak}	N/A	0.2	0.0025 to 0.4
GeoPulse Sub-bottom Profiler	1.5 to 18 kHz	223.5 dB_{Peak}	203 dB_{Peak}	55	0.1 to 22
Geo-Source 600/800	50 to 5000 Hz	222 dB_{Peak}/ 223 dB_{Peak}	206 dB_{Peak} / 212 dB_{Peak}	110	1 to 10
SeaBat 7125 Multibeam Sonar	200/400 kHz	220 dB_{Peak}	N/A	2	0.03 to 3
a/ Gardline 2016, 2017					

The survey activities will be supported by a vessel approximately 98 to 180 ft in length and capable of maintaining course and a survey speed of approximately 4.0 knots while transiting survey lines.

HRG surveys will be conducted at 900-m line spacing. Up to two FLIDARs and two wave buoys would be deployed within the lease area, and up to three potential locations for FLIDAR deployment areas will be investigated. At each FLIDAR and wave buoy deployment location the survey will be conducted along a tighter 30-m line spacing to meet BOEM requirements as set out in the July 2015 *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant and Archeological and Historic Property Information* to 30 CFR Part 585.

Given the size of the Lease Area (160,480 acres), to minimize cost, the duration of survey activities, and the period of potential impact on marine species, the Applicant has proposed conducting continuous HRG survey operations 24 hours per day. Based on 24-hour operations, the estimated duration of the survey activities would be approximately 42 days (including estimated weather down time).

As noted previously, both NOAA and BOEM have advised that the deployment of HRG survey equipment including the use of sound-producing equipment operating below 200 kHz (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. Based on the frequency ranges of the potential equipment to be used in support of the HRG survey activities (Table 1-1) and the hearing ranges of the marine mammals that have the potential to occur in the Lease Area during survey activities (Table 6-1), only USBL positioning system and the sub-bottom profilers (GeoPulse Sub-bottom Profiler and Geo-Source sparker) fall within the established marine mammal hearing ranges and have the potential to result in Level B Harassment of marine mammals.

Field verification studies performed on the Bay State Wind Lease Area (Gardline 2016) and reviewed by both NOAA and BOEM confirmed that a 200-m zone was sufficient to mitigate all noise-producing HRG survey equipment. These acoustic studies were conducted under similar operating conditions and with similar data acquisition equipment as listed in Table 1-1. BOEM approved these initial results. These results indicate that, while the 200-m zone is sufficient to mitigate all noise-producing HRG survey equipment, the zone may be overly conservative. As detailed in submitted field verification reports (Gardline 2016, Subacoustech 2016) and this application, results of the field verification for the Bay State Wind Lease Area indicate that a 75.28-m zone of ensonification more accurately represents the actual exposure of marine mammals to HRG survey equipment sound over the Level B Harassment threshold.

1.1.2 Geotechnical Survey Activities

It is anticipated that the geotechnical surveys will take place in early October, 2017. The geotechnical survey program will consist of up to 8 deep sample bore holes and adjacent 8 deep CPTs both to a depth of approximately 130 ft to 200 ft (40 m to 60 m) below the seabed, and 30 shallow CPTs up to 130 ft (40 m) below seabed.

The investigation activities are anticipated to be conducted from a 250-ft to 350-ft (76-m to 107-m) dynamically positioned (DP) drill ship. Operations will take place over a 24-hour period to ensure cost, the duration of survey activities, and the period of potential impact on marine species are minimized. Based on 24-hour operations, the estimated duration of the geotechnical survey activities would be approximately 12 days factoring in expected CPT needs inclusive of potential re-testing and excluding weather downtime. Estimated weather downtime is approximately 10 days.

Field studies conducted off the coast of Virginia (Tetra Tech 2014) to determine the underwater noise produced by borehole drilling and CPTs confirm that these activities do not result in underwater noise levels that are harassing or harmful to marine mammals. However, the initial field verification conducted for the Bay State Wind Lease Area indicates that Level B harassment of marine mammals is likely at approximately 1,640 ft (500 m) from the DP thruster sound source (Subacoustech 2016). Any proposed reduction in zone size as a result of these pending data must first be approved by NOAA prior to implementation.

1.2 Survey Activities Resulting in the Potential Incidental Taking of Marine Mammals

The potential effects of underwater noise resulting in takes on marine mammals are federally managed by NOAA under the MMPA to minimize the potential for both harm and harassment. Under the MMPA, Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; however, the actionable sound pressure level is not identified in the statute. Level B harassment is defined as any act of pursuit, torment, or annoyance that 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.

In July of 2016, NMFS finalized the *Technical Guidance for Assessing the Effect of Anthropogenic Sound on Marine Mammals.* Under this new NMFS guidance, Level A harassment is said to occur as a result of exposure to high noise levels and the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS). This revision to earlier NMFS guidelines is based on findings published by the Noise Criteria Group (Southall et al., 2007). For transient and continuous sounds, it was concluded that the potential for injury is not just related to the level of the underwater sound and the hearing bandwidth of the animal, but is also influenced by the duration of exposure. The evaluation of the onset of PTS and temporary threshold shift (TTS) provides additional species-specific insight on the potential for affect that is not captured by evaluations completed using the previous NMFS thresholds for Level A and Level B harassment alone.

Frequency weighting provides a sound level referenced to an animal's hearing ability either for individual species or classes of species, and therefore a measure of the potential of the sound to cause an effect. The measure that is obtained represents the perceived level of the sound for that animal. This is an important consideration because even apparently loud underwater sound may not effect an animal if it is at frequencies outside the animal's hearing range. In the NMFS final Guidance document, there are five hearing groups: Low-frequency (LF) cetaceans (baleen whales), Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales), High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*), Phocid pinnipeds (true seals), and Otariid pinnipeds (sea lions and fur seals). It should be noted that Otariid pinnipeds do not occur within the Lease Area.

There are specific hearing criteria thresholds provided by NMFS for each of group. These criteria apply hearing adjustment curves for each animal group known as M-weighting (see Table 1-2).

Table 1-2 M-Weighted PTS and TTS Criteria and Functional Hearing Range for Maine Mammals (NMFS, 2016)

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non-Impulsive	TTS Onset Impulsive	TTS Onset Non-Impulsive	Functional Hearing Range
LF cetaceans	219 dB_{peak} & 183 dB SEL_{cum}	199 dB SEL_{cum}	213 dB_{peak} & 168 dB SEL_{cum}	179 dB SEL_{cum}	7 Hz to 35 kHz
MF cetaceans	230 dB_{peak} & 185 dB SEL_{cum}	198 dB SEL_{cum}	224 dB_{peak} & 170 dB SEL_{cum}	178 dB SEL_{cum}	150 Hz to 160 kHz
HF cetaceans	202 dB_{peak} & 155 dB SEL_{cum}	173 dB SEL_{cum}	196 dB_{peak} & 140 dB SEL_{cum}	153 dB SEL_{cum}	275 Hz to 160 kHz
Phocid pinnipeds	218 dB_{peak} & 185 dB SEL_{cum}	201 dB SEL_{cum}	212 dB_{peak} & 170 dB SEL_{cum}	181 dB SEL_{cum}	50 Hz to 86 kHz
Otariid pinnipeds	232 dB_{peak} & 203 dB SEL_{cum}	219 dB SEL_{cum}	226 dB_{peak} & 188 dB SEL_{cum}	199 dB SEL_{cum}	60 Hz to 39 kHz

NOAA has defined the threshold level for Level B harassment at 120 dB_{RMS} re 1 µPa for continuous noise and 160 $dB_{RMS90\%}$ re 1 µPa for impulse noise. Within this zone, the sound produced by the site investigation equipment may approach or exceed ambient sound levels (i.e., threshold of perception or zone of audibility); however, actual perceptibility will be dependent on the hearing thresholds of the species under consideration and the inherent masking effects of ambient sound levels. The Level B harassment threshold was not updated with the July 2016 technical guidance.

The hearing capabilities of sea turtle are poorly known and there is little information available on the effects of noise on sea turtles. Some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. Limited research has shown that upper limit of the hearing range of sea turtles is generally in range of 1,000 to 1,200 hertz (Hz) (Tech Environmental, 2006; Martin et al., 2012). BOEM states the hearing sensitivity of most sea turtles appears to be best at frequencies between about 200 Hz and 700 Hz (BOEM, 2013).

Until recently, McCauley et al. (2000) served as the best available information on the levels of underwater noise that may produce a startle, avoidance, and/or other behavioral or physiological response in sea turtles. McCauley noted that decibel levels of 166 dB_{RMS} re 1µPa were required before any behavioral reaction (e.g., increased swimming speed) was observed, and decibel levels above 175 dB_{RMS} re 1µPa elicited avoidance behavior of sea turtles. This study used impulsive sources of noise (e.g., air gun arrays) to ascertain the underwater noise levels that produce behavioral modifications in sea turtles. More recent sound exposure guidelines for sea turtles were developed within a technical report by the ANSI-accredited Standards Committee (Popper et al. 2014); the guidelines are presented for a different categories of sources including explosions, pile driving, seismic airguns, naval sonar, and shipping and other continuous noise sources. Most sea turtles are reported to hear a limited range of low-frequency sounds that include typical anthropogenic noises such as vessel engines, drilling, low-frequency sonar, and pile driving (Dow Piniak et al. 2012). Behavioral disturbance reactions include rising from depth and remaining at the surface until the sound dissipates or leaving the area (Lenhardt 2002). Sea turtles are also known to become habituated to a steady noise, even at high levels.

Based on this and the best available information (BOEM, 2012a, b; Popper et al., 2014), NMFS believes any sea turtles exposed to underwater noise greater than 166 dB_{RMS} re 1µPa may experience behavioural disturbance/modification (e.g., movements away from ensonified area) and at levels greater than or equal to 180 dB_{RMS} re 1 µPa have the potential to cause injury (GARFO 2016). Table 1-3 summarizes the present NMFS sea turtle guidelines on underwater noise level which have the potential to cause injury or behavioral modification.

Table 1-3 NMFS Underwater Noise Criteria for Sea Turtles

	Criteria Level	Functional Hearing Range
Sea Turtles		
Injury	180 dB_{RMS} re 1 µPa	Up to 1.2 kHz (est.)
Behavioral Disturbance	166 dB_{RMS} re 1 µPa	Up to 1.2 kHz (est.)

In accordance with current NMFS guidelines, the Applicant's survey activities that could result in the incidental take of marine mammals are limited to Level B harassment caused by the generation of underwater noise from operation of the HRG survey sub-bottom profiler, and noise from the operation of DP vessel thrusters in support of geotechnical survey activities, as described in Sections 1.1.1 and 1.1.2.

1.2.1 HRG Survey Activities

The proposed survey activities for the Ocean Wind Project are expected to approximate or match the scope, vessel profile, and equipment used for the Bay State Wind Lease Area HRG survey conducted in the summer of 2016 (NOAA 2016). A minimum 200-m default exclusion zone for HRG survey equipment is specified in the New Jersey OCS-A 0498 Lease Agreement stipulation 4.4.6.1. Results for the final field verification report (Gardline 2016) indicate that while the 200-m zone is adequate to mitigate all noise-producing HRG survey equipment, the zone is highly conservative. It is expected that environmental conditions are similar for the Ocean Wind Project in comparison to what exists within the Bay State Wind Lease Area, and that noise profiles for the data acquisition equipment listed in Table 1-1 will not differ from the field verification report. . Therefore, while a 200-m default exclusion zone for HRG survey equipment will be implemented, noise impacts are not expected beyond 75.28 m of the sound sources. This 75.28-m ensonification zone is used to calculate take in subsequent sections. See Sections 11.0 and 13.0 for additional details on mitigation, monitoring, and reporting.

1.2.2 Geotechnical Survey Activities

The Applicant's survey activities that could result in the incidental take of marine mammals are limited to Level B harassment caused by the generation of underwater noise from the operation of DP vessel thrusters in support of geotechnical survey activities as described in Section 1.1.

For purposes of this evaluation, distances to the 120 dB isopleth for Level B harassment have been adopted from results of the field verification conducted in the Bay State Wind Lease Area (Subacoustech 2016). Field verification of DP thrusters indicated that the furthest distance to the Level B harassment criteria was 1,640 ft.As noted in Section 6.1.2, the Applicant has applied this 1,640-ft (500-m) ensoification zone to the 120 dB Level B harassment criteria as the basis for determining potential take. This 500-m zone was approved by BOEM and NOAA for the Bay State Wind Lease Area surveys, per correspondence from BOEM dated October 13, 2016, as a result of sound source verification (Subacoustech 2016). It is expected that vessel parameters for the DP vessel used during the geotechnical survey will approximate or match those evaluated for the Bay State Wind Project in the field. Therefore, the 500-m zone will be used to calculate take in subsequent sections.

2. Dates, Duration, and Specific Geographic Region

2.1 HRG Survey Activity

2.1.1 Dates and Duration

HRG surveys are anticipated to commence no earlier than June 1, 2017 and will last for approximately 4 to 6 weeks. This survey schedule is based on 24-hour operations and includes estimated weather down time.

2.1.2 Specific Geographic Region

The Applicant's survey activities will occur in the approximately 160,480-acre Ocean Wind Lease Area, which is a portion of the New Jersey Wind Energy Area (WEA). An evaluation of site assessment activities within the NJ WEA was fully assessed in the BOEM Environmental Assessment (EA) and associated Finding of No Significant Impact published in January 2012. A Biological Opinion on site assessment activities within the NJ WEA was issued by NOAA to BOEM in April 2013.

2.2 Geotechnical Survey Activity

2.2.1 Dates and Duration

Geotechnical surveys requiring the use of the DP drill ship will likely take place in October of 2017, at the earliest, and will last for approximately 12 days excluding weather downtime. This survey schedule is based on 24-hour operations and estimated weather down time is expected to be 10 days.

2.2.2 Specific Geographic Region

The Applicant's survey activities will occur in the approximately 160,480-acre Ocean Wind Lease Area. The Ocean Wind Project Lease Area falls within the NJ WEA (Figure 1-1). An evaluation of site assessment activities within the NJ WEA was fully assessed in the BOEM EA and associated Finding of No Significant Impact as revised in June 2014. A Biological Opinion on site assessment activities within the NJ WEA was issued by NOAA to BOEM in April 2013.

3. Species and Numbers of Marine Mammals

The EA (BOEM, 2012) reports 35 species of marine mammals (whales, dolphins, porpoise, and seals) in the Northwest Atlantic Outer Continental Shelf (OCS) region of the Mid-Atlantic that are protected by the MMPA, 5 of which are listed under the Endangered Species Act (ESA) and are known to be present, at least seasonally, in the Lease Area (see Table 3-1). A description of the status and distribution of these species are discussed in detail in Section 4.0.

Table 3-1 Marine Mammals Known to Occur in the Marine Waters of the Mid-Atlantic

Common Name	Scientific Name	ESA and MMPA Status	Estimated Population	Stock
Toothed Whales (Odontoceti)				
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	48,819	W. North Atlantic
Atlantic spotted dolphin	*Stenella frontalis*	N/A	44,715	W. North Atlantic
Bottlenose dolphin	*Tursiops truncatus*	N/A	77,532	W. North Atlantic, Offshore
Clymene dolphin	*Stenella clymene*	N/A	Unknown	W. North Atlantic
Pan-tropical spotted dolphin	*Stenella attenuata*	N/A	3,333	W. North Atlantic
Risso's dolphin	*Grampus griseus*	N/A	18,250	W. North Atlantic
Short beaked common dolphin	*Delphinus delphis*	N/A	173,486	W. North Atlantic
Striped dolphin	*Stenella coeruleoalba*	N/A	54,807	W. North Atlantic
Spinner dolphin	*Stenella longirostris*	N/A	Unknown	W. North Atlantic
White-beaked dolphin	*Lagenorhynchus albirostris*	N/A	2,003	W. North Atlantic
Harbor porpoise	*Phocoena phocoena*	N/A	79,833	Gulf of Maine/Bay of Fundy
Killer whale	*Orcinus orca*	N/A	Unknown	W. North Atlantic
False killer whale	*Pseudorca crassidens*	Strategic [a/]	442	W. North Atlantic
Long-finned pilot whale	*Globicephala melas*	N/A	5,636	W. North Atlantic
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	21,515	W. North Atlantic
Sperm whale	*Physeter macrocephalus*	Endangered	2,288	North Atlantic
Pygmy sperm whale	*Kogia breviceps*	N/A	3,785 [b/]	W. North Atlantic
Dwarf sperm whale	*Kogia sima*	N/A	3,785 [b/]	W. North Atlantic
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	6,532	W. North Atlantic
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	7,092 [c/]	W. North Atlantic
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	7,092 [c/]	W. North Atlantic
True's beaked whale	*Mesoplodon mirus*	N/A	7,092 [c/]	W. North Atlantic
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	7,092 [c/]	W. North Atlantic
Melon headed whale	*Peponocephala electra*	W. North Atlantic	Unknown	W. North Atlantic
Baleen Whales (Mysticeti)				
Minke whale	*Balaenoptera acutorostrata*	N/A	20,741	Canadian East Coast
Blue whale	*Balaenoptera musculus*	Endangered	Unknown	W. North Atlantic
Fin whale	*Balaenoptera physalus*	Endangered	1,618	W. North Atlantic
Humpback whale	*Megaptera novaeangliae*	Strategic	11,570	North Atlantic
North Atlantic right whale	*Eubalaena glacialis*	Endangered	476	W. North Atlantic
Sei whale	*Balaenoptera borealis*	Endangered	357	Nova Scotia
Bryde's whale	*Balaenoptera edeni*	N/A	33	Gulf of Mexico
Earless Seals (Phocidae)				
Gray seals	*Halichoerus grypus*	N/A	505,000	Canadian
Harbor seals	*Phoca vitulina*	N/A	75,834	W. North Atlantic
Hooded seals	*Cystophora cristata*	N/A	Unknown	W. North Atlantic
Harp seal	*Phoca groenlandica*	N/A	Unknown	W. North Atlantic

a/ 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 level; 2) which is declining and likely to be listed as threatened under the ESA; or 3) which is listed as threatened or endangered under the ESA or as depleted under the MMPA (http://www.ncseonline.org/nle/crsreports/biodiversity/biodv-11.cfm).

b/ This estimate may include both the dwarf and pygmy sperm whales.

c/ This estimate includes Gervais' and Blainville's beaked whales and undifferentiated Mesoplodon spp. beaked whales.

Sources: Waring 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

4. Affected Species Status and Distribution

As described in Section 3.0, there are up to 35 marine mammal species (whales, dolphins, porpoise, and seals) which are known to be present (some year–round, and some seasonally) in the Northwest Atlantic OCS region. The marine mammal species with the greatest likelihood of occurring in the Lease Area are listed in Table 3-1. All 35 marine mammal species identified in Table 3-1 are protected by the MMPA and some are also listed under the ESA.The 5 ESA-listed marine mammal species known to be present year round or seasonally in the waters of the Mid-Atlantic are the sperm whale, right whale, fin whale, blue whale, and sei whale. The humpback whale, which may occur year round, was recently delisted as an endangered species. These large whale species are generally migratory and typically do not spend extended periods of time in a localized area. The waters of the Mid-Atlantic (including the Lease Area) are primarily used as areas where animals occur seasonally to feed, or as habitat during seasonal movements between the more northward feeding areas and southern hemisphere breeding grounds typically used by some of the large whale species (though some winter breeding areas exist further offshore vs. in the southerly latitudes). The mid-sized whale species (minke) and large baleen whales, and the sperm whale are present year-round in the continental shelf and slope waters and may occur in the waters of the Lease Area though movements will vary with prey availability and other habitat factors. The fin and right whales have the greater potential to occur within the Lease Area however, the sperm, blue, sei and humpback whales can also occur. Because the potential for the blue whale and sei whale to occur within the Lease Area during the marine survey period is the least likely, these species will not be described further in this analysis. While strandings data indicate that gray seals have the potential to occur within the Lease Area, multiple sources indicate that their presence would not be likely within the Lease Area. BOEM (2012) indicates that the presence of gray seals would not be likely. No individual gray seals were sighted during ecological baseline surveys conducted for the New Jersey Department of Environmental Protection (NJDEP 2010). Furthermore, Northeast Navy Operations Area (OPAREA) Density Estimates indicate that data for gray seals in the Mid-Atlantic are so lacking that density estimates for this species are not possible (DoN 2007). Therefore, gray seals will not be described further in this analysis.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and the existing threats to the non-endangered or threatened and endangered marine mammals that are both common in the waters of the OCS east of New Jersey and have the likelihood of occurring, at least seasonally, in the Lease Area. These species include the humpback and minke whales, bottlenose and short-beaked common dolphins, harbor porpoise, and harbor seals (BOEM 2012). In general, the remaining non-ESA mammal species listed in Table 3-1 range outside the Ocean Wind LLC Lease Area, usually in more pelagic waters, or are so rarely sighted that their presence in the Lease Area is unlikely.

4.1 Toothed Whales (Odontonceti)

Sperm Whale (*Physeter macrocephalus*) – Endangered

Currently, there is no reliable estimate for the total number of sperm whales worldwide. The best estimate is that there are between 200,000 and 1,500,000 sperm whales, based on extrapolations from only a few areas that have useful estimates (NMFS 2006). Estimates show about 1,665 in the northern Gulf of Mexico, 14,000 in the North Atlantic, 80,000 in the North Pacific, and 9,500 in the Antarctic (NMFS 2006; Waring et al. 2009).

Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Rice 1989; Whitehead 2008). During their prime breeding period and old age, male sperm

whales are essentially solitary. Males rejoin or find nursery groups during prime breeding season. While foraging, the whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm when foraging. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2008; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, the peak breeding season occurs between October and December (NMFS 2009).

This species primarily preys on squid and octopus and are also known to prey on fish, such as lumpsuckers and redfish. Although sperm whales are generalists in terms of prey, specialization does appear to occur in a few places. The main sperm whale feeding grounds are correlated with increased primary productivity caused by upwelling.

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale. This species is found in polar to tropical waters in all oceans, from approximately 70° N to 70° S (Rice 1989; Whitehead 2003). It ranges throughout all deep oceans of the world, essentially from equatorial zones to the edges of the polar pack ice. In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre. The current abundance estimate for this species in the North Atlantic is 2,288 individuals (Waring et al. 2016). The species is listed as Endangered.

Sperm whales show a strong preference for deep waters (Rice 1989; Whitehead 2003). Their distribution is typically associated with waters over the continental shelf break and the continental slope and into deeper waters (Jefferson et al. 2008; Whitehead et al. 1992). Sperm whale concentrations near drop-offs and areas with strong currents and steep topography are correlated with high productivity. These whales occur almost exclusively at the shelf break, regardless of season (NYDOS 2013). Sperm whales are somewhat migratory; however, their migrations are not as specific as seen in most of the baleen whale species. In the North Atlantic, there appears to be a general shift northward during the summer, but there is no clear migration in some temperate areas (Rice 1989; Whitehead 2003).

Harbor Porpoise (*Phocoena phocoena*) – Non-Strategic

The harbor porpoise inhabits shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland. They are likely to occur frequently in Mid-Atlantic waters from fall through spring, reaching their highest densities in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore and in the mid-Atlantic (Kenney and Vigness-Raposa 2009; Navy 2007). After April, they migrate north towards the Gulf of Maine and Bay of Fundy. Harbor porpoises are the smallest North Atlantic cetacean, measuring at only 1.4 to 1.9 m, and feed primarily on fish, but also prey on squid and crustaceans (Reeves and Read 2003; Kenney and Vigness-Raposa 2009). Sighting records from the 1978 to 1981 Cetacean and Turtle Assessment Program (CeTAP) surveys showed porpoises in spring exhibited highest densities in the southwestern Gulf of Maine in proximity to the Nantucket Shoals and western Georges Bank, with presence throughout the southern New England shelf and Gulf of Maine (CeTAP 1982). While strandings have occurred throughout the south shore of Long Island and coastal Rhode Island, many sightings have occurred offshore in the OCS area (Kenney and Vigness-Raposa 2009). The North Atlantic harbor porpoise population is likely to be over 500,000 (Kenney and Vigness-Raposa 2009). The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 79,833 (Waring et al. 2016).

The most common threat to the harbor porpoise is from incidental mortality from fishing activities, especially from bottom-set gillnets. It has been demonstrated that the porpoise echolocation system is capable of

detecting net fibers, but they either must not have the “system activated” or else they fail to recognize the nets (Reeves et al. 2002). Roughly 365 harbor porpoises are killed by human-related activities in U.S. and Canadian waters each year. In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The plan, that pertains to the Gulf of Maine, focuses on sink gillnets and other gillnets that can catch groundfish in New England waters. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the ESA; a review of the biological status of the stock indicated that a classification of “Threatened” was not warranted (Waring et al. 2009). This species has been listed as “non-strategic” because average annual human-related mortality and injury does not exceed the potential biological removal (Waring et al. 2016).

Bottlenose Dolphin (*Tursiops truncatus*) – Non-Strategic

The bottlenose dolphin is a light- to slate-gray dolphin, roughly 8 to 12 ft (2.4 to 3.7 m) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F).

There are two distinct bottlenose dolphin morphotypes: coastal and migratory. The coastal morphotype resides along the inner continental shelf (within 7.5 km (4.5 miles) of shore) and around islands and is subdivided into 7 stocks based largely upon spatial distribution (Waring et al. 2016). These animals often move into or reside in bays, estuaries, and the lower reaches of rivers (Reeves et al. 2002). Generally, the offshore migratory morphotype is found exclusively seaward of 34 km (21 miles) and in waters deeper than 34 m. This offshore population extends along the entire continental shelf-break from Georges Bank to Florida during the spring and summer months, and has been observed in the Gulf of Maine during the late summer and fall. However, south of Cape Hatteras, these morphotype ranges overlap to some degree. According to the New Jersey Department of Environmental Protection (NJDEP; 2010), the bottlenose dolphin is present off the New Jersey coast year-round, and would likely be ubiquitous throughout the survey area. NMFS species stock assessment report estimates the population of western North Atlantic offshore bottlenose dolphin stock at approximately 77,532 individuals (Waring et al. 2016).

Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2002).

The biggest threat to the population is bycatch because they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2016). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (ACSonline 2004). Total U.S. fishery related mortality and serious injury for this stock is less than 10 percent of the calculated potential biological removal and, therefore, can be considered to be insignificant and approaching the zero mortality and serious injury rate.

Short-Beaked Common Dolphin (*Delphinus delphis*) – Non-Strategic

The short-beaked dolphin is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked dolphins feed on squids and small fish, including species that school in proximity to surface waters as well as mesopelagic species found near the surface at night (World Conservation Union [IUCN] 2010; NatureServe 2010). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NOAA 1993). This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Waring et al. 2007; 2016). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The short-beaked common dolphin feeds on small schooling fish and squid. While this dolphin species can occupy a variety of habitats, short-beaked common dolphins occur in greatest abundance within a broad band of the northeast edge of Georges Bank in the fall (Kenney and Vigness-Raposa 2009). According to the species stock report, the best population estimate for the western North Atlantic common dolphin is approximately 173,486 individuals (Waring et al. 2016).

Short-beaked common dolphins can be found either along the 650- to 6,500-ft (200- to 2,000-m) isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. The short-beaked common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north (Reeves et al. 2002) and usually inhabit tropical, subtropical, and warm-temperate waters (Waring et al. 2009; 2016).

The short-beaked common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. During 2009 to 2013, it was estimated that on average approximately 3 dolphins were killed each year by human activities (Waring et al. 2010). This number increased to 289 dolphins during 2008 to 2012 (Waring et al. 2015), and again from 2009 to 2013 where the number was estimated at 363 (Waring et al. 2016). This species is also the most common dolphin species to be stranded along the southern New England Coast (Kenney and Vigness-Raposa 2009). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2009; 2010; 2015; 2016).

4.2 Baleen Whales (Mysticeti)

North Atlantic Right Whale (*Eubalaena glacialis*) – Endangered

The North Atlantic right whale is a strongly migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. This species was listed as a federally endangered species in 1970 and is one of the most endangered large whale species in the world. The North Atlantic right whale has seen a nominal 2 percent recovery rate since it was listed as a protected species (NOAA 2015a). This is a drastic difference from the stock found in the Southern Hemisphere, which has increased at a rate of 7 to 8 percent (Knowlton and Kraus 2001). The historic range of this species reached its southern terminus between Florida and northwestern Africa and its northern terminus between Labrador and Norway (Kenney 2002). The present range of the western North Atlantic right whale population extends from the southeastern United States, which is utilized for wintering and calving, to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St.

Lawrence (Kenney 2002; Waring et al. 2007). Observations in December 2008 noted congregations of more than 40 individual right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely for higher food densities. The winter distribution of North Atlantic right whales is largely unknown, although offshore surveys have reported between one and 13 detections annually in northeastern Florida and southeastern Georgia (Waring et al. 2007; 2016). A few documented events of right whale calving have been from shallow coastal areas and bays (Kenney 2002). North Atlantic right whales may be found in feeding grounds within New England waters between February and May, with peak abundance in late March (NOAA 2005). While in New England, right whales feed mostly on copepods belonging to the *Calanus* and *Pseudocalanus* genus (Waring et al. 2015). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 miles (mi) (16 km) per hour. They can dive at least 1,000 ft (300 m) and stay submerged for typically 10 to 15 minutes, feeding on their prey below the surface (ACSonline 2004).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of whaling operations (Kenney 2002). North Atlantic right whales were hunted in southern New England until the early twentieth century. Shore-based whaling in Long Island involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern United States to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2009). Abundance estimates for the North Atlantic right whale population vary. From the 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, there were only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NMFS 1991a; Waring et al. 2004). This is a tremendous difference from pre-exploitation numbers, which are thought to be around 1,000 individuals. When the right whale was finally protected in the 1930s, it is believed that the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2004). In 2015, the Western North Atlantic population size was estimated to be at least 476 individuals (Waring et al. 2016)

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing may also negatively impact their populations (Kenney 2002). Ship strikes of individuals can impact northern right whales on a population level due to the intrinsically small remnant population that persists in the North Atlantic (Laist et al. 2001). Between 2002 and 2006, a study of marine mammal stranding and human-induced interactions reported that right whales in the western Atlantic were subject to the highest proportion of entanglements (25 of 145 confirmed events) and ship strikes (16 of 43 confirmed occurrences) of any marine mammal studied (Glass et al. 2008). Bycatch of North Atlantic right whale has also been reported in pelagic drift gillnet operations by the Northeast Fisheries Observer Program, however, no mortalities have been reported (Glass et al. 2008). From 2008 through 2012, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 3.65 per year, while ship strikes averaged 0.9 whales per year (Waring et al. 2015). For the period 2009 through 2013, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 4.3 per year. The NOAA marine mammal stock assessment for 2015 reports that the low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species than for other whales and that any single mortality or serious injury can be considered significant (Waring et al. 2016).

Most ship strikes are fatal to the North Atlantic right whales (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship for they are dark in color and maintain a low profile while swimming (World Wildlife Fund 2005). To address potential for ship strike, NMFS designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal Management Area (SMA) for right whales in December 2008. NMFS require that all vessels 65 ft (19.8 m) or longer must travel at 10 knots or less within the right whale SMA from November 1 through April 30 when right whales are most likely to pass through these waters (NOAA 2010). The most recent stock assessment report noted that studies by van der Hoop et al. (2015) have concluded large whale vessel strike mortalities decreased inside active SMAs but have increased outside inactive SMAs.

Right whales have been observed in or near waters south of New England during all four seasons; however, they are most common in the spring when they are migrating north and in the fall during their southbound migration (Kenney and Vigness-Raposa 2009).

Humpback Whale (*Megaptera novaeangliae*) – Strategic/Non-Endangered for West Indies Distinct Population Segment

The humpback whale was listed as endangered in 1970 due to population decrease resulting from overharvesting. In September 2016, NMFS revised the ESA listing for the humpback whale to identify 14 Distinct Population Segments (DPSs) based on breeding populations: West Indies, Cape Verde Islands/Northwest Africa, Hawaii, Mexico, Central America, Brazil, Gabon/Southwest Africa, Southeast Africa/Madagascar, West Australia; East Australia, Oceania, Southeastern Pacific, and Arabian Sea (81 FR 62259[1]). Under this new final rule, humpback whales are considered endangered in the Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea DPSs and are considered threatened in the Mexico DPS. For all the remaining DPSs, including the West Indies DPS, to which humpback whales along the east coast of the United States belong, humpback whales are no longer listed as endangered or threatened. Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Waring et al. 2007; Kenney and Vigness-Raposa 2009). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpbacks feed over the continental shelf in the North Atlantic between New Jersey and Greenland, consuming roughly 95 percent small schooling fish and 5 percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NMFS 1991b). Humpback whales from all of the North Atlantic migrate to the Caribbean in winter, where calves are born between January and March (Blaylock et al. 1995).

Humpback whales exhibit consistent fidelity to feeding areas within the northern hemisphere (Stevick et al. 2006). There are six subpopulations of humpback whales that feed in six different areas during spring, summer and fall. These feeding populations can be found in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and Norway (Waring et al. 2016). The highest abundance for humpback whales is distributed primarily along a relatively narrow corridor following the 328-ft (100-m) isobath across the southern Gulf of Maine from the northwestern slope of Georges Bank, south to the Great South Channel, and northward alongside Cape Cod to Stellwagen Bank and Jeffreys Ledge. In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate

[1] Volume 81, Federal Register, Number 174, Thursday, September 8, 2016, pp 62260-62320.

to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs (Waring et al. 2015). While migrating, humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring et al. 2007). Since 1989, observations of juvenile humpbacks in the Mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months.

Humpback whales were hunted as early as the seventeenth century, with most whaling operations having occurred in the nineteenth century (Kenney and Vigness-Raposa 2009). Before whaling activities, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as little as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International Whaling Commission (IWC) ban. Humpback whaling ended worldwide in 1966 (NatureServe 2010). Contemporary anthropogenic threats to humpback whales include fishery entanglements and vessel strikes. Glass et al. (2008) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine population were involved in 77 confirmed entanglements with fishery equipment and 9 confirmed ship strikes. Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of whale studied by Glass et al. (2008). A whale mortality and serious injury study conducted by Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. During this study period, humpback whales were involved in 70 reported entanglements and 12 vessel strikes, and were the most common dead species reported. This number has increased to 9 animals per year between 2009 and 20113 (Waring et al. 2016). The humpback whale population within the North Atlantic has been estimated to include approximately 11,570 individuals (Waring et al. 2015; 2016). Through photographic population estimates, humpback whales within the Gulf of Maine (the only region where these whales summer in the United States) have been estimated to consist of 600 individuals in 1979 (NMFS 1991b). According to the latest species stock assessment report, the best estimate of abundance for the Gulf of Maine stock of humpback whales is 823 individuals (Waring et al. 2016).

Fin Whale (*Balaenoptera physalus*) – Endangered

The fin whale was listed as federally endangered in 1970. Fin whales' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Gambell 1985a). They are the most commonly sighted large whales in continental shelf waters from the Mid-Atlantic coast of the United States to Nova Scotia (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982; Hain et al. 1992; Waring et al. 2008). Fin whales, much like humpback whales, seem to exhibit habitat fidelity (Waring et al. 2007; 2016; Kenney and Vigness-Raposa 2009). However, fin whales habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2009). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are still largely unknown (Waring et al. 2007; 2016). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales

in the fall from the Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whale abundance off the coast of the northeastern United States is highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). Past estimates of fin whale abundance conducted between Georges Bank and the Gulf of St. Lawrence during the feeding season in August 2006 places the western North Atlantic fin whale populations at 2,269 individuals (Waring et al. 2007). More recent estimates indicate the western North Atlantic fin whale population is 1,618 individuals (Waring et al. 2016). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2009). The gestation period for fin whales is approximately 11 months and calve births occur between late fall and winter. Females can give birth every two to three years.

Present threats to fin whales are similar to other whale species, namely fishery entanglements and vessel strikes. Fin whales seem less likely to become entangled than other whale species. Glass et al. (2008) reported that between 2002 and 2006, fin whales belonging to the Gulf of Maine population were involved in only eight confirmed entanglements with fishery equipment. Furthermore, Nelson et al. (2007) reported that fin whales exhibited a low proportion of entanglements (eight reported events) during their 2001 to 2005 study along the western Atlantic. On the other hand, vessel strikes may be a more serious threat to fin whales. Eight and 10 confirmed vessel strikes with fin whales were reported by Glass et al. (2008) and Nelson et al. (2007), respectively. This level of incidence was similar to that exhibited by the other whales studied. Conversely, a study compiling whale/vessel strike reports from historical accounts, recent whale strandings, and anecdotal records by Laist et al. (2001) reported that of the 11 great whale species studied, fin whales were involved in collisions most frequently (31 in the United States and 16 in France). From 2005 to 2009, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 2.6 per year (Waring et al. 2011) while from 2009 to 2013, this number has increased to 3.55 (Waring et al. 2016). Increase in ambient noise has also impacted fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003).

Fin whales are present in waters south of New England waters during all four seasons. In spring, summer, and fall, the main center of their distribution is in the Great South Channel area to the east of Cape Cod, which is a well-known feeding ground (Kenney and Winn 1986). Winter is the season of lowest overall abundance, but they do not depart the area entirely. Fin whales are the most common large whale encountered in continental shelf waters. The species is listed as Endangered due to the depletion of its population from whaling (Reeves et al. 1998). A recovery plan has been written and is available from NMFS for review (Waring et al. 2010; 2011).

Minke Whale (*Balaenoptera acutorostrata*) – Non-Strategic

Minke whales are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Common minke whales range between 20 and 30 ft (6 and 9 m long) (with maximum lengths of 30 to 33 ft [9 to 10 m]) and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009). The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2009). These whales basically feed below the surface of the water, and calves are usually not seen in adult feeding areas. Minke whales are almost absent from OCS waters off the western Atlantic in winter; however, they are common in the fall and abundant in spring and summer (CeTAP 1982; Kenney and Vigness-Raposa 2009). The most recent estimate for minke whales in the Canadian East

Coast stock is 20,741 (Waring et al. 2016). Minke whales have been observed south of New England during all four seasons; however, widespread abundance is highest in spring through fall (Waring et al. 2016).

As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke populations are often segregated by sex, age, or reproductive condition. Known for their curiosity, minke whales often approach boats.

Minke whales are impacted by ship strikes and bycatch from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. From 2005 to 2009, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 5.9 per year (Waring et al. 2011), while from 2009 to 2013 this increased to 7.9 per year (Waring et al. 2016). In addition, hunting for Minke whales continues today, by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al. 2002). International trade in the species is currently banned. The best recent abundance estimate for the Canadian East Coast stock is 20,741 (Waring et al. 2016). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as “non-strategic” (Waring et al. 2010; 2011; 2015; 2016).

4.3 Earless Seals (Phocidae)

Harbor Seal (*Phoca vitulina*) – Non-Strategic

Harbor seals are the most abundant seals in eastern United States waters and are commonly found in all nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida; however, their “normal” range is probably only south to New Jersey. While harbor seals occur year-round north of Cape Cod, they only occur during winter migration, typically September through May, south of Cape Cod (Southern New England to New Jersey) (Waring et al. 2015; Kenney and Vigness-Raposa 2009). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005). Harbor seals are relatively small pinnipeds, with adults ranging between 1.7 and 1.9 m in length, with females being slightly smaller than males (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009).

Harbor seals prey upon small to medium-sized fish, followed by octopus and squid, and lastly by shrimp and crabs (Kenney and Vigness-Raposa 2009). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders (Kenney and Vigness-Raposa 2009). They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. They dive to depths of about 30 to 500 ft (10 to 150 m), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes in bays near calving glaciers.

Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and autumn, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears,

and raptors (Reeves et al. 2002). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al. 2002).

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still killed legally in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). From 2006 to 2010, the average rate of mortality for the Western North Atlantic harbor seal stock from anthropogenic causes was approximately 337 per year (Waring et al. 2013) and that number has increased from 2009 through 2013 to 420 per year (waring et al. 2016). Currently, the best population estimate for harbor seals is approximately 75,834 for the Western North Atlantic stock. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as “non-strategic” (Waring et al. 2016).

5. Type of Incidental Taking Requested

The Applicant is requesting the authorization for potential non-lethal “taking” of small numbers of marine mammals to allow for incidental harassment resulting from the marine site characterization surveys. The request is based upon projected HRG and Geotechnical survey activities during the anticipated survey schedule as stated in Sections 2.1.1 and 2.2.1, respectively.

The results of the underwater acoustic data field verification studies (Gardline 2016, Subacoustech 2016) are expected to be consistent with similar marine site characterization survey activities. As evidenced in and supported by the 2016 field verification report, sound levels associated with HRG Survey Level A harassment will only occur close to the source. However, survey activities could result in temporary Level B harassment of marine mammals during use of various HRG data acquisition equipment. Results for the final field verification reports for the Bay State Wind Lease Area \ indicate that a 200-meter zone is sufficient to mitigate all noise-producing HRG survey equipment. Additionally, field verification conducted for the Bay State Wind Lease Area indicates that Level B harassment of marine mammals is approximately 1,640 ft (500 m) from the DP thruster sound source. (Subacoustech 2016) Furthermore, field studies conducted off the coast of Virginia (Tetra Tech 2014) to determine the underwater noise produced by borehole drilling and CPTs confirm that these activities do not result in underwater noise levels that are harassing or harmful to marine mammals.

The noise impacts of HRG survey equipment were evaluated under the criteria prescribed in the Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals (NMFS 2016). The criteria was applied to both the field verification survey, and a formulaic spreadsheet created by NMFS (see Table 5-1).

Table 5-1 Distances to Regulatory SEL_{CUM} Thresholds

Marine Mammal Group	PTS Onset	Field Verified Distance (m)	NMFS Spreadsheet
Sonardyne USBL Positioning System			
LF cetaceans	183 dB SEL_{cum}	n/a [a/]	- [b/]
MF cetaceans	185 dB SEL_{cum}	n/a	- [b/]
HF cetaceans	155 dB SEL_{cum}	n/a	- [b/]
Phocid pinnipeds	185 dB SEL_{cum}	n/a	- [b/]
GeoPulse Subbottom Profiler			
LF cetaceans	183 dB SEL_{cum}	n/a [a/]	1.7
MF cetaceans	185 dB SEL_{cum}	n/a	0.9
HF cetaceans	155 dB SEL_{cum}	2.8	468.6
Phocid pinnipeds	185 dB SEL_{cum}	n/a	1.6
Geo-Source Sparker up to 2.2 kJ			
LF cetaceans	183 dB SEL_{cum}	0.2	33.4
MF cetaceans	185 dB SEL_{cum}	n/a	0.8
HF cetaceans	155 dB SEL_{cum}	1.2	180.1
Phocid pinnipeds	185 dB SEL_{cum}	0.1	18
DP Thruster			
LF cetaceans	183 dB SEL_{cum}	0.2	- [b/]
MF cetaceans	185 dB SEL_{cum}	n/a	- [b/]
HF cetaceans	155 dB SEL_{cum}	0.2	- [b/]
Phocid pinnipeds	185 dB SEL_{cum}	0.1	- [b/]

a/ Indicates that the detection distance is below stated thresholds.
b/ Indicates previously unestablished (or) modelling calculation of this scenario not completed as part of previous study.

The NMFS screening level methodology (NMFS 2016) was initially used to determine zones of influence. This spreadsheet calculates distance to set thresholds based on inputs about noise source and speed of the vessel. To determine the distances to Level A thresholds, data from the field verification and technical memo addendum (Gardline 2016; Gardline 2017) were inputted into the spreadsheet to complete the refined analysis. The sub-bottom profiler and sparker were treated as mobile impulsive sound sources. The NMFS methodology for mobile impulsive sound sources makes some assumptions about the receivers. Marine mammals are considered stationary and assumed to not move up or down within the water column. There is no avoidance and the receiver accumulates sound via one pass of the source, even though there exists the potential for multiple exposures during the survey. The sub-bottom profiler was calculated with the following conditions: source level at 172.4 RMS, vessel velocity of 2.058 m/s, repetition rate of 0.182, pulse duration of 22 ms and a weighting factor adjustment of 10 based on the spectrogram for this equipment (Gardline 2016). The Geo-source sparker model used the following parameters: source level at 188.7 RMS Source level, vessel velocity of 2.058 m/s, repetition rate of 0.25 seconds, pulse duration of 10 ms and weighting factor adjustment of 3 based on the spectrograms for this equipment (Gardline 2016). The USBL used the following parameters: source level of 166.1 RMS, vessel speed of 2.058 m/s, pulse duration of 1 ms, repetition rate of 0.5 seconds and weighting factor adjustment of 35 based on the spectrogram. The resultant isopleths for the USBL were zero. The RMS source levels gathered from the field verification technical addendum (Gardline 2017). The DP thruster was modelled with a source level of 150 RMS (Subacoustech 2016) and weighting factor adjustment of 2 based on the frequency content of DP thrusters and an activity duration of 4 hours based on field observations. The cumulative SEL (SEL_{cum}) sound levels are well below the sound level for all marine mammal hearing groups at any significant distance with the exception of High Frequency Cetaceans.

Measurements from the field verification report indicate that there would be no instantaneous sound levels that would exceed PTS criteria at any significant distance. The field verification results show that all zero-

to-peak sound pressure levels are well under the PTS Onset peak criteria for all marine mammals, with some setback distances as little as 10 m. It is worth noting that the differences between the peak and root mean square (RMS) values presented in the HRG field verification study (Gardline 2016) are attributed to the fact the peak and RMS source levels were estimated independently from the measurement. The fall-off gradient of the peak measurement is typically greater than RMS when calculated in the nearfield.

The preliminary modeling results using the NMFS spreadsheet were based on original estimates of source levels and operating conditions. The sub-bottom profiler was modelled with the following conditions: source level at 208 dB RMS, vessel velocity of 2.315 m/s, pulse duration of 1 millisecond, repetition rate of 0.182 seconds and a weighting factor adjustment of 10. The Geo-source sparker model used the following parameters: source level at 221 dB RMS, pulse duration of 1 millisecond, vessel velocity of 2.315 m/s, repetition rate of 0.25 seconds and weighting factor adjustment of 3.

The NMFS technical guidance recognizes that one assumption made when applying the SELcum metric is the equal energy hypothesis (EEH), where it is assumed that sounds of equal SELcum produce an equal risk for hearing loss (i.e., if the SELcum of two sources are similar, a sound from a lower level source with a longer exposure duration may have similar risks to a shorter duration exposure from a higher level source). As has been shown to be the case with humans and terrestrial mammals, the EEH does not always accurately describe all exposure situations for marine mammals due the inherent complexity of predicting threshold shifts (NMFS 2016).

To ensure that the potential for take by Level B harassment is avoided and/or minimized to the maximum extent possible, the Applicant has committed to the mitigation measures as outlined in Sections 11.0 and 13.0, which have been successfully implemented during similar activities in the North Atlantic.

5.1 HRG Survey Activities

As detailed in Section 1.2.1, HRG equipment use would generate underwater noise with sounds exceeding the 160 $dB_{RMS90\%}$ re 1 µPa threshold for Level B harassment for impulsive sound. The Applicant is requesting the authorization for the incidental take by harassment, of small numbers of marine mammals in the waters of Ocean Wind Lease Area pursuant to Section 101 (a) (5) of the MMPA and in accordance with 50 CFR § 216 Subpart I, in support of the Applicant's survey activities. Both NOAA and BOEM have advised that sound-producing survey equipment operating below 200 kHz (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz. As a result, the following four species are requested to be approved for take by Level B Harassment for HRG surveys in the spring of 2017:

- Fin whale (*Balaenoptera physalus*)
- Bottlenose dolphin (*Tursiops truncatus*);
- Short beaked common dolphin (*Delphinus delphis*); and,
- Harbor porpoise (*Phocoena phocoena*).

As discussed further in the following sections, with the application of the proposed mitigation and monitoring measures detailed in Section 11.0, it is expected that the take of the aforementioned marine mammals will be successfully avoided.

5.2 Geotechnical Survey Activities

As detailed in Section 1.2.2, DP thruster use would generate underwater noise with sounds exceeding the 120 dB_{RMS} re 1 µPa threshold for Level B harassment for continuous sound. The Applicant is requesting the authorization for the incidental take by harassment, of small numbers of marine mammals in the waters of the Mid-Atlantic pursuant to Section 101 (a) (5) of the MMPA and in accordance with 50 CFR § 216 Subpart I, in support of the Applicant's survey activities. However, considering the brief duration of geotechnical survey activities, relatively small, previously measured zone of influence (ZOI) of only 500 m (as discussed below in Section 6.2), and proposed mitigations (presented below in Section 11), the requested estimated take by Level B Harassment by DP thruster use in support of geotechnical surveys is exceedingly small.

As a result, the following two species are requested to be approved for take by Level B Harassment for DP thruster use in the spring of 2017:

- Bottlenose dolphin (*Tursiops truncatus*); and,
- Harbor seal (*Phoca vitulina*).

As discussed further in the following sections, with the application of the proposed mitigation and monitoring measures detailed in Section 11.0, it is expected that the take of the aforementioned marine mammals will be successfully avoided.

6. Take Estimates for Marine Mammals

The Applicant seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NMFS in the proposed region of activity. Species for which authorization was evaluated include the North Atlantic right, humpback, fin, sperm, and minke whales, as well as bottlenose and common dolphins, harbor porpoise, and harbor seals. These nine species, described in detail in Section 4.0, have the highest likelihood of occurring, at least occasionally, in the Lease Area during the proposed survey events. As detailed further, the Applicant seeks authorization for the potential of "taking" of the following five species:

- Fin whale (*Balaenoptera physalus*)
- Bottlenose dolphin (*Tursiops truncatus*);
- Short beaked common dolphin (*Delphinus delphis*);
- Harbor porpoise (*Phocoena phocoena*); and,
- Harbor seal (*Phoca vitulina*).

Anticipated impacts to marine mammals from the proposed survey activities will be associated with noise propagation from the use of specific HRG survey equipment and from the use of the drill ship DP thrusters. It should be noted that the estimates of exposure for marine mammals as presented in this section are conservative. Based on the review of protected species observer sightings reports for similar surveys conducted along the Atlantic coast, data suggests that with the application of the mitigation and monitoring actions as proposed in Section 11.0, that exposure of marine mammals to harassing level acoustic levels during survey activities can be effectively minimized (ESS 2013; Dominion 2013 and 2014).

6.1 Basis for Estimating Numbers of Marine Mammals that Might be "Taken by Harassment"

Most marine animals can perceive underwater sounds over a broad range of frequencies from about 10 hertz (Hz) to more than 10,000 Hz (10 kHz). Many of the dolphins and porpoises use even higher

frequency sound for echolocation and perceive these high frequency sounds with high acuity. Marine mammals respond to low-frequency sounds with broadband intensities of more than about 120 dB re 1 µPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al. 1991). The functional hearing ranges for the marine mammals in this evaluation have a potential for acoustic take by Level B harassment in the Lease Area at the time of the proposed surveys (see Table 1-2 for hearing ranges by functional hearing groups).

Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Potential effects of anthropogenic sounds to marine mammals can include physical injury (e.g., temporary or permanent loss of hearing sensitivity), behavioral modification (e.g., changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds).

The survey activities that have the potential to cause harassment as defined by the MMPA include the noise produced by various HRG survey data acquisition equipment and the noise produced by the drill ship DP thrusters. As stated previously, the Applicant conducted hydroacoustic modeling assessments and field verification of the representative HRG survey equipment to better understand both the level and extent of underwater noise generated by the marine site characterization survey activities and their potential to impact marine species. (Gardline 2016, Subacoustech 2016)

6.1.1 Basis for HRG Survey Take Estimates

The basis for the HRG survey take estimate is the number of marine mammals that would be exposed to sound levels in excess of Level B harassment criteria for impulsive noise (160 $dB_{RMS90\%}$ re 1 µPa). Typically this is determined by multiplying the ZOI out to the Level B harassment criteria isopleth by local marine mammal density estimates, and then correcting for seasonal use by marine mammals, seasonal duration of project-specific noise-generating activities, and estimated duration of individual activities when the maximum noise-generating activities are intermittent or occasional. In the absence of any part of this information, it becomes prudent to take a conservative approach to ensure the potential number of takes is not greatly underestimated.

Field verification studies were performed for the Bay State Wind Lease Area and reviewed by both NOAA and BOEM (Gardline 2016, Gardline, 2017). Upon request by NMFS, the Bay State Wind field verification measurements were revised (NMFS personal communication by email dated April 11, 2017). Source levels were back calculated by fitting measurement data to a spherical propagation model (Gardline 2017). This approach is more conservative than using practical spreading when determining apparent source levels. The RMS source levels for acoustic equipment to be utilized by Ocean Wind are presented in Table 6-1.

Table 6-1 Field Verified HRG Survey Data Acquisition Equipment Apparent Source Levels (RMS)

Representative HRG Survey Equipment	Apparent Source Level Measured During Bay State Wind Survey
Sonardyne Ranger 2 USBL	166.10 dB_{RMS}
Klein 3000H Sidescan Sonar	N/A
GeoPulse Sub-bottom Profiler	172.45 dB_{RMS}
Geo-Source 600/800	182.10 dB_{RMS} / 188.15 dB_{RMS}
SeaBat 7125 Multibeam Sonar	N/A

NMFS requested that forward calculated distances for noise thresholds be calculated use the conservative practical spreading model. As noted in Table 5-2, the 800J Geo-Source is the loudest sound source and therefore governs the Zone of Impact determination for the survey. The distance to the Level B harassment threshold is 2.56 m for the USBL system, 6.77 m for the sub-bottom profiler, and 75.28 m for the 800J setting of the Geo-Source. As a conservative measure to account for some of the potential variation of operating conditions, the maximum distance to the Level B harassment threshold is used to determine estimated exposure for HRG survey equipment (75.28 m). Field verification for the Bay State Wind Project was conducted under similar operating conditions and with similar data acquisition equipment as will be encountered during the proposed Ocean Wind HRG survey. It is worth noting that this propagation method does not consider the beamwidth or directivity of the sound sources, or the variable characteristics of the ocean environment, both of which can reduce horizontal propagation distances.

6.1.2 Basis for Geotechnical Survey Take Estimates

The basis for the take estimate is the number of marine mammals that would be exposed to sound levels in excess of Level B harassment criteria (120 dB_{RMS} re 1 µPa). Distance to the Level B harassment criteria was field verified during work conducted Bay State Wind Lease Area. While field verification for the Bay State Wind geotechnical survey indicates that the distance to the 120 dB isopleth reaches approximately 1,640 ft (500 m) from the DP vessel (Subacoustech 2016), the Applicant has applied this 1,640-ft (500-m) radial ZOI for the drill ship thrusters, as previously approved by BOEM and NOAA. As with HRG survey, the representative area ensonified to the MMPA Level B threshold for DP thruster use was used to estimate take. The maximum critical distance to the MMPA threshold was also used to support the development of the monitoring and/or mitigation programs (see Section 11.0).

6.2 Estimate of Numbers of Marine Mammals that Might be "Taken by Harassment"

Estimates of take are computed according to the following formula as provided by NOAA (Personal Communication, November 24, 2015):

Estimated Take = D x ZOI x (d)

Where:

D = average highest species density (number per m^2)

ZOI = maximum ensonified area to MMPA thresholds for impulsive noise (160 $dB_{RMS90\%}$ re 1 µPa); maximum ensonified area to MMPA thresholds for continuous noise (120 dB_{RMS} re 1 µPa)

d = number of days

Per new NOAA guidance for mobile sound sources, the ZOI was calculated according to the following formula (Personal Communication, November 24, 2015):

ZOI = maximum ensonified area around the sound source x the line miles traveled over a 24-hr period.

It should be noted however, that this calculation will result in an over conservative ZOI as it assumes that once an area along a survey trackline is ensonified by the sound source that the area will remain ensonified at a level that will result in Level B acoustic take (160 $dB_{RMS90\%}$ re 1 µPa) throughout the entire 24-hr period. As evidenced in Appendices A, B and C and summarized in Sections 1.2.1 and 1.2.2, the only time survey activities could result in take by Level B acoustic harassment is if a marine mammal were to enter into the ensonified area associated with the HRG survey equipment being operated and by the drill ship DP thrusters.

The data used as the basis for estimating cetacean density ("D") for the Lease Area are sightings per unit effort (SPUE) derived by Duke University (Roberts et al. 2016). For pinnipeds, the only available

comprehensive data for seal abundance continues to be the Northeast Navy Operations Area (OPAREA) Density Estimates (DoN 2007). SPUE (or, the relative abundance of species) is derived by using a measure of survey effort and number of individual cetaceans sighted. SPUE allows for comparison between discrete units of time (i.e. seasons) and space within a project area (Shoop and Kenney, 1992). The Duke University (Roberts et al. 2016) cetacean density data represent models derived from aggregating line-transect surveys conducted over 23 years by 5 institutions (NOAA NMFS Northeast Fisheries Science Center [NEFSC], New Jersey Department of Environmental Protection [NJDEP], NOAA NMFS Southeast Fisheries Science Center [SEFSC], University of North Carolina Wilmington [UNCW], Virginia Aquarium & Marine Science Center [VAMSC]), the results of which are freely available online at the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) repository. Monthly density values were within the survey area were averaged by season to provide seasonal density estimates. The OPAREA Density Estimates (DoN 2007) used for pinniped densities were based on data collected through NMFS Northeast Fisheries Science Center aerial surveys conducted between 1998 and 2005.

Due to the spatial distribution and transient nature of marine mammal species identified; the relatively short duration of the activities and the time of year the Applicant proposes to conduct marine characterization survey activities; and the implementation of the mitigation measures as described in Section 11.0, these activities are not likely to result in serious injury or death of marine mammals. In addition, the take estimates as provided in Section 6.2.1 are not only based on an overly conservative ZOI but they do not take into consideration mitigation measures and therefore are likely a significant overestimate of the actual potential for take by Level B acoustic harassment.

6.2.1 Estimate of Potential Project HRG Survey Takes by Harassment

The maximum critical distances to the MMPA thresholds of 246.98 ft (75.28 m), as calculated above in Section 6.1.1 based on final Bay State Wind Lease Area field verification report measurements (Gardline 2016, Subacoustech 2016), has been used to estimate potential take. A survey track line with 900x900 m line spacing, including additional 100x100 m line spacing was used to estimate total track length (approximately 1,560 km) and total survey duration given a vessel speed of 4 nautical miles per hour (knots). Estimates of take by HRG survey equipment has been based on a daily ZOI of 10.35 mi^2 (26.8 km^2) and a resulting total survey period of 42 days. The daily ZOI is based on the worst case ensonified radial distance of 246.98 ft (75.28 m) and a maximum survey track line of 110.4 mi (177.6 km) per day (24-hour period) based on an average vessel speed of 4 knots. Density data from Roberts et al. (2016) were mapped within the boundary of the Lease Area (Figure 1-1) using geographic information systems (GIS). Based on the proposed HRG survey schedule (June 2017), take calculations were based on the average summer seasonal species density (June through August) as reported by Roberts et al. (2016) within the Lease Area boundary. Mid-Atlantic OPAREA Density Estimates (DoN 2007) as reported for the summer season were used to estimate pinniped densities.

The resulting take estimates (rounded to the nearest whole number) for North Atlantic right, humpback, fin, sperm and minke whales, as well as, bottlenose and common dolphins, harbor porpoise, and harbor and gray seals are presented in Table 6-2. Statistically, the numbers presented in Table 6-2 represent a maximum for take estimates of 0.062, 0.386, 0.018, and 0.006 percent of the respective populations (Table 3-1) for fin whales, bottlenose and common dolphins, and harbor porpoise, and 0.000 percent of the respective populations (Table 3-1) for each of the remaining species listed. Since the calculation does not take into account whether the animal "harassed" is the same individual multiple times – which is a potential scenario and would result in actual harassment to far fewer individuals than calculated but in a higher

cumulative take for those individual animals – the calculated take numbers are thus considered the upper boundary of the animal population that could be affected. These numbers also represent potential take based on an assumption that no mitigation is applied during HRG survey activities, which will not be the case. Mitigation and monitoring of potential take during HRG survey activities is detailed in Section 11.0. Based on the review of protected species observer sightings reports of similar surveys conducted along the Atlantic coast, it is expected that with the application of the proposed mitigation and monitoring measures, the take of marine mammals as presented in Table 6-2 will be avoided. (ESS 2013; Dominion 2013 and 2014).

Table 6-2 Marine Mammal Density and Estimated Level B Harassment Take Numbers during HRG Survey Activities

Species	Density for Summer (No./100 km²)	Calculated Take (No.)	Requested Take Authorization (No.)
North Atlantic right whale	0.00	0.03	0
Humpback whale	0.01	0.14	0
Fin whale	0.08	0.89	1
Sperm whale	0.01	0.06	0
Minke whale	0.02	0.22	0
Bottlenose dolphin	25.34	284.81	285
Short beaked common dolphin	2.82	31.64	32
Harbor porpoise	0.12	1.39	5 a/
Harbor seal	0.00	0.00	0

a/ Requested authorization increased to anticipated pod size for harbor porpoise.

6.2.2 Estimate of Potential DP Thrusters Takes by Harassment

Estimates of DP vessel thruster use during geotechnical survey activities have been based on a maximum ZOI of 0.31 mi² (0.79 km²). As detailed in Section 6.1.2, this ZOI represents the field-verified ensonified area for DP thruster use. DP thruster use is expected to take place for a period of approximately 12 days. Based on the proposed geotechnical survey schedule (October 2017), take calculations were based on the average fall seasonal species density (September through November) as reported by Roberts et al. (2016), mapped within the boundary of the Lease Area (Figure 1-1) in the same manner as described in section 6.2.1. Pinniped density for the fall season was estimated using the Mid-Atlantic OPAREA Density Estimates (DoN 2007) in the same manner as described in section 6.2.1. Based upon these conservative assumptions, estimated take (rounded to the nearest whole number) for North Atlantic right, humpback, fin, sperm and minke whales, as well as, bottlenose and common dolphins, harbor porpoise, and harbor seals are presented in Table 6-3. Given the lower population densities during the survey time period, short duration of activities, and the relatively small field-verified ensonified area, the calculated takes for fin, sperm and minke whales, as well as, common dolphins and harbor porpoise, and harbor seals were all estimated to be 1 or less at a fraction of an individual. Statistically, the numbers presented in Table 6-3 represent a maximum for take estimates of 0.001 percent of respective populations (Table 3-1) for bottlenose dolphins and harbor seals, and 0.000 percent of the respective populations (Table 3-1) for each of the remaining species listed. Mitigation and monitoring of potential species interactions during geotechnical survey activities is detailed in Section 11.0. It is expected, that with the application of the proposed mitigation and monitoring measures, the take of marine mammals as presented in Table 6-3 will be avoided.

Table 6-3 Marine Mammal Density and Estimated Level B Harassment Take Numbers during DP Thruster Activities

Species	Density for Fall (No./100 km²)	Calculated Take (No.)	Requested Take Authorization (No.)
North Atlantic right whale	0.01	0.00	0
Humpback whale	0.01	0.00	0
Fin whale	0.06	0.01	0
Sperm whale	0.00	0.00	0
Minke whale	0.01	0.00	0
Bottlenose dolphin	11.44	1.08	1 [a/]
Short beaked common dolphin	2.81	0.27	0
Harbor porpoise	0.16	0.02	0
Harbor seal	9.74	0.92	1

a/ It is understood that typical pod size for bottlenose dolphins can be 2 to 15 individuals (NOAA 2015b). Given that take for this species has been requested to cover HRG survey activities, in conjunction with proposed mitigations, the Applicant has determined that increasing take to account for pod size is not necessary.

7. Anticipated Impacts of the Activity

Consideration of negligible impact is required for NMFS to authorize the incidental take of marine mammals. In 50 CFR § 216.103, NMFS defines negligible impact to be "an impact resulting from a specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks [of marine mammals] through effects on annual rates of recruitment or survival." Based upon best available data regarding the marine mammal species (including density, status, and distribution) that are likely to occur in the Lease Area, the Applicant concludes that exposure to marine mammal species and stocks during marine site characterization surveys would result in short-term minimal effects and would not affect the overall annual recruitment or survival for the following reasons:

- As detailed in Section 1.2 and submitted field verification reports (Gardline 2016; Subacoustech 2016), potential acoustic exposures from survey activities are within the non-injurious behavioral effects zone (Level B harassment);
- The potential for take as estimated in Sections 6.2.1 and 6.2.2 represents a highly conservative estimate of harassment based upon typical HRG survey scenarios and DP vessel operations utilizing an overly conservative ZOI and without taking into consideration the effects of standard mitigation and monitoring measures; and
- The protective measures as described in Section 11.0 are designed to avoid and/or minimize the potential for interactions with and exposure to marine mammals.

Marine mammals are mobile free-ranging animals and have the capacity to exit an area when noise-producing survey activities are initiated. Based on the conservative take estimations, survey activities may disturb more than one individual for some species (mainly dolphins), but in conjunction with other aforementioned factors we conclude the short-term HRG survey activities and geotechnical survey DP thruster use are not expected to result in population-level effects and that individuals will return to normal behavioral patterns after activities have ceased or after the animal has left the area under survey.

8. Anticipated Impacts on Subsistence Uses

There are no traditional subsistence hunting areas in the Lease Area.

9. Anticipated Impacts on Habitat

9.1 HRG Survey Activities

Bottom disturbance associated with the HRG activities may include grab sampling to validate the seabed classification obtained from the multibeam echosounder/sidescan sonar data. This will typically be accomplished using a Mini-Harmon Grab with 0.1 m^2 sample area or the slightly larger Harmon Grab with a 0.2 m^2 sample area. The temporary and localized impact of the ZOI in relation to the comparatively vast area of surrounding open ocean, would render any potential impacts to prey availability or potential avoidance by marine mammals would be insignificant and not likely to affect marine mammal species. The HRG survey equipment will not contact the seafloor and would not be a source of air or water pollution. Impact to prey species is expected to be limited to avoidance of the area around the HRG survey activities and short-term changes in behavior. Such impacts are not expected to result in population-level effects on prey species (BOEM 2012). Individuals disturbed by a survey would likely return to normal behavioral patterns after the survey has ceased or after the animal has left the survey area. Because of the limited immediate area of ensonification and duration of individual HRG surveys, few fish may be expected in most cases to be present within the survey areas (BOEM 2012).

Impact on marine mammal habitat from these activities will be negligible.

9.2 Geotechnical Survey Activities

Bottom disturbance associated with the geotechnical survey program will consist of the 8 deep bore holes of approximately 3 to 4 inches (in; 7.6 to 10.1 centimeters [cm]) diameter, the 30 shallow CPTs of up to approximately 2 in (5 cm) in diameter, and the 8 deep CPTs approximately 2 in (5 cm) in diameter. To the extent that sediment samples are collected by drilling equipment, the disposition of the sediment core material itself could cause short-term water quality impacts, such as turbidity and a degradation of water clarity in the immediate area of disturbance. These impacts are anticipated to be temporary and minor (BOEM 2012).

Due to the small footprint of geotechnical survey activities, the temporary nature of the action, and likely availability of similar benthic habitat around the sampling location, it is expected that this activity would have negligible benthic effects that could impact prey species occurring in the immediate area (BOEM 2012). Impact on marine mammal habitat from these activities will be negligible.

10. Anticipated Effects of Habitat Impacts on Marine Mammals

As stated in Section 9.0, the effects to marine mammals from loss or modification of habitat from the proposed survey activities will be insignificant and discountable.

11. Mitigation Measures

The Applicant commits to engaging in ongoing consultations with NMFS. Per the Lease, the Applicant has committed the following comprehensive set of mitigation measures during marine site characterization surveys. The mitigation procedures outlined in this section are based on protocols and procedures that

have been successfully implemented and resulted in no take of marine mammals for similar offshore projects and previously approved by NMFS (ESS 2013; Dominion 2013 and 2014). Unless otherwise specified, the following mitigation measures apply to both HRG survey and geotechnical survey activities.

11.1 Vessel Strike Avoidance Procedures

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans, pinnipeds, and sea turtles and slow down or stop their vessels to avoid striking these protected 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, but are not limited to, 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 and crew will maintain vigilant watch for cetaceans, pinnipeds and sea turtles and slow down or stop their vessel to avoid striking these protected species.
- 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 500 m or greater from any sighted North Atlantic right whale.
- If underway, vessels must steer a course away from any sited North Atlantic right whale at 10 knots (<18.5 km/h) or less until the 500 m minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path, or within 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 100 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m.
- All vessels will maintain a separation distance of 100 m 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.
- All vessels will maintain a separation distance of 50 m or greater from any sighted delphinoid cetacean. Any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Any vessel underway reduces vessel speed to 10 knots 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.
- All vessels underway will not diver to approach any delphinoid cetacean or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted delphinoid cetacean or pinniped.
- All vessels will maintain a separation distance of 50 m (164 ft) 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.

11.2 Seasonal Operating Requirements

Between watch shifts members of the monitoring team will consult 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 coasts of Delaware and New Jersey. The proposed survey activities will also occur in June and October, 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 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 DMN the Applicant will work with NMFS to shut down and/or altered the survey activities to avoid the DMA.

11.3 Exclusion and Monitoring Zone Implementation

An exclusion zone will be established and continuously monitored to minimize impacts to marine mammals and sea turtles in accordance with the following:

- *HRG Survey* – The Applicant will establish and maintain the 200-m default exclusion zone specified in stipulation 4.4.6.1 of the New Jersey OCS-A 0498 Lease Agreement, recognizing that this is highly conservative,. 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 (Section 11.1). These stated requirements will be included in the site-specific training to be provided to the survey team.
- *DP Vessel Thruster Use during Geotechnical Survey* – The Applicant proposes to establish and maintain a 500-m monitoring and exclusion zone during the use of DP thrusters. This monitoring zone is based on field-verified distances established during similar survey work conducted within the Bay State Wind Lease Area (Subacoustech 2016). This monitoring and exclusion zone will be established to prevent potential marine mammal interactions during all geotechnical operations where DP thrusters are employed, as described in Section 1.2.2.

11.4 Visual Monitoring Program

An exclusion zone is an area established for the Protected Species Observers (PSOs) to monitor for the presence of marine mammals. While recognizing that the minimum 200-m default exclusion zone for HRG survey equipment, as specified in the New Jersey OCS-A 0498 Lease Agreement stipulation 4.4.6.1., may be overly conservative, the Applicant will establish a 200-m default exclusion zone for all HRG survey operations. Like exclusion zones, a monitoring zone is an area established for the PSOs to monitor for the presence of marine mammals. Visual monitoring of the established exclusion and monitoring zone(s) will be performed by qualified and NMFS-approved PSOs. Observer qualifications will include direct field experience on a marine mammal/sea turtle 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, 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, and 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. The Applicant will provide resumes of all proposed PSOs and PAM operators (including alternates) to BOEM for review and approval by NMFS at least 45 days prior to the start of survey operations. Each PSO will follow the specified monitoring period for each of the following survey activities:

- *HRG Survey* – Per the results of the final HRG field verification study performed for the Bay State Wind Lease Area (Gardline 2016), the Applicant proposes to employ a 200-meter exclusion zone during HRG surveys when noise-producing data acquisition equipment is in operation. PSOs will be responsible for visually monitoring and identifying marine mammals approaching 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 enforce 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.

  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 siting 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, night-vision equipment (Appendix B), and infrared technology (Appendix C) will be used. Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.

  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.

  The PSOs will begin observation of the exclusion zone 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.

  Data on all PAM/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 and sea turtles. 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.
- *DP Vessel Thruster Use during Geotechnical Survey* – The PSOs will begin observation of the monitoring zone during all geotechnical operations where DP thrusters are employed. Observations of the monitoring zone will continue throughout the survey activity and/or while DP thrusters are in

use. PSOs will be responsible for visually monitoring and identifying marine mammals approaching or entering the established monitoring zone 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 enforce 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.

PSOs will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to the vessel and/or monitoring zone using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the siting 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, night-vision equipment, and infrared technology will be used. Position data will be recorded using hand-held or vessel GPS units for each sighting.

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 PAM/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 and sea turtles. 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.

11.5 Passive Acoustic Monitoring Program

To support 24-hour survey operations, the Applicant will include PAM as part of the project monitoring during the geophysical and geotechnical survey programs during nighttime operations to provide for optimal acquisition of species detections at night. 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 75 Hz to 30 kHz).

The PAM operator(s) will monitor the hydrophone signals in real time both aurally (using headphones) and visually (via the monitor screen displays). PAM operators will communicate detections to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measure.

11.6 Ramp-Up Procedures

Where technically feasible, 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 periods of inclement conditions 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. When technically feasible the power would then be gradually turned up and other acoustic sources added in way such that the source level would increase in steps not exceeding 6 dB per 5-minute period. If marine mammals are sighted 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 or sea turtles are sighted for a period of 60 minutes.

The DP vessel thrusters will be engaged to support the safe operation of the vessel and crew while conducting geotechnical survey activities and require use as necessary. Therefore, there is no opportunity to engage in a ramp-up procedure.

11.7 Shut-Down and Power-Down Procedures

The exclusion and monitoring zone around the noise-producing activities (HRG survey equipment and DP Thruster use) will be maintained, 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. The following outlines the shut-down procedures:

- *HRG Survey* – If a non-delphinoid cetacean or sea turtle is sighted at or within the established exclusion zone (200-meter during HRG survey data acquisition equipment operation), 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 of all cetaceans, pinnipeds, and sea turtles for 60 minutes.

  If a delphinoid cetacean or pinniped is sighted at or within the exclusion zone, the HRG survey equipment (including the sub-bottom profiler) must be powered down to the lowest power output that is technically feasible. 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 or (2) a determination by the PSO after a minimum of 10 minutes of observation that the delphinoid cetacean or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. An incursion into the exclusion zone by a non-delphinoid cetacean or sea turtle during power down requires implementation of the shut-down procedures as described above.

  If the HRG sound source (including the sub-bottom profiler) shuts down for reasons other than encroachment into the exclusion zone by a non-delphinoid cetacean or sea turtle 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, pinnipeds and sea turtles for 60 minutes. If the pause is less than 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, pinnipeds, and sea turtles. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart 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, pinnipeds, and sea turtles for 60 minutes.

- *DP Vessel Thruster Use during Geotechnical Survey* – During geotechnical survey activities, a constant position over the drill, coring, or CPT site must be maintained to ensure the integrity of the survey equipment. Any stoppage of DP vessel thruster during the proposed geotechnical activities has the potential to result in significant damage to survey equipment. Therefore, during geotechnical survey activities if marine mammals enter or approach the established exclusion and monitoring zone, the Applicant proposes to reduce DP thruster to the maximum extent possible, except under circumstances when reducing DP thruster use would compromise safety (both human health and environmental) and/or the integrity of the equipment. Reducing thruster energy will effectively reduce the potential for exposure of marine mammals and sea turtles to sound energy. After decreasing thruster energy, PSOs will continue to monitor marine mammal and/or sea turtle behavior and determine if the animal(s) is moving towards or away from the established monitoring zone. If the animal(s) continues to move towards the sound source then DP thruster use would remain at the reduced level. Normal use will resume when PSOs report that the marine mammals have moved away from and remained clear of the monitoring zone for a minimum of 60 minutes since last the sighting.

12. Arctic Plan of Cooperation

Potential impacts to species or stocks of marine mammals will be limited to individuals of marine mammal species located in the northeast region of the United States, and will not affect Arctic marine mammals. Given that the Project is not located in Arctic waters, the activities associated with the Applicant's marine characterization surveys will not have an adverse effect on the availability of marine mammals for subsistence uses allowable under the MMPA.

13. Monitoring and Reporting

13.1 Monitoring

Visual and passive acoustic monitoring protocols are described in Section 11.

13.2 Reporting

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

- The Applicant will contact BOEM and NMFS within 24 hours of the commencement of survey activities and again within 24 hours of the completion of the activity.
- Any observed significant behavioral reactions (e.g., animals departing the area) or injury or mortality to any marine mammals or sea turtles must be reported to BOEM and NMFS within 24 hours of observation. Dead or injured protected species (e.g., marine mammals, sea turtles and sturgeon) are reported to NMFS Northeast Region's 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 BOEM and NMFS 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 or the injury or death, the vessel must assist with any salvage effort as requested by NMFS.

- Within 90 days after completion of the marine site characterization survey activities, a final technical report will be provided to BOEM, and NMFS that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during survey activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

In addition to the 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 to BOEM and NOAA 30 days after the completion of survey activities and as a final version 60 days after completion of the survey.

14. Suggested Means of Coordination Research

All marine mammal data collected by the Applicant during marine characterization survey activities will be provided to NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking and evaluate its effects.

All hydroacoustic data and resulting transmission loss rates collected during field verification of the safety and/or exclusion zone by the Applicant during HRG surveys will be provided to NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking from survey activities and evaluate its effects.

15. List of Preparers

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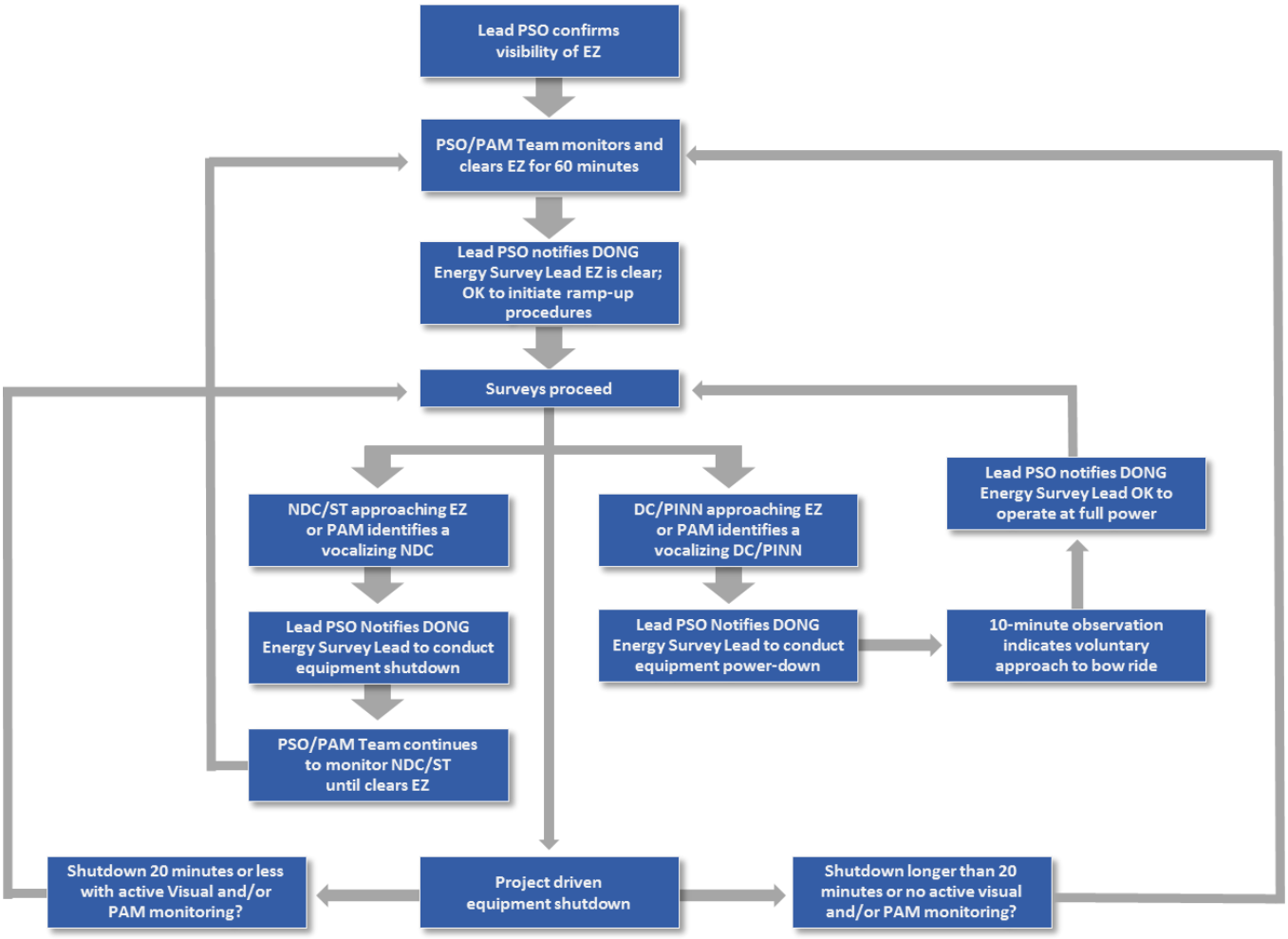
Appendix A

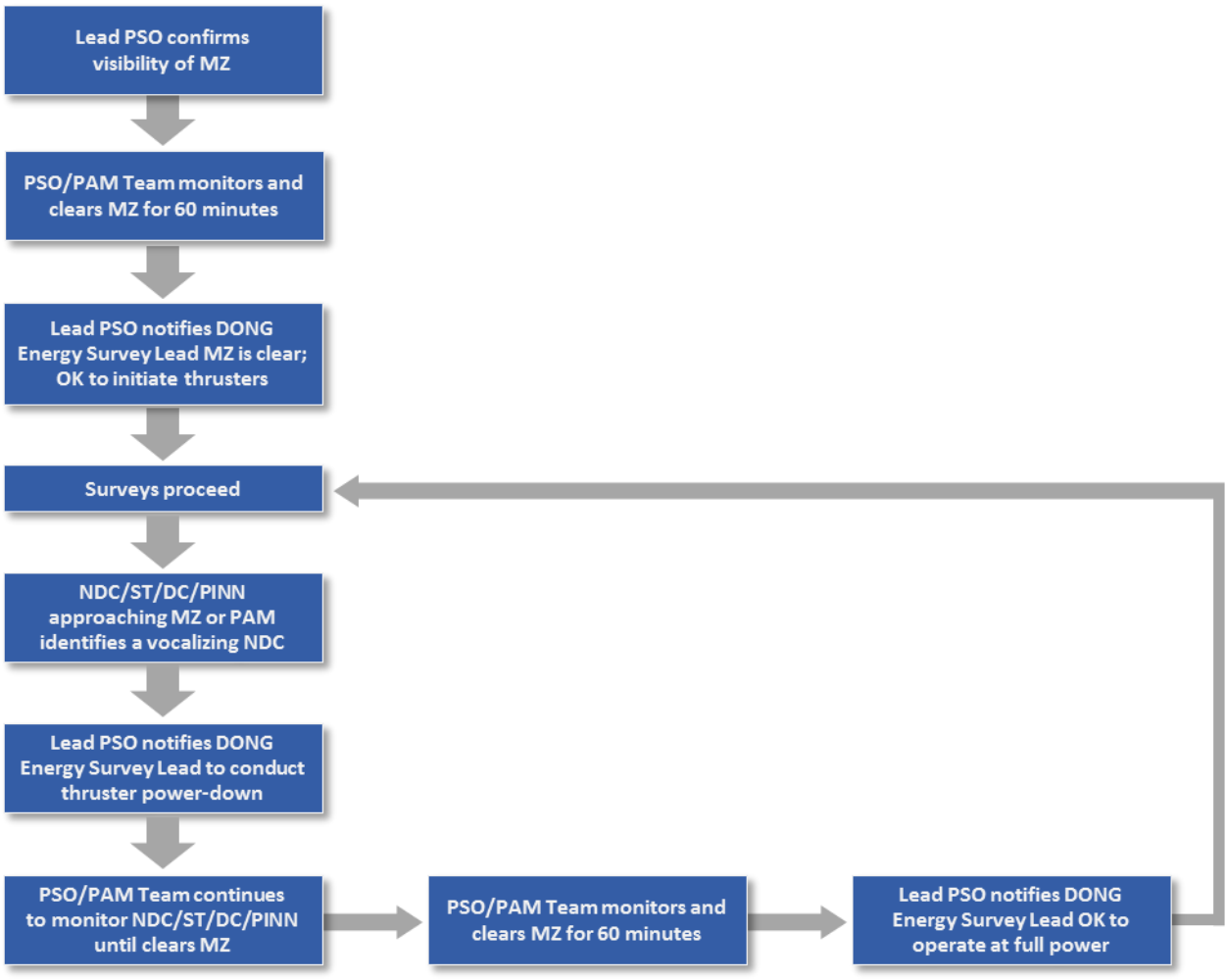
Ocean Wind Offshore Wind Farm – Mitigation and Monitoring Communications Flow Diagrams

HRG Survey Communications Flow Diagram



PSO = Protected Species Observer
PAM + Passive Acoustic Monitor
EZ= Exclusion Zone
NDC = Non-Delphinoid Cetacean
ST = Sea Turtle
DC = Delphinoid Cetacean
PINN = Pinniped

Geotechnical Survey Communications Flow Diagram



PSO = Protected Species Observer
PAM + Passive Acoustic Monitor
MZ= Exclusion Zone

DC = Delphinoid Cetacean
NDC = Non-Delphinoid Cetacean

ST = Sea Turtle
PINN = Pinniped

Appendix B

Night Vision Equipment Specifications

MOROVISION NIGHT VISION
LIGHT THE NIGHT™

PVS-7 Goggle Generation 3 PINNACLE®

The PVS-7 (PVS-7B/D) is the standard issue goggle type supplied to the U.S. Military and its allies. Equipped with a factory new, high-performance, ITT Generation 3 **PINNACLE®** image intensifier tube, the PVS-7 Gen 3 **PINNACLE®** night vision goggle is designed for the most demanding of night time applications. Battle-proven technology includes Automatic Brightness Control (ABC) which automatically adjusts the brightness of the image tube to achieve the highest quality image resolution under varying light conditions as well as a built-in infra-red illuminator which allows the user to operate under zero light conditions. Lightweight and versatile, the PVS-7 Gen 3 **PINNACLE®** night vision goggle can be hand-held, head-mounted, and helmet-mounted. Standard accessories and System Data Sheet included.

PART #: MVP-MVPVS7-3P

Standard Accessories Included:

- **Head Mount Assembly** – Allows for hands free operation. Accommodates user's head size and eye positioning.
- **Medium & Thick Brow Pads** – Changeable pads. **Eye Cups** - Prevents the emission of stray light or facial reflections.
- **Lens Cap**
- **Soft Carrying Case** – Provides convenient storage.
- **Shoulder Strap** – Attaches to the PVS-7 carrying case for easy portability.
- **Lens Paper** – Used to lightly clean the objective and eyepiece glass surfaces.
- **Sacrificial Window**– Shields the optics from sand, air particles or anything that may scratch the lens.
- **Demist Shields** – Snaps onto the eyepiece to prevent condensation from forming on the optics.
- **Operators Manual** - Instructional users guide.
- **Batteries** – Two (2) AA
- **Data Sheet** – System Test Data Sheet

Features and Benefits:

- High resolution 64 lp/mm (Min) **PINNACLE®**, high gain and high photoresponse in visible and near infrared
- Multifunctional: Hand-held, head-mounted or helme mounted.
- Lightweight only 24 oz w/ batteries
- Equipped with momentary or continuous IR switch
- Automatic high-light cutoff
- Comprehensive two-year warranty

Optional Accessories (not included):

- 3x Mil-Spec Magnifier Lens
- 5x Mil-Spec Magnifier Lens
- Helmet Mount Assembly (PASGT/MICH)
- Sacrificial Window
- Magnetic Compass
- SKB Mil-Standard Hard Case
- And more... (see website)

MOROVISION NIGHT VISION, INC.
23382 Mill Creek Drive, Suite D-115
Laguna Hills, CA 92653

By Phone: Toll Free 1-800-424-8222 or 949-581-9988
By Fax: 949-581-1133
Email: info@morovision.com
Website: http://www.morovision.com

MORO VISION NIGHT VISION
LIGHT THE NIGHT™

SPECIFICATIONS: PVS-7 Goggle Generation 3 PINNACLE®

Intensifier Tube	Generation	3 U.S. (ITT PINNACLE®)
	Resolution	64 lp/mm (Min)
	Film	Thin
	Gate	Auto-Gated
Optics	Magnification	1x
	Field of View	40 ± 2°
	Objective Lens	F/1.2
	Eyepiece Lens	EFL 26mm
	Diopter Adjustment	+2 to -6 diopters
	Interpupillary Adjustment	55 to 71mm
	Range of Focus	20cm to infinity ∞
Power	Power Source	Two (2) AA size batteries
	Operating Time	Approx. 30 hrs at room temp.
Environmental Characteristics	Operating Temperature	-51° C to +52° C
	Storage Temperature	-51° C to +85° C
Physical Characteristics	Size:	
	Length	6 3/8"
	Height	3"
	Width	6"
	Weight:	
	w/batteries	24 oz (680 grams)
Warranty	System	Two (2) years

The night vision binoculars will be used in conjunction with handheld infrared spotlights:

Larson Electronics LLC www.LarsonElectronics.com
9419 E US HWY 175, Kemp, TX 75143 Phone: 903.498.3363 Fax: 903.498.3364 Email: sales@LarsonElectronics.com

Links (Click on the below items to view):

- Manual
- STEP
- DXF
- Hi-Res Image 1 - 110V Handheld Infrared LED Spotlight

Larson Electronics LLC www.LarsonElectronics.com
9419 E US HWY 175, Kemp, TX 75143 Phone: 903.498.3363 Fax: 903.498.3364 Email: sales@LarsonElectronics.com

This lightweight, ultra rugged, ergonomic handheld Larson Electronics infrared LED spotlight operates on 110VAC wall plug in. Alternatively, the step down transformer can be removed and operator can run unit off a 12 volt system (with a 12 volt plug-in cord). This Larson Electronics spotlight ships with a 25 foot cord, a 110VAC/12VDC step down transformer, and the 3W infrared LED handheld unit itself. The unique reflector and lens configuration produces a 700 foot beam in spotlight mode, with 180 lumen. This light, being IR LED, produces a wide spot pattern. Backed by a 3 year warranty, our new Larson Electronics handheld spotlight is ideal for security, hunting, police work, military operations and various other applications where a 110VAC powerful infrared handheld spotlight is needed. This unit produces light output in the 850 or 940 nanometer (NM) range. 850NM is visible through most consumer IR cameras, 940NM requires more advanced, generation 4, military grade night vision optics in order to view the beam produced by the unit. Please choose your nanometer wavelength below.

This handheld spotlight was designed for a specific purpose and the materials were chosen for the same purpose. There are many handheld lights with similar configuration, however we noticed that quality and durability does not meet the needs of most of our work oriented and industrial users.

Click Photo to Enlarge

Click Photo to Enlarge

Click Photo to Enlarge

This handheld spotlight was designed to be lightweight and durable. The materials were chosen for the same purpose. This 3 watt IR LED handheld light has a high impact nylon handle and machined aluminum LED housing. The driver board for the LED is potted within the LED head. The LED head is rated at 120,000 hours (15 years of non-stop use). The 16 gauge internal wiring and connectors are simple, well insulated and well constructed.

The reflector is uniquely shaped and shallow, capturing and focusing the light efficiently and effectively. Combined with a convex lens and inset lens positioning, this light optimally and efficiently captures and projects the right amount of light where the operator wants it. The position of the bulb and the shape of reflector are different than most handheld lighting products. The difference is in how much of the emitted light is captured and focused. In many ways, light shares the properties of the water. With many spotlights, a great deal of the light "spills" on the ground around the light source. While a beam continues to project, much of the light "spills" out around the source, robbing the desired, projected beam of its power. Often times, as much as 50 percent of the light is lost. In the Larson Electronics spotlight configuration, more than 90 percent of the emitted light is captured and focused. A side benefit of this is a reduction of "casting," a phenomenon that occurs when the light "spills" around the light source. Often times, when surrounded by water, snow or other reflective surfaces, the light spillage will cause "casting" which effectively prevents the human eye from adjusting and seeing the objects at distance the spotlight was used to see.

The infrared LED is packaged and bound within a patented reflector system. This is a single 3 Watt LED configuration, not a cluster of low grade LEDs. The reflector captures and focuses the light efficiently and effectively. A thick Lexan lens protects the LED and reflector package and the entire assembly is potted into the machined aluminum head. The black powder coating protects the aluminum from oxidation.

The light output on this handheld infrared LED light is shockingly strong. We see a lot of lighting technology, and while we saw the longevity and low current draw advantages, we weren't big fans of LEDs because they didn't project light well. They did better as short range flood lights. But recently, the developments in LEDs and related reflector technology are amazing. This light projects a bright, white beam to 700 feet and covers an area about 75 feet wide. Unlike halogen or HID lights, there is not a distinct beam edge. The beam sort of tapers off as it fans out. The 700 foot beam length means that we could read license plates, addresses and other markings at that range easily. This LED light produces an infrared light in the 850NM or 940NM range. These units require night vision optics in able to view the light produced from these

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units.
This ultra-durable handheld spotlight weighs only 13 ounces, which makes it easy to carry and operate. The unit is balanced for ergonomic comfort and handling. The ergonomic handle is 4.5 inches long, 1.5 inches deep and 5/8 inch thick, making it easy to hold, even in wet, slipper conditions. The nylon handle has a no-slip textured surface to improve grip as well. Complete with the 25' cord and the converter, this unit's total weight is approx. 9lbs.
The booted push button switch is conveniently placed so the user can easily access the switch with their fore finger for quick on/off action.
We have changed the wiring and the plug on the current model. Internally, we added 2 strain reliefs and a wire tie.
A 3/8-16 inch brass nut fixture is imbedded in the base of the handle enabling the operator to mount a magnetic base, like our MM-2 or MM-5 to the light. Alternatively, the operator can tripod mount this spotlight as well.
This Larson Electronics spotlight has a lanyard attachment at the top of the handle for users that want to secure the light in the event they lose their grip.
The materials used in the construction of the light are UV, water, impact and chemical resistant.
This handheld spotlight draws 0.03 amps on a 110 volt system.
CE CERTIFIED

Part #: HL-85-3W1-IR-110V (49602)

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Links (Click on the below items to view):

- Manual
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- Hi-Res Image 1 - 110V Handheld Infrared LED Spotlight

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- Hi-Res Image 2 - 110V Handheld Infrared LED Spotlight
- Hi-Res Image 3 - 110V Handheld Infrared LED Spotlight
- Hi-Res Image 4 - 110V Handheld Infrared LED Spotlight
- Hi-Res Image 5 - 110V Handheld Infrared LED Spotlight
- Hi-Res Image 6 - 110V Handheld Infrared LED Spotlight
- Hi-Res Image 7 - 110V Handheld Infrared LED Spotlight

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HL-85-3W1-IR

INFRARED LIGHT

1. These handheld spotlights are offered in 850 nanometer and 940 nanometer configurations. A night vision system (i.e. night vision goggles or an infrared camera) *is required* to be able to use the infrared light output of this handheld spotlight.
2. 850NM can be seen by GEN 2 night vision systems. Typical night vision goggles are GEN 2.
3. 940NM can be seen by GEN 3 night vision systems. Most 940NM systems are government use equipment.

POWER

1. The spotlight can be plugged into cigarette plug sockets, attached directly to 12 volt DC batteries, etc.
2. Each unit is configured for either 12 volts or 24 volts. They are multi-voltage and can operate on any *low voltage* power supply from 9 to 32 volts DC.
3. Power transformers (DCP-5-DP) can be purchased through our website to run this LED spotlight from household wall outlets.

DETACHABLE CORDS

1. Each cord is attached via a weatherproof 2-pin Deutsch connector.
2. The cords are detachable by depressing the tab on the top of the connectors. This enables the operator to leave the cord connected to the power source and remove and store the light.
3. Additional or replacement cords can be ordered from our website. We offer 16 foot coil cords with a cigarette plug (C-16-CC-CP), 21 foot cords with ring terminals (C-21-RT), 16 foot cords with battery clamps (C-16-BC), and 16 foot straight cords with cigarette plugs (C-16-CP).

MOUNTING

1. These units are handheld via the pistol grip handle, but can be mounted via the 3/8-16" brass nut fastener embedded into the base of the handle.
2. We offer a 100lb magnetic base (MM-2) for magnetic mounting, and a permanent mounting plate with swiveling and tilting bracket (PMB-4X4) for permanent mounting.

Appendix C

Infrared Equipment Specifications