DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XE283

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Geophysical Surveys in the Atlantic Ocean

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

ACTION: Notice; five proposed incidental harassment authorizations; request for comments.

SUMMARY: NMFS has received five requests for authorization to take marine mammals incidental to conducting geophysical survey activity in the Atlantic Ocean. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue incidental harassment authorizations (IHA) to incidentally take marine mammals during the specified activities.

DATES: Comments and information must be received no later than July 6, 2017.

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Laws@noaa.gov.*

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

Information Solicited: NMFS is seeking public input on these requests for authorization as outlined below and request that interested persons submit information, suggestions, and comments concerning the applications. We will only consider comments that are relevant to marine mammal species that occur in U.S. waters of the Mid- and South Atlantic and the potential effects of geophysical survey activities on those species and their habitat.

Comments indicating general support for or opposition to hydrocarbon exploration or any comments relating to hydrocarbon development (*e.g.,* leasing, drilling) are not relevant to this request for comments and will not be considered. Comments should indicate whether they are general to the proposed authorizations described herein or are specific to one or more of the five proposed authorizations, and should be supported by data or literature citations as appropriate.

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

SUPPLEMENTARY INFORMATION:

Availability

Electronic copies of the applications and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.nmfs.noaa.gov/pr/permits/incidental/oilgas.htm.* In case of problems accessing these documents, please call the contact listed above.

National Environmental Policy Act

In 2014, the Bureau of Ocean Energy Management (BOEM) produced a Programmatic Environmental Impact Statement (PEIS) to evaluate potential significant environmental effects of geological and geophysical (G&G) activities on the Mid- and South Atlantic Outer Continental Shelf (OCS), pursuant to requirements of the National Environmental Policy Act (NEPA). These activities include geophysical surveys in support of hydrocarbon exploration, as are proposed in the MMPA applications before NMFS. The PEIS is available online at: *www.boem.gov/Atlantic-G-G-PEIS/.* NMFS participated in development of the PEIS as a cooperating agency and believes it appropriate to adopt the analysis in order to assess the impacts to the human environment of issuance of the subject IHAs. Information in the IHA applications, BOEM's PEIS, and this notice collectively provide the environmental information related to proposed issuance of these IHAs for public review and comment.

We will review all comments submitted in response to this notice as we complete the NEPA process, including a final decision of whether to adopt BOEM's PEIS and sign a Record of Decision related to issuance of IHAs, prior to a final decision on the incidental take authorization requests.

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Summary of Requests

In 2014–15, we received five separate requests for authorization for take of marine mammals incidental to geophysical surveys in support of hydrocarbon exploration in the Atlantic Ocean. The applicants are companies that provide services, such as geophysical data acquisition, to the oil and gas industry. Upon review of these requests, we submitted questions, comments, and requests for additional information to the individual applicant companies. As a result of these interactions, the applicant companies provided revised versions of the applications that we determined were adequate and complete.

On August 18, 2014, we received an application from Spectrum Geo Inc. (Spectrum), followed by revised versions on November 25, 2014, May 14, 2015, and July 6, 2015. TGS–NOPEC Geophysical Company (TGS) submitted an application on August 25, 2014, followed by revised versions on November 17, 2014, and July 21, 2015. We also received a request from ION GeoVentures (ION) on September 5, 2014, followed by a revised version on June 24, 2015.

We subsequently posted these applications for public review and sought public input (80 FR 45195; July 29, 2015), stating that we would only consider comments relevant to marine mammal species that occur in U.S. waters of the Mid- and South Atlantic and the potential effects of geophysical survey activities on those species. We stated further that any comments should be supported by data or literature citations as appropriate, that comments indicating general support for or opposition to oil and gas exploration and development would not be considered inasmuch as such comments are not relevant to our consideration of the requests under the MMPA, and that we were particularly interested in information addressing the following topics:

1. Best available scientific information and appropriate use of such information in assessing potential effects of the specified activities on marine mammals and their habitat;

2. Application approaches to estimating acoustic exposure and take of marine mammals; and,

3. Appropriate mitigation measures and monitoring requirements for these activities.

We note that this notice for proposed IHAs does not concern one additional company (TDI-Brooks International, Inc. (TDI Brooks)) whose application was referenced in our July 29, 2015, **Federal Register** notice, and includes two other companies (WesternGeco, LLC (Western) and CGG) whose applications were not included in our July 29, 2015, notice. TDI-Brooks International, Inc. submitted a request for authorization related to a proposed survey to conduct deep water multibeam bathymetry and sub-bottom profiler data acquisition on October 22, 2014. However, public comment indicated that this application was improperly considered adequate and complete, and we subsequently concurred with this assessment and returned the application to TDI-Brooks for revision. We will provide separate notice of any proposed authorization related to this applicant upon receipt of an adequate and complete application, if appropriate.

The comments and information received during this public review period informed development of the proposed IHAs discussed in this notice, and all letters received are available online at *www.nmfs.noaa.gov/pr/permits/incidental/oilgas.htm.*

Following the close of the public review period, we received revised versions of several applications: From Spectrum on September 18, 2015, and from TGS on February 10, 2016. We received additional information from ION on February 29, 2016. Spectrum revised the scope of their proposed survey effort, while TGS and ION revised their estimates of the number of potential incidents of marine mammal exposure to underwater noise. Western submitted a request for authorization on March 3, 2015, followed by a revised version on February 17, 2016, that we determined was adequate and complete. CGG submitted a request for authorization on December 21, 2015, followed by revised versions on February 18, 2016, April 6, 2016, and May 26, 2016. These applications are adequate and complete at this time and are substantially similar to other applications previously released for public review. We do not anticipate offering additional discretionary public review of applications should we receive further requests for authorization related to proposed geophysical survey activity in the Atlantic Ocean.

All requested authorizations would be valid for the statutory maximum of one year from the date of effectiveness. All applicants propose to conduct two-dimensional (2D) marine seismic surveys using airgun arrays. Generally speaking, these surveys may occur within the U.S. Exclusive Economic Zone (*i.e.,* to 200 nautical miles (nmi)) from Delaware to approximately Cape Canaveral, Florida and corresponding with BOEM's Mid- and South Atlantic OCS planning areas, as well as additional waters out to 350 nmi from shore (Figure 1). Please see the applications for specific details of survey design. The use of airgun arrays is expected to produce underwater sound at levels that have the potential to result in harassment of marine mammals. Multiple cetacean species with the expected potential to be present during all or a portion of the proposed surveys are described below.

Because the specified activity, specified geographic region, and proposed dates of activity are substantially similar for the five separate requests for authorization, we have determined it appropriate to provide a joint notice for the five proposed authorizations. However, while we provide relevant information together, we consider the potential impacts of the specified activities independently and make preliminary determinations specific to each request for authorization, as required by the MMPA.

Description of the Specified Activities

In this section, we provide a generalized discussion that is broadly applicable to all five requests for authorization, with project-specific portions indicated.

Overview

The five applicants propose to conduct deep penetration seismic surveys using airgun arrays as an acoustic source. Seismic surveys are one method of obtaining geophysical data used to characterize the subsurface structure, in this case in support of hydrocarbon exploration. The proposed surveys would be 2D surveys, designed to acquire data over large areas in order to screen for potential hydrocarbon prospectivity. To contrast, three-dimensional surveys may use similar acoustic sources but are designed to cover smaller areas with greater resolution (*e.g.,* with closer survey line spacing). A deep penetration survey uses an acoustic source suited to provide data on geological formations that may be thousands of meters (m) beneath the seafloor, as compared with a survey that may be intended to evaluate shallow subsurface formations or the seafloor itself (*e.g.,* for hazards).

An airgun is a device used to emit acoustic energy pulses into the seafloor, and generally consists of a steel cylinder that is charged with high-pressure air. Release of the compressed air into the water column generates a signal that reflects (or refracts) off of the seafloor and/or subsurface layers having acoustic impedance contrast. When fired, a brief (~0.1 second (s)) pulse of sound is emitted by all airguns nearly simultaneously. The airguns are silent during the intervening periods, with the array typically fired on a fixed distance (or shot point) interval. This interval may vary depending on survey objectives, but a typical interval for a 2D survey in relatively deep water might be 25 m (approximately every 10 s, depending on vessel speed). The return signal is recorded by a listening device and later analyzed with computer interpretation and mapping systems used to depict the subsurface. In this case, towed streamers contain hydrophones that would record the return signal.

Individual airguns are available in different volumetric sizes and, for deep penetration seismic surveys, are towed in arrays (*i.e.,* a certain number of airguns of varying sizes in a certain arrangement) designed according to a given company's method of data acquisition, seismic target, and data processing capabilities. A typical large airgun array, as was considered in BOEM's PEIS (BOEM, 2014a), may have a total volume of approximately 5,400 in^3. The notional array modeled by BOEM consists of 18 airguns in three identical strings of six airguns each, with individual airguns ranging in volume from 105–660 in^3. Sound levels for airgun arrays are typically modeled or measured at some distance from the source and a nominal source level then back-calculated. Because these arrays constitute a distributed acoustic source rather than a single point source (*i.e.,* the ''source'' is actually comprised of multiple sources with some pre-determined spatial arrangement), the highest sound levels measurable at any location in the water will be less than the nominal source level. A common analogy is to an array of light bulbs; at sufficient distance the array will appear to be a single point source of light but individual sources, each with less intensity than that of the whole, may be discerned at closer distances. In addition, the effective source level for sound propagating in near-horizontal directions (*i.e.,* directions likely to impact most marine mammals in the vicinity of an array) is likely to be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array. The horizontal propagation of sound is reduced by noise cancellation effects created when sound from neighboring airguns on the same horizontal plane partially cancel each other out.

Survey protocols generally involve a predetermined set of survey, or track, lines. The seismic acquisition vessel (source vessel) will travel down a linear track for some distance until a line of data is acquired, then turn and acquire data on a different track. In addition to the line over which data acquisition is desired, full-power operation may include run-in and run-out. Run-in is approximately 1 kilometer (km) of full-power source operation before starting a new line to ensure equipment is functioning properly, and run-out is additional full-power operation beyond the conclusion of a trackline (typically half the distance of the acquisition streamer behind the source vessel) to ensure that all data along the trackline are collected by the streamer. Line turns typically require two to three hours due to the long trailing streamers (*e.g.,* 10 km). Spacing and length of tracks varies by survey. Survey operations often involve the source vessel, supported by a chase vessel. Chase vessels typically support the source vessel by protecting the long hydrophone streamer from damage (*e.g.,* from other vessels) and otherwise lending logistical support (*e.g.,* returning to port for fuel, supplies, or any necessary personnel transfers). Chase vessels do not deploy acoustic sources for data acquisition purposes; the only potential effects of the chase vessels are those associated with normal vessel operations.

Dates and Duration

All companies requested IHAs covering the statutory maximum of one year from the date of issuance, but the expected temporal extent of survey activity varies by company and may be subject to unpredictability due to inclement weather days, equipment maintenance and/or repair, transit to and from ports to survey locations, and other contingencies. Spectrum plans a six-month data acquisition program, consisting of an expected 165 days of seismic operations. TGS plans a full year data acquisition program, with an estimated 308 days of seismic operations. ION plans a six-month data acquisition program, with an estimated 70 days of seismic data collection. Western plans a full year data acquisition program, with an estimated 208 days of seismic operations. CGG plans a six-month data acquisition program (July–December), with an estimated 155 days of seismic operations. Seismic operations would typically occur 24 hours per day.

Specific Geographic Region

The proposed survey activities would occur off the Atlantic coast of the U.S., within BOEM's Mid-Atlantic and South Atlantic OCS planning areas (*i.e.,* from Delaware to Cape Canaveral, FL), and out to 350 nmi (648 km) (see Figure 1, reproduced from BOEM, 2014a). The seaward limit of the region is based on the maximum constraint line for the extended continental shelf (ECS) under the United Nations Convention on the Law of the Sea. Until such time as an ECS is established by the U.S., the region between the U.S. exclusive economic zone (EEZ) boundary and the ECS maximum constraint line (*i.e.,* 200–350 nmi from shore) is part of the global commons, and BOEM determined it appropriate to include this area within the area of interest for geophysical survey activity.

The specific survey areas differ within this region; please see maps provided in the individual applications (Spectrum: Figure 1; Western: Figures 1–1 to 1–4; TGS: Figures 1–1 to 1–4; ION: Figure 1; CGG: Figure 3). A map of all proposed surveys may be viewed online at: *www.boem.gov/Atlantic-G-and-G-Permitting/* (accessed on October 18, 2016); however, note that this map displays all permits requested from BOEM, including potential surveys for companies who have not yet requested authorization under the MMPA. The survey shown as ''GXTechnology'' on the referenced map is the same as what we describe here as being proposed by ION. In addition to general knowledge and other citations contained herein, this section relies upon the descriptions found in Sherman and Hempel (2009) and Wilkinson *et al.* (2009). As referred to here, productivity refers to fixated carbon (*i.e.,* g $C/m^2/yr$) which relates to the carrying capacity of an ecosystem.

BILLING CODE 3510–22–P

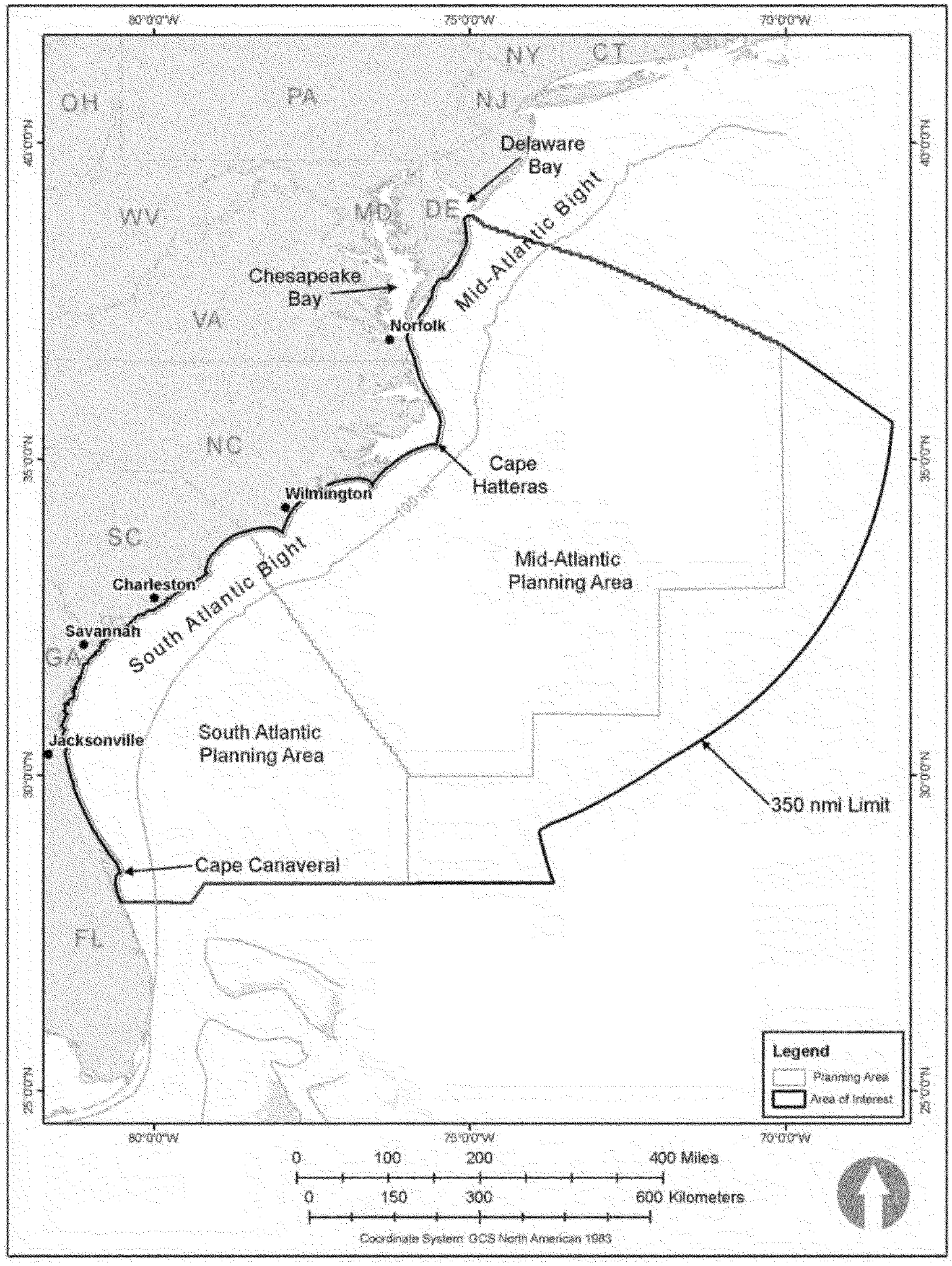

Figure 1. Specific Geographic Region

BILLING CODE 3510–22–C

The entire U.S. Atlantic coast region extends from the Gulf of Maine past Cape Hatteras to Florida. The region is characterized by its temperate climate and proximity to the Gulf Stream Current, and is generally considered to be of moderately high productivity, although the portion of the region from Cape Cod to Cape Hatteras is one of the most productive areas in the world due to upwellings along the shelf break created by the western edge of the Gulf Stream. Sea surface temperatures (SST) exhibit a broad range across this region, with winter temperatures ranging from 2–20 °C in the north and 15–22 °C in the south, while summer temperatures, consistent in the south at approximately 28 °C, range from 15–27 °C in the northern portion.

The northern portion of this region (*i.e.,* north of Cape Hatteras) is more complex, with four major sub-areas, only one of which is within the specified geographic region: The Mid-Atlantic Bight (MAB). South of Cape Cod, there is strong stratification along the coast where large estuaries occur (*e.g.,* Chesapeake Bay, Pamlico Sound). The Gulf Stream is highly influential on both the northern and southern portions of the region, but in different ways. Meanders of the current directly affect the southern portion of the region, where the Gulf Stream is closer to shore, while warm-core rings indirectly affect the northern portion (Belkin *et al.,* 2009). In addition, subarctic influences can reach as far south as the MAB, but the convergence of the Gulf Stream with the coast near Cape Hatteras does not allow for significant northern influence into waters of the South Atlantic Bight.

The MAB includes the continental shelf and slope waters from Georges Bank to Cape Hatteras, NC. The retreat of the last ice sheet shaped the morphology and sediments of this area. The continental shelf south of New England is broad and flat, dominated by fine grained sediments (sand and silt). The shelf slopes gently away from the shore out to approximately 100 to 200 km offshore, where it transforms into the continental slope at the shelf break (at water depths of 100 to 200 m). Along the shelf break, numerous deep-water canyons incise the slope and shelf. The sediments and topography of the canyons are much more heterogeneous than the predominantly sandy top of the shelf, with steep walls and outcroppings of bedrock and deposits of clay.

The southwestern flow of cold shelf water feeding out of the Gulf of Maine and off Georges Bank dominates the circulatory patterns in this area. The countervailing Gulf Stream provides a source of warmer water along the coast as warm-core rings and meanders break off from the Gulf Stream and move shoreward, mixing with the colder shelf and slope water. As the shelf plain narrows to the south (the extent of the continental shelf is narrowest at Cape Hatteras), the warmer Gulf Stream waters run closer to shore.

The southeast continental shelf area extends approximately 1,500 km from Cape Hatteras, NC south to the Straits of Florida (Yoder, 1991). The continental shelf in the region reaches up to approximately 200 km offshore. The Gulf Stream influences the region with minor upwelling occurring along the Gulf Stream front. The area is approximately 300,000 km^2, includes several protected areas and coral reefs (Aquarone, 2008); numerous estuaries and bays, nearshore and barrier islands; and extensive coastal marshes that provide habitats for numerous marine and estuarine species. A 10–20 km wide coastal zone is characterized by high levels of primary production throughout the year, while offshore, on the middle and outer shelf, upwelling along the Gulf Stream front and intrusions from the Gulf Stream cause seasonal phytoplankton blooms. Because of its high productivity, this sub-region supports active commercial and recreational fisheries (Shertzer *et al.,* 2009).

Detailed Description of Activities

Detailed survey descriptions, as given in specific applications, are provided here without regard for the mitigation measures proposed by NMFS. In some cases, our proposed mitigation measures may affect the proposed survey plan (*e.g.,* distance from coast, areas to be avoided at certain times of year). Please see ''Proposed Mitigation,'' later in this document, for details on those proposed mitigation requirements. Please see Table 1 for a summary of airgun array characteristics.

ION—ION proposes to conduct a 2D marine seismic survey off the U.S. east coast from Delaware to northern Florida (~38.5° N. to ~27.9° N.), and from 20 km from the coast to >600 km from the coast (see Figure 1 of ION's application). The survey would involve one source vessel, the M/V *Discoverer,* and one chase vessel, the M/V *Octopus,* or similar (see ION's application for vessel details). The *Discoverer* has a cruising speed of 9.5 knots (kn), maximum speed of 10 kn, and would tow gear during data acquisition at ~4 kn. The survey plan consists of five widely-spaced transect lines (~20–190 km apart) roughly parallel to the coast and 14 widely-spaced transect lines (~30–220 km apart) in the onshore-offshore direction totaling ~13,062 km of data acquisition line. Effort planned by depth bin is as follows: ~48 percent >3,000 m; ~18 percent 1,000–3,000 m; ~22 percent 100–1,000 m; ~12 percent <100 m. There would be limited additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard. Therefore, there could be some small amount of use of the acoustic source not accounted for in the total estimated line-km; however, this activity is difficult to quantify in advance and would represent an insignificant increase in effort.

The acoustic source planned for deployment is a 36-airgun array with a total volume of 6,420 in^3. The source vessel would tow a single hydrophone streamer, up to 12 km long. The 36-airgun array would consist of a mixture of Bolt 1500LL and sleeve airguns ranging in volume from 40 in^3 to 380 in^3; the larger (300–380 in^3) airguns would be Bolt airguns, and the smaller (40–150 in^3) airguns would be sleeve airguns. The difference between the two types of airguns is in the mechanical parts that release the pressurized air; however, the bubble and acoustic energy released by the two types of airguns are effectively the same. The airguns would be configured as four identical linear arrays or ''strings'' (see Figure 3 of ION's application). Each string would have nine airguns; the first and last airguns in the strings would be spaced ~15.5 m apart.

The four airgun strings would be distributed across an approximate area of 34 x 15.5 m behind the vessel and would be towed ~50–100 m behind the vessel at 10-m depth. The firing pressure of the array would be 2,000 pounds per square inch (psi). The airgun array would fire every 50 m or 20–24 s, depending on exact vessel speed—a longer interval than is typical of most industry seismic surveys. ION provided modeling results for their array, including notional source signatures, 1/3-octave band source levels as a function of azimuth angle, and received sound levels as a function of distance and direction at 16 representative sites in the proposed survey area. For more detail, please see ''Estimated Take by Incidental Harassment,'' later in this document, as well as Figures 4–6 and Appendix A of ION's application.

Spectrum—Spectrum proposes to conduct a 2D marine seismic survey off the U.S. east coast from Delaware to northern Florida, extending throughout BOEM's Mid- and South Atlantic OCS planning areas. The survey would be conducted on an approximately 25 x 32 km grid; grid size may vary to minimize overall survey distance (see Figure 1 of Spectrum's application). The closest trackline to shore would be approximately 35 km (off Cape Hatteras). The survey would involve one source vessel and one chase vessel (see Spectrum's application for vessel details). The survey plan includes a total of approximately 21,635 km of data acquisition line, including allowance for lines expected to be resurveyed due to environmental or technical reasons. Water depths range from 30 to 5,410 m. There would be limited additional operations associated with equipment testing, startup, and repeat coverage of any areas where initial data quality is sub-standard.

The acoustic source planned for deployment is a 32-airgun array with a total volume of 4,920 in^3. The source vessel would tow a single 12-km hydrophone streamer. The 32-airgun array would consist of individual airguns ranging in volume from 50 in^3 to 250 in^3. The firing pressure of the array would be 2,000 psi. The airguns would be configured as four subarrays (see Figure 2 in Appendix A of Spectrum's application). Each string would have eight to ten airguns and strings would be spaced 10 m apart; the total array dimensions would be 40 m wide x 30 m long.

The four airgun strings would be towed at 6 to 10-m depth and the airgun array would fire every 25 m or 10 s, depending on exact vessel speed (expected to be 4–5 kn). Spectrum provided modeling results for their array, including notional source signatures, 1/3-octave band source levels as a function of azimuth angle, and received sound levels as a function of distance and direction at 16 representative sites in the proposed survey area. For more detail, please see Appendix A of Spectrum's application, as well as ''Estimated Take by Incidental Harassment,'' later in this document.

TGS—TGS proposes to conduct a 2D marine seismic survey off the U.S. east coast from Delaware to northern Florida, extending throughout BOEM's Mid- and South Atlantic OCS planning areas (see Figure 1–1 of TGS's application). The survey would involve two source vessels operating independently of one another (expected to operate at least 100 km apart), with each attended by one chase vessel. This approach was selected to allow TGS to complete the survey plan within one year rather than spread over multiple years. The survey plan consists of two contiguous survey grids with differently spaced lines (see Figures 1–1 to 1–4 of TGS's application). Lines are spaced 100 km apart in approximately the eastern half of the project area and approximately 25 km apart in the western portion of the survey area. A third, more detailed grid (6–10 km spacing) covers the continental shelf drop-off, approximately near the center of the proposed survey area from north to south. The closest trackline to the coast would be 25 km. The survey plan includes a total of 55,133 km of data acquisition line plus an additional 3,167 km of trackline expected for run-in/run-out, for a total of 58,300 km. Water depths range from 25–5,500 m. There would be limited additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard.

The acoustic sources planned for deployment are 48-airgun arrays with a total volume of 4,808 in^3. However, only 40 individual airguns would be used at any given time, with remaining airguns held in reserve in case of equipment failure. The source vessels would tow a single 12-km long hydrophone streamer. The airgun array would use Sodera G-gun II airguns ranging in volume from 22 in^3 to 250 in^3. The airguns would be configured as four identical subarrays (see Figure 3 in Appendix B of TGS's application), with individual elements spaced 8 m apart and arranged such that the largest elements are in the middle of each subarray and smaller sources at the front and end. The four airgun strings would be towed behind the vessel at 7-m depth. The airgun array would fire every 25 m (approximately every 10 s, depending on vessel speed), with expected transit speed of 4–5 kn. More detail regarding TGS's acoustic source and modeling related to TGS's application is provided in ''Estimated Take by Incidental Harassment,'' later in this document, as well as Appendix B of TGS's application.

Western—Western proposes to conduct a 2D marine seismic survey off the U.S. east coast from Maryland to northern Florida, extending through the majority of BOEM's Mid- and South Atlantic OCS planning areas (see Figure 1–1 of Western's application). The survey plan consists of a survey grid with differently spaced lines (see Figures 1–1 to 1–4 of Western's application). Lines are spaced 25 km apart in approximately the southwestern third of the project area and approximately 6 km apart in the remainder of the survey area. The closest trackline to the coast would be 30 km. The survey plan includes a total of 26,641 km of data acquisition line plus an additional 689 km of lines expected for run-in/run-out, for a total of 27,330 km. Water depths range from 20–4,700 m. The survey would involve one source vessel, the M/V *Western Pride,* as well as two chase vessels, the M/V *Michael Lawrence* and M/V *Amber G,* and a supply vessel, the M/V *Melinda B. Adams* or similar (see Appendix B of Western's application for vessel details). There would be limited additional operations associated with equipment testing, startup, and repeat coverage of any areas where initial data quality is sub-standard.

The seismic source planned for deployment is a 24-airgun array with a total volume of 5,085 in^3. The source vessel would tow a single 10.5-km hydrophone streamer. The 24-airgun array would consist of individual Bolt v5085 airguns. The airguns would be configured as three identical subarrays of eight airguns each with 8 m spacing between strings. The three airgun strings would be towed at 10-m depth and the airgun array would fire every 37.5 m (approximately every 16 s, depending on vessel speed), with expected transit speed of 4–5 kn. More detail regarding Western's acoustic source and modeling related to Western's application is provided in ''Estimated Take by Incidental Harassment,'' later in this document, as well as Appendix B of Western's application.

CGG—CGG proposes to conduct a 2D marine seismic survey off the U.S. east coast from Virginia to Georgia, extending through the majority of BOEM's Mid- and South Atlantic OCS planning areas (see Figure 3 of CGG's application). The survey plan consists of 53 survey tracklines in a 20 km by 20 km orthogonal grid (see Figure 3 of CGG's application). The tracklines would be 300 to 750 km in length, with the closest trackline to the coast at 80 km. The survey plan includes a total of 28,670 km of data acquisition line, in water depths ranging from 100–5,000 m. The survey would involve one source vessel, as well as two support vessels. There would be limited additional operations associated with equipment testing, startup, and repeat coverage of any areas where initial data quality is sub-standard.

The seismic source planned for deployment is a 36-airgun array with a total volume of 5,400 $in.^3$ The source vessel would tow a single 10 to 12-km hydrophone streamer. The 36-airgun array would consist of individual Bolt 1900/1500 airguns. The airguns would be configured as four subarrays of nine airguns each (see Figure 2 in CGG's application), with total dimensions of 24 m width by 16.5 m length and 8 m separation between strings. The four airgun strings would be towed at 7-m depth and the airgun array would fire every 25 m (approximately every 16 s, depending on vessel speed), with expected transit speed of 4.5 kn. More detail regarding CGG's acoustic source and modeling related to CGG's application is provided in ''Estimated Take by Incidental Harassment,'' later in this document, as well as CGG's application.

TABLE 1—SURVEY AND AIRGUN ARRAY CHARACTERISTICS

Company	Total planned survey (km)	Total volume (in³)	Number of guns	Number of strings	Nominal source output (downward) [1]			Shot interval (m)	Tow depth (m)
					0-pk	pk-pk	rms		
ION	13,062	6,420	36	4	257	263	[4] 247	50	10
Spectrum	21,635	4,920	32	4	266	272	243	25	6–10
TGS	58,300	4,808	40	4	255	[3]	240	25	7
Western	27,330	5,085	24	3	[3]	262	235	37.5	10
CGG	28,670	5,400	36	4	[3]	259	[3 4] 243	25	7
BOEM [2]	n/a	5,400	18	3	247	[3]	233	n/a	6.5

[1] See "Description of Active Acoustic Sound Sources," later in this document, for discussion of these concepts.
[2] Notional array characteristics modeled and source characterization outputs from BOEM's PEIS (2014a) provided for comparison.
[3] Values not given; however, SPL (pk-pk) is usually considered to be approximately 6 dB higher than SPL (0-pk) (Greene, 1997).
[4] Value decreased from modeled 0-pk value by minimum 10 dB (Greene, 1997).

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, ''and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking'' for certain subsistence uses. NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)). Here we provide a single description of proposed mitigation measures, including those contained in the applicants' requests, as we propose to require the same measures of all applicants.

We reviewed the applicants' proposals, the requirements specified in BOEM's PEIS, seismic mitigation protocols required or recommended elsewhere (*e.g.,* DOC, 2013; IBAMA, 2005; Kyhn *et al.,* 2011; JNCC, 2010; DEWHA, 2008; BOEM, 2016a; DFO, 2008; MMOA, 2015; Nowacek and Southall, 2016), and the available scientific literature. We also considered recommendations given in a number of review articles (*e.g.,* Weir and Dolman, 2007; Compton *et al.,* 2008; Parsons *et al.,* 2009; Wright and Cosentino, 2015; Stone, 2015). The suite of mitigation measures proposed here differs in some cases from the measures proposed by the applicants and/or those specified by BOEM in their PEIS and Record of Decision (ROD) in order to reflect what we believe to be the most appropriate suite of measures to satisfy the requirements of the MMPA. In carrying out the MMPA's mandate, we apply a context-specific balance between the manner in which and the degree to which measures are expected to reduce impacts to the affected species or stocks and their habitat and practicability for the applicant. (The framework for such an evaluation is explained further in 82 FR 19460, 19502 (April 27, 2017) (Proposed Rule for Take of Marine Mammals Incidental to U.S. Navy Operation of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar.) Both of these facets point to the need for a basic system of seismic mitigation protocols (which may be augmented as necessary) that may be implemented in the field, reduce subjective decision-making for observers to the extent possible, and appropriately weighs a range of potential outcomes from sound exposure in determining what should be avoided or minimized where possible.

Past mitigation protocols for geophysical survey activities using airgun arrays have focused on avoidance of exposures to received sound levels exceeding NMFS's historical injury criteria (*e.g.,* 180 dB rms), rather than also weighing the potentially detrimental effects of increased input of sound at lower levels into the environment (*e.g.,* through use of mitigation guns or extended periods on the water to reshoot lines following shutdowns of the acoustic source), while also unrealistically assuming that shutdown protocols are capable of avoiding all potential for auditory injury. In addition to a basic suite of seismic mitigation protocols, we also include measures that might not be required for other activities (*e.g.,* time-area closures specific to the proposed surveys discussed here) but that are warranted here given the proposed spatiotemporal scope of these specified activities and associated potential for population-level effects and/or take of large numbers of individuals of certain species.

Mitigation-Related Monitoring

Monitoring by independent, dedicated, trained marine mammal observers is required. Note that, although we propose requirements related only to observation of marine mammals, we hereafter use the generic term ''protected species observer'' (PSO) to avoid confusion with protocols that may be required of the applicants pursuant to other relevant statutes. Independent observers are employed by a third-party observer provider; vessel crew may not serve as PSOs. Dedicated observers are those who have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct the seismic survey operator (*i.e.,* vessel captain and crew) with regard to the presence of marine mammals and mitigation requirements. Communication with the operator may include brief alerts regarding maritime hazards. Trained PSOs have successfully completed an approved PSO training course (see ''Proposed Monitoring and Reporting''), and experienced PSOs have additionally gained a minimum of 90 days at-sea experience working as a PSO during a deep penetration seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. Both visual and acoustic monitoring is required; training and experience is specific to either visual or acoustic PSO duties. An experienced visual PSO must have completed approved, relevant training and gained the requisite experience working as a visual PSO. An experienced acoustic PSO must have completed a passive acoustic monitoring (PAM) operator training course and gained the requisite experience working as an acoustic PSO (*i.e.,* PAM operator).

NMFS does not currently approve specific training courses; observers may be considered appropriately trained by having satisfactorily completed training that meets all the requirements specified herein (see ''Proposed Monitoring and Reporting''). In order for PSOs to be approved, NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course. A PSO may be trained and/or experienced as both a visual PSO and PAM operator and may perform either duty, pursuant to scheduling requirements. PSO watch schedules shall be devised in consideration of the following restrictions: (1) A maximum of two consecutive hours on watch followed by a break of at least one hour between watches for visual PSOs; (2) a maximum of four consecutive hours on watch followed by a break of at least two consecutive hours between watches for PAM operators; and (3) a maximum of 12 hours observation per 24-hour period. Further information regarding PSO requirements may be found in the ''Proposed Monitoring and Reporting'' section, later in this document.

Visual—All source vessels must carry a minimum of one experienced visual PSO, who shall be designated as the lead PSO, coordinate duty schedules and roles, and serve as primary point of contact for the operator. While it is desirable for all PSOs to be qualified through experience, we do not wish to foreclose opportunity for newly trained PSOs to gain the requisite experience. Therefore, the lead PSO shall devise the duty schedule such that experienced PSOs are on duty with trained PSOs (*i.e.,* those PSOs with appropriate training but who have not yet gained relevant experience) to the maximum extent practicable in order to provide necessary mentorship. During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array (see ''Ramp-ups'' below). PSOs should use NOAA's solar calculator (*www.esrl.noaa.gov/gmd/grad/solcalc/*) to determine sunrise and sunset times at their specific location. We recognize that certain daytime conditions (*e.g.,* fog, heavy rain) may reduce or eliminate effectiveness of visual observations; however, on-duty PSOs shall remain alert for marine mammal observational cues and/or a change in conditions.

With regard to specific observational protocols, we largely follow those described in Appendix C of BOEM's PEIS (BOEM, 2014a). The lead PSO shall determine the most appropriate observation posts that will not interfere with navigation or operation of the vessel while affording an optimal, elevated view of the sea surface. PSOs shall coordinate to ensure 360° visual coverage around the vessel, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner. Within these broad outlines, the lead PSO and PSO team will have discretion to determine the most appropriate vessel- and survey-specific system for implementing effective marine mammal observational effort. Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, should be relayed to the source vessel and to the PSO team.

Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset. If any marine mammal is observed at any distance from the vessel, a PSO would record the observation and monitor the animal's position (including latitude/longitude of the vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer. A PSO would continue to observe the area to watch for the animal to resurface or for additional animals that may surface in the area. Visual PSOs shall communicate all observations to PAM operators, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), PSOs should conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods.

Acoustic—All source vessels must use a towed PAM system for potential detection of marine mammals. The system must be monitored at all times during use of the acoustic source, and acoustic monitoring must begin at least 30 minutes prior to ramp-up. All source vessels shall carry a minimum of one experienced PAM operator. PAM operators shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination. We acknowledge generally that PAM has significant limitations. For example, animals may only be detected when vocalizing, species making directional vocalizations must vocalize towards the array to be detected, species identification and localization may be difficult, etc. However, we believe that for certain species and in appropriate environmental conditions it is a useful complement to visual monitoring during good sighting conditions and that it is the only meaningful monitoring technique during periods of poor visibility. Further detail regarding PAM system requirements may be found in the ''Proposed Monitoring'' section, later in this document. The effectiveness of PAM depends to a certain extent on the equipment and methods used and competency of the PAM operator, but no established standards are currently in place. We do offer some specifications later in this document and each applicant has provided a PAM plan.

Following protocols described by the New Zealand Department of Conservation for seismic surveys conducted in New Zealand waters (DOC, 2013), survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

- Daylight hours and sea state is less than or equal to Beaufort sea state (BSS) 4;
- No marine mammals (excluding small delphinoids; see below) detected solely by PAM in the exclusion zone (see below) in the previous two hours;
- NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and
- Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

As noted previously, all source vessels must carry a minimum of one experienced visual PSO and one experienced PAM operator. Although a given PSO may carry out either visual PSO or PAM operator duties during a survey (assuming appropriate training), the required experienced PSOs may not be the same person. The observer designated as lead PSO (including the full team of visual PSOs and PAM operators) must be an experienced visual PSO. The applicant may determine how many PSOs are required to adequately fulfill the requirements specified here. To summarize, these requirements are: (1) Separate experienced visual PSOs and PAM operators; (2) 24-hour acoustic monitoring during use of the acoustic source; (3) visual monitoring during use of the acoustic source by two PSOs during all daylight hours and during nighttime ramp-ups; (4) maximum of two consecutive hours on watch followed by a minimum of one hour off watch for visual PSOs and a maximum of four consecutive hours on watch followed by a minimum of two consecutive hours off watch for PAM operators; and (5) maximum of 12 hours of observational effort per 24-hour period for any PSO, regardless of duties.

Buffer Zone and Exclusion Zone

The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) should be communicated to the operator to prepare for the potential shutdown of the acoustic source. Use of the buffer zone in relation to ramp-up is discussed under ''Ramp-up.'' Further detail regarding the exclusion zone and shutdown requirements is given under ''Exclusion Zone and Shutdown Requirements.''

Ramp-Up

Ramp-up of an acoustic source is intended to provide a gradual increase in sound levels, enabling animals to move away from the source if the signal is sufficiently aversive prior to its reaching full intensity. We infer on the basis of behavioral avoidance studies and observations that this measure results in some reduced potential for auditory injury and/or more severe behavioral reactions. Dunlop *et al.* (2016) studied the effect of ramp-up during a seismic airgun survey on migrating humpback whales, finding that although behavioral response indicating potential avoidance was observed, there was no evidence that ramp-up was more effective at causing aversion than was a constant source. Regardless, the majority of whale groups did avoid the source vessel at distances greater than the radius of most mitigation zones (Dunlop *et al.,* 2016). Although this measure is not proven and some arguments have been made that use of ramp-up may not have the desired effect of aversion (which is itself a potentially negative impact assumed to be better than the alternative), ramp-up remains a relatively low cost, common sense component of standard mitigation. Ramp-up is most likely to be effective for more sensitive species (*e.g.,* beaked whales) with known behavioral responses at greater distances from an acoustic source (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Miller *et al.,* 2015).

The ramp-up procedure involves a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved. Ramp-up is required at all times as part of the activation of the acoustic source (including source tests; see ''Miscellaneous Protocols'' for more detail) and may occur at times of poor visibility, assuming appropriate acoustic monitoring with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation should only occur at night where operational planning cannot reasonably avoid such circumstances. For example, a nighttime initial ramp-up following port departure is reasonably avoidable and may not occur. Ramp-up may occur at night following acoustic source deactivation due to line turn or mechanical difficulty. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.

Ramp-up procedures follow the recommendations of IAGC (2015). Ramp-up would begin by activating a single airgun (*i.e.,* array element) of the smallest volume in the array. Ramp-up continues in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. There will generally be one stage in which doubling the number of elements is not possible because the total number is not even. This should be the last stage of the ramp-up sequence. These requirements may be modified on the basis of any new information presented that justifies a different protocol. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups should be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in. We adopt this approach to ramp-up (increments of array elements) because it is relatively simple to implement for the operator as compared with more complex schemes involving activation by increments of array volume, or activation on the basis of element location or size. Such approaches may also be more likely to result in irregular leaps in sound output due to variations in size between individual elements within an array and their geometric interaction as more elements are recruited. It may be argued whether smooth incremental increase is necessary, but stronger aversion than is necessary should be avoided. The approach proposed here is intended to ensure a perceptible increase in sound output per increment while employing increments that produce similar degrees of increase at each step.

PSOs must monitor a 1,000-m buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance). The pre-clearance period may occur during any vessel activity (*i.e.,* transit, line turn). Ramp-up should be planned to occur during periods of good visibility when possible; operators should not target the period just after visual PSOs have gone off duty. Following deactivation of the source for reasons other than mitigation, the operator must communicate the near-term operational plan to the lead PSO with justification for any planned nighttime ramp-up. Any suspected patterns of abuse should be reported by the lead PSO and would be investigated by NMFS. Ramp-up may not be initiated if any marine mammal (including small delphinoids) is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs will monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone.

Exclusion Zone and Shutdown Requirements

An exclusion zone is a defined area within which occurrence of a marine mammal triggers mitigation action intended to reduce potential for certain outcomes, *e.g.,* auditory injury, disruption of critical behaviors. The PSOs must establish a minimum exclusion zone with a 500 m radius as a perimeter around the airgun array (rather than being centered on the array or around the vessel itself). If a marine mammal appears within, enters, or appears on a course to enter this zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the PAM operator is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement (see below).

This shutdown requirement is in place for all marine mammals, with the exception of small delphinoids under certain circumstances. As defined here, the small delphinoid group is intended to encompass those members of the Family Delphinidae most likely to voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array (*e.g.,* bow riding). This exception to the shutdown requirement applies solely to specific genera of small dolphins—*Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus* (see Table 4)—and only applies if the animals are traveling, including approaching the vessel. If, for example, an animal or group of animals is stationary for some reason (*e.g.,* feeding) and the source vessel approaches the animals, the shutdown requirement applies. An animal with sufficient incentive to remain in an area rather than avoid an otherwise aversive stimulus could either incur auditory injury or disruption of important behavior. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented. We do not require that a PSO determine the intent of the animal(s)—an inherently subjective proposition—but simply whether any potential intersection of the animal with the 500-m exclusion zone would be caused due to the vessel's approach towards relatively stationary animals.

We propose this small delphinoid exception because a shutdown requirement for small delphinoids under all circumstances is of known concern regarding practicability for the applicant due to increased shutdowns, without likely commensurate benefit for the animals in question. Small delphinoids are generally the most commonly observed marine mammals in the specific geographic region and would typically be the only marine mammals likely to intentionally approach the vessel. As described below, auditory injury is extremely unlikely to occur for mid-frequency cetaceans (*e.g.,* delphinids), as this group is relatively insensitive to sound produced at the predominant frequencies in an airgun pulse while also having a relatively high threshold for the onset of auditory injury (*i.e.,* permanent threshold shift). Please see ''Potential Effects of the Specified Activity on Marine Mammals'' later in this document for further discussion of sound metrics and thresholds and marine mammal hearing. A large body of anecdotal evidence indicates that small delphinoids commonly approach vessels and/or towed arrays during active sound production for purposes of bow riding, with no apparent effect observed in those delphinoids (*e.g.,* Barkaszi *et al.,* 2012). The increased shutdowns resulting from such a measure would require source vessels to revisit the missed track line to reacquire data, resulting in an overall increase in the total sound energy input to the marine environment and an increase in the total duration over which the survey is active in a given area. Although other mid-frequency hearing specialists (*e.g.,* large delphinoids) are no more likely to incur auditory injury than are small delphinoids, they are much less likely to approach vessels. Therefore, retaining a shutdown requirement for large delphinoids would not have similar impacts in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water. We do anticipate some benefit for a shutdown requirement for large delphinoids in that it simplifies somewhat the total array of decision-making for PSOs and may preclude any potential for physiological effects other than to the auditory system as well as some more severe behavioral reactions for any such animals in close proximity to the source vessel.

BOEM's PEIS (BOEM, 2014a) provided modeling results for auditory injury zones on the basis of auditory injury criteria described by Southall *et al.* (2007). These zones were less than 10 m on the basis of maximum peak pressure, and a maximum of 18 m on the basis of cumulative sound exposure level (including application of relevant M-weighting filters). However, the recent finalization of NMFS's new technical acoustic guidance made these predictions irrelevant (NMFS, 2016). We calculated potential radial distances to auditory injury zones on the basis of maximum peak pressure using values provided by the applicants (Table 1) and assuming a simple model of spherical spreading propagation. These are as follows: Low-frequency cetaceans, 50–224 m; mid-frequency cetaceans, 14–63 m; and high-frequency cetaceans, 355–1,585 m. The 500-m radial distance of the standard exclusion zone is intended to be precautionary in the sense that it would be expected to contain sound exceeding peak pressure injury criteria for all hearing groups other than high-frequency cetaceans, while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. Although significantly greater distances may be observed from an elevated platform under good conditions, we believe that 500 m is likely regularly attainable for PSOs using the naked eye during typical conditions.

An appropriate exclusion zone based on cumulative sound exposure level (cSEL) criteria would be dependent on the animal's applied hearing range and how that overlaps with the frequencies produced by the sound source of interest (*i.e.,* via marine mammal auditory weighting functions) (NMFS, 2016), and may be larger in some cases than the zones calculated on the basis of the peak pressure thresholds (and larger than 500 m) depending on the species in question and the characteristics of the specific airgun array. In particular, it is likely that exclusion zone radii would be larger for low-frequency cetaceans, because their most susceptible hearing range overlaps the low frequencies produced by airguns, but that the zones would remain very small for mid-frequency cetaceans (*i.e.,* including the ''small delphinoids'' described above), whose range of best hearing largely does not overlap with frequencies produced by airguns. In order to more realistically incorporate the technical guidance's weighting functions over a seismic array's full acoustic band, we obtained unweighted spectrum data (modeled in 1 Hz bands) for a reasonably equivalent acoustic source (*i.e.,* a 36-airgun array with total volume of 6,600 in^3. Using these data, we made adjustments (dB) to the unweighted spectrum levels, by frequency, according to the weighting functions for each relevant marine mammal hearing group. We then converted these adjusted/weighted spectrum levels to pressures (micropascals) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within NMFS's

User Spreadsheet (*i.e.,* override the Spreadsheet's more simple weighting factor adjustment). Using the User Spreadsheet's ''safe distance'' methodology for mobile sources (described by Sivle *et al.,* 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 4.5 kn, shot intervals specified by the applicants, and pulse duration of 100 ms, we then calculated potential radial distances to auditory injury zones. These distances were smaller than those calculated on the basis of the peak pressure criterion, with the exception of the low-frequency cetacean hearing group (calculated zones range from 80–4,766 m). Therefore, our proposed 500-m exclusion zone contains the entirety of any potential injury zone for mid-frequency cetaceans, while the zones within which injury could occur may be larger for high-frequency cetaceans (on the basis of peak pressure and depending on the specific array) and for low-frequency cetaceans (on the basis of cumulative sound exposure). Only three species of high-frequency cetacean could occur in the proposed survey areas: the harbor porpoise and two species of the Family Kogiidae. Harbor porpoise are expected to occur rarely and only in the northern portion of the survey area. However, we propose a shutdown measure for *Kogia* spp. to address these potential injury concerns (described later in this section).

However, it is important to note that consideration of exclusion zone distances is inherently an essentially instantaneous proposition—a rule or set of rules that requires mitigation action upon detection of an animal. This indicates that consideration of peak pressure thresholds is most relevant, as compared with cumulative sound exposure level thresholds, as the latter requires that an animal accumulate some level of sound energy exposure over some period of time (*e.g.,* 24 hours). A PSO aboard a mobile source will typically have no ability to monitor an animal's position relative to the acoustic source over relevant time periods for purposes of understanding whether auditory injury is likely to occur on the basis of cumulative sound exposure and, therefore, whether action should be taken to avoid such potential. Therefore, definition of an exclusion zone based on cSEL thresholds is of questionable relevance given relative motion of the source and receiver (*i.e.,* the animal). Cumulative SEL thresholds are likely more relevant for purposes of modeling the potential for auditory injury than they are for informing real-time mitigation. We recognize the importance of the accumulation of sound energy to an understanding of the potential for auditory injury and that it is likely that, at least for low-frequency and high-frequency cetaceans, some potential auditory injury is likely impossible to mitigate and should be considered for authorization.

In summary, our intent in prescribing a standard exclusion zone distance is to (1) encompass zones for most species within which auditory injury could occur on the basis of instantaneous exposure; (2) provide additional protection from the potential for more severe behavioral reactions (*e.g.,* panic, antipredator response) for marine mammals at relatively close range to the acoustic source; (3) provide consistency for PSOs, who need to monitor and implement the exclusion zone; and (4) to define a distance within which detection probabilities are reasonably high for most species under typical conditions. Our use of 500 m as the zone is not based directly on any quantitative understanding of the range at which auditory injury would be entirely precluded or any range specifically related to disruption of behavioral patterns. Rather, we believe it is a reasonable combination of factors. This zone would contain all potential auditory injury for mid-frequency cetaceans, would contain all potential auditory injury for both low- and mid-frequency cetaceans as assessed against peak pressure thresholds (NMFS, 2016), and has been proven as a feasible measure through past implementation by operators in the Gulf of Mexico (GOM; as regulated by BOEM pursuant to the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 1331–1356)). In summary, a practicable criterion such as this has the advantage of familiarity and simplicity while still providing in most cases a zone larger than relevant auditory injury zones, given realistic movement of source and receiver. Increased shutdowns, without a firm idea of the outcome the measure seeks to avoid, simply displace seismic activity in time and increase the total duration of acoustic influence as well as total sound energy in the water (due to additional ramp-up and overlap where data acquisition was interrupted).

Shutdown of the acoustic source is also required (at any distance) in other circumstances:

• Upon observation of a right whale at any distance. Recent data concerning the North Atlantic right whale, one of the most endangered whale species (Best *et al.,* 2001), indicate uncertainty regarding the population's recovery and a possibility of decline (Kraus *et al.,* 2005; Waring *et al.,* 2016; Pettis and Hamilton, 2016). We believe it appropriate to eliminate potential effects to individual right whales to the extent possible.

• For TGS only, due to a high predicted amount of exposures (Table 10), we propose that shutdown be required upon observation of a fin whale at any distance. If the observed fin whale is within the behavioral harassment zone, it would still be considered to have experienced harassment, but by immediately shutting down the acoustic source the duration of harassment is minimized and the significance of the harassment event reduced as much as possible. This measure is not proposed for implementation by Spectrum, ION, CGG, or Western.

• Upon observation of a large whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult. Disturbance of cow-calf pairs, for example, could potentially result in separation of vulnerable calves from adults. Given the endangered status of most large whale species and the difficulty of correctly identifying some rorquals at greater distances, as well as the functional sensitivity of the mysticete whales to frequencies associated with the subject geophysical survey activity, we believe this measure is necessary.

• Upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel. Disturbance of deep-diving species such as sperm whales could result in avoidance behavior such as diving and, given their diving capabilities, it is possible that the vessel's course could take it closer to the submerged animals. As noted by Weir and Dolman (2007), a whale diving ahead of the source vessel within 2 km may remain on the vessel trackline until the ship approaches the whale's position before beginning horizontal movement. If undetected by PAM, it is possible that a shutdown might not be triggered and a severe behavioral response caused.

• Upon any observation (visual or acoustic) of a beaked whale or *Kogia* spp. Similar to the sperm whale measure described above, these species are deep divers and it is possible that disturbance could provoke a severe behavioral response leading to injury. Unlike the sperm whale, we recognize that there are generally low detection probabilities for beaked whales and *Kogia* spp., meaning that many animals of these species may go undetected. For example, Barlow and Gisiner (2006) predict a roughly 24–48 percent reduction in the probability of detecting beaked whales during seismic mitigation monitoring efforts as compared with typical research survey efforts (Barlow (1999) estimates such probabilities at 0.23 to 0.45 for Cuvier's and Mesoplodont beaked whales, respectively). Similar detection probabilities have been noted for *Kogia* spp., though they typically travel in smaller groups and are less vocal, thus making detection more difficult (Barlow and Forney, 2007). As discussed later in this document (see ''Estimated Take by Incidental Harassment''), there are high levels of predicted exposures for beaked whales in particular. Because it is likely that only a small proportion of beaked whales and *Kogia* spp. potentially affected by the proposed surveys would actually be detected, it is important to avoid potential impacts when possible. Additionally for *Kogia* spp.—the one species of high-frequency cetacean likely to be encountered—auditory injury zones relative to peak pressure thresholds may range from approximately 350–1,500 m from the acoustic source, depending on the specific array characteristics (NMFS, 2016).

- Upon observation of an aggregation of marine mammals of any species that does not appear to be traveling. Under these circumstances, we assume that the animals are engaged in some important behavior (*e.g.,* feeding, socializing) that should not be disturbed. By convention, we define an aggregation as six or more animals. This definition may be modified on the basis of any new information presented that justifies a different assumption.

Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch; hand-held UHF radios are recommended. When both visual PSOs and PAM operators are on duty, all detections must be immediately communicated to the remainder of the on-duty team for potential verification of visual observations by the PAM operator or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the PAM operator is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdowns at any distance), a 30-minute clearance period must be observed following the last observation of the animal(s). We recognize that BOEM may require a longer clearance period (*e.g.,* 60 minutes). However, at typical survey speed of approximately 4.5 kn, the vessel would cover greater than 4 km during the 30-minute clearance period. Although some deep-diving species are capable of remaining submerged for periods up to an hour, it is unlikely that they would do so both while experiencing potential adverse reaction to the acoustic stimulus and remaining within the exclusion zone of the moving vessel. Extending the clearance period would not appreciably increase the likelihood of detecting the animals prior to reactivating the acoustic source.

If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. We define ''brief periods'' in keeping with other clearance watch periods and to avoid unnecessary complexity in protocols for PSOs. For any longer shutdown (*e.g.,* during line turns), pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

Power-Down

Power-down can be used either as a reverse ramp-up or may simply involve reducing the array to a single element or ''mitigation source,'' and has been allowed in past MMPA authorizations as a substitute for full shutdown. We address use of a mitigation source below. In a power-down scenario, it is assumed that turning off power to individual array elements reduces the size of the ensonified area such that an observed animal is then outside some designated area. However, we have no information as to the effect of powering down the array on the resulting sound field. In 2012, NMFS and BOEM held a monitoring and mitigation workshop focused on seismic survey activity. Industry representatives indicated that the end result may ultimately be increased sound input to the marine environment due to the need to re-shoot the trackline to prevent gaps in data acquisition (unpublished workshop report, 2012). For this reason and because a power-down may not actually be useful, our proposal requires full shutdown in all applicable circumstances; power-down is not allowed.

Mitigation Source

Mitigation sources may be separate individual airguns or may be an airgun of the smallest volume in the array, and are often used when the full array is not being used (*e.g.,* during line turns) in order to allow ramp-up during poor visibility. The general premise is that this lower-intensity source, if operated continuously, would be sufficiently aversive to marine mammals to ensure that they are not within an exclusion zone, and therefore, ramp-up may occur at times when pre-clearance visual watch is minimally effective. There is no information to suggest that this is an effective protective strategy, yet we are certain that this technique involves input of extraneous sound energy into the marine environment, even when use of the mitigation source is limited to some maximum time period. For these reasons, we do not believe use of the mitigation source is appropriate and do not propose to allow its use. However, as noted above, ramp-up may occur under periods of poor visibility assuming that no acoustic or visual detections are made during a 30-minute pre-clearance period. This is a change from how mitigation sources have been considered in the past in that the visual pre-clearance period is typically assumed to be highly effective during good visibility conditions and viewed as critical to avoiding auditory injury and, therefore, maintaining some likelihood of aversion through use of mitigation sources during poor visibility conditions is valuable.

In light of the available information, we think it more appropriate to acknowledge the limitations of visual observations—even under good conditions, not all animals will be observed and cryptic species may not be observed at all—and recognize that while visual observation is a common sense mitigation measure its presence should not be determinative of when survey effort may occur. Given the lack of proven efficacy of visual observation in preventing auditory injury, its absence should not imply such potentially detrimental impacts on marine mammals, nor should use of a mitigation source be deemed a sensible substitute component of seismic mitigation protocols. We also believe that consideration of mitigation sources in the past has reflected an outdated balance, in which the possible prevention of relatively few instances of auditory injury is outweighed by many more instances of unnecessary behavioral disturbance of animals and degradation of acoustic habitat.

Miscellaneous Protocols

The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source should be avoided. Firing of the acoustic source at any volume above the stated production volume is not authorized for these proposed IHAs; the operator must provide information to the lead PSO at regular intervals confirming the firing volume.

Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

We encourage the applicant companies and operators to pursue the following objectives in designing, tuning, and operating acoustic sources: (1) Use the minimum amount of energy necessary to achieve operational objectives (*i.e.,* lowest practicable source level); (2) minimize horizontal propagation of sound energy; and (3) minimize the amount of energy at frequencies above those necessary for the purpose of the survey. However, we are not aware of available specific measures by which to achieve such certifications. In fact, BOEM recently announced that an expert panel convened to determine whether it would be feasible to develop standards to determine a lowest practicable source level has determined that it would not be reasonable or practicable to develop such metrics (see Appendix L in BOEM, 2016b). Minimizing production of sound at frequencies higher than are necessary would likely require design, testing, and use of wholly different airguns than are proposed for use by the applicants. At minimum, notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented for reporting. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

There has been some attention paid to the establishment of minimum separation distances between operating source vessels, and BOEM may require a minimum 40-km geographic separation distance (BOEM, 2014b). The premise regarding this measure is either to provide a relatively noise-free corridor between vessels conducting simultaneous surveys such that animals may pass through rather than traveling larger distances to go around the source vessels or to reduce the cumulative sound exposure for an animal in a given location. There is no information supporting the effectiveness of this measure, and participants in a 2012 monitoring and mitigation workshop focused on seismic survey activity held by NMFS and BOEM were skeptical regarding potential efficacy of this measure (unpublished workshop report, 2012). Unintended consequences were a concern of some participants, including the possibility that converging sound fields could confuse animals and/or prevent egress from an area. In fact, it may be more effective as a protective measure to group acoustic sources as closely together as possible, in which case the SEL exposure would not be appreciably louder and an animal would have a better chance of avoiding exposure than through the supposed corridor (thus also potentially shortening total duration of sound exposure).

The desired effect of such a measure is too speculative and would impose additional burden on applicants. Therefore, we do not propose to require any minimum separation distance between source vessels. Operators do typically maintain a minimum separation of about 17.5 km between concurrent surveys to avoid interference (*i.e.,* overlapping reflections received from multiple source arrays) (BOEM, 2014a). As noted previously, TGS (the only company proposing to use two source vessels) plans to maintain a minimum separation of approximately 100 km between their own source vessels.

Closure Areas

Coastal Restriction—No seismic survey effort may occur within 30 km of the coast. The intent of this restriction is to provide additional protection for coastal stocks of bottlenose dolphin, all of which are designated as depleted under the MMPA because they were determined to be below their optimum sustainable population level (*i.e.,* the number of animals that will result in the maximum productivity of the population, keeping in mind the carrying capacity of their ecosystem). Already designated as depleted, an Unusual Mortality Event (UME) affected bottlenose dolphins along the Atlantic coast, from New York to Florida, from 2013–15. Genetic analyses performed to date indicate that 99 percent of dolphins impacted were of the coastal ecotype, which may be expected to typically occur within 20 km of the coast. A 10 km buffer is provided to encompass the area within which sound exceeding 160 dB rms would reasonably be expected to occur (see additional discussion in next section). Further discussion of this UME is provided under ''Description of Marine Mammals in the Area of the Specified Activity,'' later in this document.

The coastal form of bottlenose dolphin is known to occur further offshore than 20 km, but available information suggests that exclusion of harassing sound from a 20 km coastal zone would avoid the vast majority of impacts. There is generally a discontinuity in bottlenose dolphin distribution between nearshore areas inhabited by coastal ecotype dolphins and the deeper offshore waters inhabited by offshore ecotype dolphins (Kenney, 1990; Roberts *et al.,* 2016), with some possibility that this discontinuity represents habitat partitioning between bottlenose dolphins and Atlantic spotted dolphins (which occur in high density on the shelf in areas where there is generally low density of bottlenose dolphin). The separation between offshore and coastal morphotypes varies depending on location and season, with the ranges overlapping to some degree south of Cape Hatteras. Coastwide, systematic biopsy collection surveys were conducted during the summer and winter to evaluate the degree of spatial overlap between the two morphotypes. North of Cape Lookout, North Carolina, there was a clear discontinuity with coastal ecotype dolphins found in waters less than 20 m depth and offshore ecotype dolphins found in waters greater than 40 m depth. South of Cape Lookout, spatial overlap was found although the probability of a sampled group being from the coastal ecotype decreased with increasing depth (Garrison *et al.,* 2003). Prior to these surveys, coastal ecotype dolphins were provisionally assumed to occur within a spatial boundary of 27 km from shore for the region south of Cape Hatteras during winter and a boundary of 12 km from shore for the region north of Cape Hatteras during summer (Garrison, 2001 in Garrison *et al.,* 2003). Here, we adopt a coastwide 20 km spatial boundary for simplicity and under the assumption that it would contain the vast majority of coastal bottlenose dolphins.

Proposal of this measure should not be interpreted as NMFS's determination that harassment of coastal bottlenose dolphins cannot be authorized. However, when considering the likely benefit to the species against the impact to applicants, we believe that inclusion of this measure is warranted. Approximately 1,650 dolphin carcasses were recovered during the UME, and it is likely that many more dolphins died whose carcasses were not recovered. Considering just the known dead could represent greater than five percent of the pre-UME abundance for all coastal ecotype dolphins within the affected area. Ongoing areas of research related to the UME include understanding its impacts on the status of the affected stocks, as well as continuing monitoring and modeling designed to inform understanding of impacts on the surviving population. Given this uncertainty, a precautionary approach is warranted. We note that three applicants, Spectrum, CGG, and Western, do not propose to conduct survey effort within 30 km of the coast, and effort within 30 km for the other two applicants would represent a small fraction of overall survey effort.

North Atlantic Right Whale—We propose seasonal restriction of survey effort such that particular areas of expected importance for North Atlantic right whales are not ensonified by levels of sound expected to result in behavioral harassment, including designated critical habitat, vessel speed limit seasonal management areas (SMAs), a coastal strip containing SMAs, and vessel speed limit dynamic management areas (DMAs). Although right whales may also use areas farther offshore, these areas are expected to provide substantial protection of right whales within the migratory corridor and calving and nursery grounds and, when coupled with the absolute shutdown provision described previously for right whales, may reasonably be expected to eliminate most potential for behavioral harassment of right whales.

The North Atlantic right whale was severely depleted by historical whaling, and currently has a small population abundance (*i.e.,* less than 500 individuals) that is considered to be extremely low relative to the optimum sustainable population (Waring *et al.,* 2016). Surveys in recent years have detected an important shift in habitat use patterns, with fewer whales observed in feeding areas and counts for calves and adults on the southeastern calving grounds the lowest recorded since those surveys began (Waring *et al.,* 2016). At the same time, the current estimate of the minimum number of whales alive (as described in NMFS's draft 2016 stock assessment report) suggests that abundance has declined. While the authors caution that this apparent decrease should be interpreted with caution and in conjunction with apparent shifts in habitat use, it is possible that the population has declined. An increased number of carcasses were recovered in 2004–05, including six adult females. Kraus *et al.* (2005) determined that this mortality rate increase would reduce population growth by approximately ten percent per year, a trend not detected in subsequent years. Furthermore, the current annual estimate of anthropogenic mortality is over five times the potential biological removal level (see ''Description of Marine Mammals in the Area of the Specified Activity'' for further discussion of these concepts). The small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales (Waring *et al.,* 2016). Given these considerations, and the likelihood that any disturbance of right whales is consequential, here we take a precautionary approach to mitigation.

Mid-Atlantic SMAs for vessel speed limits are in effect from November 1 through April 30, while southeast SMAs are in effect from November 15 through April 15 (see 50 CFR 224.105). However, as a precautionary approach all areas discussed here for proposed mitigation would be in effect from November 1 through April 30. Because we intend to use these areas to reduce the likelihood of exposing right whales to noise from airgun arrays that might result in harassment, we require that source vessels maintain a minimum standoff of 10 km from the area. Sound propagation modeling results provided for a notional large airgun array in BOEM's PEIS indicate that a 10 km distance would likely contain received levels of sound exceeding 160 dB rms under a wide variety of conditions (*e.g.,* 21 scenarios encompassing four depth regimes, four seasons, two bottom types). See Appendix D of BOEM's PEIS for more detail. The 95 percent ranges (*i.e.,* the radius of a circle encompassing 95 percent of grid points equal to or greater than the 160 dB threshold value) provided in Table D–22 of BOEM's PEIS range from 4,959–9,122 m, with mean of 6,838 m. Restricting scenario results to fall/winter and water depths <1,000 m reduces the number of relevant scenarios to six, with the range of radial distances from 8,083–8,896 m (mean of 8,454 m).

BILLING CODE 3510–22–P

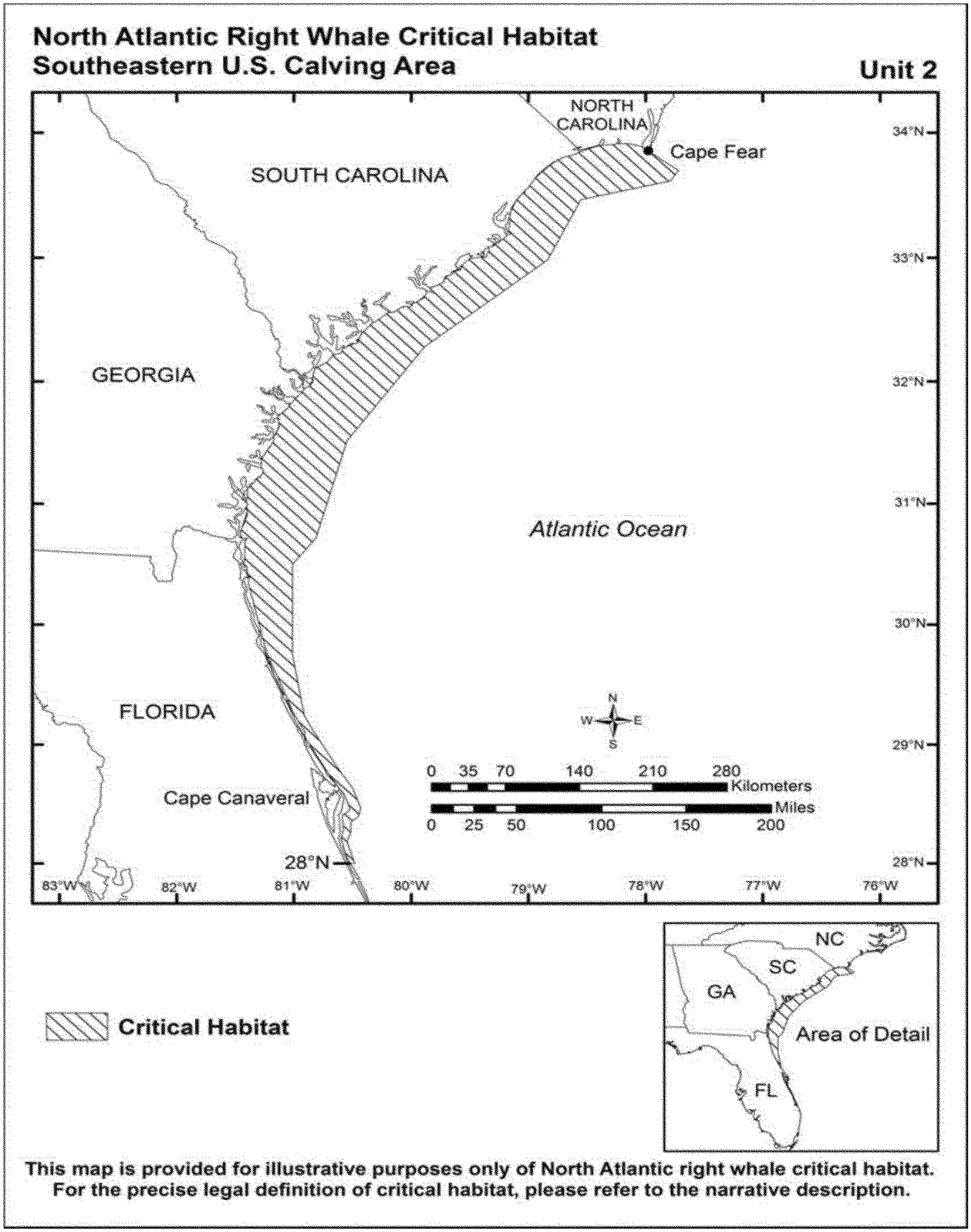

Figure 2. North Atlantic Right Whale Critical Habitat, Southeast U.S.

BILLING CODE 3510–22–C

The portion of critical habitat within the proposed survey area includes nearshore and offshore waters of the southeastern U.S., extending from Cape Fear, North Carolina south to 28° N. The specific area designated as critical habitat, as defined by regulation (81 FR 4838; January 27, 2016), is demarcated by rhumb lines connecting the specific points identified in Table 2. This area is depicted in Figure 2, and the restriction on survey effort within 10 km of this area would be in effect from November through April, when right whales are known to use the area.

A coastal strip containing all SMAs would also be avoided by a minimum standoff distance of 10 km, as would DMAs. These are areas in which right whales are likely to be present when such areas are in effect; mandatory or voluntary speed restrictions for certain vessels are in place in these areas respectively when in effect to reduce the risk of ship strike. Because these areas are intended to reduce the risk of ship strike involving right whales, they are designated in consideration of both right whale presence during migratory periods and commercial shipping traffic. Our concern is not limited to ship strike; therefore the standoff areas based on the SMAs are extended to a continuous coastal strip with a 10 km buffer. Mid-Atlantic SMAs (from Delaware to northern Georgia) are intended to protect whales on the migratory route and are generally defined as a 20 nmi (37 km) radial distance around the entrance to certain ports. Therefore, no survey effort may occur within 47 km of the coast between November and April. This strip is superseded where either designated critical habitat or the southeast SMA provides a larger restricted area. The southeast SMA, intended to protect whales on the calving and nursery grounds, includes the area bounded to the north by 31°27′ N., to the south by 29°45′ N., and to the east by 80°51′36″ W. No survey effort may occur within 10 km of this area between November and April. The combined area of our proposed restriction—composed of the greater of designated critical habitat, the 20 nmi coastal strip, and the southeastern SMA (all buffered by 10 km)—is depicted in Figure 3.

TABLE 2—BOUNDARIES OF DESIGNATED CRITICAL HABITAT FOR NORTH ATLANTIC RIGHT WHALES

Latitude	Longitude	Latitude	Longitude
33°51′ N.	At shoreline	29°08′ N.	80°51′ W.
33°42′ N.	77°43′ W.	28°50′ N.	80°39′ W.
33°37′ N.	77°47′ W.	28°38′ N.	80°30′ W.
33°28′ N.	78°33′ W.	28°28′ N.	80°26′ W.
32°59′ N.	78°50′ W.	28°24′ N.	80°27′ W.
32°17′ N.	79°53′ W.	28°21′ N.	80°31′ W.
31°31′ N.	80°33′ W.	28°16′ N.	80°31′ W.
30°43′ N.	80°49′ W.	28°11′ N.	80°33′ W.
30°30′ N.	81°01′ W.	28°00′ N.	80°29′ W.
29°45′ N.	81°01′ W.	28°00′ N.	At shoreline.
29°15′ N.	80°55′ W.		

Reproduced from 50 CFR 226.203(b)(2).

DMAs are also associated with a scheme established by the final rule for vessel speed limits (73 FR 60173; October 10, 2008; extended by 78 FR 73726; December 9, 2013) to reduce the risk of ship strike for right whales. In association with those regulations, NMFS established a program whereby vessels are requested, but not required, to abide by speed restrictions or avoid locations when certain aggregations of right whales are detected outside SMAs. Generally, the DMA construct is intended to acknowledge that right whales can occur outside of areas where they predictably and consistently occur due to, *e.g.,* varying oceanographic conditions that dictate prey concentrations. NMFS establishes DMAs by surveying right whale habitat and, when a specific aggregation is sighted, creating a temporary zone (*i.e.,* DMA) around the aggregation. DMAs are in effect for 15 days when designated and automatically expire at the end of the period, but may be extended if whales are re-sighted in the same area.

BILLING CODE 3510–22–P

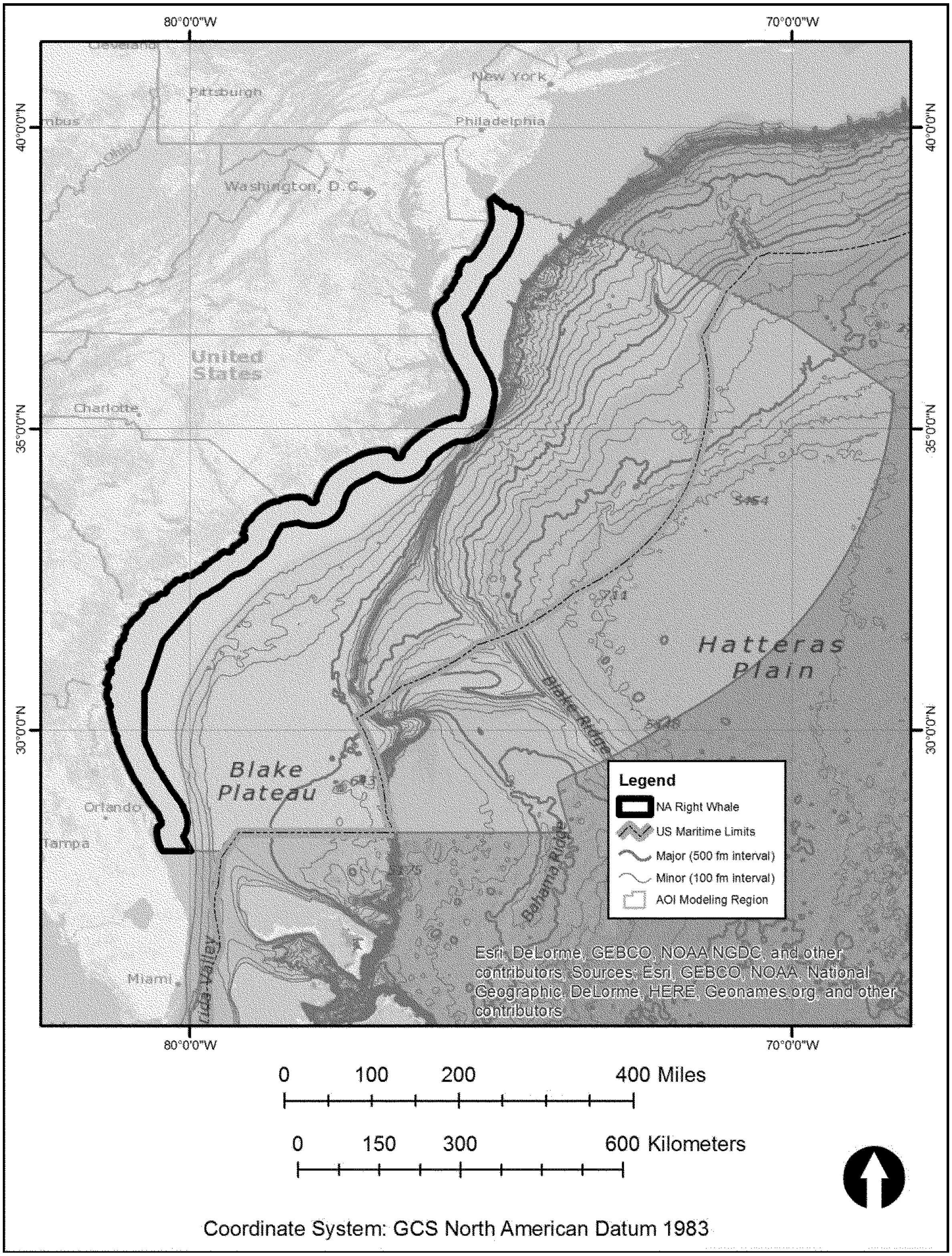

Figure 3. Proposed Time-area Restriction for North Atlantic Right Whale.

BILLING CODE 3510–22–C

Designation of DMAs follows certain protocols identified in 73 FR 60173 (October 10, 2008):

1. A circle with a radius of at least 3 nmi (5.6 km) is drawn around each observed group. This radius is adjusted for the number of right whales seen in the group such that the density of four right whales per 100 nmi^2 (185 km^2) is maintained. The length of the radius is determined by taking the inverse of the four right whales per 100 nmi^2 density (24 nmi^2 per whale). That figure is

equivalent to an effective radial distance of 3 nmi for a single right whale sighted, 4 nmi for two whales, 5 nmi for three whales, etc.

2. If any circle or group of contiguous circles includes three or more right whales, this core area and its surrounding waters become a candidate temporary zone. After NMFS identifies a core area containing three or more right whales, as described here, it will expand this initial core area to provide a buffer area in which the right whales could move and still be protected.

NMFS determines the extent of the DMA zone by:

3. Establishing a 15-nmi (27.8-km) radius from the sighting location used to draw a larger circular zone around each core area encompassing a concentration of right whales. The sighting location is the geographic center of all sightings on the first day of an event; and

4. Identifying latitude and longitude lines drawn outside but tangential to the circular buffer zone(s).

NMFS issues announcements of DMAs to mariners via its customary maritime communication media (*e.g.,* NOAA Weather radio, Web sites, email and fax distribution lists) and any other available media outlets. Information on the possibility of establishment of such zones is provided to mariners through written media such as *U.S. Coast Pilots* and *Notice to Mariners* including, in particular, information on the media mariners should monitor for notification of the establishment of a DMA. Upon notice via the above media of DMA designation, survey operators must cease operation if within 10 km of the boundary of a designated DMA and may not conduct survey operations within 10 km of a designated DMA during the period in which the DMA is active. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

Proposal of this measure should not be interpreted as NMFS's determination that harassment of right whales cannot be authorized. However, when considering the current status of the species, likely benefit of the measure to the species, and likely impact to applicants, we believe that inclusion of this measure is warranted.

Other Species—Predicted acoustic exposures are moderate to high for certain potentially affected marine mammal species (see Table 10) and, regardless of the absolute numbers of predicted exposures, the scope of proposed activities (*i.e.,* proposed survey activity throughout substantial portions of many species range and for substantial portions of the year) gives rise to concern regarding the impact on certain potentially affected stocks. Therefore, we take the necessary step of identifying additional spatiotemporal restrictions on survey effort, as described here (Figure 4 and Table 3). Our qualitative assessment leads us to believe that implementation of these measures is expected to provide both meaningful control on the numbers of animals affected as well as biologically meaningful benefit for the affected animals by restricting survey activity and the effects of the sound produced in areas of residency and/or preferred habitat that support higher densities for the stocks during substantial portions of the year.

The restrictions described here are primarily targeted towards protection of sperm whales, beaked whales (*i.e.,* Cuvier's beaked whale or *Mesoplodon* spp. but not the northern bottlenose whale; see ''Description of Marine Mammals in the Area of the Specified Activity''), Atlantic spotted dolphin, and pilot whales. For all four species or guilds, the amount of predicted exposures is moderate to high. For the Atlantic spotted dolphin, our impetus in delineating a restriction on survey effort is solely due to this high amount of predicted exposures to survey noise. For other species, the moderate to high amount of predicted exposures in conjunction with other contextual elements provides the impetus to develop appropriate restrictions. Beaked whales are considered to be a particularly acoustically sensitive species. The sperm whale is an endangered species, also considered to be acoustically sensitive and potentially subject to significant disturbance of important foraging behavior. Pilot whale populations in U.S. waters of the Atlantic are considered vulnerable due to high levels of mortality in commercial fisheries, and are therefore likely to be less resilient to other stressors, such as disturbance from the proposed surveys.

In some cases, we expect substantial subsidiary benefit for additional species that also find preferred habitat in the designated area of restriction. In particular, Area #5 (Figure 4), although delineated in order to specifically provide an area of anticipated benefit to beaked whales, sperm whales, and pilot whales, is expected to host a diverse cetacean fauna (*e.g.,* McAlarney *et al.,* 2015). Our analysis (described below) indicates that species most likely to derive subsidiary benefit from this time-area restriction include the bottlenose dolphin, Risso's dolphin, and common dolphin. For species with density predicted through stratified models, similar analysis is not possible and assumptions regarding potential benefit of time-area restrictions are based on known ecology of the species and sightings patterns and are less robust. Nevertheless, subsidiary benefit for Areas #2–4 (Figure 4) should be expected for species known to be present in these areas (*e.g.,* assumed affinity for slope/abyss areas off Cape Hatteras): *Kogia* spp., pantropical spotted dolphin, Clymene dolphin, and rough-toothed dolphin.

In order to consider potential restriction of survey effort in time and space, we considered the outputs of habitat-based predictive density models (Roberts *et al.,* 2016) as well as available information concerning focused marine mammal studies within the proposed survey areas, *e.g.,* photo-identification, telemetry, acoustic monitoring. The latter information was used primarily to provide verification for some of the areas and times considered, and helps to confirm that areas of high predicted density are in fact preferred habitat for these species. Please see ''Marine Mammal Density Information,'' later in this document, for a full description of the density models. We used the density model outputs by creating core abundance areas, *i.e.,* an area that contains some percentage of predicted abundance for a given species or species group. The purpose of a core abundance area is to represent the smallest area containing some percentage of the predicted abundance of each species. Summing all the cells (pixels) in the species distribution product gives the total predicted abundance. Core area is calculated by ranking cells by their abundance value from greatest to least, then summing cells with the highest abundance values until the total is equal to or greater than the specified percentage of the total predicted abundance. For example, if a 50 percent core abundance area is produced, half of the predicted abundance falls within the identified core area, and half occurs outside of it. In creating core abundance areas, we considered data outputs over the entire Atlantic coast scale rather than limiting to the proposed survey areas. This is appropriate because we are concerned with impacts to a stock as a whole, and therefore were interested in core abundance based on total predicted abundance rather than just abundance predicted over some subset of a stock's range. We were not able to consider core abundance areas for species with stratified models showing uniform density; however, this information informs us as to whether those species may receive subsidiary benefit from a given time-area restriction.

To determine core abundance areas, we follow a three-step process:

- Determine the predicted total abundance of a species/time period by adding up all cells of the density raster (grid) for the species/time period. For the Roberts *et al.* (2016) density rasters, density is specified as the number of animals per 100 km^2 cell.
- Sort the cells of the species/time period density raster from highest density to the lowest.
- Sum and select the raster cells from highest to lowest until a certain percentage of the total abundance is reached.

The selected cells represent the smallest area that represents a given percentage of abundance. We created a range of core abundance areas for each species of interest, but ultimately determined that 25 percent core abundance area was appropriate in most cases for our purpose. The larger the percentage of abundance captured, the larger the area. Generally speaking, we found that 25 percent core abundance provided the best balance between the areas given by larger (impracticably large areas for purposes of restricting survey effort) and smaller (ineffective areas for purposes of providing meaningful protection) areas. However, for sperm whales, our analysis showed that the 25 percent core abundance area covered a large portion of slope waters in the northern mid-Atlantic region and, therefore, what we believe to be an impracticably large area for potential restriction of survey effort. Although sperm whales are broadly distributed on the slope throughout the year, at the five percent core abundance threshold we found that the model predictions indicate a relatively restricted area of preferred habitat across all seasons in the vicinity of the shelf break to the north of Cape Hatteras. This area, together with spatially separated canyon features contained within the 25 percent core abundance areas and previously identified as preferred habitat for beaked whales, form the basis for our proposed time-space restriction for sperm whales. Core abundance maps are provided online at *www.nmfs.noaa.gov/pr/permits/incidental/oilgas.htm.*

In summary, we propose the following closure areas (depicted in Figure 4):

- In order to protect coastal bottlenose dolphins, a 30-km coastal strip (20 km plus 10 km buffer) would be closed to use of the acoustic source year-round.
- An area proposed for protection of the North Atlantic right whale (Figure 3). The area is comprised of the furthest extent at any location of three distinct components: (1) A 47-km coastal strip (20-nmi plus 10 km buffer) throughout the entire Mid- and South Atlantic OCS planning areas; (2) designated critical habitat, buffered by 10 km; and (3) the designated southeastern seasonal management area, buffered by 10 km. This area would be closed to use of the acoustic source from November through April. Dynamic management areas (buffered by 10 km) are also closed to use of the acoustic source when in effect.

The 10-km buffer (intended to reasonably prevent sound output from the acoustic source exceeding received levels expected to result in behavioral harassment from entering the proposed closure areas) is built into the areas defined below and in Table 3. Therefore, we do not separately mention the addition of the buffer.

BILLING CODE 3510–22–P

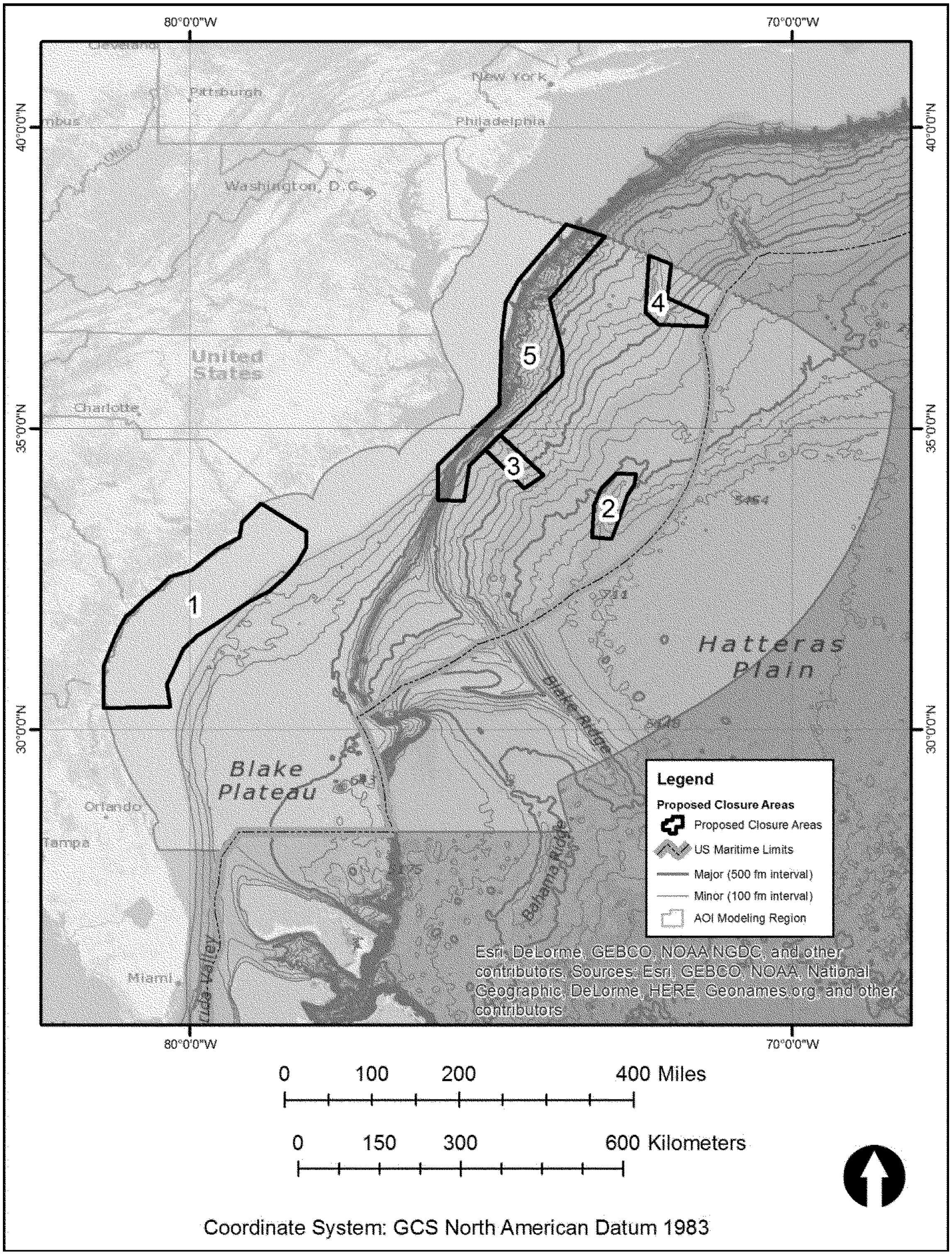

Figure 4. Proposed Time-area Restrictions.

BILLING CODE 3510–22–C

- An area proposed for protection of Atlantic spotted dolphin (Area #1, Figure 4). The area contains the on-shelf portion of a 25 percent core abundance area for the species, and is comprised of lines that demarcate the northern and southern extent of this area, connected by a line marking 100 km distance from shore (as indicated in Table 3). This area would be closed to use of the acoustic source from June through August. This restriction would not be required for ION or CGG.
- Deepwater canyon areas. Areas #2–4 (Figure 4) are proposed as defined in Table 3 and would be closed to use of

the acoustic source year-round. Although they may be protective of additional species (*e.g., Kogia* spp.), Area #2 is expected to be particularly beneficial for beaked whales and Areas #3–4 are expected to be particularly beneficial for both beaked whales and sperm whales.

• Shelf break off Cape Hatteras and to the north, including slope waters around ''The Point.'' Area #5 is proposed as defined in Table 3 and would be closed to use of the acoustic source from July through September. Although this closure is expected to be beneficial for a diverse species assemblage, Area #5 is expected to be particularly beneficial for beaked whales, sperm whales, and pilot whales.

Beaked Whale

Beaked whales are typically deep divers, foraging for mesopelagic squid and fish, and are often found in deep water near high-relief bathymetric features, such as slopes, canyons, and escarpments where these prey are found (*e.g.,* Madsen *et al.,* 2014; MacLeod and D'Amico, 2006; Moors-Murphy, 2014). Sightings of Cuvier's beaked whale are almost exclusively in the continental shelf edge and continental slope areas, while *Mesoplodon* spp. sightings have occurred principally along the shelf-edge and deeper oceanic waters (CETAP, 1982; Waring *et al.,* 1992; Tove, 1995; Waring *et al.,* 2001; Hamazaki, 2002; Palka, 2006; Waring *et al.,* 2014). Roberts *et al.* (2016)'s results suggest that beaked whales do not undertake large seasonal migrations, and are therefore associated with significant habitat features year-round or with some degree of residency (Roberts *et al.,* 2015l; Gowans *et al.,* 2000; MacLeod and D'Amico, 2006). In support of patterns seen in the density model outputs, MacLeod and D'Amico (2006) state that beaked whale occurrence is linked particularly to features such as slopes, canyons, escarpments and oceanic islands. Northern bottlenose whales and Sowerby's beaked whales were found to preferentially occur in a marine canyon rather than the neighboring shelf, slope and abyssal areas (Hooker *et al.,* 1999, 2002). Cuvier's beaked whales are also known to associate with canyons (D'Amico *et al.,* 2003; Williams *et al.,* 1999), and Blainville's beaked whales were also found to preferentially occur over the upper reaches of a canyon (MacLeod and Zuur, 2005). Sighting rates of beaked whales in the western North Atlantic are significantly higher within canyon areas than non-canyon areas (Waring *et al.,* 2001). It is possible, however, that such occurrence patterns are linked more strongly to oceanographic features influencing prey distribution, which may or may not be permanently linked to seabed topography (MacLeod and D'Amico, 2006).

Submarine canyons are important features of the shelf and slope region from Cape Hatteras to the north, with both major and minor canyons abundant in the region. Roberts *et al.* (2016) predicted beaked whale density at year-round temporal resolution, with model predictions showing concentrated distribution in deep waters over high-relief bathymetry where high prey density would be expected due to entrainment of nutrient-rich sediments and organic material (Moors-Murphy, 2014). Highest densities were predicted in areas along the continental slope and in and around submarine canyons (Roberts *et al.,* 2016). The core abundance area analysis highlighted three such submarine canyon areas as being of year-round importance to beaked whales (Areas #2–4, see Figure 4). Area #3 is centered on Hatteras Canyon, a major canyon system that cuts a deep valley across the upper continental rise before terminating on the lower rise. Area #2, in deeper water, encompasses the Hatteras Transverse Canyon (HTC). HTC is downslope of and fed by both Hatteras and Albemarle Canyons (which dissect the slope) and their channel extensions, as well as smaller unnamed canyons and canyon channels, and is bounded by the Hatteras Ridge, which is a major transverse barrier deflecting turbidity currents into the HTC (Gardner *et al.,* 2016). Area #4 is centered on a large, deepwater valley system that is fed by a complex series of canyons and gullies incising the slope between Hendrickson and Baltimore Canyons (note that the entire shelf break north of Cape Hatteras, including many of these canyons and gullies, is included in our Area #5 (Figure 4) which is discussed below). In delineating the actual area proposed for restriction on survey effort, we expanded from 10 x 10 km grid cells specifically predicted as being within the beaked whale 25 percent core abundance area to include adjacent cells that also cover the relevant bathymetric feature. Assuming that beaked whales are present in these areas, their use of these habitat areas would not be expected to be restricted within the feature and we delineate the proposed closure areas accordingly. We assume that beaked whales associate with these features year-round, and each of the three areas is proposed as a year-round closure.

Area #5 (Figure 4) was designed as a multi-species area, primarily focused on pilot whales, beaked whales, and sperm whales. This area is focused on a particularly dynamic and highly productive environment off of Cape Hatteras (sometimes referred to as ''Hatteras Corner'' or ''The Point'') and the shelf break environment running to the north (to the boundary of BOEM's Mid-Atlantic OCS planning area) and to the south. This environment off of Cape Hatteras is created through the confluence of multiple currents and water masses, including the Gulf Stream (SAFMC, 2003), over complex bottom topography and hosts a high density and diversity of cetaceans (*e.g.,* McAlarney *et al.,* 2015). For beaked whales, our core abundance area analysis predicts that the shelf break area running from The Point to the southern extent of Area #5 would be within the 25 percent core abundance area, while the remainder of the shelf break to the north would be within the 50 percent core abundance area. This finding is supported by passive acoustic monitoring effort, which detected echolocation signals from Cuvier's beaked whales consistently throughout the year (95 percent of 741 recording days across all seasons), suggesting that beaked whales are resident to this area (Stanistreet *et al.,* 2015). Gervais' beaked whales were detected more sporadically (33 percent of recording days). Monthly aerial surveys conducted from 2011–2014 in the same region, from shallow continental shelf waters across the continental shelf break and into deep pelagic waters, also detected beaked whales in all months of the year (McLellan *et al.,* 2015). All beaked whale sightings occurred along the continental shelf break. Baird *et al.* (2015) reported results from three tagged Cuvier's beaked whales, which largely remained in slope waters off the coasts of North Carolina, Virginia, and Maryland. Although this limited number of tags makes it difficult to draw conclusions, the authors hypothesize that the observed movements may be representative of a resident population.

Although beaked whales are likely present in this area year-round, there is significant overlap between this proposed restriction and the area of highest interest by the applicant companies. Therefore, we determined that practicability concerns dictate that we establish a temporal component to this closure rather than designate this area as a year-round closure (as is the case for Areas #2–4). Roberts *et al.* (2016) predicted density for pilot whales and beaked whales at year-round temporal resolution; therefore, the output of those models does not help to designate a temporal aspect to this proposed restriction. However, the model produced for sperm whales predicts density at a monthly resolution and informed our delineation of temporal bounds for this closure. The model predicts the greatest density of sperm whales in this region from June through October, with the highest overall abundance predicted for July through September (Roberts *et al.,* 2015n). Therefore, we propose that Area #5 be in effect as a seasonal area closure from July through September.

Sperm Whale

Although sperm whales are one of the most widely distributed marine mammals, they are typically more abundant in areas of high primary productivity (Jaquet *et al.,* 1996) and thus may be expected to occur in greater numbers in areas where physiographic and oceanographic features serve to aggregate prey (*e.g.,* squid). Sperm whales are in fact commonly associated with submarine canyons (Moors-Murphy, 2014) and, specifically in this region, have been found to be associated with canyons (Whitehead *et al.,* 1992), the north wall of the Gulf Stream (Waring *et al.,* 1993), and temperature fronts and warm-core eddies (Waring *et al.,* 2001; Griffin, 1999). Areas #3–4 (Figure 4), described above for beaked whales, were also identified as areas of high predicted density for sperm whales. Roberts *et al.* (2016) predicted sperm whale density at monthly temporal resolution, and core abundance analysis conducted at a monthly time-step predicts that Area #3 is of year-round importance for sperm whales, while Area #4 is within the sperm whale 25 percent core abundance area for seven months of the year (Jun-Dec). CETAP (1982) reported sightings of sperm whales north of Cape Hatteras off the shelf and along the shelf break during all four seasons, while acoustic monitoring detected sperm whales every month of the year off the shelf near Onslow Bay, North Carolina (Stanistreet *et al.,* 2012; Hodge and Read, 2014; Debich *et al.,* 2014; Hodge *et al.,* 2015).

As noted above, Area #5 (Figure 4) is a multi-species area, primarily focused on pilot whales, beaked whales, and sperm whales, and is proposed to be in effect from July through September. In particular, Area #5's ''bulge'' to the north and east of Cape Hatteras was indicated as high-density sperm whale habitat contained within the five percent core abundance area in all months, but as a larger area and with higher predicted density during July through September, as discussed above. During these months, the 25 percent core abundance area for sperm whales is predicted as covering a large swath of the region from the region of The Point off and to the south of Cape Hatteras north to the planning area boundary and including shelf break waters east over the entire slope and into abyssal waters in some locations. As described previously, due to the large size of this area, we based this component of Area #5 on the relevant portion of the five percent core abundance are for sperm whales. This area, predicted to host the highest density of sperm whales, was contiguous to and somewhat overlapping with the shelf break strip suggested by core abundance area analysis for beaked whales and pilot whales. We believe this reflects the appropriate balance between necessary protective measures for this species and practicability for the applicant companies, which would be severely restricted in their ability to survey the area of interest were our proposed closure larger in terms of either space or time.

Pilot Whale

Pilot whales are distributed primarily along the continental shelf edge, occupying areas of high relief or submerged banks, and are also associated with the Gulf Stream wall and thermal fronts along the shelf edge (Waring *et al.,* 2016). Roberts *et al.* (2016) predicted pilot whale density at year-round temporal resolution. High pilot whale density was predicted throughout the year at an area of the shelf break and continental slope north of where the Gulf Stream separates from the shelf at Cape Hatteras. Sightings were reported in this vicinity in nearly every month of the year (Roberts *et al.,* 2015c).The entire shelf break area from Cape Hatteras north to the boundary of the planning area was predicted as being within the pilot whale 25 percent core abundance area. However, within this predicted core abundance area, the region immediately offshore of the Cape Hatteras shelf break and to the north extending into waters over the slope was predicted as containing notably higher density of pilot whales. This area is retained within the core abundance area even when the threshold is reduced to 5 percent, indicating that it is one of the most important areas in the region for any species. These patterns are supported by observation, including telemetry. Thorne *et al.* (2015) tracked the movements of 18 short-finned pilot whales off Cape Hatteras between May and December 2014 (mean tag deployment of 57 days) and quantified their habitat use relative to environmental variables. Results showed that pilot whales have a strong affinity for the shelf break, with more than 90 percent of locations occurring within 20 km of the shelf break (*i.e.,* 1,000 m depth contour) and more than 65 percent occurring within 5 km of the shelf break, and highlight the importance of static habitat features for the species. As a result of similar tagging work, Foley *et al.* (2015) found that, despite long-distance movements, pilot whales displayed a high degree of site fidelity off Cape Hatteras. Intra- and inter-annual as well as intra- and inter-seasonal matches to an existing photo-identification catalog were made, and some individuals were matched over periods of up to eight years. The authors hypothesize that that the shelf break offshore of Cape Hatteras is an important area for this species, to which individuals return frequently. Area #5 (Figure 4) was designed accordingly to encompass these important pilot whale habitat areas and, as described previously, is proposed to be in effect from July through September.

Atlantic Spotted Dolphin

Atlantic spotted dolphins are widely distributed in tropical and warm temperate waters of the western North Atlantic, and regularly occur in continental shelf waters south of Cape Hatteras and in continental shelf edge and continental slope waters north of this region (Payne *et al.,* 1984; Mullin and Fulling, 2003). Sightings have also been made along the north wall of the Gulf Stream and warm-core ring features (Waring *et al.,* 1992). This disjunct distribution may be due to the occurrence of two ecotypes of the species: A larger form that inhabits the continental shelf and is usually found inside or near the 200-m isobath and a smaller offshore form (Mullin and Fulling, 2003; Waring *et al.,* 2014). Morphometric, genetic, and acoustic data support the suggestion that two ecotypes inhabit this region (Baron *et al.,* 2008; Viricel and Rosel, 2014) and observational data are consistent with this distribution pattern. Existing data show a dense cluster of observations along the continental shelf between Florida and Virginia and a second, more dispersed cluster off the shelf and north of the Gulf Stream (north of Cape Hatteras) (Roberts *et al.,* 2015o). As would be expected from these patterns, results from Roberts *et al.* (2016) predict the following density pattern: Low near the shore, high in the mid-shelf, low near the shelf break, then higher again offshore.

Although there are no relevant considerations with regard to population context or specific stressors that lead us to develop mitigation focused on Atlantic spotted dolphins, the predicted amount of acoustic exposure for the species is among the highest for all species across three of the five applicant companies. Therefore, we believe it appropriate to delineate a time-area restriction for the sole purpose of reducing likely acoustic exposures for the species, for those three companies (*i.e.,* we propose that this restriction be implemented for Spectrum, TGS, and Western but not for CGG or ION). As noted above, observational data indicate that the area of likely highest density for Atlantic spotted dolphin is on-shelf south of Cape Hatteras. This is also an area of relatively little interest to the applicant companies (in contrast with the second area of relatively high density for Atlantic spotted dolphin, off the shelf to the north of the Gulf Stream). Our core abundance area analysis indeed suggests that the two areas comprise the 25 percent core abundance area for the species, with the on-shelf region roughly contained by the 100-m isobath offshore of Georgia and South Carolina. We thus delineate our proposed closure area by the northern and southern extent of the predicted on-shelf component of the 35 percent core abundance area, bounded by a line 100 km from shore (which roughly corresponds with the 100-m isobath). We assume that this may present a simpler, more practicable way for vessel operators to mark the area to be avoided, but invite public comment regarding operators' capacity to mark areas to be avoided using different methods (*e.g.,* coordinates, depth contours, specific distances from shore, shapefiles).

Our assumption here is that given the absence of other contextual factors demanding special protection of spotted dolphins, a seasonal restriction would be sufficient to guarantee that the species is afforded some protection from harassment in one of the areas most important for it. Because there is little information about the species migration patterns, and Roberts *et al.* (2016) predicted density at a year-round temporal resolution, we delineate the proposed closure on the basis of NMFS' observational data. Current shipboard observational data was collected during June-August 2011 (Waring *et al.,* 2014). Although Roberts *et al.* (2015o) suggest that monthly model results should not be relied upon, we note that these results do show likely highest abundance in this portion of the proposed survey areas in the summer months (June through September). Therefore, we propose that Area #1 be in effect from June through August.

TABLE 3—BOUNDARIES OF PROPOSED TIME-AREA RESTRICTIONS DEPICTED IN FIGURE 4

Area	Latitude	Longitude	Area	Latitude	Longitude
1	30° 20′ 50″ N.	At shoreline	4	36° 55′ 20″ N.	72° 26′ 18″ W.
1 [1]	30° 22′ 25″ N.	80° 19′ 55″ W.	4	37° 52′ 21″ N.	72° 22′ 31″ W.
1 [1]	33° 17′ 03″ N.	78° 04′ 00″ W.	4	37° 43′ 53″ N.	72° 00′ 32″ W.
1	33° 45′ 01″ N.	At shoreline	4	37° 43′ 54″ N.	72° 00′ 40″ W.
2	33° 31′ 16″ N.	72° 52′ 07″ W.	4	37° 09′ 52″ N.	72° 04′ 31″ W.
2	33° 10′ 05″ N.	72° 59′ 59″ W.	4	36° 52′ 01″ N.	71° 24′ 31″ W.
2	33° 11′ 23″ N.	73° 19′ 36″ W.	5	37° 08′ 30″ N.	74° 01′ 42″ W.
2	33° 43′ 34″ N.	73° 17′ 43″ W.	5	36° 15′ 12″ N.	73° 48′ 37″ W.
2	33° 59′ 43″ N.	73° 10′ 16″ W.	5	35° 53′ 14″ N.	73° 49′ 02″ W.
2	34° 15′ 10″ N.	72° 55′ 37″ W.	5	34° 23′ 07″ N.	75° 21′ 33″ W.
2	34° 14′ 02″ N.	72° 36′ 00″ W.	5	33° 47′ 37″ N.	75° 27′ 25″ W.
2	34° 03′ 33″ N.	72° 37′ 27″ W.	5	33° 48′ 31″ N.	75° 52′ 58″ W.
2	33° 53′ 00″ N.	72° 44′ 31″ W.	5	34° 23′ 57″ N.	75° 52′ 50″ W.
3	34° 13′ 21″ N.	74° 07′ 33″ W.	5	35° 22′ 29″ N.	74° 51′ 50″ W.
3	34° 00′ 07″ N.	74° 26′ 41″ W.	5	36° 32′ 31″ N.	74° 49′ 31″ W.
3	34° 38′ 40″ N.	75° 05′ 52″ W.	5	37° 05′ 39″ N.	74° 45′ 37″ W.
3	34° 53′ 24″ N.	74° 51′ 11″ W.	5	37° 27′ 53″ N.	74° 32′ 40″ W.
4	36° 41′ 17″ N.	71° 25′ 47″ W.	5	38° 23′ 15″ N.	73° 45′ 06″ W.
4	36° 43′ 20″ N.	72° 13′ 25″ W.	5	38° 11′ 17″ N.	73° 06′ 36″ W.

[1] These two points are connected by a line marking 100 km distance from shoreline.

National Marine Sanctuaries—As a result of consultation between BOEM and NOAA's Office of National Marine Sanctuaries, all surveys would maintain a minimum buffer of 15 km around the boundaries of the Gray's Reef and Monitor National Marine Sanctuaries. Gray's Reef NMS is located approximately 26 km off the Georgia coast and protects 57 km². The Monitor NMS is located approximately 26 km off the North Carolina coast and protects the wreck of the USS *Monitor.* Any benefit to marine mammals from these restrictions would likely be minimal.

Coastal Zone Management Act—As a result of coordination with relevant states pursuant to the Coastal Zone Management Act, Spectrum agreed to certain closure requirements (which may be partially or entirely subsumed by proposed closures described above):

- No survey operations within 125 nmi (232 km) of Maryland's coast from April 15 to November 15.
- No survey operations within the 30-m depth isobath off the South Carolina coast.
- No survey operations within 20 nmi (37 km) of Georgia's coast from April 1 to September 15 and within 30 nmi (56 km) of Georgia's coast from November 15 to April 15.

Vessel Strike Avoidance

These proposed measures generally follow those described in BOEM's PEIS. These measures apply to all vessels associated with the proposed survey activity (*e.g.,* source vessels, chase vessels, supply vessels) and include the following:

1. Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel, according to the parameters stated below, to ensure the potential for strike is minimized. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to

distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

2. All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15). See *www.fisheries.noaa.gov/pr/shipstrike/* for more information on these areas.

3. Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity of the vessel; therefore, precautionary measures should be exercised when an animal is observed.

4. All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

a. While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

b. If a whale is spotted in the path of a vessel or within 500 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 500 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

5. All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

a. The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

b. If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

6. All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

General Measures

All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

We have carefully evaluated the suite of mitigation measures described here to preliminarily determine whether they are likely to effect the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals, (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any mitigation measure(s) we prescribe should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the number (total number or number at biologically important time or location) of individual marine mammals exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(3) A reduction in the number (total number or number at biologically important time or location) of times any individual marine mammal would be exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(4) A reduction in the intensity of exposure to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing the severity of behavioral harassment only).

(5) Avoidance or minimization of adverse effects to marine mammal habitat, paying particular attention to the prey base, blockage or limitation of passage to or from biologically important areas, permanent destruction of habitat, or temporary disturbance of habitat during a biologically important time.

(6) For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of these measures, we have preliminarily determined that they provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

We recognize that BOEM may require more stringent measures through survey-specific permits issued to applicant companies under its authorities pursuant to the OCSLA (43 U.S.C. 1331–1356). NMFS's Endangered Species Act Interagency Cooperation Division (Interagency Cooperation Division) may also require that more stringent or additional measures be included in any issued IHAs via any required consultation pursuant to section 7 of the Endangered Species Act. Please see ''Proposed Authorizations,'' below, for requirements specific to each proposed IHA.

Description of Marine Mammals in the Area of the Specified Activity

We have reviewed the applicants' species descriptions—which summarize available information regarding status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of the potentially affected species—for accuracy and completeness and refer the reader to Sections 3 and 4 of the applications, as well as to NMFS's Stock Assessment Reports (SAR; *www.nmfs.noaa.gov/pr/sars/*), instead of reprinting the information here. Additional general information about these species (*e.g.,* physical and behavioral descriptions) may be found on NMFS's Web site (*www.nmfs.noaa.gov/pr/species/mammals/*), in BOEM's PEIS, or in the U.S. Navy's Marine Resource Assessments (MRA) for relevant operating areas (*i.e.,* Virginia Capes, Cherry Point, and Charleston/Jacksonville (DoN, 2008a,b,c)). The MRAs are available online at: *www.navfac.navy.mil/products_and_services/ev/products_and_services/marine_resources/marine_resource_assessments.html.* Table 4 lists all species with expected potential for occurrence in the mid- and south Atlantic and summarizes information related to the population or stock, including potential biological removal (PBR). For taxonomy, we follow Committee on Taxonomy (2016). PBR, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population, is considered in concert with known sources of ongoing anthropogenic mortality (as described in NMFS's SARs). Species that could potentially occur in the proposed survey areas but are not expected to have reasonable potential to be harassed by any proposed survey are described briefly but omitted from further analysis. These include extralimital species, which are species that do not normally occur in a given area but for which there are one or more occurrence records that are considered beyond the normal range of the species. For status of species, we provide information regarding U.S. regulatory status under the MMPA and ESA.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study area. NMFS's stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. Survey abundance (as compared to stock or species abundance) is the total number of individuals estimated within the survey area, which may or may not align completely with a stock's geographic range as defined in the SARs. These surveys may also extend beyond U.S. waters.

In some cases, species are treated as guilds. In general ecological terms, a guild is a group of species that have similar requirements and play a similar role within a community. However, for purposes of stock assessment or abundance prediction, certain species may be treated together as a guild because they are difficult to distinguish visually and many observations are ambiguous. For example, NMFS's Atlantic SARs assess *Mesoplodon* spp. and *Kogia* spp. as guilds. Here, we consider pilot whales, beaked whales (excluding the northern bottlenose whale), and *Kogia* spp. as guilds. In the following discussion, reference to ''pilot whales'' includes both the long-finned and short-finned pilot whale, reference to ''beaked whales'' includes the Cuvier's, Blainville's, Gervais, Sowerby's, and True's beaked whales, and reference to ''*Kogia* spp.'' includes both the dwarf and pygmy sperm whale.

Thirty-four species (with 39 managed stocks) are considered to have the potential to co-occur with the proposed survey activities. Extralimital species or stocks unlikely to co-occur with survey activity include nine estuarine bottlenose dolphin stocks, four pinniped species, the white-beaked dolphin (*Lagenorhynchus albirostris*), and the beluga whale (*Delphinapterus leucas*). The white-beaked dolphin is generally found only to southern New England, with sightings concentrated in the Gulf of Maine and around Cape Cod. Beluga whales have rarely been sighted as far south as New Jersey, but are considered extralimital in New England. Seals in the western Atlantic are, in general, occurring more frequently in areas further south than are considered typical and increases in pinniped sightings and stranding events have been documented in the mid-Atlantic. However, all seals are considered rare or extralimital in the mid-Atlantic and, further, would generally be expected to occur in relatively shallow nearshore waters outside the proposed survey areas (note also that we propose a restriction on survey activity in coastal waters ranging from a minimum of 30 km (year-round) out to 47 km (November–April)). The gray seal's (*Halichoerus grypus grypus*) winter range extends south to New Jersey, while the harp seal (*Pagophilus groenlandicus*) is generally found in Canada, although individual seals are observed as far south as New Jersey during January–May. The harbor seal's (*Phoca vitulina concolor*) winter range is generally from southern New England to New Jersey, though it may occasionally extend south to northern North Carolina. Unpublished marine mammal stranding records for the most recent five-year period (2011–2015) for the Atlantic coast from Delaware to Georgia show 38, 24, and 44 strandings for these three species, respectively (with one additional record of an unidentified seal). These occurrences are generally limited to the mid-Atlantic (Delaware to North Carolina), with one harbor seal recorded from South Carolina and no records from Georgia. The hooded seal (*Cystophora cristata*) generally remains near Newfoundland in winter and spring, and visits the Denmark Strait for molting in summer. However, hooded seals are highly migratory, preferring deeper water than other seals, and individuals have been observed in deep water as far south as Florida and the Caribbean. Such observations are rare and unpredictable, and there were no recorded strandings of hooded seals during the 2011–2015 period.

Estuarine stocks of bottlenose dolphin primarily inhabit inshore waters of bays, sounds, and estuaries, and stocks are defined adjacent to the proposed survey area from Pamlico Sound, North Carolina to Indian River Lagoon, Florida. However, NMFS's SARs generally describe estuarine stock ranges as including coastal waters to 1 km (though North Carolina stocks are described as occurring out to 3 km at certain times of year). Therefore, these stocks would not be impacted by the proposed seismic surveys. In addition, the West Indian manatee (*Trichechus manatus latirostris*) may be found in coastal waters of the Atlantic. However, manatees are managed by the U.S. Fish and Wildlife Service and are not considered further in this document. All managed stocks in this region are assessed in NMFS's U.S. Atlantic SARs (*e.g.,* Waring *et al.,* 2016). All values presented in Table 4 are the most recent available at the time of publication and are available in the 2015 SARs (Waring *et al.,* 2016) and draft 2016 SARs (available online at: *www.nmfs.noaa.gov/pr/sars/draft.htm*).

TABLE 4—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF PROPOSED SURVEY ACTIVITIES

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2]	Predicted abundance (CV) [3]	PBR	Annual M/SI (CV) [4]
Order Cetartiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)							
Family Balaenidae							
North Atlantic right whale.	*Eubalaena glacialis*	Western North Atlantic (WNA).	E/D; Y	440 (n/a; 440; n/a)	*535 (0.45)	1.0	5.66
Family Balaenopteridae (rorquals)							
Humpback whale	*Megaptera novaeangliae novaeangliae.*	Gulf of Maine	-; N	823 (n/a; 823; 2008)	*1,637 (0.07)	13	9.05
Minke whale	*Balaenoptera acutorostrata acutorostrata.*	Canadian East Coast	-; N	2,591 (0.81; 1,425; 2011).	*2,112 (0.05)	14	8.25
Bryde's whale	*B. edeni brydei*	None defined [5]	-; n/a	n/a	7 (0.58)	n/a	n/a
Sei whale	*B. borealis borealis*	Nova Scotia	E/D; Y	357 (0.52; 236; 2011)	*717 (0.30)	0.5	0.8
Fin whale	*B. physalus physalus*	WNA	E/D; Y	1,618 (0.33; 1,234; 2011).	4,633 (0.08)	2.5	3.8
Blue whale	*B. musculus musculus*	WNA	E/D; Y	Unknown (n/a; 440; n/a).	11 (0.41)	0.9	Unk
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)							
Family Physeteridae							
Sperm whale	*Physeter macrocephalus*	North Atlantic	E/D; Y	2,288 (0.28; 1,815; 2011).	5,353 (0.12)	3.6	0.8
Family Kogiidae							
Pygmy sperm whale.	*Kogia breviceps*	WNA	-; N	3,785 (0.47; 2,598; 2011) [6].	[6] 678 (0.23)	21	3.5 (1.0)
Dwarf sperm whale.	*K. sima*	WNA	-; N				
Family Ziphiidae (beaked whales)							
Cuvier's beaked whale.	*Ziphius cavirostris*	WNA	-; N	6,532 (0.32; 5,021; 2011).	[6] 14,491 (0.17)	50	0.4
Gervais beaked whale.	*Mesoplodon europaeus*	WNA	-; N	7,092 (0.54; 4,632; 2011) [6].		46	0.2
Blainville's beaked whale.	*M. densirostris*	WNA	-; N				
Sowerby's beaked whale.	*M. bidens*	WNA	-; N				
True's beaked whale.	*M. mirus*	WNA	-; N				
Northern bottlenose whale.	*Hyperoodon ampullatus*	WNA	-; N	Unknown	90 (0.63)	Undet.	0
Family Delphinidae							
Rough-toothed dolphin.	*Steno bredanensis*	WNA	-; N	271 (1.0; 134; 2011)	532 (0.36)	1.3	0
Common bottlenose dolphin.	*Tursiops truncatus truncatus.*	WNA Offshore	-; N	77,532 (0.40; 56,053; 2011).	[6] 97,476 (0.06)	561	39.4 (0.29)
		WNA Coastal, Northern Migratory.	D; Y	11,548 (0.36; 8,620; 2010–11).		86	1.0–7.5
		WNA Coastal, Southern Migratory.	D; Y	9,173 (0.46; 6,326; 2010–11).		63	0–12
		WNA Coastal, South Carolina/Georgia.	D; Y	4,377 (0.43; 3,097; 2010–11).		31	1.2–1.6
		WNA Coastal, Northern Florida.	D; Y	1,219 (0.67; 730; 2010–11).		7	0.4
		WNA Coastal, Central Florida.	D; Y	4,895 (0.71; 2,851; 2010–11).		29	0.2
Clymene dolphin	*Stenella clymene*	WNA	-; N	6,086 (0.93; 3,132; 1998) [7].	12,515 (0.56)	Undet.	0
Atlantic spotted dolphin.	*S. frontalis*	WNA	-; N	44,715 (0.43; 31,610; 2011).	55,436 (0.32)	316	0
Pantropical spotted dolphin.	*S. attenuata attenuata*	WNA	-; N	3,333 (0.91; 1,733; 2011).	4,436 (0.33)	17	0
Spinner dolphin	*S. longirostris longirostris*	WNA	-; N	Unknown	262 (0.93)	Undet.	0
Striped dolphin	*S. coeruleoalba*	WNA	-; N	54,807 (0.3; 42,804; 2011).	75,657 (0.21)	428	0
Short-beaked common dolphin.	*Delphinus delphis delphis*	WNA	-; N	70,184 (0.28; 55,690; 2011).	86,098 (0.12)	557	409 (0.10)
Fraser's dolphin	*Lagenodelphis hosei*	WNA	-; N	Unknown	492 (0.76)	Undet.	0

TABLE 4—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF PROPOSED SURVEY ACTIVITIES—Continued

Common name	Scientific name	Stock	ESA/MMPA status; strategic (Y/N) [1]	NMFS stock abundance (CV, N_{min}, most recent abundance survey) [2]	Predicted abundance (CV) [3]	PBR	Annual M/SI (CV) [4]
Atlantic white-sided dolphin.	*Lagenorhynchus acutus*	WNA	-; N	48,819 (0.61; 30,403; 2011).	37,180 (0.07)	304	74 (0.2)
Risso's dolphin	*Grampus griseus*	WNA	-; N	18,250 (0.46; 12,619; 2011).	7,732 (0.09)	126	53.6 (0.28)
Melon-headed whale.	*Peponocephala electra*	WNA	-; N	Unknown	1,175 (0.50)	Undet.	0
Pygmy killer whale	*Feresa attenuata*	WNA	-; N	Unknown	n/a	Undet.	0
False killer whale	*Pseudorca crassidens*	WNA	-; Y	442 (1.06; 212; 2011)	95 (0.84)	2.1	Unk
Killer whale	*Orcinus orca*	WNA	-; N	Unknown	11 (0.82)	Undet.	0
Short-finned pilot whale.	*Globicephala macrorhynchus.*	WNA	-; Y	21,515 (0.37; 15,913; 2011).	[6] 18,977 (0.11)	159	192 (0.17)
Long-finned pilot whale.	*G. melas melas*	WNA	-; Y	5,636 (0.63; 3,464; 2011).		35	38 (0.15)
Family Phocoenidae (porpoises)							
Harbor porpoise	*Phocoena phocoena phocoena.*	Gulf of Maine/Bay of Fundy.	-; N	79,833 (0.32; 61,415; 2011).	*45,089 (0.12)	706	437 (0.18)

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

[2] NMFS marine mammal stock assessment reports online at: *www.nmfs.noaa.gov/pr/sars/.* CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For the right whale, the abundance value represents a count of individually identifiable animals; therefore there is only a single abundance estimate with no associated CV. For humpback whales, the stock abundance estimate of 823 is based on photo-identification evidence and represents the minimum number alive in 2008, specific to the Gulf of Maine stock. The minimum estimate of 440 blue whales represents recognizable photo-identified individuals.

[3] This information represents species- or guild-specific abundance predicted by recent habitat-based cetacean density models (Roberts *et al.,* 2016). These models provide the best available scientific information regarding predicted density patterns of cetaceans in the U.S. Atlantic Ocean, and we provide the corresponding abundance predictions as a point of reference. Total abundance estimates were produced by computing the mean density of all pixels in the modeled area and multiplying by its area. Roberts *et al.* (2016) did not produce a density model for pygmy killer whales off the east coast. For those species marked with an asterisk, the available information supported development of either two or four seasonal models; each model has an associated abundance prediction. Here, we report the maximum predicted abundance.

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

[5] Bryde's whales are occasionally reported off the southeastern U.S. and southern West Indies. NMFS defines and manages a stock of Bryde's whales believed to be resident in the northern Gulf of Mexico, but does not define a separate stock in the Atlantic Ocean.

[6] Abundance estimates are in some cases reported for a guild or group of species when those species are difficult to differentiate at sea. Similarly, the habitat-based cetacean density models produced by Roberts *et al.* (2016) are based in part on available observational data which, in some cases, is limited to genus or guild in terms of taxonomic definition. NMFS's SARs present pooled abundance estimates for *Kogia* spp. and *Mesoplodon* spp., while Roberts *et al.* (2016) produced density models to genus level for *Kogia* spp. and *Globicephala* spp. and as a guild for most beaked whales (*Ziphius cavirostris* and *Mesoplodon* spp.). Finally, Roberts *et al.* (2016) produced a density model for bottlenose dolphins that does not differentiate between offshore and coastal stocks.

[7] NMFS's abundance estimates for the Clymene dolphin is greater than eight years old and not considered current. PBR is therefore considered undetermined for this stock, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimate.

For the majority of species potentially present in the specific geographic region, NMFS has designated only a single generic stock (*e.g.,* ''western North Atlantic'') for management purposes. This includes the ''Canadian east coast'' stock of minke whales, which includes all minke whales found in U.S. waters. For the humpback and sei whales, NMFS defines stocks on the basis of feeding locations, *i.e.,* Gulf of Maine and Nova Scotia, respectively. However, our reference to humpback whales and sei whales in this document refers to any individuals of the species that are found in the specific geographic region. For the bottlenose dolphin, NMFS defines an oceanic stock and multiple coastal stocks.

In Table 4 above, we report two sets of abundance estimates: Those from NMFS's SARs and those predicted by Roberts *et al.* (2016). Please see footnotes 2–3 for more detail. The estimates found in NMFS's SARs remain the best estimates of current stock abundance in most cases. These estimates are typically generated from the most recent shipboard and/or aerial surveys conducted, and often incorporate correction for detection bias. However, for purposes of assessing estimated exposures relative to abundance—used in this case to understand the scale of the predicted takes compared to the population and to inform our small numbers finding—we generally believe that the Roberts *et al.* (2016) abundance predictions are most appropriate because the outputs of these models were used in most cases to generate the exposure estimates and therefore provide the most appropriate comparison. The Roberts *et al.* (2016) abundance estimates represent the output of predictive models derived from observations and associated environmental parameters and are in fact based on substantially more data than are NMFS's SAR abundance estimates, which are typically derived from only the most recent survey effort. In some cases, the use of more data to inform an abundance estimate can lead to a conclusion that there may be a more appropriate abundance estimate to use for the specific comparison to exposure estimates noted above than that provided in the SARs. For example, NMFS's pilot whale abundance estimates show substantial year-to-year variability. For the Florida to Bay of Fundy region, single-year estimates from 2004 and 2011 (the most recent offered in the SARs) differed by 21 percent, indicating that it may be more appropriate to use the model prediction, as the model incorporates data from 1992–2013.

As a further illustration of the distinction between the SARs and model-predicted abundance estimates, the current NMFS stock abundance estimate for the Atlantic spotted dolphin is based on direct observations from shipboard and aerial surveys conducted in 2011 and corrected for detection bias whereas the exposure estimates presented herein for Atlantic spotted dolphin are based on the abundance predicted by a density surface model informed by observations from 1992–2014 and covariates associated at the observation level. To directly compare the estimated exposures predicted by the outputs of the Roberts *et al.* (2016) model to NMFS's SAR abundance would therefore not be meaningful. However, our use of the Roberts *et al.* (2016) abundance predictions for this purpose should not be interpreted as a statement that those predictions are considered to be more accurate than those presented in NMFS's SARs; rather they are a different set of information entirely and more appropriate, at times, for our analysis. For the example of Atlantic spotted dolphin, we make relative comparisons between the exposures predicted by the outputs of the model and the overall abundance predicted by the model. The best current abundance estimate for the western North Atlantic stock of Atlantic spotted dolphins is still appropriately considered to be that presented in the SAR. Where there are other considerations that lead us to believe that an abundance other than that predicted by Roberts *et al.* (2016) is most appropriate for use here, we provide additional discussion below.

NMFS's abundance estimate for the North Atlantic right whale is based on a census of individual whales identified using photo-identification techniques and is therefore the most appropriate abundance estimate; the current estimate represents whales known to be alive in 2012 (*www.nmfs.noaa.gov/pr/sars/draft.htm*).

The 2007 Canadian Trans-North Atlantic Sighting Survey (TNASS), which provided full coverage of the Atlantic Canadian coast (Lawson and Gosselin, 2009), provided abundance estimates for multiple stocks. The abundance estimates from this survey were corrected for perception and availability bias, when possible. In general, where the TNASS survey effort provided superior coverage of a stock's range (as compared with NOAA shipboard survey effort), we elect to use the resulting abundance estimate over either the current NMFS abundance estimate (derived from survey effort with inferior coverage of the stock range) or the Roberts *et al.* (2016) prediction. The TNASS data were not made available to the model authors (Roberts *et al.,* 2015a).

We use the TNASS abundance estimate for the Canadian North Atlantic stock of minke whales and for the short-beaked common dolphin. The TNASS survey also produced an abundance estimate of 3,522 (CV = 0.27) fin whales. Although Waring *et al.* (2016) suggest that the current abundance estimate of 1,618 fin whales, derived from 2011 NOAA shipboard surveys, is the best because it represents the most current data (despite not including a significant portion of the stock's range), we believe the TNASS estimate is most appropriate for use here precisely because it better covered the stock's range. Note that, while the same TNASS survey produced an abundance estimate of 2,612 (CV = 0.26) humpback whales, the survey did not provide superior coverage of the stock's range in the same way that it did for minke and fin whales (Waring *et al.,* 2016; Lawson and Gosselin, 2011). In addition, based on photo-identification only 39 percent of individual humpback whales observed along the mid- and south Atlantic U.S. coast are from the Gulf of Maine stock (Barco *et al.,* 2002). Therefore, we use the Roberts *et al.* (2016) prediction for humpback whales.

The TNASS also provided an abundance estimate for pilot whales (16,058; CV = 0.79), but covered habitats expected to contain long-finned pilot whales exclusively (Waring *et al.,* 2016). Pilot whale biopsy samples collected from 1998–2007 and analyzed to support an analysis of the likelihood that a sample is from a given species of pilot whale as a function of sea surface temperature and water depth showed that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales, though there is an area of overlap between the two species primarily along the shelf break off the coast of New Jersey (between 38–40° N.) (Waring *et al.,* 2016). Therefore, most pilot whales potentially affected by the proposed surveys would likely be short-finned pilot whales.

NMFS's current abundance estimate for *Kogia* spp. is substantially higher than that provided by Roberts *et al.* (2016). However, the data from which NMFS's estimate is derived was not made available to the authors (Roberts *et al.,* 2015h), and those more recent surveys reported observing substantially greater numbers of *Kogia* spp. than did earlier surveys (43 sightings, more than the combined total of 31 reported from all surveys from 1992–2014 considered by Roberts *et al.* (2016)) (NMFS, 2011). A 2013 NOAA survey, also not available to the model authors, reported 68 sightings of *Kogia* spp. (NMFS, 2013a). In addition, the SARs report an increase in *Kogia* spp. strandings (92 from 2001–05; 187 from 2007–11) (Waring *et al.,* 2007; 2013). A simultaneous increase in at-sea observations and strandings suggests increased abundance of *Kogia* spp., though NMFS has not conducted any trend analysis (Waring *et al.,* 2013). Therefore, we believe the most appropriate abundance estimate for use here is that currently reported by NMFS. In fact, Waring *et al.* (2013) suggest that because this estimate was corrected for perception bias but not availability bias, the true estimate could be two to four times larger.

Biologically Important Areas—Several biologically important areas for marine mammals are recognized from proposed survey areas in the mid- and south Atlantic. As referenced previously under ''Proposed Mitigation'', critical habitat is designated for the North Atlantic right whale within the southeast U.S. (81 FR 4838; January 27, 2016). Critical habitat is defined by section 3 of the ESA as (1) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such areas are essential for the conservation of the species. Critical habitat for the right whale in the southeast U.S. (*i.e.,* Unit 2) encompasses calving habitat and is designated on the basis of the following essential features: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7 °C, and never more than 17 °C; and (3) water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 nmi^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves. The specific area associated with such features and designated as critical habitat was described previously under ''Proposed Mitigation.'' There is no critical habitat designated for any other species within the proposed survey area.

Biologically important areas for North Atlantic right whales in the mid- and south Atlantic were further described by LaBrecque *et al.* (2015). The authors describe an area of importance for reproduction that somewhat expands the boundaries of the critical habitat designation, including waters out to the 25-m isobath from Cape Canaveral to Cape Lookout from mid-November to mid-April, on the basis of habitat analyses (Good, 2008; Keller *et al.,*

2012) and sightings data (*e.g.,* Keller *et al.,* 2006; Schulte and Taylor, 2012) indicating that sea surface temperatures between 13 to 15 °C and water depths between 10–20 m are critical parameters for calving. Right whales leave northern feeding grounds in November and December to migrate along the continental shelf to the calving grounds or to unknown winter areas before returning to northern areas by late spring. Right whales are known to travel along the continental shelf, but it is unknown whether they use the entire shelf area or are restricted to nearshore waters (Schick *et al.,* 2009; Whitt *et al.,* 2013). LaBrecque *et al.* (2015) define an important area for migratory behavior on the basis of aerial and vessel-based survey data, photo-identification data, radio-tracking data, and expert judgment; we compared our composite right whale closure area (described previously under ''Proposed Mitigation'') in a GIS to that defined by the authors and found that it is contained within our area.

As noted by LaBrecque *et al.* (2015), although additional cetacean species are known to have strong links to bathymetric features, there is currently insufficient information to specifically identify these areas. For example, pilot whales and Risso's dolphins aggregate at the shelf break in the proposed survey area, and Atlantic spotted dolphins occupy the shelf region from southern Virginia to Florida. These and other locations predicted as areas of high abundance (Roberts *et al.,* 2016) form the basis of proposed spatiotemporal restrictions on survey effort as described under ''Proposed Mitigation.'' In addition, other data indicate potential areas of importance that are not yet fully described. Risch *et al.* (2014) describe minke whale presence offshore of the shelf break (evidenced by passive acoustic recorders), which may be indicative of a migratory area, while other data provides evidence that sei whales aggregate near meandering frontal eddies over the continental shelf in the Mid-Atlantic Bight (Newhall *et al.,* 2012).

Unusual Mortality Events (UME)—A UME is defined under the MMPA as ''a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response.'' From 1991 to the present, there have been approximately ten formally recognized UMEs affecting marine mammals in the proposed survey area and involving species under NMFS's jurisdiction. One involves ongoing investigation. The most recent of these, which is ongoing, involves humpback whales. A recently ended UME involved bottlenose dolphins.

Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through North Carolina. Partial or full necropsy examinations have been conducted on approximately half of the 42 known cases. Of the 20 cases examined, 10 cases had evidence of blunt force trauma or pre-mortem propeller wounds indicative of vessel strike, which is over six times above the 16-year average of 1.5 whales showing signs of vessel strike in this region. Because this finding of pre-mortem vessel strike is not consistent across all of the whales examined, more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. Three previous UMEs involving humpback whales have occurred since 2000, in 2003, 2005, and 2006. More information is available at *www.nmfs.noaa.gov/pr/health/mmume/2017humpbackatlanticume.html* (accessed May 22, 2017).

Beginning in July 2013, elevated strandings of bottlenose dolphins were observed along the Atlantic coast from New York to Florida. The investigation was closed in 2015, with the UME ultimately being attributed to cetacean morbillivirus (though additional contributory factors are under investigation; *www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html*; accessed June 21, 2016). Dolphin strandings during 2013–15 were greater than six times higher than the average from 2007–12, with the most strandings reported from Virginia, North Carolina, and Florida. A total of approximately 1,650 bottlenose dolphins stranded from June 2013 to March 2015 and, additionally, a small number of individuals of several other cetacean species stranded during the UME and tested positive for morbillivirus (humpback whale, fin whale, minke whale, pygmy sperm whale, and striped dolphin). Only one offshore ecotype dolphin has been identified, meaning that over 99 percent of affected dolphins were of the coastal ecotype (D. Fauquier; pers. comm.). Research, to include analyses of stranding samples and post-UME monitoring and modeling of surviving populations, will continue in order to better understand the impacts of the UME on the affected stocks. Notably, an earlier major UME in 1987–88 was also caused by morbillivirus. Over 740 stranded dolphins were recovered during that event.

Additional recent UMEs include various localized events with undetermined cause involving bottlenose dolphins (*e.g.,* South Carolina in 2011; Virginia in 2009); an event affecting common dolphins and Atlantic white-sided dolphins from North Carolina to New Jersey (2008; undetermined); and humpback whales in the North Atlantic (2006; undetermined). For more information on UMEs, please visit: *www.nmfs.noaa.gov/pr/health/mmume/.*

Take Reduction Planning—Take reduction plans are designed to help recover and prevent the depletion of strategic marine mammal stocks that interact with certain U.S. commercial fisheries, as required by Section 118 of the MMPA. The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the mortality and serious injury of marine mammals incidental to commercial fishing to less than the potential biological removal level. The long-term goal is to reduce, within five years of its implementation, the mortality and serious injury of marine mammals incidental to commercial fishing to insignificant levels, approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans. Take reduction teams are convened to develop these plans.

There are several take reduction plans in place for marine mammals in the proposed survey areas of the mid- and south Atlantic. We described these here briefly in order to fully describe, in conjunction with referenced material, the baseline conditions for the affected marine mammal stocks. The Atlantic Large Whale Take Reduction Plan (ALWTRP) was implemented in 1997 to reduce injuries and deaths of large whales due to incidental entanglement in fishing gear. The ALWTRP is an evolving plan that changes as we learn more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. It has several components, including restrictions on where and how gear can be set and requirements for entangling gears (*i.e.,* trap/pot and gillnet gears). The ALWTRP addresses those species most affected by fishing gear entanglements, *i.e.,* North Atlantic right whale, humpback whale, fin whale, and minke whale. Annual human-caused mortality exceeds PBR for the first three of these species, all of which are listed as endangered under the ESA. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/protected/whaletrp/.*

NMFS implemented a Harbor Porpoise Take Reduction Plan (HPTRP) to reduce interactions between harbor porpoise and commercial gillnet gear in both New England and the mid-Atlantic. The HPTRP has several components including restrictions on where, when, and how gear can be set, and in some areas requires the use of acoustic deterrent devices. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/protected/porptrp/.*

The Atlantic Trawl Gear Take Reduction Team was developed to address the incidental mortality and serious injury of pilot whales, common dolphins, and white-sided dolphins incidental to Atlantic trawl fisheries. More information is available online at: *www.greateratlantic.fisheries.noaa.gov/Protected/mmp/atgtrp/.* Separately, NMFS established a Pelagic Longline Take Reduction Plan (PLTRP) to address the incidental mortality and serious injury of pilot whales in the mid-Atlantic region of the Atlantic pelagic longline fishery. The PLTRP includes a special research area, gear modifications, outreach material, observer coverage, and captains' communications. Pilot whales incur substantial incidental mortality and serious injury due to commercial fishing (annual human-caused mortality equal to 121 and 109 percent of PBR for short- and long-finned pilot whales, respectively), and therefore are of particular concern. More information is available online at: *www.nmfs.noaa.gov/pr/interactions/trt/pl-trt.html.*

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analyses'' section will include an analysis of how these specific activities will impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, and the ''Proposed Mitigation'' section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks. In the following discussion, we provide general background information on sound and marine mammal hearing before considering potential effects to marine mammals from ship strike and sound produced through use of airgun arrays.

Description of Active Acoustic Sound Sources

This section contains a brief technical background on sound, the characteristics of certain sound types, and on metrics used in this proposal inasmuch as the information is relevant to the specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the ''loudness'' of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to 1 μPa), while the received level is the SPL at the listener's position (referenced to 1 μPa).

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

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy contained within a pulse, and considers both intensity and duration of exposure. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-p) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure. Another common metric is peak-to-peak sound pressure (pk-pk), which is the algebraic difference between the peak positive and peak negative sound pressures. Peak-to-peak pressure is typically approximately 6 dB higher than peak pressure (Southall *et al.,* 2007).

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for pulses produced by the airgun arrays considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.,* wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.,* vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including the following (Richardson *et al.,* 1995):

- *Wind and waves:* The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf sound becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.

- *Precipitation:* Sound from rain and hail impacting the water surface can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.
- *Biological:* Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.
- *Anthropogenic:* Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly. Sound from identifiable anthropogenic sources other than the activity of interest (*e.g.,* a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

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

Sounds are often considered to fall into one of two general types: Pulsed and non-pulsed (defined in the following). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.,* Ward, 1997 in Southall *et al.,* 2007). Please see Southall *et al.* (2007) for an in-depth discussion of these concepts.

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

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems (such as those used by the U.S. Navy). The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

The active acoustic sound sources proposed for use (*i.e.,* airgun arrays) produce pulsed signals. No other active acoustic systems are proposed for use for data acquisition purposes. Airguns produce sound with energy in a frequency range from about 10–2,000 Hz, with most energy radiated at frequencies below 200 Hz. The amplitude of the acoustic wave emitted from the source is equal in all directions (*i.e.,* omnidirectional), but airgun arrays do possess some directionality due to different phase delays between guns in different directions. Airgun arrays are typically tuned to maximize functionality for data acquisition purposes, meaning that sound transmitted in horizontal directions and at higher frequencies is minimized to the extent possible.

Vessel noise, produced largely by cavitation of propellers and by machinery inside the hull, is considered a non-pulsed sound. Sounds emitted by survey vessels are low frequency and continuous, but would be widely dispersed in both space and time. Survey vessel traffic is of very low density compared to commercial shipping traffic or commercial fishing vessels and would therefore be expected to represent an insignificant incremental increase in the total amount of anthropogenic sound input to the marine environment. We do not consider vessel noise further in this analysis.

Acoustic Effects

Here, we first provide background information on marine mammal hearing before discussing the potential effects of the use of active acoustic sources on marine mammals.

Marine Mammal Hearing—Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.,* low-frequency cetaceans). Subsequently, NMFS (2016) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Pinniped functional hearing is not discussed here, as no pinnipeds are expected to be affected by the specified activity. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): Generalized hearing is estimated to occur between approximately 7 Hz and 35 kHz, with best hearing estimated to be from 100 Hz to 8 kHz;

• Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 to less than 100 kHz;

• High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus,* on the basis of recent echolocation data and genetic data): Generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.

For more detail concerning these groups and associated frequency ranges, please see NMFS (2016) for a review of available information. Thirty-four marine mammal species, all cetaceans, have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 4. Of the species that may be present, seven are classified as low-frequency cetaceans (*i.e.,* all mysticete species), 24 are classified as mid-frequency cetaceans (*i.e.,* all delphinid and ziphiid species and the sperm whale), and three are classified as high-frequency cetaceans (*i.e.,* harbor porpoise and *Kogia* spp.).

Potential Effects of Underwater Sound—Please refer to the information given previously (''Description of Active Acoustic Sources'') regarding sound, characteristics of sound types, and metrics used in this document. Note that, in the following discussion, we refer in many cases to a recent review article concerning studies of noise-induced hearing loss conducted from 1996–2015 (*i.e.,* Finneran, 2015). For study-specific citations, please see that work. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can potentially result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We first describe specific manifestations of acoustic effects before providing discussion specific to the use of airgun arrays.

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

We describe the more severe effects certain non-auditory physical or physiological effects only briefly as we do not expect that use of airgun arrays are reasonably likely to result in such effects (see below for further discussion). Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al.,* 1973). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Tal *et al.,* 2015). The survey activities considered here do not involve the use of devices such as explosives or mid-frequency tactical sonar that are associated with these types of effects.

When a live or dead marine mammal swims or floats onto shore and is incapable of returning to sea, the event is termed a ''stranding'' (16 U.S.C. 1421h(3)). Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series (*e.g.,* Geraci *et al.,* 1999). However, the cause or causes of most strandings are unknown (*e.g.,* Best, 1982). Combinations of dissimilar stressors may combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other would not be expected to produce the same outcome (*e.g.,* Sih *et al.,* 2004). For further description of specific stranding events see, *e.g.,* Southall *et al.,* 2006, 2013; Jepson *et al.,* 2013; Wright *et al.,* 2013.

Use of military tactical sonar has been implicated in a majority of investigated stranding events, although one stranding event was associated with the use of seismic airguns. This event occurred in the Gulf of California, coincident with seismic reflection profiling by the R/V *Maurice Ewing* operated by Columbia University's Lamont-Doherty Earth Observatory and involved two Cuvier's beaked whales (Hildebrand, 2004). The vessel had been firing an array of 20 airguns with a total volume of 8,500 in^3 (Hildebrand, 2004; Taylor *et al.,* 2004). Most known stranding events have involved beaked whales, though a small number have involved deep-diving delphinids or sperm whales (*e.g.,* Mazzariol *et al.,* 2010; Southall *et al.,* 2013). In general, long duration (~1 second) and high-intensity sounds (>235 dB SPL) have been implicated in stranding events (Hildebrand, 2004). With regard to beaked whales, mid-frequency sound is typically implicated (when causation can be determined) (Hildebrand, 2004). Although seismic airguns create predominantly low-frequency energy, the signal does include a mid-frequency component.

1. *Threshold Shift*—Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Finneran, 2015). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). Repeated sound

exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.,* 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, and there is no PTS data for cetaceans, but such relationships are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several decibels above (a 40-dB threshold shift approximates PTS onset; *e.g.,* Kryter *et al.,* 1966; Miller, 1974) that inducing mild TTS (a 6-dB threshold shift approximates TTS onset; *e.g.,* Southall *et al.* 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds for impulse sounds (such as airgun pulses as received close to the source) are at least 6 dB higher than the TTS threshold on a peak-pressure basis and PTS cumulative sound exposure level thresholds are 15 to 20 dB higher than TTS cumulative sound exposure level thresholds (Southall *et al.,* 2007). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

For mid-frequency cetaceans in particular, potential protective mechanisms may help limit onset of TTS or prevent onset of PTS. Such mechanisms include dampening of hearing, auditory adaptation, or behavioral amelioration (*e.g.,* Nachtigall and Supin, 2013; Miller *et al.,* 2012; Finneran *et al.,* 2015; Popov *et al.,* 2016).

TTS is the mildest form of hearing impairment that can occur during exposure to sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals.

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

Finneran et al. (2015) measured hearing thresholds in three captive bottlenose dolphins before and after exposure to ten pulses produced by a seismic airgun in order to study TTS induced after exposure to multiple pulses. Exposures began at relatively low levels and gradually increased over a period of several months, with the highest exposures at peak SPLs from 196 to 210 dB and cumulative (unweighted) SELs from 193–195 dB. No substantial TTS was observed. In addition, behavioral reactions were observed that indicated that animals can learn behaviors that effectively mitigate noise exposures (although exposure patterns must be learned, which is less likely in wild animals than for the captive animals considered in this study). The authors note that the failure to induce more significant auditory effects likely due to the intermittent nature of exposure, the relatively low peak pressure produced by the acoustic source, and the low-frequency energy in airgun pulses as compared with the frequency range of best sensitivity for dolphins and other mid-frequency cetaceans.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale, harbor porpoise, and Yangtze finless porpoise (*Neophocoena asiaeorientalis*)) exposed to a limited number of sound sources (*i.e.,* mostly tones and octave-band noise) in laboratory settings (Finneran, 2015). In general, harbor porpoises have a lower TTS onset than other measured cetacean species (Finneran, 2015). Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes.

Critical questions remain regarding the rate of TTS growth and recovery after exposure to intermittent noise and the effects of single and multiple pulses. Data at present are also insufficient to construct generalized models for recovery and determine the time necessary to treat subsequent exposures as independent events. More information is needed on the relationship between auditory evoked potential and behavioral measures of TTS for various stimuli. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al.* (2007), Finneran and Jenkins (2012), Finneran (2015), and NMFS (2016).

2. *Behavioral Effects*—Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.,* minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.,* species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.,* Richardson *et al.,* 1995; Wartzok *et al.,* 2003; Southall *et al.,* 2007; Weilgart, 2007; Archer *et al.,* 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al.,* 2012), and can vary depending on characteristics associated with the sound source (*e.g.,* whether it is moving or stationary, number of sources, distance from the source). Please see Appendices B–C of Southall *et al.* (2007) for a review of studies involving marine mammal behavioral responses to sound.

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

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.,* Lusseau and Bejder, 2007; Weilgart, 2007; NRC, 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely, and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark, 2000; Ng and Leung, 2003; Nowacek *et al.;* 2004; Goldbogen *et al.,* 2013a, b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

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

Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to airgun arrays at received levels in the range 140–160 dB at distances of 7–13 km, following a phase-in of sound intensity and full array exposures at 1–13 km (Madsen *et al.,* 2006; Miller *et al.,* 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were 6 percent lower during exposure than control periods (Miller *et al.,* 2009). These data raise concerns that seismic surveys may impact foraging behavior in sperm whales, although more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior (Miller *et al.,* 2009).

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.,* Kastelein *et al.,* 2001, 2005, 2006; Gailey *et al.,* 2007; Gailey *et al.,* 2016).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003; Foote *et al.,* 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al.,* 1994).

Cerchio *et al.* (2014) used passive acoustic monitoring to document the presence of singing humpback whales off the coast of northern Angola and to opportunistically test for the effect of seismic survey activity on the number of singing whales. Two recording units were deployed between March and December 2008 in the offshore environment; numbers of singers were counted every hour. Generalized Additive Mixed Models were used to assess the effect of survey day (seasonality), hour (diel variation), moon phase, and received levels of noise (measured from a single pulse during each ten minute sampled period) on singer number. The number of singers significantly decreased with increasing received level of noise, suggesting that humpback whale breeding activity was disrupted to some extent by the survey activity.

Castellote *et al.* (2012) reported acoustic and behavioral changes by fin whales in response to shipping and airgun noise. Acoustic features of fin whale song notes recorded in the Mediterranean Sea and northeast

Atlantic Ocean were compared for areas with different shipping noise levels and traffic intensities and during a seismic airgun survey. During the first 72 h of the survey, a steady decrease in song received levels and bearings to singers indicated that whales moved away from the acoustic source and out of the study area. This displacement persisted for a time period well beyond the 10-day duration of seismic airgun activity, providing evidence that fin whales may avoid an area for an extended period in the presence of increased noise. The authors hypothesize that fin whale acoustic communication is modified to compensate for increased background noise and that a sensitization process may play a role in the observed temporary displacement.

Seismic pulses at average received levels of 131 dB re 1 μPa^2-s caused blue whales to increase call production (Di Iorio and Clark, 2010). In contrast, McDonald *et al.* (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the acoustic source vessel (estimated received level 143 dB pk-pk). Blackwell *et al.* (2013) found that bowhead whale call rates dropped significantly at onset of airgun use at sites with a median distance of 41–45 km from the survey. Blackwell *et al.* (2015) expanded this analysis to show that whales actually increased calling rates as soon as airgun signals were detectable before ultimately decreasing calling rates at higher received levels (*i.e.,* 10-minute cSEL of ~127 dB). Overall, these results suggest that bowhead whales may adjust their vocal output in an effort to compensate for noise before ceasing vocalization effort and ultimately deflecting from the acoustic source (Blackwell *et al.,* 2013, 2015). These studies demonstrate that even low levels of noise received far from the source can induce changes in vocalization and/or behavior for mysticetes.

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.,* 1995). For example, gray whales are known to change direction—deflecting from customary migratory paths—in order to avoid noise from seismic surveys (Malme *et al.,* 1984). Humpback whales showed avoidance behavior in the presence of an active seismic array during observational studies and controlled exposure experiments in western Australia (McCauley *et al.,* 2000). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.,* Bowles *et al.,* 1994; Goold, 1996; Stone *et al.,* 2000; Morton and Symonds, 2002; Gailey *et al.,* 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.,* Bejder *et al.,* 2006; Teilmann *et al.,* 2006).

Forney *et al.* (2017) detail the potential effects of noise on marine mammal populations with high site fidelity, including displacement and auditory masking, noting that a lack of observed response does not imply absence of fitness costs and that apparent tolerance of disturbance may have population-level impacts that are less obvious and difficult to document. As we discuss in describing our proposed mitigation earlier in this document, avoidance of overlap between disturbing noise and areas and/ or times of particular importance for sensitive species may be critical to avoiding population-level impacts and because, particularly for animals with high site fidelity, there may be a strong motivation to remain in the area despite negative impacts. Forney *et al.* (2017) state that, for these animals, remaining in a disturbed area may reflect a lack of alternatives rather than a lack of effects. Among other case studies, the authors discuss beaked whales off Cape Hatteras, noting the apparent importance of this area to the species and citing studies indicating long-term, year-round fidelity. This information leads the authors to conclude that failure to appropriately address potential effects in this particular area could lead to severe biological consequences for these beaked whales, in part because displacement may adversely affect foraging rates, reproduction, or health, while an overriding instinct to remain could lead to more severe acute effects (Forney *et al.,* 2017).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.,* directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.,* when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.,* Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.,* Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

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

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

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

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

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.,* Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Romano *et al.,* 2002a). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

4. *Auditory Masking*—Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.,* 1995; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

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

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

Ship Strike

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

Pace and Silber (2005) also found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded 90 percent at 17 kn. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death through increased likelihood of collision by pulling whales toward the vessel (Clyne, 1999; Knowlton *et al.,* 1995). In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between 8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward one hundred percent above 15 kn.

In an effort to reduce the number and severity of strikes of the endangered North Atlantic right whale, NMFS implemented speed restrictions in 2008 (73 FR 60173; October 10, 2008). These restrictions require that vessels greater than or equal to 65 ft (19.8 m) in length travel at less than or equal to 10 kn near key port entrances and in certain areas of right whale aggregation along the U.S. eastern seaboard. Conn and Silber (2013) estimated that these restrictions reduced total ship strike mortality risk levels by 80 to 90 percent.

For vessels used in seismic survey activities, vessel speed while towing gear is typically only 4–5 kn. At these speeds, both the possibility of striking a marine mammal and the possibility of a strike resulting in serious injury or mortality are discountable. At average transit speed, the probability of serious injury or mortality resulting from a strike is less than 50 percent. However, the likelihood of a strike actually happening is again discountable. Ship strikes, as analyzed in the studies cited above, generally involve commercial shipping, which is much more common in both space and time than is geophysical survey activity. Jensen and Silber (2004) summarized ship strikes of large whales worldwide from 1975–2003 and found that most collisions occurred in the open ocean and involved large vessels (*e.g.,* commercial shipping). Commercial fishing vessels were responsible for three percent of recorded collisions, while no such incidents were reported for geophysical survey vessels during that time period.

It is possible for ship strikes to occur while traveling at slow speeds. For example, a hydrographic survey vessel traveling at low speed (5.5 kn) while conducting mapping surveys off the central California coast struck and killed a blue whale in 2009. The State of California determined that the whale had suddenly and unexpectedly surfaced beneath the hull, with the result that the propeller severed the whale's vertebrae, and that this was an unavoidable event. This strike represents the only such incident in approximately 540,000 hours of similar coastal mapping activity ($p = 1.9 \times 10^{-6}$; 95% CI = $0–5.5 \times 10^{-6}$; NMFS, 2013b). In addition, a research vessel reported a fatal strike in 2011 of a dolphin in the Atlantic, demonstrating that it is possible for strikes involving smaller cetaceans to occur. In that case, the incident report indicated that an animal apparently was struck by the vessel's propeller as it was intentionally swimming near the vessel. While indicative of the type of unusual events that cannot be ruled out, neither of these instances represents a circumstance that would be considered reasonably foreseeable or that would be considered preventable.

Although the likelihood of vessels associated with seismic surveys striking a marine mammal are low, we require a robust ship strike avoidance protocol (see ''Proposed Mitigation''), which we believe eliminates any foreseeable risk of ship strike. We anticipate that vessel collisions involving seismic data acquisition vessels towing gear, while not impossible, represent unlikely, unpredictable events for which there are no preventive measures. Given the required mitigation measures, the relatively slow speeds of vessels towing gear, the presence of bridge crew watching for obstacles at all times (including marine mammals), the presence of marine mammal observers, and the small number of seismic survey cruises, we believe that the possibility of ship strike is discountable and, further, that were a strike of a large whale to occur, it would be unlikely to result in serious injury or mortality. No incidental take resulting from ship strike is anticipated, and this potential effect of the specified activity will not be discussed further in the following analysis.

Other Potential Impacts—Here, we briefly address the potential risks due to entanglement and contaminant spills. We are not aware of any records of marine mammal entanglement in towed arrays such as those considered here. The discharge of trash and debris is prohibited (33 CFR 151.51–77) unless it is passed through a machine that breaks up solids such that they can pass through a 25-mm mesh screen. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste. Some personal items may be accidentally lost overboard. However, U.S. Coast Guard and Environmental Protection Act regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Any permits issued by BOEM would include guidance for the handling and disposal of marine trash and debris, similar to the Bureau of Safety and Environmental Enforcement's (BSEE) NTL 2012–G01 (''Marine Trash and Debris Awareness and Elimination'') (BSEE, 2012; BOEM, 2014b). There are no meaningful entanglement risks posed by the described activity, and entanglement risks are not discussed further in this document.

Marine mammals could be affected by accidentally spilled diesel fuel from a vessel associated with proposed survey activities. Quantities of diesel fuel on the sea surface may affect marine mammals through various pathways: Surface contact of the fuel with skin and other mucous membranes, inhalation of concentrated petroleum vapors, or ingestion of the fuel (direct ingestion or by the ingestion of oiled prey) (*e.g.,* Geraci and St. Aubin, 1980, 1985, 1990). However, the likelihood of a fuel spill during any particular geophysical survey is considered to be remote, and the potential for impacts to marine mammals would depend greatly on the size and location of a spill and meteorological conditions at the time of the spill. Spilled fuel would rapidly spread to a layer of varying thickness and break up into narrow bands or windrows parallel to the wind direction. The rate at which the fuel spreads would be determined by the prevailing conditions such as temperature, water currents, tidal streams, and wind speeds. Lighter, volatile components of the fuel would evaporate to the atmosphere almost completely in a few days. Evaporation rate may increase as the fuel spreads because of the increased surface area of the slick. Rougher seas, high wind speeds, and high temperatures also tend to increase the rate of evaporation and the proportion of fuel lost by this process (Scholz *et al.,* 1999). We do not anticipate potentially meaningful effects to marine mammals as a result of any contaminant spill resulting from the proposed survey activities, and contaminant spills are not discussed further in this document.

Anticipated Effects on Marine Mammal Habitat

Effects to Prey—Marine mammal prey varies by species, season, and location and, for some, is not well documented. Fish react to sounds which are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pulsed sound on fish, although several are based on studies in support of construction projects (*e.g.,* Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson *et al.,* 1992; Skalski *et al.,* 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality. The most likely impact to fish from survey activities at the project area would be temporary avoidance of the area. The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short timeframe in which any given acoustic source vessel would be operating in any given area. However, adverse impacts may occur to a few species of fish which may still be present in the project area despite operating in a reduced work window in an attempt to avoid important fish spawning time periods.

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

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic, or may be intentionally introduced to the marine environment for data acquisition purposes (as in the use of airgun arrays). Anthropogenic noise varies widely in its frequency content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please see also the previous discussion on masking under ''Acoustic Effects''), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). For more detail on these concepts see, *e.g.,* Barber *et al.,* 2010; Pijanowski *et al.,* 2011; Francis and Barber, 2013; Lillis *et al.,* 2014.

Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). Although the signals emitted by seismic airgun arrays are generally low frequency, they would also likely be of short duration and transient in any given area due to the nature of these surveys. As described previously, exploratory surveys such as these cover a large area but would be transient rather than focused in a given location over time and therefore would not be considered chronic in any given location.

In summary, activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat or populations of fish species or on the quality of acoustic habitat. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Estimated Take by Incidental Harassment

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

Anticipated takes would primarily be by Level B harassment, as use of the acoustic source (*i.e.,* airgun array) has the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result from use of the acoustic source, primarily for either high-frequency or low-frequency hearing specialists due to larger predicted auditory injury zones (on the basis of peak pressure and cumulative SEL, respectively). Auditory injury is unlikely to occur for most mid-frequency hearing specialists (*e.g.,* dolphins, sperm whale). The proposed mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. It is unlikely that lethal takes would occur even in the absence of the proposed mitigation and monitoring measures, and no such takes are anticipated or proposed for authorization.

Sound Thresholds

We have historically used generic acoustic thresholds (see Table 5) to determine when an activity that produces sound might result in impacts to a marine mammal such that a take by harassment might occur. These thresholds should be considered guidelines for estimating when harassment may occur (*i.e.,* when an animal is exposed to levels equal to or exceeding the relevant criterion) in specific contexts; however, useful contextual information that may inform our assessment of effects is typically lacking and we consider these thresholds as step functions. We are aware of suggestions regarding new criteria concerning behavioral disruption (*e.g.,* Nowacek *et al.,* 2015), but there is currently no scientific agreement on the matter. NMFS will consider potential changes to the historical criteria for behavioral harassment in the future.

TABLE 5—HISTORICAL ACOUSTIC EXPOSURE CRITERIA FOR IMPULSIVE SOURCES

Criterion	Definition	Threshold
Level A harassment	Injury (onset PTS—any level above that which is known to cause TTS).	180 dB rms (cetaceans).
Level B harassment	Behavioral disruption	160 dB rms (impulse sources).

However, NMFS has recently introduced new technical guidance for auditory injury (equating to Level A harassment under the MMPA); for more information, please visit *www.nmfs.noaa.gov/pr/acoustics/guidelines.htm* (NMFS, 2016). Historical threshold levels for auditory injury were developed in the late 1990s using the best information available at the time (*e.g.,* HESS, 1999). Since the adoption of these historical thresholds, our understanding of the effects of noise on marine mammal hearing has greatly advanced (*e.g.,* Southall *et al.,* 2007; Finneran, 2015). The new technical guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, reflects the best available science, and better predicts the potential for auditory injury than does NMFS's historical criteria. The technical guidance reflects the best available science on the potential for noise to affect auditory sensitivity by:

- Dividing sound sources into two groups (*i.e.,* impulsive and non-impulsive) based on their potential to affect hearing sensitivity;
- Choosing metrics that better address the impacts of noise on hearing sensitivity, *i.e.,* peak sound pressure level (peak SPL) (better reflects the physical properties of impulsive sound sources, to affect hearing sensitivity) and cumulative sound exposure level (cSEL) (accounts for not only level of exposure but also durations of exposure);
- Dividing marine mammals into hearing groups and developing auditory weighting functions based on the science supporting that not all marine mammals hear and use sound in the same manner.

NMFS's new technical guidance (NMFS, 2016) builds upon the foundation provided by Southall *et al.* (2007), while incorporating new information available since development of that work (*e.g.,* Finneran, 2015). Southall *et al.* (2007) recommended specific thresholds under the dual metric approach (*i.e.,* peak SPL and cumulative SEL) and that marine mammals be divided into functional hearing groups based on measured or estimated functional hearing ranges. The premise of the dual criteria approach is that, while there is no definitive answer to the question of which acoustic metric is most appropriate for assessing the potential for injury, both the received level and duration of received signals are important to an understanding of the potential for auditory injury. Therefore, peak SPL is used to define a pressure criterion above which auditory injury is predicted to occur, regardless of exposure duration (*i.e.,* any single exposure at or above this level is considered to cause auditory injury), and cSEL is used to account for the total energy received over the duration of sound exposure (*i.e.,* both received level and duration of exposure) (Southall *et al.,* 2007; NMFS, 2016). As a general principle, whichever criterion is exceeded first (*i.e.,* results in the largest isopleth) would be used as the effective injury criterion (*i.e.,* the more precautionary of the criteria). Note that cSEL acoustic threshold levels incorporate marine mammal auditory weighting functions, while peak pressure thresholds do not (*i.e.,* flat or unweighted). NMFS (2016) recommends 24 hours as a maximum accumulation period relative to cSEL thresholds. For further discussion of auditory weighting functions and their application, please see NMFS (2016). Table 6 displays thresholds provided by NMFS (2016).

TABLE 6—EXPOSURE CRITERIA FOR AUDITORY INJURY FOR IMPULSIVE SOURCES

Hearing group	Peak pressure [1] (dB)	Cumulative sound exposure level [2] (dB)
Low-frequency cetaceans	219	183
Mid-frequency cetaceans	230	185
High-frequency cetaceans	202	155

[1] Referenced to 1 μPa; unweighted within generalized hearing range.
[2] Referenced to 1 $\mu Pa^2 s$; weighted according to appropriate auditory weighting function.

NMFS considers these updated thresholds and associated weighting functions to be the best available information for assessing whether exposure to specific activities is likely to result in changes in marine mammal hearing sensitivity. However, all applications were submitted and declared adequate and complete prior to finalization of the technical guidance, based on the best available information at the time. BOEM's PEIS (BOEM, 2014a) does provide information enabling a reasonable approximation of potential acoustic exposures relative to the ''Southall criteria.'' While the peer-reviewed criteria provided by Southall *et al.* (2007) differ from that described by NMFS (2016), they do function substantively as a reasonable precursor to the new technical guidance. We derived applicant specific exposure estimates for Level A harassment from BOEM's PEIS and then corrected these to reasonably account for NMFS's new technical guidance. This process is described below (see ''Level A Harassment'').

Sound Field Modeling

BOEM's PEIS (BOEM, 2014a) provides information related to estimation of the sound fields that would be generated by potential geophysical survey activity on the mid- and south Atlantic OCS. We provide a summary description of that modeling effort here; for more information, please see Appendix D of BOEM's PEIS (Zykov and Carr, 2014 in BOEM, 2014a). The acoustic modeling generated a three-dimensional acoustic propagation field as a function of source characteristics and physical properties of the ocean for later integration with marine mammal density information in an animal movement model to estimate potential acoustic exposures.

The authors selected 15 modeling sites throughout BOEM's Mid-Atlantic and South Atlantic OCS planning areas for use in modeling predicted sound fields resulting from use of the airgun array. The water depth at the sites varied from 30–5,400 m. Two types of bottom composition were considered: Sand and clay, their selection depending on the water depth at the source. Twelve possible sound speed profiles for the water column were used to cover the variation of the sound velocity distribution in the water with location and season. Twenty-one distinct propagation scenarios resulted from considering different sound speed profiles at some of the modeling sites. Two acoustic propagation models were employed to estimate the acoustic field radiated by the sound sources. A version of JASCO Applied Science's Marine Operations Noise Model (MONM), based on the Range-dependent Acoustic Model (RAM) parabolic-equations model, MONM–RAM, was used to estimate the SELs for low-frequency sources (below 2 kHz) such as an airgun array. For more information on sound propagation model types, please see, *e.g.,* Etter (2013). The model takes into account the geoacoustic properties of the sea bottom, vertical sound speed profile in the water column, range-dependent bathymetry, and the directivity of the source. The directional source levels for the airgun array was modeled using the Airgun Array Source Model (AASM) based on the specifications of the source such as the arrangement and volume of the guns, firing pressure, and depth below the sea surface. The modeled directional source levels were used as the input for the acoustic propagation model. For background information on major factors affecting underwater sound propagation, please see Zykov and Carr (2014).

The modeling used a 5,400 in^3 airgun array as a representative example. The array has dimensions of 16 x 15 m and consists of 18 air guns placed in three identical strings of six air guns each (please see Figure D–6 of Zykov and Carr (2014)). The volume of individual air guns ranges from 105–660 in^3. Firing pressure for all elements is 2,000 psi. The depth below the sea surface for the array was set at 6.5 m. Please see Table 1 for a comparison to the airgun arrays proposed for use by the applicant companies. Horizontal third-octave band directionality plots resulting from source modeling are shown in Figure D–8 of Zykov and Carr (2014).

As noted, the AASM was used to predict the directional source level (SL) of the airgun array. The MONM was then used to estimate the acoustic field at any range from the source. MONM–RAM was used to predict the directional transmission loss (TL) footprint from various source locations corresponding to the selected modeling sites. The received level (RL) at any 3D location away from the source is calculated by combining the SL and TL, both of which are direction dependent, using the fundamental relation $RL = SL - TL$. Acoustic TL and RL are a function of depth, range, bearing, and environmental properties of the propagation medium. The RLs estimated by MONM, like the SLs from which they are computed, are expressed in terms of the SEL metric over the duration of a single source pulse. Sound exposure level is expressed in units of dB re 1 $\mu Pa^2 \cdot s$. For the purposes of this study, the SEL results were converted to the rms SPL metric using a range dependent conversion coefficient.

The U.S. Naval Oceanographic Office's Generalized Digital Environmental Model database was used to extract sound velocity profiles for the mid- and south Atlantic in order to characterize the entire water body into a discreet number of specific propagation regions. The profiles were selected to reflect the variation of sea water properties at the different locations selected throughout the mid- and south Atlantic OCS as well as seasonal variation at the same location (*i.e.,* winter, spring, summer, fall). The profiles for each season were grouped into about 17 regions with similar propagation characteristics and representative profiles for each region were selected. Finally, the bottom characteristics for each of these 17 regions were examined to determine if any region needed to be divided to accommodate the influence of the various bottom types on that region's propagation. The result was 21 separate modeling regions that in sum captured the propagation for the entire area; therefore, taken in conjunction with the 15 applicable sites there were a total of 21 modeling scenarios applicable to the airgun array. These scenarios are detailed in Table D–21 in Zykov and Carr (2014). Each acoustic modeling scenario is characterized by a unique combination of parameters. The main variables in the environment configuration are the bathymetry and the sound velocity profile in the water column. The geoacoustic properties of the sea bottom are directly correlated with the water depth of the modeling site. Four depth regions were classified based on bathymetry: Shallow continental shelf (<60 m); continental shelf (60–150 m); continental slope (150–1,000 m); and deep ocean (>1,000 m). The modeling results show that the largest threshold radii are typically associated with sites in intermediate water depths (250 and 900 m). Low frequencies propagate relatively poorly in shallow water (*i.e.,* water depths on the same order as or less than the wavelength). At intermediate water depths, this stripping of low-frequency sound no longer occurs, and longer-range propagation can be enhanced by the channeling of sound caused by reflection from the surface and seafloor (depending on the nature of the sound speed profile and sediment type).

Table 7 shows scenario-specific modeling results for distances to the 160 dB level; results presented are for the 95 percent range to threshold. Given a regularly gridded spatial distribution of modeled RLs, the 95 percent range is defined as the radius of a circle that encompasses 95 percent of the grid points whose value is equal to or greater than the threshold value. This definition is meaningful in terms of potential impact to an animal because, regardless of the geometrical shape of the noise footprint for a given threshold level, it always provides a range beyond which no more than five percent of a uniformly distributed population would be exposed to sound at or above that level. The maximum range, which is simply the distance to the farthest occurrence of the threshold level, is the more conservative but may misrepresent the effective exposure zone. For example, there are cases where the volume ensonified to a specific level may not be continuous and small pockets of higher RLs may be found far outside the main ensonified volume (for example, because of convergence). If only the maximum range is presented, a false impression of the extent of the acoustic field can be given (Zykov and Carr, 2014).

TABLE 7—MODELING SCENARIOS AND SITE-SPECIFIC MODELED THRESHOLD RADII FROM BOEM'S PEIS

Scenario No.	Site No.[1]	Water depth (m)	Season	Bottom type	Threshold radii (m)[2]
1	1	5,390	Winter	Clay	4,969
2	2	2,560	Winter	Clay	5,184
3	3	880	Winter	Sand	8,104
4	4	249	Winter	Sand	8,725
5	5	288	Winter	Sand	8,896
6	1	5,390	Spring	Clay	4,989
7	6	3,200	Spring	Clay	5,026
8	3	880	Spring	Sand	8,056
9	7	251	Spring	Sand	8,593
10	8	249	Spring	Sand	8,615
11	1	5,390	Summer	Clay	4,973
12	6	3,200	Summer	Clay	5,013
13	3	880	Summer	Sand	8,095
14	9	275	Summer	Sand	9,122
15	10	4,300	Fall	Clay	5,121
16	11	3,010	Fall	Clay	5,098
17	12	4,890	Fall	Clay	4,959
18	13	3,580	Fall	Clay	5,069
19	3	880	Fall	Sand	8,083
20	14	100	Fall	Sand	8,531
21	15	51	Fall	Sand	8,384
Mean					6,838

Adapted from Tables D–21 and D–22 of Zykov and Carr (2014).
[1] Please see Figure D–35 of Zykov and Carr (2014) for site locations.
[2] Threshold radii to 160 dB (rms) SPL, 95 percent range.

We provide this description of the modeling performed for BOEM's PEIS as a general point of reference for the proposed surveys, and also because three of the applicant companies—TGS, CGG, and Western—directly use these results to inform their exposure modeling, rather than performing separate sound field modeling. As described by BOEM (2014a), the modeled array was selected to be representative of the large airgun arrays likely to be used by geophysical exploration companies in the mid- and south Atlantic OCS. Therefore, we use the BOEM (2014a) results as a reasonable proxy for those two companies (please see ''Detailed Description of Activities'' for further description of the acoustic sources proposed for use by these two companies). ION and Spectrum elected to perform separate sound field modeling efforts, and these are described below. For generally applicable conclusions, as summarized from Appendix A of ION's application, see below.

ION—ION provided information related to estimation of the sound fields that would be generated by their proposed geophysical survey activity on the mid- and south Atlantic OCS. We provide a summary description of that modeling effort here; for more information, please see Appendix A of ION's application (Li, 2014; referred to hereafter as Appendix A of ION's application). ION proposes to use a 36-element airgun array with a 6,420 in^3 total firing volume (please see ''Detailed Description of Activities'' for further description of ION's acoustic source). The modeling assumed that ION would operate from July to December. Sixteen representative sites were selected along survey track lines planned by ION for use in modeling predicted sound fields resulting from use of the airgun array (see Figure 2 in Appendix A of ION's application for site locations). Two acoustic propagation models were employed to estimate the acoustic field radiated by the sound sources. As was described above for BOEM's PEIS, the acoustic signature of the airgun array was predicted using AASM and MONM was used to calculate the sound propagation and acoustic field near each defined site. The modeling process follows generally that described previously for BOEM's PEIS. Key differences are the characteristics of the acoustic source (see Table 1), locations of the modeled sites, and the use of a restricted set of sound velocity profiles (*e.g.,* fall and winter). Table 8 shows site-specific modeling results for distances to the 160 dB level; results presented are for the 95 percent range to threshold.

TABLE 8—SITE-SPECIFIC MODELED THRESHOLD RADII FOR ION

Site No.[1]	Water depth (m)	Season	Threshold radii (m)[2]
1	45	Fall	4,740
		Winter	5,270
2	820	Fall	7,470
		Winter	7,490
3	1,000	Fall	7,530
		Winter	7,480

TABLE 8—SITE-SPECIFIC MODELED THRESHOLD RADII FOR ION—Continued

Site No.[1]	Water depth (m)	Season	Threshold radii (m)[2]
4	40	Fall	4,200
		Winter	5,220
5	650	Fall	7,270
		Winter	7,370
6	1,500	Fall	5,210
		Winter	5,250
7	2,600	Fall	5,420
		Winter	5,390
8	30	Fall	4,480
		Winter	4,770
9	700	Fall	8,210
		Winter	8,250
10	3,300	Fall	5,410
		Winter	5,380
11	4,200	Fall	5,390
		Winter	5,360
12	30	Fall	3,250
		Winter	4,860
13	140	Fall	6,470
		Winter	6,750
14	2,400	Fall	5,460
		Winter	5,450
17[3]	2,200	Fall	5,600
		Winter	5,570
18[3]	4,180	Fall	5,400
		Winter	5,380
Mean		Fall	5,383
		Winter	5,953
		Overall	5,836

Adapted from Tables 1 and 17 of Appendix A in ION's application.
[1] Please see Figure 2 of Appendix A in ION's application for site locations.
[2] Threshold radii to 160 dB (rms) SPL, 95 percent range.
[3] Results for sites 15 and 16 are not presented, as the sites are outside the proposed survey area.

Spectrum—Spectrum provided information related to estimation of the sound fields that would be generated by their proposed geophysical survey activity on the mid- and south Atlantic OCS. We provide a summary description of that modeling effort here; for more information, please see Appendix A of Spectrum's application (Frankel *et al.,* 2015; referred to hereafter as Appendix A of Spectrum's application). Spectrum plans to use a 32-element airgun array with a 4,920 in^3 total firing volume (please see ''Detailed Description of Activities'' for further description of Spectrum's acoustic source). Array characteristics were input into the GUNDALF model to calculate the source level and predict the array signature. The directivity pattern of the airgun array was calculated using the beamforming module in the CASS-GRAB acoustic propagation model. These models provided source input information for the range-dependent acoustic model (RAM), which was then used to predict acoustic propagation and estimate the resulting sound field. The RAM model creates frequency-specific, three-dimensional directivity patterns (sound field) based upon the size and location of each airgun in the array. As described previously, physical characteristics of the underwater environment (*e.g.,* sound velocity profile, bathymetry, substrate composition) are critical to understanding acoustic propagation; 16 modeling locations were selected that span the acoustic conditions of the proposed seismic survey area. ION and Spectrum used the same modeling locations (Table 8). In contrast to ION's approach, Spectrum elected to use sound velocity profiles for winter and spring and assumed that half of the survey would occur in winter and half in spring. Table 9 shows site-specific modeling results for distances to the 160 dB level; results presented are for the 95 percent range to threshold.

TABLE 9—SITE-SPECIFIC MODELED THRESHOLD RADII FOR SPECTRUM

Site No.[1]	Water depth (m)	Threshold radii (m)[2]
1	45	12,400
2	820	9,900
3	1,000	9,600
4	40	7,850
5	650	9,350
6	1,500	7,600
7	2,600	6,700
8	30	7,650
9	700	9,150
10	3,300	6,700
11	4,200	7,000
12	30	24,300
13	140	14,750
14	2,400	7,650
17[3]	2,200	8,600
18[3]	4,180	7,200
Mean		9,775

Adapted from Table 6 of Spectrum's application.
[1] Please see Figure 5 of Appendix A in Spectrum's application for site locations.
[2] Threshold radii to 160 dB (rms) SPL, 95 percent range.
[3] Results for sites 15 and 16 are not presented, as the sites are outside the proposed survey area.

Generally applicable conclusions were discussed in Appendix A of ION's application, and are summarized here.

At shallow water sites, the sound field at long distances is dominated by intermediate frequencies (*i.e.,* 100–500 Hz) and the sound field varies significantly with direction because of the correspondingly high directivity of the source at these frequencies. Lower frequency energy is more rapidly attenuated and so is not able to propagate to very long distances. In contrast, the long-range spectra at deeper-water sites contain more low-frequency energy, resulting in longer propagation distances, and the shape of the sound field is also more strongly influenced by the directionality of the airgun array at low frequencies (*i.e.,* tens of hertz). Differences across seasons and sites are generally not great due to similar sound velocity profiles (*e.g.,* dominant downward refraction for depths greater than approximately 100 m) and counter-balancing effects of depth versus substrate composition. Shallow-water sites have mostly sandy sediments, which are more acoustically reflective, but low frequencies (as are produced by airguns) propagate relatively poorly in shallow water. Deep-water sites are located over clay sediments, which are associated with greater bottom loss, but this is balanced by the better low-frequency propagation in deep water. The largest threshold radii are seen in intermediate depths, because these sites are located over acoustically reflective sand sediments but in depths at which low-frequency sound is no longer stripped out. Further, longer-range propagation at these sites can be increased by sound channeling due to reflection from the sea surface and seabed (depending on the sound velocity profiles and sediment types).

Marine Mammal Density Information

The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). Historically, distance sampling methodology (Buckland *et al.,* 2001) has been applied to visual line-transect survey data to estimate abundance within large geographic strata (*e.g.,* Fulling *et al.,* 2003; Mullin and Fulling, 2004; Palka, 2006). Design-based surveys that apply such sampling techniques produce stratified abundance estimates and do not provide information at appropriate spatiotemporal scales for assessing environmental risk of a planned survey. To address this issue of scale, efforts were developed to relate animal observations and environmental correlates such as sea surface temperature in order to develop predictive models used to produce fine-scale maps of habitat suitability (*e.g.,* Waring *et al.,* 2001; Hamazaki, 2002; Best *et al.,* 2012). However, these studies generally produce relative estimates that cannot be directly used to quantify potential exposures of marine mammals to sound, for example. A more recent approach known as density surface modeling, as seen in DoN (2007) and Roberts *et al.* (2016), couples traditional distance sampling with multivariate regression modeling to produce density maps predicted from fine-scale environmental covariates (*e.g.,* Becker *et al.,* 2014).

At the time the applications were initially developed, the best available information concerning marine mammal densities in the proposed survey area was the U.S. Navy's Navy Operating Area (OPAREA) Density Estimates (NODEs) (DoN, 2007). These habitat-based cetacean density models utilized vessel-based and aerial survey data collected by NMFS from 1998–2005 during broad-scale abundance studies. Modeling methodology is detailed in DoN (2007). A more advanced cetacean density modeling effort, described in Roberts *et al.* (2016), was ongoing during initial development of the applications, and the model outputs were made available to the applicant companies. All information relating to this effort was made publically available in March 2016.

The Roberts *et al.* (2016) modeling effort provided several key improvements with respect to the NODEs effort. While the NODEs effort utilized a robust collection of NMFS survey data, Roberts *et al.* (2016) expanded on this by incorporating additional aerial and shipboard survey data from NMFS and from other organizations collected over the period 1992–2014, ultimately incorporating 60 percent more shipboard and five hundred percent more aerial survey hours than did NODEs. In addition, Roberts *et al.* (2016) controlled for the influence of sea state, group size, availability bias, and perception bias on the probability of making a sighting, whereas NODEs controlled for none of these. There are multiple reasons why marine mammals may be undetected by observers. Animals are missed because they are underwater (availability bias) or because they are available to be seen, but are missed by observers (perception and detection biases) (*e.g.,* Marsh and Sinclair, 1989). Negative bias on perception or detection of an available animal may result from environmental conditions, limitations inherent to the observation platform, or observer ability. Therefore, failure to correct for these biases may lead to underestimates of cetacean abundance. Use of additional data was used to improve detection functions for taxa that were rarely sighted in specific survey platform configurations. The degree of underestimation would likely be particularly impactful for species that exhibit long dive times, such as sperm and beaked whales, or are hard for observers to detect, such as harbor porpoises. Roberts *et al.* (2016) modeled density from eight physiographic and 16 dynamic oceanographic and biological covariates, as compared with two dynamic environmental covariates considered in NODEs. In summary, consideration of additional survey data and an improved modeling strategy allowed for an increased number of taxa modeled and better spatiotemporal resolutions of the resulting predictions. In general, we consider the models produced by Roberts *et al.* (2016) to be the best available source of data regarding cetacean density in the Atlantic. More information, including the model results and supplementary information for each model, is available at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/.*

Aerial and shipboard survey data produced by the Atlantic Marine Assessment Program for Protected Species (AMAPPS) program provides an additional source of information regarding marine mammal presence in the proposed survey areas. These surveys represent a collaborative effort between NMFS, BOEM, and the Navy. Although the cetacean density models described above do include survey data from 2010–14, the AMAPPS data was not made available to the model authors. Future model updates will incorporate these data, but as of this writing the AMAPPS data comprises a separate source of information (NMFS, 2010a, 2011, 2012, 2013a, 2014, 2015a).

Description of Exposure Estimates

Here, we provide applicant-specific descriptions of the processes employed to estimate potential exposures of marine mammals to given levels of received sound. The discussions provided here are specific to estimated exposures to NMFS criterion for Level B harassment (*i.e.,* 160 dB rms); we provide a separate discussion below regarding our process for estimating potential incidents of Level A harassment. We first describe the exposure modeling process performed for BOEM's PEIS as point of reference. Appendix E of the PEIS (BOEM, 2014a) provides full details.

This description builds on the description of sound field modeling provided earlier in this section and in

Appendix D of BOEM's PEIS. As described previously, 21 distinct acoustic propagation regions were defined. Reflecting seasonal differences in sound velocity profiles, these regions were specific to each season—there were five acoustic propagation regions in both winter and spring, four in summer, and seven propagation regions in fall (see Figures E–11 through E–14 in Appendix E of BOEM's PEIS). The seasonal distribution of marine mammals was examined using the NODEs database (DoN, 2007) to see if there was any additional correlation with the propagation regions. The seasonal distribution for each species was examined by overlaying the charts of the 21 acoustic modeling regions and the average density of each species was then numerically determined for each region. For each species modeled through the NODEs effort, the model outputs are four seasonal surface density plots (*e.g.,* Figure E–15 in Appendix E of BOEM's PEIS). However, the NODEs models do not provide outputs for the extended continental shelf areas seaward of the EEZ; therefore, known density information at the edge of the area modeled by NODEs was extrapolated to the remainder of the study area.

The results of the acoustic modeling exercise (*i.e.,* estimated 3D sound field) and the region-specific density estimates were then input into Marine Acoustics, Inc.'s Acoustic Integration Model (AIM). AIM is a software package developed to predict the exposure of receivers (*e.g.,* an animal) to any stimulus propagating through space and time through use of a four-dimensional, individual-based, Monte Carlo-based statistical model. Within the model, simulated marine animals (*i.e.,* animats) may be programmed to behave in specific ways on the basis of measured field data. An animat movement engine controls the geographic and vertical movements (*e.g.,* speed and direction) of sound sources and animats through four dimensions (time and space) according to user inputs. Species that normally inhabit specific environments can be constrained in the model to stay within that habitat (*e.g.,* deep-water species may be restricted from entering shallow waters where they would not be found).

Species-specific animats were created with programmed behavioral parameters describing dive depth, surfacing and dive durations, swimming speed, course change, and behavioral aversions (*e.g.,* water too shallow). The programmed animats were then randomly distributed over a given bounded simulation area; boundaries extend at least one degree of latitude or longitude beyond the extent of the vessel track to ensure an adequate number of animats in all directions, and to ensure that the simulation areas extend beyond the area where substantial behavioral reactions might be anticipated. Because the exact positions of sound sources and animals are not known in advance for proposed activities, multiple runs of realistic predictions are used to provide statistical validity to the simulated scenarios. Each species-specific simulation is seeded with a given density of animats; in this case, approximately 4,000 animats. In most cases, this represents a higher density of animats in the simulation (0.1 animats/km^2) than occurs in the real environment. A separate simulation was created and run for each combination of location, movement pattern, and marine mammal species.

A model run consists of a user-specified number of steps forward in time, in which each animat is moved according to the rules describing its behavior. For each time step of the model run, the received sound levels at each animat (*i.e.,* each marine mammal) are calculated. AIM returns the movement patterns of the animats, and the received sound levels are calculated separately using the given acoustic propagation predictions at different locations. At the end of each time step, an animat ''evaluates'' its environment, including its 3D location, the time, and any received sound level, and may alter its course to react to the environment per any programmed aversions.

Animat positions relative to the acoustic source (*i.e.,* range, bearing, and depth) were used to extract received level estimates from the acoustic propagation modeling results. The source levels, and therefore subsequently the received levels, include the embedded corrections for signal pulse length and M-weighting. M-weighting is a type of frequency weighting curve intended to reflect the differential potential for sound to affect marine mammals based on their sensitivity to the particular frequencies produced (Southall *et al.,* 2007). Please see Appendix D of BOEM's PEIS for further description of the application of M-weighting filters. For each bearing, distance, and depth from the source, the received level values were expressed as SPLs (rms) with units of dB re 1μ Pa. These are then converted back to intensity and summed over the duration of the exercise to generate an integrated energy level, expressed in terms of dB re 1 μPa^2-sec or dB SEL. The number of animats per species that exceeded a given criterion (*e.g.,* 160 dB rms; 198 dB cSEL) may then be determined, and these results scaled according to the relationship of model-to-real world densities per species. That is, the exposure results are corrected using the actual species- and region-specific density derived from the density model outputs to give real-world estimates of exposure to sound exceeding a given received level. In this case, the user-specified densities are typically at least an order of magnitude greater than the real-world densities to ensure a statistically valid result; therefore, the modeling result is corrected or scaled by the ratio of the actual density divided by the modeled density. Although there is substantial uncertainty associated with both the acoustic sound field estimation and animal movement modeling steps, confidence intervals were not developed for the exposure estimate results, in part because calculating confidence limits for numbers of Level B harassment takes would imply a level of quantification and statistical certainty that does not currently exist (BOEM, 2014a). Further detail regarding all aspects of the modeling process is provided in Appendix E of BOEM's PEIS.

As noted previously, the NODEs models (DoN, 2007) provided the best available information at the time of initial development for these applications. Outputs of the cetacean density models described by Roberts *et al.* (2016) were subsequently made available to the applicant companies. Two applicants (TGS and Western) elected to consider the new information and produced revised applications accordingly. CGG also used the new information in developing their application. Two applicants (Spectrum and ION) declined to use the Roberts *et al.* (2016) density models. However, because NMFS determined that the Roberts *et al.* (2016) density models represent the best available information (in relation to the NODEs models) we worked with Marine Acoustics, Inc.—which performed the initial exposure modeling provided in the Spectrum and ION applications—to produce revised exposure estimates utilizing the outputs of the Roberts *et al.* (2016) density models.

In order to revise the exposure estimates for Spectrum and ION, we first needed to extract appropriate density estimates from the Roberts *et al.* (2016) model outputs. Because both Spectrum and ION used modeling processes conceptually similar to that described above for BOEM's PEIS, these density estimates would replace those previously derived from the NODEs models in rescaling the exposure estimation results from those derived from animal movement modeling using a user-specified density. We summarize the steps involved in calculating mean marine mammal densities over the 21 modeling areas used in both BOEM's PEIS and the applications here:

- Roberts *et al.* (2016) predicted densities on an annual or monthly time period. When the time period was annual, we used the same density for all seasons. When the time period was monthly, we calculated the mean density for each season (using ArcGIS' cell statistics tool).
- We converted the Roberts *et al.* (2016) density units (animals/100 km^2) to animals/km^2.
- As was the case for the NODEs model outputs, the Roberts *et al.* (2016) model outputs are restricted to the U.S. EEZ. Although relevant information regarding cetacean densities in areas of the western North Atlantic beyond the EEZ was recently provided by Mannocci *et al.* (2017), this information was not available to the applicants in developing their applications and was not available to NMFS in preparing this document. Therefore, we similarly extended the edge densities to cover the area outside of the data extent. This was performed by converting the seasonal rasters to numeric Python arrays, then using Python array functions to extend the edge cells.
- With new density values covering the entire modeling extent, we then calculated the average density for each of the 21 modeling areas (using ArcGIS' Zonal Statistics as Table tool).

Spectrum—Spectrum's sound field estimation process was previously described, and their exposure modeling process is substantially similar to that described above for BOEM's PEIS. The exposure estimation results described in Spectrum's application are based on the NODEs models. Because the NODEs model outputs do not cover the full extent of the proposed survey area, density estimates from the eastern-most edge where data are known were extrapolated seaward to the spatial extent of the proposed survey area. The same acoustic propagation regions described for BOEM's PEIS were used by Spectrum for exposure modeling; however, Spectrum limited their analysis to winter and spring seasons and therefore used only ten of the 21 regions. Half of proposed survey activity was assumed to occur in winter and half in spring.

As was described for BOEM's PEIS, Spectrum used AIM to model animal movements within the estimated 3D sound field. However, Spectrum elected to seed the simulations with a lower animat density (0.05 animats/km^2) than was used for BOEM's PEIS modeling effort. Spectrum stated that the modeled animat density value was determined through a sensitivity analysis that examined the stability of the predicted exposure estimates as a function of animat density and that the modeled density was determined to accurately capture the full distributional range of probabilities of exposure for the proposed survey. Similar to the modeling performed for BOEM's PEIS, the source levels and therefore subsequently the received levels include the embedded corrections for M-weighting (Southall *et al.,* 2007).

AIM simulations consisted of 25 hours of survey track for each modeling site and animal group. This duration was selected to use a 24-hour sound energy accumulation period for exposure estimation. The first hour of model output is then discarded, as animal distributions will be unduly influenced by initial conditions. In addition, there was a difference between the amount of modeled survey trackline within each modeling region and the actual proposed amount of survey trackline. The potential impacts were scaled by the ratio of the total length of proposed trackline to the modeled length of trackline in each modeling region. Spectrum elected to program certain species' animats with one aversion; normally deep-water species were not allowed to move into waters shallower than 100 m. Avoidance of right whales as indicated by the time-area restrictions required by BOEM's ROD (BOEM, 2014b) was also accounted for.

Similar to modeling conducted for BOEM's PEIS, received sound level and 3D position of each animat were recorded to calculate exposure estimates at each time step. Thus unweighted SPL(rms) and SEL values, as well as M-weighted SEL values, were calculated and compared with their respective criteria. The SEL values at each time step were converted back to intensity and summed, to produce the 24-hr cSEL value for each individual animat. The numbers of animats with SPL(rms) and cSEL values that exceeded their respective regulatory criteria were considered exposed for that criteria.

Spectrum also included a mitigation simulation in their modeling process, *i.e.,* they attempted to quantify the effects that a shutdown for marine mammals occurring within a 500 m exclusion zone and subsequent 60 minute clearance period would have on exposure estimates. As was described for BOEM's PEIS, dataset outputs of the AIM simulation model contain an animat's received sound level (SEL or SPL), the distance between the source and the animat, and the depth of the animat. Spectrum used the distance value to determine if the animat was in the 500-m exclusion zone and the depth of the animat was used to determine if it was at or near the surface. If both of these conditions were true, then the animat was considered 'available' to be observed. However, an animal that is available to be observed may still be missed by an observer due to perception bias. Therefore, Spectrum attempted to model the probability that an animal available for observation would in fact be observed. A random number was generated and compared to the detection probability for the species being modeled (*P*(detect); detection probabilities are shown in Table 14 of Appendix A in Spectrum's application). If the random number was less than the *P*(detect) value then the animal was considered to have been detected; if greater, the animal was considered undetected. If an animat was detected, AIM would simulate the effect of the acoustic source being shut down by setting the received sound levels of all animats in the model run to zero for the next 60 minutes. Predicted exposures without this mitigation simulation were also presented (see Tables 15–16 in Appendix A of Spectrum's application for a comparison of the mitigation simulation effect).

In summary, the original exposure results were obtained using AIM to model source and animat movements, with received SEL for each animat predicted at a 30-second time step. This predicted SEL history was used to determine the maximum SPL (rms or peak) and cSEL for each animat, and the number of exposures exceeding relevant criteria recorded. The number of exposures are summed for all animats to get the number of exposures for each species, with that summed value then scaled by the ratio of real-world density to the model density value. The final scaling value was the ratio of the length of the modeled survey line and the length of proposed survey line in each modeling region. As described above, the exposure estimates provided in Spectrum's application were based on the NODEs model outputs. In order to make use of the best available information (*i.e.,* Roberts *et al.* (2016)), we extracted species- and region-specific density values as described above. These were provided to Marine Acoustics, Inc. in order to rescale the original exposure results produced using the seeded animat density; revised exposure estimates are shown in Table 10.

ION—ION's sound field estimation process was previously described, and their exposure modeling process is substantially similar to that described above for BOEM's PEIS (and for Spectrum). We do not repeat those descriptions in full but summarize some key elements and differences relating to ION's approach. Further detail may be found in Appendix B of ION's application.

The exposure estimation results described in ION's application are based on the NODEs models. The same acoustic propagation regions described for BOEM's PEIS were used by ION for exposure modeling; however, ION limited their analysis to summer and fall seasons and therefore used only 11 of the 21 regions. Whichever season returned the higher number of estimated exposures for a given species was assumed to be the season in which the survey occurred, *i.e.,* ION's requested take authorization corresponds to the higher of the two seasonal species-specific exposure estimates.

As was described for BOEM's PEIS, ION used AIM to model animal movements within the estimated 3D sound field. ION proposes to conduct survey effort along lines roughly parallel to and roughly perpendicular to the east coast. Because a number of these lines are similar to each other in terms of direction and location, a reduced number of modeling lines—five alongshore and five perpendicular to shore—were created to represent all of the proposed survey lines. The lines were then further broken into segments that correspond to the boundaries of the modeling regions (see Figure 4 in Appendix B of ION's application). Simulation durations varied depending on model line length. After models were run for each line segment and subsegment, the results from all segments in each of the survey areas were scaled to reflect the actual length of proposed survey lines and then combined. ION elected to seed the simulations with a variable animat density because of the variable length of the tracks and the varied habitat of some species. ION did not account for potential effectiveness of mitigation in their modeling effort.

In summary, the original exposure results were obtained using AIM to model source and animat movements, with received SEL for each animat predicted at a 30-second time step. This predicted SEL history was used to determine the maximum SPL (rms or peak) and cSEL for each animat, and the number of exposures exceeding relevant criteria recorded. The number of exposures are summed for all animats to get the number of exposures for each species, with that summed value then scaled by the ratio of real-world density to the model density value. The final scaling value was the ratio of the length of the modeled survey line and the length of proposed survey line in each modeling region. As described above, the exposure estimates provided in ION's application were based on the NODEs model outputs. In order to make use of the best available information (*i.e.,* Roberts *et al.* (2016)), we extracted species- and region-specific density values as described above. These were provided to Marine Acoustics, Inc. in order to rescale the original exposure results produced using the seeded animat density; revised exposure estimates are shown in Table 10.

TGS and Western—Because TGS and Western follow the same approach to estimating potential marine mammal exposures to underwater sound, we provide a single description. It is also important to note that both companies propose the use of a mitigation source (*i.e.,* 90 in^3 airgun) for line turns and transits not exceeding three hours and produced exposure estimates for such use of the source. As described previously in ''Proposed Mitigation,'' we do not propose to allow use of the mitigation source. Therefore, exposure estimates produced by both companies that account for proposed use of the source will be slightly overestimated. This applies only to the ten species whose exposure estimates are based on the Roberts *et al.* (2016) density models, as we were not presented with exposure estimates specific to the full-power array versus the mitigation source. The companies assumed that the sound field estimates provided by BOEM (2014a) would be applicable and consider three depth bins: <880 m, 880–2,560 m, >2,560 m. The 15 modeling sites have a notable depth discontinuity within the overall range (51–5,390 m), with no sites at depths between 880–2,560 m. When considering the 21 modeling scenarios across the 15 sites, threshold radii shown in Table 7 break down evenly with 11 at depths ≤880 m and ten at depths ≥2,560 m. The mean threshold radius for the scenarios at shallow sites is 8,473 m; for the scenarios at deep sites the average is 5,040 m. The overall mean for all scenarios is 6,838 m. Because there are no sites for depths between 880–2,560 m, we assume that the overall mean threshold distance is appropriate.

Because both applications were prepared by Smultea Environmental Sciences, LLC (SES) under contract to the applicant companies, in this section we refer hereafter to ''SES'' rather than to ''TGS and Western.'' SES considered both the Roberts *et al.* (2016) density models as well as the AMAPPS data (NMFS, 2010a, 2011, 2012, 2013a, 2014). In so doing, SES determined that there are aspects of the Roberts *et al.* (2016) methodology that limit the model outputs' applicability to estimating marine mammal exposures to underwater sound. In summary, SES described the following issues:

- There are very few sightings of some species despite substantial survey effort;
- The modeling approach extrapolates based on habitat associations and assumes some species' occurrence in areas where they have never been or were rarely documented (despite substantial effort);
- In some cases, uniform density models spread densities of species with small sample sizes across large areas of the EEZ without regard to habitat, and;
- The most recent NOAA shipboard and aerial survey data (*i.e.,* AMAPPS) were not included in model development.

In response to these general concerns regarding suitability of model outputs for exposure estimation, SES developed a scheme related to the number of observations in the dataset available to Roberts *et al.* (2016) for use in developing the density models. Extremely rare species (*i.e.,* less than four sightings in the proposed survey area) were considered to have a very low probability of encounter, and it was assumed that the species might be encountered once. Therefore, a single group of the species was considered as expected to be exposed to sound exceeding the 160 dB rms harassment criterion. We agree with this approach and further describe relevant information related to these species in subsequent sections below.

As described previously, marine mammal abundance has traditionally been estimated by applying distance sampling methodology (Buckland *et al.,* 2001) to visual line-transect survey data. Buckland *et al.* (2001) recommend a minimum sample size of 60–80 sightings to provide reasonably robust estimates of density and abundance to fit the mathematical detection function required for this estimation; smaller sample sizes result in higher variance and thus less confidence and less accurate estimates. For species meeting this guideline within the proposed survey area, SES used Roberts *et al.* (2016)'s model. For species with fewer sightings (but with greater than four sightings in the proposed survey area), SES used what they refer to as ''Line Transect Theory'' in conjunction with AMAPPS data to estimate species density within the assumed 160 dB rms zone of ensonification.

Ten species or species groups met SES' requirement of having at least 60 sightings within the proposed survey area in the dataset available to Roberts *et al.* (2016): Atlantic spotted dolphin, pilot whales, striped dolphin, beaked whales, bottlenose dolphin, Risso's dolphin, short-beaked common dolphin, sperm whale, humpback whale, and North Atlantic right whale. Roberts *et al.* (2016) were able to produce models at annual resolution for the first four species and at monthly resolution for the latter six. Because of proposed measures to avoid most impacts to the right whale, SES used monthly data only for May to October to estimate potential exposures. As an aside, we acknowledge that this approach is not correct. Rather than ignoring the months November–April, we believe the correct approach would be to use the results for those months, but only for the grid cells outside of the proposed closure areas. However, we do not believe that this is a meaningful error, as our proposed mitigation measures related to right whales (*i.e.,* avoidance of sound input into areas where right whales are expected to occur and an absolute shutdown requirement upon observation of any right whale at any distance) are anticipated to substantially avoid acute effects to right whales. SES summarizes the steps involved in this process as follows:

- Calculate area of ensonification to ≥160 dB (rms) around the operating acoustic source, including all track lines, run-outs, and ramp-ups/run-ins, assuming depth-specific isopleth distances described above. Overlapping areas were treated as if they did not overlap (*i.e.,* they were added together as separate polygon areas to account for multiple exposures in the same location), and were thus included in the total area used to estimate exposures.
- Calculate species-specific density estimates for each of the 10 km x 10 km grid cells used in the density models. For species with monthly resolution, an annual average was calculated, with the exception of the right whale which used the May–October average only.
- The density models' area of data coverage does not extend outside of the EEZ. As noted previously, although relevant information regarding cetacean densities in areas of the western North Atlantic beyond the EEZ was recently provided by Mannocci *et al.* (2017), this information was not available to SES in developing these applications. Therefore, available sighting data were used to evaluate whether a species had been observed offshore close to the EEZ; no specific distance was used because it was impossible to determine exact distances from the EEZ using available reports. For the humpback whale and right whale, available information indicated that the species would not be expected to occur outside the EEZ. For the remaining species, SES extrapolated density from the nearest neighbor grid cell. Assuming such uniform density swaths over long range outside the area of data coverage may overestimate potential exposures.
- For each 10 km x 10 km grid cell and for the areas of extrapolation outside the EEZ, SES then multiplied the estimated ensonified area by the appropriate density to produce estimates of exposure exceeding the 160 dB rms criterion.
- The projected ensonified area was mapped relative to right whale closure areas described by BOEM (2014b); therefore, this element of proposed mitigation was accounted for to a certain extent.

Seven species or species groups met SES' criterion for conducting exposure modeling, but did not have the recommended 60 sightings in the survey area: minke whale, fin whale, *Kogia* spp., harbor porpoise, pantropical spotted dolphin, clymene dolphin, and rough-toothed dolphin. For these species, SES did not feel use of the density models was appropriate and developed a method using the available data instead (*i.e.,* AMAPPS data as well as data considered by Roberts *et al.* (2016), excluding results of surveys conducted entirely outside of an area roughly coincident with the proposed survey area); species-specific rationale is provided in section 6.3 of either application. Please see section 6.3 of either application for further details regarding the AMAPPS survey effort considered by SES. Table 6–1 in either application summarizes the AMAPPS data available for consideration by the authors. Although Roberts *et al.* (2016) developed detection functions for these species by using proxies as necessary, SES suggests that the fact that sightings of these species are not common indicate the species are less common than the density models show. SES states further that, while use of the density models for these species may be appropriate for localized activities, using them over broad geographical scales ultimately grossly overestimates the likely exposures of these species. SES summarizes the steps involved in this process as follows (see Table 6–4 in either application for numerical process details):

- Calculate the transect area, specific to aerial and vessel surveys, that would be considered to include sightings of all animals present for each species based on effective strip widths (ESW; the distance at which missed sightings made inside the distance is equal to detected sightings outside of it) obtained from the literature. The transect area is equal to twice the ESW multiplied by the length of transect (see Table 6–3 in either application for ESW values and citations).
- Calculate the mean density (in groups/km^2) for each species for aerial and vessel surveys; multiply by mean group size to get an individual-based density estimate.
- Adjust the densities using a correction factor ($g(0)$) to account for animals missed due to observation biases. General $g(0)$ values for aerial and vessel surveys for each species from the literature were used (see Table 6–3 in either application for $g(0)$ values and citations). Densities for vessel-based and aerial surveys were then averaged for each species; proposed survey lines cover areas included in both aerial and vessel survey effort and this method accounts for high and low density areas across the survey.
- Calculate the number of animals of each species that would potentially occur within the previously determined 160-dB depth-specific radii and sum for an estimate of total incidents of exposure.

To be clear, we believe the density models described by Roberts *et al.* (2016) provide the best available information and recommend their use for species other than those expected to be extremely rare in a given area. However, SES used the most recent observational data available. We acknowledge their concerns regarding use of predictive density models for species with relatively few observations in the proposed survey area, *e.g.,* that model-derived density estimates must be applied cautiously on a species-by-species basis with the recognition that in some cases the out-of-bound predictions could produce unrealistic results (Becker *et al.,* 2014). Further, use of uniform (*i.e.,* stratified) density models assumes a given density over a large geographic range which may include areas where the species has rarely or never been observed. For the seven species or species groups that SES applied their alternative approach to, five are modeled in whole or part through use of stratified models. We also acknowledge (as do Roberts *et al.* (2016)) that predicted habitat may not be occupied at expected densities or that models may not agree in all cases with known occurrence patterns, and that there is uncertainty associated with predictive habitat modeling (*e.g.,* Becker *et al.,* 2010; Forney *et al.,* 2012). Overall, SES suggest that it is more appropriate in some circumstances to use less complex models requiring less knowledge of habitat preferences that do not risk overprediction of occurrence in areas that are suitable but for which there is no indication the species is common (or sometimes even present). We determined that their alternative approach (for seven species or species groups) is acceptable and provide further discussion. Importantly, we recognize that there is no model or approach that is always the most appropriate and that there may be multiple approaches that may be considered acceptable.

As described previously in this document, on July 29, 2015, we published a **Federal Register** notice inviting public review and comment on the applications we had received. In response to this opportunity to comment, J.J. Roberts and P.N. Halpin of Duke University's Marine Geospatial Ecology Lab submitted a public comment letter, which is available online with all other comments received at *www.nmfs.noaa.gov/pr/permits/incidental/oilgas.htm.* In part, Roberts and Halpin offered a critique of SES' methods and rationale while also commending their use of the AMAPPS data. We discussed the points raised by Roberts and Halpin with SES, which subsequently made certain corrections and prepared revised versions of the TGS and Western applications. M. Smultea and S. Courbis of SES submitted a letter (available on the same Web site) detailing their responses to these points. However, the use of an alternative methodology for the seven species is fundamentally the same and forms the basis for our proposed take authorization for those species (for TGS and Western).

Roberts and Halpin raised several key points (we also include any resolution in the bulleted points below):

- The Buckland *et al.* (2001) recommendation that sample size should generally be at least 60–80 should be considered as general guidance but not an absolute rule and, in fact, Buckland *et al.* (2001) provide no theoretical proof for it. Miller and Thomas (2015) provide an example where a detection function fitted to 30 sightings resulted in a detection function with low bias. NMFS's line-transect abundance estimates are in some cases based on many fewer sightings, *e.g.,* stock assessments based on Palka (2012). Roberts and Halpin also point out that SES used certain detection functions from Mullin and Fulling (2003), which were based on fewer than 60 observations. Please see the letters provided by Duke University and SES, respectively, for opposing points of view on this issue.
- SES does not correct for observation bias, resulting in underestimation of density. SES subsequently corrected this issue by using estimates of *g*(0) to correct for bias, as described above.
- SES used erroneous or inappropriate ESWs for several species, resulting in an overestimate of effective survey area and therefore an underestimate of density. SES subsequently incorporated additional ESW information and addressed these issues to the extent possible given the available data.
- Following on the first point described above, ESWs used by SES are based on less robust detection functions than those used by Roberts *et al.* (2016).
- SES did not take into account what is known about the habitat of the species it modeled using this method. For example, Roberts *et al.* (2016) appropriately assumed an on-shelf density of zero for *Kogia* spp., whereas SES derived a *Kogia* spp. density estimate by including on-shelf survey effort, where *Kogia* spp. would not be expected. SES countered that, for *Kogia* spp. in particular, the more recent AMAPPS data provides substantial new information regarding *Kogia* spp. due to the increased sightings in recent years and suggest that for exposure estimation exercises over broad scales such as these, it is less important where a species is encountered in relation to how many will be encountered.
- SES declined to use density models for certain species on the basis of a lack of observations within the proposed survey area, although the models are based on numerous observations overall. Roberts and Halpin state that, because the models incorporate substantial survey effort within the proposed survey area, they are well-informed with regard to the likelihood of species occurrence under relevant environmental conditions. However, this does not alter the fact that these species have only rarely been observed within the proposed survey area and, therefore, SES' contention that use of a predictive density model to estimate potential acoustic exposures is not the most appropriate method for some species.
- SES' combination of aerial and vessel-based densities is inappropriate, due to substantial biases in terms of distribution of survey effort, *i.e.,* aerial surveys occurred primarily on-shelf while vessel-based surveys mainly occurred off-shelf. Therefore, use of a simple mean can result in unknown bias for species with either oceanic or on-shelf distribution. Roberts and Halpin suggest combining density estimates by dividing survey transects into segments, estimating density separately for aerial and shipboard surveys, and producing a combined estimate that accounts for the area effectively surveyed by each. However, because the proposed surveys would occur both on and off the shelf, it does not seem that any potential bias would unduly influence the overall results obtained by SES.
- SES does not adequately consider available information (*i.e.,* acoustic monitoring results; Risch *et al.,* 2014) for the minke whale. However, while available acoustic monitoring data suggests seasonal presence of minke whales, it remains unclear in the absence of visual observations where the whales are in relation to the acoustic recorders and how many may be present.

CGG—CGG used applicable results from BOEM's sound field modeling exercise in conjunction with the outputs of models described by Roberts *et al.* (2016) to inform their estimates of likely acoustic exposures. Considering only the BOEM modeling sites that are in or near CGG's proposed survey area provided a mean radial distance to the 160 dB rms criterion of 6,751 m (range 5,013–8,593 m). CGG used ArcGIS (further detail regarding CGG's spatial analysis is provided as an appendix to CGG's application) to conduct an exposure analysis as described in their application and summarized as follows:

- A circle with a 6,751 m radius (representing the extent of the average expected 160 dB rms ensonification zone) was drawn around each trackline, effectively resulting in a survey track with 13,502 m total width. Taxon-specific model outputs, averaged over the six-month period planned for the survey (*i.e.,* July–December) where relevant, were uploaded into ArcGIS with the assumed ensonification zone to provide estimates of marine mammal exposures to noise above the 160 dB rms threshold.
- The Roberts *et al.* (2016) 100 km^2 grid cells—the spatial scale on which taxon-specific predicted abundance information is provided—were converted into a compatible format and then spatially referenced over the tracklines and associated areas of ensonification. The tracklines and associated areas of ensonification were populated with the cetacean density grids by calculating the difference between the pre- and post-extracted area.

- Roberts *et al.* (2016) did not provide predicted abundance information for areas beyond the EEZ. As noted previously, although relevant information regarding cetacean densities in areas of the western North Atlantic beyond the EEZ was recently provided by Mannocci *et al.* (2017), this information was not available to CGG in developing their application. Therefore, CGG performed an interpolation analysis to estimate density values for the approximately 11 percent of planned survey area outside the EEZ that was not included in Roberts *et al.* (2016).

Level A Harassment

As discussed earlier in this document, BOEM's PEIS (2014a) provides auditory injury exposure results on the basis of the Southall *et al.* (2007) guidance. In order to use the results provided by BOEM (2014a) in a way that adequately takes NMFS's technical acoustic guidance into consideration, we considered the total potential exposure of marine mammals to sound exceeding the relevant criterion and estimated such exposures that may occur as a result of each specific survey as a relative proportion of total line-km. We compiled predicted 2D seismic survey activity across all years considered in BOEM's PEIS (see Table E–11 of Appendix E in BOEM's PEIS), which yields a potential total of 616,174 line-km. We divided each company's proposed total trackline by this total before multiplying the total species-specific estimated exposures across years by this proportion to yield a total survey-specific estimate of potential Level A harassment on the basis of the Southall received energy criterion (for low-frequency cetaceans) and the 180-dB rms criterion (for mid- and high-frequency cetaceans) (see Tables Attachment E–4 and Attachment E–5 of Appendix E in BOEM's PEIS). Whether using the Southall guidance (Southall *et al.,* 2007) or NMFS's new technical guidance (NMFS, 2016) (*i.e.,* in consideration of both auditory weighting functions for cSEL and thresholds for both cSEL and peak pressure), accumulation of energy would be considered to be the predominant source of potential auditory injury for low-frequency cetaceans, while instantaneous exposure to peak pressure received levels would be considered to be the predominant source of injury for both mid- and high-frequency cetaceans. Although NMFS's historical 180-dB rms injury criterion is no longer reflective of the best available science, the exposure results provided in BOEM's PEIS relative to the criterion are the most appropriate for use in providing ''corrected'' estimates based on the relevant peak pressure thresholds. Use of these results provides a proxy for the highly uncertain risk of auditory injury due to any proposed survey, which we then adjusted to reasonably account for NMFS's new technical acoustic guidance.

For low-frequency cetaceans, in order to ''correct'' these estimates of potential Level A exposure to account for NMFS's new technical acoustic guidance, we followed the process outlined previously under ''Exclusion Zone and Shutdown Requirements.'' We obtained spectrum data (in 1 Hz bands) for a reasonably equivalent acoustic source in order to appropriately incorporate weighting functions (*i.e.,* those described in NMFS (2016) and Southall *et al.* (2007)) over the source's full acoustic band. Using these data, we made adjustments (dB) to the spectrum levels, by frequency, according to the weighting functions for each relevant hearing group. We then converted these adjusted/weighted spectrum levels to pressures (micropascals) in order to integrate them over the entire broadband spectrum, resulting in weighted source levels by hearing group. Using the safe distance methodology described by Sivle *et al.* (2014) with the hearing group-specific weighted source levels, and assuming spherical spreading propagation, source velocity of 4.5 kn, pulse duration of 100 milliseconds (ms), and applicant-specific shot intervals, we then calculated potential radial distances to auditory injury zones on the basis of the two separate sets of weighting functions and thresholds. Comparison of the predicted hearing group-specific areas ensonified above thresholds defined in Southall *et al.* (2007) and NMFS (2016) provided correction factors that we then applied to the exposure results calculated on the basis of the Southall *et al.* (2007) criteria. These ''corrected'' results are provided in Table 11.

For mid- and high-frequency cetaceans, we also calculated potential radial distances to auditory injury zones on the basis of the relevant peak pressure thresholds alone, assuming spherical spreading propagation (auditory weighting functions are not used in considering potential injury due to peak pressure received levels). Comparison of the predicted hearing group-specific areas ensonified above thresholds defined by the historical NMFS criterion (*i.e.,* 180-dB rms) and NMFS (2016) provided correction factors that we then applied to the BOEM PEIS exposure results calculated on the basis of the 180-dB rms criterion. These ''corrected'' results, which are more conservative than results for these two hearing groups calculated on the basis of the cSEL approach, are provided in Table 11.

We recognize that the Level A exposure estimates provided here are a rough approximation of actual exposures, for several reasons. First, specific trackline locations proposed by the applicant companies may differ somewhat from those considered in BOEM's PEIS. However, as noted above, BOEM's PEIS assumes a total of 616,174 line-km of 2D survey effort conducted over seven years. Therefore, it is likely that all portions of the proposed survey area are considered in the PEIS analysis. Second, the PEIS exposure estimates are based on outputs of the NODEs models (DoN, 2007) versus the density models described by Roberts *et al.* (2016), which we believe represent the best available information for purposes of exposure estimation. There are additional reasons why any estimate of exposures to levels of sound exceeding the Level A harassment criteria is likely an approximation: We do not have sufficient information to approximate the probability of marine mammal aversion and subsequent likelihood of Level A exposure and we do not generally incorporate the effects of mitigation on the likelihood of Level A exposure (though this is of less importance when considering the potential for Level A exposure due to cumulative exposure of sound energy). Our intention is to use the information available to us, in reflection of available science regarding the potential for auditory injury, to acknowledge the potential for such outcomes in a way that we think is a reasonable approximation.

We note here that four of the five applicant companies (excepting Spectrum) declined to request authorization of take by Level A harassment. Although ION's proposed survey is smaller in terms of survey line-km, their source is larger in terms of predicted acoustic output (see Table 1). TGS, CGG, and Western claim, in summary, that Level A exposures will not occur largely due to the effectiveness of proposed mitigation. We do not find this assertion credible and propose to authorize take by Level A harassment, as displayed in Table 11.

Rare Species

Certain species potentially present in the proposed survey areas are expected to be encountered only extremely rarely, if at all. Although Roberts *et al.* (2016) provide density models for these species (with the exception of the pygmy killer whale), due to the small numbers of sightings that underlie these models' predictions we believe it appropriate to account for the small likelihood that these species would be encountered by assuming that these species might be encountered once by a given survey, and that Level A harassment would not occur for these species. With the exception of the northern bottlenose whale, none of these species should be considered cryptic (*i.e.,* difficult to observe when present) versus rare (*i.e.,* not likely to be present). Average group size was determined by considering known sightings in the western North Atlantic (CETAP, 1982; Hansen *et al,* 1994; NMFS, 2010a, 2011, 2012, 2013a, 2014, 2015a; Waring *et al.,* 2007, 2015). It is important to note that our proposal to authorize take equating to harassment of one group of each of these species is not equivalent to expected exposure. We do not expect that these rarely occurring (in the proposed survey area) species will be exposed at all, but provide a precautionary authorization of take. We provide a brief description for each of these species.

Sei Whale—Very little is known of sei whales in the western North Atlantic outside of northern feeding grounds, and much of what is known of sei whale distribution and movements is based on whaling records (Prieto *et al.,* 2012). Spring is the period of greatest abundance in U.S. waters, but sightings are concentrated on feeding grounds in the Gulf of Maine and in the vicinity of Georges Bank, outside the proposed survey areas (CETAP, 1982; Hain *et al.,* 1985). There are no definitive sightings reported south of 40° N., *i.e.,* no sightings reported from the proposed survey areas, although NOAA surveys in 1992 and 1995 reported four ambiguous sightings of ''Bryde's or sei whales'' between Florida and Cape Hatteras in winter (Roberts *et al.,* 2015j). Additionally, passive acoustic monitoring has detected sei whales in the winter near Onslow Bay, North Carolina, and near the shelf break off of Jacksonville, Florida (*e.g.,* Read *et al.,* 2010, 2012; Frasier *et al.,* 2016; Debich *et al.,* 2013, 2014; Norris *et al.,* 2014), and one sei whale stranding is reported from North Carolina (Byrd *et al.,* 2014). It is worth noting that the model authors include the four ambiguous sightings in both the sei whale and Bryde's whale models, thereby potentially overestimating the density of one species or the other but acknowledging the potential presence of both species in the area (Roberts *et al.,* 2015j). Schilling *et al.* (1992) report a mean group size of 1.8 sei whales, similar to the average group size of 2.2 whales across all NMFS observations in the Atlantic. We assume an average group size of two whales.

Bryde's Whale—NMFS defines and manages a stock of Bryde's whales believed to be resident in the northern Gulf of Mexico, but does not define a separate stock in the western North Atlantic Ocean. Bryde's whales are occasionally reported off the southeastern U.S. and southern West Indies (Leatherwood and Reeves, 1983). Genetic analysis suggests that Bryde's whales from the northern Gulf of Mexico represent a unique evolutionary lineage distinct from other recognized Bryde's whale subspecies, including those found in the southern Caribbean and southwestern Atlantic off Brazil (Rosel and Wilcox, 2014). Two strandings from the southeastern U.S. Atlantic coast share the same genetic characteristics with those from the northern Gulf of Mexico but it is unclear whether these are extralimital strays or they indicate the population extends from the northeastern Gulf of Mexico to the Atlantic coast of the southern U.S. (Byrd *et al.,* 2014; Rosel and Wilcox, 2014). There are no definitive sightings of Bryde's whales from the U.S. Atlantic reported from surveys considered by Roberts *et al.* (2016), although, as noted above for the sei whale, NOAA surveys in 1992 and 1995 reported four ambiguous sightings of ''Bryde's or sei whales'' between Florida and Cape Hatteras in winter. These four ambiguous sightings provide the basis for a stratified density model (Roberts *et al.,* 2016). There are no NMFS observations of Bryde's whales outside the Gulf of Mexico, but Silber *et al.* (1994) reported an average group size of 1.2 whales from the Gulf of California. Given the similarities to sei whales, we assume an average group size of two whales.

Blue Whale—The blue whale is best considered as an occasional visitor in US Atlantic waters, which may represent the current southern limit of its feeding range (CETAP, 1982; Wenzel *et al.,* 1988). NMFS's minimum population abundance estimate is based on photo-identification of recognizable individuals in the Gulf of St. Lawrence (Waring *et al.,* 2010), and the few sightings in U.S. waters occurred in the vicinity of the Gulf of Maine. All sightings have occurred north of 40° N. (Roberts *et al.,* 2015e). However, blue whales have been detected acoustically in deep waters north of the West Indies and east of the U.S. EEZ (Clark, 1995). Roberts *et al.* (2016) produced a stratified density model on the basis of a few blue whale sightings in the vicinity of the Gulf of Maine (Roberts *et al.,* 2015e). Reports of blue whales in the eastern tropical Pacific and off of Australia are typically of lone whales or groups of two (Reilly and Thayer, 1990; Gill, 2002); NMFS sightings in the Atlantic are only of lone whales. Therefore, we assume an average group size of one whale.

Northern Bottlenose Whale—Northern bottlenose whales are considered extremely rare in U.S. Atlantic waters, with only five NMFS sightings. The southern extent of distribution is generally considered to be approximately Nova Scotia (though Mitchell and Kozicki (1975) reported stranding records as far south as Rhode Island), and there have been no sightings within the proposed survey areas. Whitehead and Wimmer (2005) estimated the size of the population on the Scotian Shelf at 163 whales (95 percent CI 119–214). Whitehead and Hooker (2012) report that northern bottlenose whales are found north of approximately 37.5° N. and prefer deep waters along the continental slope. Roberts *et al.* (2016) produced a stratified density model on the basis of four sightings in the vicinity of Georges Bank (Roberts *et al.,* 2015b). The five sightings in U.S. waters yield a mean group size of 2.2 whales, while MacLeod and D'Amico report a mean group size of 3.6 (n = 895). Here, we assume an average group size of four whales.

Killer Whale—Killer whales are also considered rare in U.S. Atlantic waters (Katona *et al.,* 1988; Forney and Wade, 2006), constituting 0.1 percent of marine mammal sightings in the 1978–81 Cetacean and Turtle Assessment Program surveys (CETAP, 1982). Roberts *et al.* (2016) produced a stratified density model on the basis of four killer whale sightings (Roberts *et al.,* 2015g), though Lawson and Stevens (2014) provide a minimum abundance estimate of 67 photo-identified individual killer whales. Available information suggests that survey encounters with killer whales would be unlikely but could occur anywhere within the proposed survey area and at any time of year (*e.g.,* Lawson and Stevens, 2014). Silber *et al.* (1994) reported observations of two and 15 killer whales in the Gulf of California (mean group size 8.5), while May-Collado *et al.* (2005) described mean group size of 3.6 whales off the Pacific coast of Costa Rica. Based on 12 CETAP sightings and one group observed during NOAA surveys (CETAP, 1982; NMFS, 2014), the average group size in the Atlantic is 6.8 whales. Therefore, we assume an average group size of seven whales.

False Killer Whale—Although records of false killer whales from the U.S. Atlantic are uncommon, a combination of sighting, stranding, and bycatch records indicates that this species does occur in the western North Atlantic (Waring *et al.,* 2015). Baird (2009) suggests that false killer whales may be naturally uncommon throughout their range. Roberts *et al.* (2016) produced a stratified density model on the basis of two false killer whale sightings (Roberts *et al.,* 2015m), and NMFS produced the first abundance estimate for false killer whales on the basis of one sighting during 2011 shipboard surveys (Waring *et al.,* 2015). Similar to the killer whale, we believe survey encounters would be unlikely but could occur anywhere within the proposed survey area and at any time of year. Mullin *et al.* (2004) reported a mean false killer whale group size of 27.5 from the Gulf of Mexico, and May-Collado *et al.* (2005) described mean group size of 36.2 whales off the Pacific coast of Costa Rica. The few sightings from CETAP (1982) and from NOAA shipboard surveys give an average group size of 10.3 whales. As a precaution, we will assume an average group size of 28 whales, as reported from the Gulf of Mexico.

Pygmy Killer Whale—The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters, and is assumed to be part of the cetacean fauna of the tropical western North Atlantic (Jefferson *et al.* 1994; Waring *et al.,* 2007). Pygmy killer whales are rarely observed by NOAA surveys outside the Gulf of Mexico—one group was observed off of Cape Hatteras in 1992—and the rarity of such sightings may be due to a naturally low number of groups compared to other cetacean species (Waring *et al.,* 2007). NMFS has never produced an abundance estimate for this species and Roberts *et al.* (2016) were not able to produce a density model for the species. The 1992 sighting was of six whales; therefore, we assume an average group size of six.

Melon-headed Whale—Similar to the pygmy killer whale, the melon-headed whale is distributed worldwide in tropical to sub-tropical waters, and is assumed to be part of the cetacean fauna of the tropical western North Atlantic (Jefferson *et al.* 1994; Waring *et al.,* 2007). Melon-headed whales are rarely observed by NOAA surveys outside the Gulf of Mexico—groups were observed off of Cape Hatteras in 1999 and 2002—and the rarity of such sightings may be due to a naturally low number of groups compared to other cetacean species (Waring *et al.,* 2007). NMFS has never produced an abundance estimate for this species and Roberts *et al.* (2016) produced a stratified density model on the basis of four sightings (Roberts *et al.,* 2015d). The two sightings reported by Waring *et al.* (2007) yield an average group size of 50 whales.

Spinner Dolphin—Distribution of spinner dolphins in the Atlantic is poorly known, but they are thought to occur in deep water along most of the U.S. coast south to the West Indies and Venezuela (Waring *et al.,* 2014). There have been a handful of sightings in deeper waters off the northeast U.S. and one sighting during a 2011 NOAA shipboard survey off North Carolina, as well as stranding records from North Carolina south to Florida and Puerto Rico (Waring *et al.,* 2014). Roberts *et al.* (2016) provide a stratified density model on the basis of two sightings (Roberts *et al.,* 2015i). Regarding group size, Mullin *et al.* (2004) report a mean of 91.3 in the Gulf of Mexico; May-Collado (2005) describe a mean of 100.6 off the Pacific coast of Costa Rica; and CETAP (1982) sightings in the Atlantic yield a mean group size of 42.5 dolphins. As a precaution, we will assume an average group size of 91 dolphins, as reported from the Gulf of Mexico.

Fraser's Dolphin—As was stated for both the pygmy killer whale and melon-headed whale, the Fraser's dolphin is distributed worldwide in tropical waters, and is assumed to be part of the cetacean fauna of the tropical western North Atlantic (Perrin *et al.,* 1994; Waring *et al.,* 2007). The paucity of sightings of this species may be due to naturally low abundance compared to other cetacean species (Waring *et al.,* 2007). Despite possibly being more common in the Gulf of Mexico than in other parts of its range (Dolar, 2009), there were only five reported sightings during NOAA surveys from 1992–2009. In the Atlantic, NOAA surveys have yielded only two sightings (Roberts *et al.,* 2015f). May-Collado *et al.* (2005) reported a single observation of 158 Fraser's dolphins off the Pacific coast of Costa Rica, and Waring *et al.* (2007) describe a single observation of 250 Fraser's dolphins in the Atlantic, off Cape Hatteras. Therefore, we assume an average group size of 204 dolphins.

Atlantic White-sided Dolphin—White-sided dolphins are found in temperate and sub-polar continental shelf waters of the North Atlantic, primarily in the Gulf of Maine and north into Canadian waters (Waring *et al.,* 2016). Palka *et al.* (1997) suggest the existence of stocks in the Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea. Stranding records from Virginia and North Carolina suggest a southerly winter range extent of approximately 35° N. (Waring *et al.,* 2016); therefore, it is possible that the proposed surveys could encounter white-sided dolphins. Roberts *et al.* (2016) elected to split their study area at the north wall of the Gulf Stream, separating the cold northern waters, representing probable habitat, from warm southern waters, where white-sided dolphins are likely not present (Roberts *et al.,* 2015k). Over 600 observations of Atlantic white-sided dolphins during CETAP (1982) and during NMFS surveys provide a mean group size estimate of 47.7 dolphins, while Weinrich *et al.* (2001) reported a mean group size of 52 dolphins. Here, we assume an average group size of 48 dolphins.

Table 10 displays the estimated incidents of potential exposures above given received levels of sound that are used to estimate Level B harassment, as derived by various methods described above. We do not include the 11 rarely occurring species described above, because our assumption that a single group of each species would be encountered does not constitute an exposure estimate (however they are considered in Table 11 for our proposed take authorizations). Total applicant-specific exposure estimates as a proportion of the most appropriate abundance estimate are presented. As described previously, for most species these estimated exposure levels apply to a generic western North Atlantic stock defined by NMFS for management purposes. For the humpback and sei whale, any takes are assumed to occur to individuals of the species occurring in the specific geographic region (which may or may not be individuals from the Gulf of Maine and Nova Scotia stocks, respectively). For bottlenose dolphins, NMFS defines an offshore stock and multiple coastal stocks of dolphins, and we are not able to quantitatively determine the extent to which the estimated exposures may accrue to the oceanic versus various coastal stocks. However, because of the spatial distribution of proposed survey effort and our proposed mitigation, we assume that almost all incidents of take for bottlenose dolphins would accrue to the offshore stock.

TABLE 10—ESTIMATED INCIDENTS OF POTENTIAL EXPOSURE FOR LEVEL B HARASSMENT

Common name	Abundance estimate	Spectrum		TGS		ION		Western		CGG	
		Level B	%	Level B	%	Level B	%	Level B	%	Level B	%
North Atlantic right whale	440	64	15	12	3	11	3	6	1	1	<1
Humpback whale	1,637	46	3	72	4	7	<1	49	3	7	<1
Minke whale	20,741	428	2	219	1	12	<1	103	<1	134	1
Fin whale	3,522	341	10	1,148	33	5	<1	538	15	50	1
Sperm whale	5,353	1,145	21	3,974	74	39	1	2,001	37	1,406	26
Kogia spp	3,785	211	6	1,232	33	31	1	577	15	249	7
Beaked whales	14,491	3,497	24	13,423	93	516	4	5,095	35	3,722	26
Rough-toothed dolphin	532	206	39	270	52	13	2	127	24	183	34
Common bottlenose dolphin	97,476	38,091	39	45,041	46	2,646	3	23,849	24	9,276	10
Clymene dolphin	12,515	6,613	53	1,102	9	273	2	517	4	6,609	53
Atlantic spotted dolphin	55,436	17,421	31	45,594	82	639	1	19,063	34	6,880	12
Pantropical spotted dolphin	4,436	1,671	38	1,542	35	84	2	723	16	1,623	37
Striped dolphin	75,657	8,339	11	26,136	35	233	<1	9,191	12	6,722	9
Short-beaked common dolphin	173,486	11,312	7	57,793	33	428	<1	20,936	12	6,220	4
Risso's dolphin	7,732	772	10	3,563	46	95	1	1,627	21	831	11
Globicephala spp	18,977	2,841	15	9,834	52	217	1	4,766	25	2,043	11
Harbor porpoise	45,089	637	1	334	1	21	<1	157	<1	32	<1

"Abundance estimate" reflects what we believe is the most appropriate abundance estimate against which to compare each applicant's estimated exposures exceeding the 160 dB rms criterion. "%" represents predicted exposures exceeding the Level B harassment criterion as a percentage of abundance. We do not include predicted Level A exposures because these incidents are also included as Level B exposures and inclusion of these numbers would result in double-counting.

Table 11 provides the numbers of take by Level A and Level B harassment proposed for authorization. The proposed take authorizations combine the exposure estimates displayed in Table 10, estimated potential incidents of Level A harassment derived as described above, and the average group size information discussed previously in this section for sei whale, Bryde's whale, blue whale, northern bottlenose whale, Fraser's dolphin, melon-headed whale, false killer whale, pygmy killer whale, killer whale, spinner dolphin, and white-sided dolphin. For applicant- and species-specific proposed take authorizations marked by an asterisk, the predicted exposures (Table 10) have been reduced to 30 percent of the abundance estimate. The MMPA limits our ability to authorize take incidental to a specified activity to "small numbers" of marine mammals and, although this concept is not defined in the statute, NMFS interprets the concept in relative terms through comparison of the estimated number of individuals expected to be taken to an estimation of the relevant species or stock size. A relative approach to small numbers has been upheld in past litigation (see, *e.g.,* CBD v. Salazar, 695 F.3d 893 (9th Cir. 2012)). Here, we propose a take authorization limit of 30 percent of a stock abundance estimate. Although 30 percent is not a hard and fast cut-off, in cases such as this where exposure estimates constitute sizable percentages of the stock abundance and there are no qualitative factors to inform why the actual percentages are likely to be lower in fact, we believe it is appropriate to limit our proposed take authorizations to reasonably ensure the levels do not exceed "small numbers." Proposed mechanisms to limit take to this amount are discussed further under "Small Numbers Analyses" and "Proposed Monitoring and Reporting."

TABLE 11—NUMBERS OF POTENTIAL INCIDENTAL TAKE PROPOSED FOR AUTHORIZATION

Common name	Spectrum		TGS		ION		Western		CGG	
	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
North Atlantic right whale	0	64	0	12	0	11	0	6	0	[1] 2
Humpback whale	16	46	22	72	12	7	2	49	22	7
Minke whale	0	428	1	219	0	12	0	103	1	134
Bryde's whale	0	2	0	2	0	2	0	2	0	2
Sei whale	0	2	0	2	0	2	0	2	0	2
Fin whale	0	341	0	* 1,057	0	5	0	538	0	50
Blue whale	0	1	0	1	0	1	0	1	0	1
Sperm whale	5	1,145	4	* 1,606	1	39	2	* 1,606	1	1,406
Kogia spp	14	211	10	* 1,136	3	31	5	577	4	249
Beaked whales	13	3,497	10	* 4,347	0	516	5	* 4,347	4	3,722
Northern bottlenose whale	0	4	0	4	0	4	0	4	0	4
Rough-toothed dolphin	0	* 160	0	* 160	0	[2] 14	0	127	0	* 160
Common bottlenose dolphin	210	* 29,243	162	* 29,243	44	2,646	84	23,849	62	9,276
Clymene dolphin	7	* 3,755	5	1,102	1	273	3	517	2	* 3,755
Atlantic spotted dolphin	102	* 16,631	78	* 16,631	21	639	41	* 16,631	30	6,880
Pantropical spotted dolphin	15	* 1,331	12	* 1,331	3	84	6	723	4	* 1,331
Spinner dolphin	0	91	0	91	0	91	0	91	0	91
Striped dolphin	67	8,339	52	* 22,697	14	233	27	9,191	20	6,722
Short-beaked common dolphin	113	11,312	87	* 52,046	24	428	45	20,936	33	6,220
Fraser's dolphin	0	204	0	204	0	204	0	204	0	204
Atlantic white-sided dolphin	0	48	0	48	0	48	0	48	0	48
Risso's dolphin	56	772	43	* 2,320	12	95	22	1,627	17	831
Melon-headed whale	0	50	0	50	0	50	0	50	0	50
Pygmy killer whale	0	6	0	6	0	6	0	6	0	6
False killer whale	0	28	0	28	0	28	0	28	0	28
Killer whale	0	7	0	7	0	7	0	7	0	7
Pilot whales	94	2,841	72	* 5,693	20	217	38	4,766	28	2,043

TABLE 11—NUMBERS OF POTENTIAL INCIDENTAL TAKE PROPOSED FOR AUTHORIZATION—Continued

Common name	Spectrum		TGS		ION		Western		CGG	
	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B	Level A	Level B
Harbor porpoise	6	637	4	334	1	21	2	157	2	32

* Proposed take authorization limited to 30 percent of best population abundance estimate.
[1] Increased from predicted exposure of one whale (Table 10) to account for assumed minimum group size (*e.g.,* Parks and Tyack, 2005).
[2] Exposure estimate (Table 10) increased by one to account for average group size observed during AMAPPS survey effort.

Analyses and Preliminary Determinations

Negligible Impact Analyses

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

We first provide a generic description of our approach to the negligible impact analyses for this action, which incorporates elements of the impact assessment methodology described by Wood *et al.* (2012), before providing applicant-specific analysis. For each potential activity-related stressor, we consider the potential impacts on affected marine mammals and the likely significance of those impacts to the affected stock or population as a whole. Potential risk due to vessel collision and related mitigation measures as well as potential risk due to entanglement and contaminant spills were addressed under ''Proposed Mitigation'' and ''Potential Effects of the Specified Activity on Marine Mammals'' and are not discussed further, as there are minimal risks expected from these potential stressors.

Our analyses incorporate a simple matrix assessment approach to generate relative impact ratings that couple potential magnitude of effect on a stock and likely consequences of those effects for individuals, given biologically relevant information (*e.g.,* compensatory ability). Impact ratings are then combined with consideration of contextual information, such as the status of the stock or species, in conjunction with our proposed mitigation strategy, to ultimately inform our preliminary determinations. Figure 5 provides an overview of this framework. Elements of this approach are subjective and relative within the context of these particular actions and, overall, these analyses necessarily require the application of professional judgment.

BILLING CODE 3510–22–P

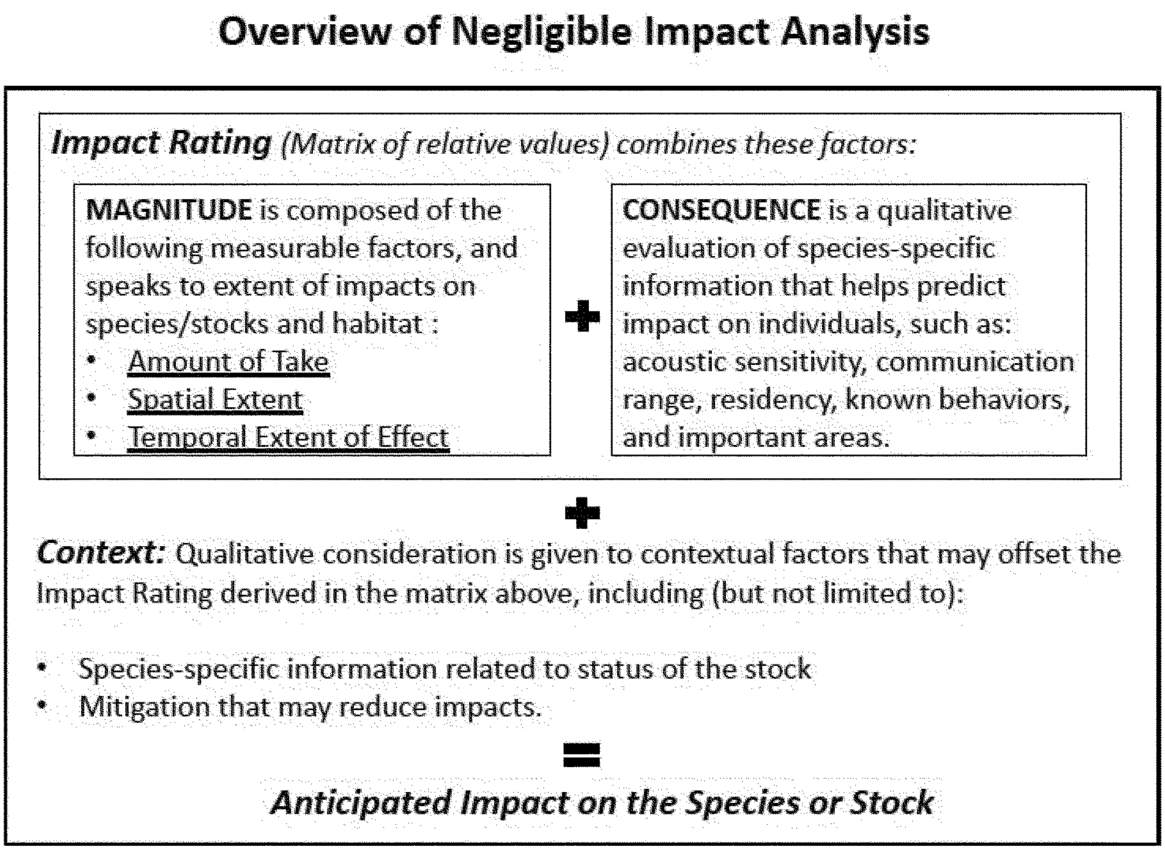

Figure 5. Overview of Negligible Impact Analysis Structure.

BILLING CODE 3510–22–C

Magnitude—We consider magnitude of effect as a semi-quantitative evaluation of measurable factors presented as relative ratings that address the extent of expected impacts to a species or stock and their habitat. Magnitude ratings are developed as a combination of measurable factors: The amount of take, the spatial extent of the effects in the context of the species range, and the duration of effects.

Amount of Take

We consider authorized Level B take less than five percent of population abundance to be de minimis, while authorized Level B taking between 5-15 percent is low. A moderate amount of authorized taking by Level B harassment would be from 15–25 percent, and high above 25 percent. Although we do not define quantitative metrics relating to amount of potential take by Level A harassment, for all applicant companies the expected potential for Level A harassment is expected to be low (Table 11).

Spatial Extent

Spatial extent relates to overlap of the expected range of the affected stock with the expected footprint of the stressor. While we do not define quantitative metrics relative to assessment of spatial extent, a relatively low impact would be a localized effect on the stock's range, a relatively moderate impact would be a regional-scale effect (meaning that the overlap between stressor and range was partial), and a relatively high impact would be one in which the degree of overlap between stressor and range is near total. For a mobile activity occurring over a relatively large, regional-scale area, this categorization is made largely on the basis of the stock range in relation to the action area. For example, the harbor porpoise is expected to occur almost entirely outside of the proposed survey areas (Waring *et al.,* 2016; Roberts *et al.,* 2016) and therefore despite the large extent of proposed survey activity, the spatial extent of potential stressor effect would be low. A medium degree of effect would be expected for a species such as the Risso's dolphin, which has a distribution in shelf and slope waters along the majority of the U.S. Atlantic coast, and which also would be expected to have greater abundance in mid-Atlantic waters north of the proposed survey areas in the summer (Waring *et al.,* 2016; Roberts *et al.,* 2016). This means that the extent of potential stressor for this species would at all times be expected to have some overlap with a portion of the stock, while some portion (increasing in summer and fall months) would at all times be outside the stressor footprint. A higher degree of impact with regard to spatial extent would be expected for a species such as the Clymene dolphin, which is expected to have a generally more southerly distribution (Waring *et al.,* 2016; Roberts *et al.,* 2016) and thus more nearly complete overlap with the expected stressor footprint in BOEM's Mid- and South Atlantic planning areas.

In Tables 14–18 below, spatial extent is presented as a range for certain species with known migratory patterns. We expect spatial extent (overlap of stock range with proposed survey area) to be low for right whales from May through October but moderate from November through April, due to right whale movements into southeastern shelf waters in the winter for calving. The overlap is considered moderate during winter because not all right whales make this winter migration, and those that do are largely found in shallow waters where little survey effort is planned. Spatial extent for humpback whales is expected to be low for most of the year, but likely moderate during winter, while spatial extent for minke whales is likely low in summer, moderate in spring and fall, and high in winter. While we consider spatial extent to be low year-round for fin whales, their range overlap with the proposed survey area does vary across the seasons and is closer to moderate in winter and spring. We expect spatial extent for common dolphins to be lower in fall but generally moderate. Similarly, we expect spatial extent for Risso's dolphins to be lower in summer but generally moderate. Although proposed survey plans differ across applicant companies, all cover large spatial scales that extend throughout much of BOEM's Mid- and South Atlantic OCS planning areas, and we do not expect meaningful differences across surveys with regard to spatial extent.

Temporal Extent

We consider a temporary effect lasting up to one month (prior to the animal or habitat reverting to a ''normal'' condition) to be short-term, whereas long-term effects are more permanent, lasting beyond one season (with animals or habitat potentially reverting to a ''normal'' condition). Moderate-term is therefore defined as between 1-3 months. Duration describes how long the effects of the stressor last. Temporal frequency may range from continuous to isolated (may occur one or two times), or may be intermittent. These metrics and their potential combinations help to derive the ratings summarized in Table 12. Temporal extent is not indicated in Tables 14–18 below, as it did not affect the magnitude rating for each applicant.

TABLE 12—MAGNITUDE RATING

Amount of take	Spatial extent	Duration and frequency	Magnitude rating
High	Any	Any	High.
Any except de minimis	High	Any.	
Moderate	Moderate	Any except short-term/isolated	
Moderate	Moderate	Short-term/isolated	Medium.
Moderate	Low	Any.	
Low	Moderate	Any.	
Low	Low	Any except short-term/intermittent or isolated	
Low	Low	Short-term/intermittent or isolated	Low.
De minimis	Any	Any	De minimis.

Adapted from Table 3.4 of Wood *et al.* (2012).

Likely Consequences—These considerations of amount, extent, and duration give an understanding of expected magnitude of effect for the stock or species and their habitat, which is then considered in context of the likely consequences of those effects for individuals. We consider likely relative consequences through a qualitative evaluation of species-specific information that helps predict the consequences of the known information addressed through the magnitude rating, *i.e.,* expected effects. This evaluation considers factors including acoustic sensitivity, communication range, known aspects of behavior relevant to a consideration of consequences of effects, and assumed compensatory abilities to engage in important behaviors (*e.g.,* breeding, foraging) in alternate areas. The magnitude rating and likely consequences are combined to produce an impact rating (Table 13).

For example, if a delphinid species is predicted to have a high amount of disturbance and over a high degree of spatial extent, that stock would receive a high magnitude rating for that particular proposed survey. However, we may then assess that the species may have a high degree of compensatory ability; therefore, our conclusion would be that the consequences of any effects are likely low. The overall impact rating in this scenario would be moderate. Table 13 summarizes impact rating scenarios.

TABLE 13—IMPACT RATING

Magnitude rating	Consequences (for individuals)	Impact rating
High	High/medium	High.
High	Low	Moderate.
Medium	High/medium	
Low	High	
Medium	Low	Low.
Low	Medium/low	
De minimis	Any	De minimis.

Adapted from Table 3.5 of Wood *et al.* (2012).

Likely consequences, as presented in Tables 14–18 below, are considered medium for each species of mysticete whales with greater than a de minimis amount of exposure, due to the greater potential that survey noise may subject individuals of these species to masking of acoustic space for social purposes (*i.e.,* they are low frequency hearing specialists). Likely consequences are considered medium for sperm whales due to potential for survey noise to disrupt foraging activity. The likely consequences are considered high for beaked whales due to the combination of known acoustic sensitivity and expected residency patterns, as we expect that compensatory ability for beaked whales will be low due to presumed residency in certain shelf break and deepwater canyon areas covered by the proposed survey area. Similarly, *Kogia* spp. are presumed to be a more acoustically sensitive species, but unlike beaked whales we expect that *Kogia* spp. would have a reasonable compensatory ability to perform important behavior in alternate areas, as they are expected to occur broadly over the continental slope (*e.g.,* Bloodworth and Odell, 2008)—therefore, we assume that consequences would be low for *Kogia* spp. generally. Consequences are considered low for most delphinids, as it is unlikely that disturbance due to survey noise would entail significant disruption of normal behavioral patterns, long-term displacement, or significant potential for masking of acoustic space. However, for pilot whales we believe likely consequences to be medium due to expected residency in areas of importance and, therefore, lack of compensatory ability. Because the nature of the stressor is the same across applicant companies, we do not expect meaningful differences with regard to likely consequences.

Context—In addition to impact ratings, we then also consider additional relevant contextual factors in a qualitative fashion. This consideration of context is applied to a given impact rating in order to produce a final assessment of impact to the stock or species, *i.e.,* our preliminary negligible impact determinations. Relevant contextual factors include population status, other stressors, and proposed mitigation.

Here, we reiterate discussion relating to our development of targeted mitigation measures and note certain contextual factors, which are applicable to negligible impact analyses for all five applicant companies. Applicant-specific analyses are provided later.

• We developed mitigation requirements (*i.e.,* time-area restrictions) designed specifically to provide benefit to certain species or stocks for which we predict a relatively moderate to high amount of exposure to survey noise and/or which have contextual factors that we believe necessitate special consideration. The proposed time-area restrictions, described in detail in ''Proposed Mitigation'' and depicted in Figures 3–4), are designed specifically to provide benefit to the North Atlantic right whale, bottlenose dolphin, sperm whale, beaked whales, pilot whales, and Atlantic spotted dolphin. In addition, we expect these areas to provide some subsidiary benefit to additional species that may be present. In particular, Area #5 (Figure 4), although delineated in order to specifically provide an area of anticipated benefit to beaked whales, sperm whales, and pilot whales, is expected to host a diverse assemblage of cetacean species. The output of the Roberts *et al.* (2016) models, as used in core abundance area analyses (described in detail in ''Proposed Mitigation''), indicates that species most likely to derive subsidiary benefit from this time-area restriction include the bottlenose dolphin (offshore stock), Risso's dolphin, and common dolphin. For species with density predicted through stratified models, core abundance analysis is not possible and assumptions regarding potential benefit of time-area restrictions are based on known ecology of the species and sightings patterns and are less robust. Nevertheless, subsidiary benefit for Areas #2–5 (Figure 4) should be expected for species known to be present in these areas (*e.g.,* assumed affinity for shelf/slope/abyss areas off Cape Hatteras): *Kogia* spp., pantropical spotted dolphin, Clymene dolphin, and rough-toothed dolphin.

These proposed measures benefit both the primary species for which they were designed and the species that may benefit secondarily by reducing the likely number of individuals exposed to survey noise and, for resident species in areas where seasonal closures are proposed, reducing the numbers of times that individuals are exposed to survey noise (also discussed in ''Small Numbers Analyses,'' below). However, and perhaps of greater importance, we expect that these restrictions will reduce disturbance of these species in the places most important to them for critical behaviors such as foraging and socialization. Area #2 (Figure 4), which is proposed as a year-round closure, is assumed to be an area important for beaked whale foraging, while Areas #3–4 (also proposed as year-round closures) are assumed to provide important foraging opportunities for sperm whales as well as beaked whales. Area #5, proposed as a seasonal closure, is comprised of shelf-edge habitat where beaked whales and pilot whales are believed to be year-round residents as well as slope and abyss habitat predicted to contain high abundance of sperm whales during the period of closure. Further detail regarding rationale for these closures is provided under ''Proposed Mitigation.''

• The North Atlantic right whale, sei whale, fin whale, blue whale, and sperm whale are listed as endangered under the Endangered Species Act, and all coastal stocks of bottlenose dolphin are designated as depleted under the MMPA (and have recently experienced an unusual mortality event, described earlier in this document). However, sei whales and blue whales are unlikely to be meaningfully impacted by the proposed activities (see ''Rare Species'' below). All four mysticete species are also classified as endangered (*i.e.,* ''considered to be facing a very high risk of extinction in the wild'') on the International Union for Conservation of Nature Red List of Threatened Species, whereas the sperm whale is classified as vulnerable (*i.e.,* ''considered to be facing a high risk of extinction in the wild'') (IUCN, 2016). Our proposed mitigation is designed to avoid impacts to the right whale and to depleted stocks of bottlenose dolphin. Survey activities must avoid all areas where the right whale and coastal stocks of bottlenose dolphin may be reasonably expected to occur, and we propose to require shutdown of the acoustic source upon observation of any right whale at any distance. If the observed right whale is within the behavioral harassment zone, it would still be considered to have experienced harassment, but by immediately shutting down the acoustic source the duration of harassment is minimized and the significance of the harassment event reduced as much as possible.

Although listed as endangered, the primary threat faced by the sperm whale (*i.e.,* commercial whaling) has been eliminated and, further, sperm whales in the western North Atlantic were little affected by modern whaling (Taylor *et al.,* 2008). Current potential threats to the species globally include vessel strikes, entanglement in fishing gear, anthropogenic noise, exposure to contaminants, climate change, and marine debris. However, for the North Atlantic stock, the most recent estimate of annual human-caused mortality and serious injury (M/SI) is just 22 percent of the potential biological removal (PBR) level for the stock. As described previously, PBR is defined as ''the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.'' For depleted stocks, levels of human-caused mortality and serious injury exceeding the PBR level are likely to delay restoration of the stock to OSP level by more than ten percent in comparison with recovery time in the absence of human-caused M/SI.

The most recent status review for the species stated that existing regulatory mechanisms appear to minimize threats to sperm whales and that, despite uncertainty regarding threats such as climate change, contaminants, and anthropogenic noise, the significance of threat facing the species should be considered low to moderate (NMFS, 2015b). Nevertheless, existing empirical data (*e.g.,* Miller *et al.,* 2009) highlight the potential for seismic survey activity to negatively impact foraging behavior of sperm whales. In consideration of this likelihood, the species status, and the relatively high amount of predicted exposures to survey noise, we have given special consideration to mitigation focused on sperm whales and have defined time-area restrictions (see ''Proposed Mitigation'' and Figure 4) specifically designed to reduce such impacts on sperm whales in areas expected to be of greatest importance (*i.e.,* slope habitat and deepwater canyons).

Although the primary direct threat to fin whales was addressed through the moratorium on commercial whaling, vessel strike and entanglement in commercial fishing gear remain as substantive direct threats for the species in the western North Atlantic. As noted below, the most recent estimate of annual average human-caused mortality for the fin whale in U.S. waters is above the PBR value (Table 4). In addition, the mysticete whales are particularly sensitive to sound in the frequency range output from use of airgun arrays (*e.g.,* NMFS, 2016). However, there is conflicting evidence regarding the degree to which this sound source may significantly disrupt the behavior of mysticete whales. Generally speaking, mysticete whales have been observed to react to seismic vessels but have also been observed continuing normal behavior in the presence of seismic vessels, and behavioral context at the time of acoustic exposure may be influential in the degree to which whales display significant behavioral reactions. In addition, while Edwards *et al.* (2015) found that fin whales were likely present in all seasons in U.S. waters north of 35° N., most important habitat areas are not expected to occur in the proposed survey areas. Primary feeding areas are outside the project area in the Gulf of Maine and off Long Island (LaBrecque *et al.,* 2015) and, while Hain *et al.* (1992) suggested that calving occurs during winter in the mid-Atlantic, Waring *et al.* (2016) state that it is unknown where calving, mating, and wintering occur for most of the population. Further, fin whales are not considered to engage in regular mass movements along well-defined migratory corridors (NMFS, 2010b). The model described by Roberts *et al.* (2016), which predicted density at a monthly time step, suggests an expectation that, while fin whales may be present year-round in shelf and slope waters north of Cape Hatteras, the large majority of predicted abundance in U.S. waters would be found outside the proposed survey areas to the north. Very few fin whales are likely present in the proposed survey areas in summer months. Therefore, we have determined that development of time-area restriction specific to fin whales is not warranted. However, fin whales present along the shelf break north of Cape Hatteras during the closure period associated with Area #5 (Figure 4) would be expected to benefit from the time-area restriction designed primarily to benefit pilot whales, beaked whales, and sperm whales.

- Critical habitat is designated only for the North Atlantic right whale, and there are no biologically important areas (BIA) described within the region (other than for the right whale, and the described BIA is similar to designated critical habitat). Our proposed mitigation is designed to minimize impacts to important habitat for the North Atlantic right whale.
- Average annual human-caused M/SI exceeds the PBR level for the North Atlantic right whale, sei whale, fin whale, and for both long-finned and short-finned pilot whales (see Table 4). Average annual M/SI is considered unknown for the blue whale and the false killer whale (PBR is undetermined for a number of other species (Table 4), but average annual human-caused M/SI is zero for all of these). Although threats are considered poorly known for North Atlantic blue whales, PBR is less than one and ship strike is a known cause of mortality for all mysticete whales. The most recent record of ship strike mortality for a blue whale in the U.S. EEZ is from 1998 (Waring *et al.,* 2010). False killer whales also have a low PBR value (2.1), and may be susceptible to mortality in commercial fisheries. One false killer whale was reported as entangled in the pelagic longline fishery in 2011, but was released alive and not seriously injured. Separately, a stranded false killer whale in 2009 was classified as due to a fishery interaction. Incidental take of the sei whale, blue whale, false killer whale, and long-finned pilot whale is considered unlikely and we propose to authorize take by behavioral harassment only for a single group of each of the first three species as a precaution. Although long-finned pilot whales are unlikely to occur in the action area in significant numbers, the density models that inform our exposure estimates consider pilot whales as a guild. It is important to note that our discussion of M/SI in relation to PBR values provides necessary contextual information related to the status of stocks; we do not equate harassment (as defined by the MMPA) with M/SI.

We addressed our consideration of specific mitigation efforts for the right whale and fin whale above. In response to this population context concern for pilot whales, in conjunction with relatively medium to high amount of predicted exposures to survey noise for pilot whales, we have given special consideration to mitigation focused on pilot whales and have defined time-area restrictions (see ''Proposed Mitigation'' and Figure 4) specifically designed to reduce such impacts on pilot whales in areas expected to be of greatest importance (*i.e.,* shelf edge north of Cape Hatteras).

- Beaked whales are considered to be particularly acoustically sensitive (*e.g.,* Tyack *et al.,* 2011; DeRuiter *et al.,* 2013; Stimpert *et al.,* 2014; Miller *et al.,* 2015). Considering this sensitivity in conjunction with the relatively high amount of predicted exposures to survey noise we have given special consideration to mitigation focused on beaked whales and have defined time-area restrictions (see ''Proposed Mitigation'' and Figure 4) specifically designed to reduce such impacts on beaked whales in areas expected to be of greatest importance (*i.e.,* shelf edge south of Cape Hatteras and deepwater canyon areas).

Rare Species—As described previously, there are multiple species that should be considered rare in the proposed survey areas and for which we propose to authorize only nominal and precautionary take of a single group. Specific to each of the five applicant companies, we do not expect meaningful impacts to these species (*i.e.,* sei whale, Bryde's whale, blue whale, killer whale, false killer whale, pygmy killer whale, melon-headed whale, northern bottlenose whale, spinner dolphin, Fraser's dolphin, Atlantic white-sided dolphin) and preliminarily find that the total marine mammal take from each of the specified activities will have a negligible impact on these marine mammal species. We do not discuss these 11 species further in these analyses.

Spectrum—Spectrum proposes a 165-day survey program, or 45 percent of the year (approximately two seasons). However, the proposed survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 1 of Spectrum's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 14 displays relevant information leading to impact ratings for each species resulting from Spectrum's proposed survey. In general, we note that although the temporal and spatial scale of the proposed survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that many individuals may receive limited exposure to survey noise. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 14—MAGNITUDE AND IMPACT RATINGS, SPECTRUM

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
North Atlantic right whale	Low	Low-Moderate	Medium	Medium	Moderate.
Humpback whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Minke whale	De minimis	Low-High	De minimis	n/a	De minimis.
Fin whale	Low	Low	Medium	Medium	Moderate.
Sperm whale	Moderate	Moderate	High	Medium	High.
Kogia spp	Low	High	High	Low	Moderate.
Beaked whales	Moderate	Moderate	High	High	High.
Rough-toothed dolphin	High	High	High	Low	Moderate.
Common bottlenose dolphin	High	High	High	Low	Moderate.
Clymene dolphin	High	High	High	Low	Moderate.
Atlantic spotted dolphin	High	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	High	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Short-beaked common dolphin	Low	Low-moderate	Medium	Low	Low.
Risso's dolphin	Low	Low-moderate	Medium	Low	Low.
Pilot whales	Low	Moderate	Medium	Medium	Moderate.
Harbor porpoise	De minimis	Low	De minimis	n/a	De minimis.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the proposed mitigation described previously is important in order for us to make the necessary finding and, in consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a moderate impact rating overall, but we expect that for two seasons (summer and fall) almost no fin whales will be present in the proposed survey area. For the remainder of the year, it is likely that less than one quarter of the population will be present within the proposed survey area (Roberts *et al.,* 2016), meaning that despite medium rankings for magnitude and likely consequences, these impacts would be experienced by only a small subset of the overall population. In consideration of the moderate impact rating, the likely proportion of the population that may be affected by the specified activities, and the lack of evidence that the proposed survey area is host to important behavior that may be disrupted, we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale and beaked whales are high and, further, consequence factors reinforce high impact ratings for both. Magnitude rating for pilot whales is medium but, similar to beaked whales, we expect that compensatory ability will be low due to presumed residency in areas targeted by the proposed survey—leading to a moderate impact rating. However, regardless of impact rating, the consideration of likely consequences and contextual factors leads us to conclude that targeted mitigation is important to support a finding that the effects of the proposed survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have proposed shutdown of the acoustic source upon observation of a beaked whale at any distance from the source vessel. In consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have proposed shutdown of the acoustic source upon observation of *Kogia* spp. at any distance from the source vessel. In consideration of these factors—likely population increase and proposed mitigation—we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on *Kogia* spp.

Despite medium to high magnitude ratings, remaining delphinid species receive low to moderate impact ratings due to a lack of propensity for behavioral disruption due to geophysical survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the proposed survey area would likely be little affected at the population level by the proposed activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2016; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our proposed mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin, and provides substantial benefit to the on-shelf portion of the Atlantic spotted dolphin population. We also expect that meaningful subsidiary benefit will accrue to certain species from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and proposed mitigation—we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, Clymene dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on the humpback whale, minke whale, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from Spectrum's proposed survey activities will have a negligible impact on all affected marine mammal species or stocks.

TGS—TGS proposes a 308-day survey program, or 84 percent of the year (slightly more than three seasons). However, the proposed survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figures 1–1 to 1–4 of TGS's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. We note that TGS proposes to deploy two independent source vessels, which would in effect increase the spatial extent of survey noise at any one time but, because the vessels would not be operating within the same area or reshooting lines already covered, this would not be expected to increase the duration or frequency of exposure experienced by individual animals. Table 15 displays relevant information leading to impact ratings for each species resulting from TGS's proposed survey. In general, we note that although the temporal and spatial scale of the proposed survey activity is large, the fact that the mobile acoustic sources would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that many individuals may receive limited exposure to survey noise. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 15—MAGNITUDE AND IMPACT RATINGS, TGS

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
North Atlantic right whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Humpback whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Minke whale	De minimis	Low-High	De minimis	n/a	De minimis.
Fin whale	High	Low	High	Medium	High.
Sperm whale	High	Moderate	High	Medium	High.
Kogia spp	High	High	High	Low	Moderate.
Beaked whales	High	Moderate	High	High	High.
Rough-toothed dolphin	High	High	High	Low	Moderate.
Common bottlenose dolphin	High	High	High	Low	Moderate.
Clymene dolphin	Low	High	High	Low	Moderate.
Atlantic spotted dolphin	High	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	High	High	High	Low	Moderate.
Striped dolphin	High	Low	High	Low	Moderate.
Short-beaked common dolphin	High	Low-moderate	High	Low	Moderate.
Risso's dolphin	High	Low-moderate	High	Low	Moderate.
Pilot whales	High	Moderate	High	Medium	High.
Harbor porpoise	De minimis	Low	De minimis	n/a	De minimis.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the proposed mitigation described previously is important in order for us to make the necessary finding and, in consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a high impact rating overall, due to the high amount of exposure predicted for TGS's proposed survey activity. As described previously, we expect that for two seasons (summer and fall) almost no fin whales will be present in the proposed survey area and that, for the remainder of the year, it is likely that less than one quarter of the population will be present within the proposed survey area (Roberts *et al.,* 2016), meaning that these impacts would be experienced by only a small subset of the overall population. However, given the high amount of predicted exposure, we believe that additional mitigation requirements are warranted and propose that TGS be subject to a shutdown requirement for fin whales. If the observed fin whale is within the behavioral harassment zone, it would still be considered to have experienced harassment, but by immediately shutting down the acoustic source the duration of harassment is minimized and the significance of the harassment event reduced as much as possible. In consideration of the likely proportion of the population that may be affected by the specified activities, the lack of evidence that the proposed survey area is host to important behavior that may be disrupted, and the proposed mitigation, we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale, beaked whales, and pilot whales are high and, further, consequence factors reinforce high impact ratings for all three. In addition, regardless of impact rating, the consideration of likely consequences and contextual factors leads us to conclude that targeted mitigation is important to support a finding that the effects of the proposed survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have proposed shutdown of the acoustic source upon observation of a beaked whale at any distance from the source vessel. In consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have proposed shutdown of the acoustic source upon observation of *Kogia* spp. at any distance from the source vessel. In consideration of these factors—likely population increase and proposed mitigation—we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on *Kogia* spp.

Despite high magnitude ratings, remaining delphinid species receive moderate impact ratings due to a lack of propensity for behavioral disruption due to geophysical survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the proposed survey area would likely be little affected at the population level by the proposed activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2016; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our proposed mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin, and provides substantial benefit to the on-shelf portion of the Atlantic spotted dolphin population. We also expect that meaningful subsidiary benefit will accrue to certain species from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and proposed mitigation—we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, Clymene dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on the humpback whale, minke whale, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from TGS's proposed survey activities will have a negligible impact on all affected marine mammal species or stocks.

ION—ION proposes a 70-day survey program, or 19 percent of the year (slightly less than one season). However, the proposed survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 1 of ION's application). Therefore, although the survey would be moderate-term (*i.e.,* from 1–3 months) in total duration, we would not expect the duration of effect to be greater than short and isolated to intermittent in any given area. Table 16 displays relevant information leading to impact ratings for each species resulting from ION's proposed survey. In general, we note that although the spatial scale of the proposed survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that many individuals may receive limited exposure to survey noise. The nature of such potentially transitory exposure means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 16—MAGNITUDE AND IMPACT RATINGS, ION

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
North Atlantic right whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Humpback whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Minke whale	De minimis	Low-High	De minimis	n/a	De minimis.
Fin whale	De minimis	Low	De minimis	n/a	De minimis.
Sperm whale	De minimis	Moderate	De minimis	n/a	De minimis.
Kogia spp	De minimis	High	De minimis	n/a	De minimis.
Beaked whales	De minimis	Moderate	De minimis	n/a	De minimis.

TABLE 16—MAGNITUDE AND IMPACT RATINGS, ION—Continued

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
Rough-toothed dolphin	De minimis	High	De minimis	n/a	De minimis.
Common bottlenose dolphin	De minimis	High	De minimis	n/a	De minimis.
Clymene dolphin	De minimis	High	De minimis	n/a	De minimis.
Atlantic spotted dolphin	De minimis	Moderate	De minimis	n/a	De minimis.
Pantropical spotted dolphin	De minimis	High	De minimis	n/a	De minimis.
Striped dolphin	De minimis	Low	De minimis	n/a	De minimis.
Short-beaked common dolphin	De minimis	Low-moderate	De minimis	n/a	De minimis.
Risso's dolphin	De minimis	Low-moderate	De minimis	n/a	De minimis.
Pilot whales	De minimis	Moderate	De minimis	n/a	De minimis.
Harbor porpoise	De minimis	Low	De minimis	n/a	De minimis.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the proposed mitigation described previously is important in order for us to make the necessary finding and, in consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from ION's proposed survey activities will have a negligible impact on the North Atlantic right whale.

Also regardless of impact rating, consideration of assumed behavioral susceptibility and lack of compensatory ability (*i.e.,* the consequence factors that are disregarded in our matrix assessment for ION) as well as additional contextual factors leads us to conclude that the proposed targeted time-area mitigation described previously is important to support a finding that the effects of the proposed survey will have a negligible impact for the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.). As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive, and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries. Further, we expect that compensatory ability for beaked whales will be low due to presumed residency in certain shelf break and deepwater canyon areas covered by the proposed survey area and that compensatory ability for pilot whales will also be low due to presumed residency in areas targeted by the proposed survey. *Kogia* spp. are also considered to have heightened acoustic sensitivity and therefore we have proposed shutdown of the acoustic source upon observation of a beaked whale or a *Kogia* spp. at any distance from the source vessel. In consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from ION's proposed survey activities will have a negligible impact on the sperm whale, beaked whales, pilot whales, and *Kogia* spp.

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we preliminarily find that the total marine mammal take from ION's proposed survey activities will have a negligible impact on all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, Clymene dolphin, Risso's dolphin humpback whale, minke whale, fin whale, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from ION's proposed survey activities will have a negligible impact on all affected marine mammal species or stocks.

Western—Western proposes a 208-day survey program, or 57 percent of the year (slightly more than two seasons). However, the proposed survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figures 1–1 to 1–4 of Western's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 17 displays relevant information leading to impact ratings for each species resulting from Western's proposed survey. In general, we note that although the temporal and spatial scale of the proposed survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that many individuals may receive limited exposed to survey noise. The nature of such potentially transitory exposure (which we nevertheless assume here is of moderate duration and intermittent, versus isolated) means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 17—MAGNITUDE AND IMPACT RATINGS, WESTERN

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
North Atlantic right whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Humpback whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Minke whale	De minimis	Low-High	De minimis	n/a	De minimis.
Fin whale	Low	Low	Medium	Medium	Moderate.
Sperm whale	High	Moderate	High	Medium	High.
Kogia spp	Low	High	High	Low	Moderate.
Beaked whales	High	Moderate	High	High	High.
Rough-toothed dolphin	Moderate	High	High	Low	Moderate.

TABLE 17—MAGNITUDE AND IMPACT RATINGS, WESTERN—Continued

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
Common bottlenose dolphin	Moderate	High	High	Low	Moderate.
Clymene dolphin	De minimis	High	De minimis	n/a	De minimis.
Atlantic spotted dolphin	High	Moderate	High	Low	Moderate.
Pantropical spotted dolphin	Moderate	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Short-beaked common dolphin	Low	Low-moderate	Medium	Low	Low.
Risso's dolphin	Moderate	Low-moderate	High	Low	Moderate.
Pilot whales	Moderate	Moderate	High	Medium	High.
Harbor porpoise	De minimis	Low	De minimis	n/a	De minimis.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the proposed mitigation described previously is important in order for us to make the necessary finding and, in consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on the North Atlantic right whale. The fin whale receives a moderate impact rating overall, but we expect that for two seasons (summer and fall) almost no fin whales will be present in the proposed survey area. For the remainder of the year, it is likely that less than one quarter of the population will be present within the proposed survey area (Roberts *et al.,* 2016), meaning that despite medium rankings for magnitude and likely consequences, these impacts would be experienced by only a small subset of the overall population. In consideration of the moderate impact rating, the likely proportion of the population that may be affected by the specified activities, and the lack of evidence that the proposed survey area is host to important behavior that may be disrupted, we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on the fin whale.

Magnitude ratings for the sperm whale, beaked whales, and pilot whales are high and, further, consequence factors reinforce high impact ratings for all three. In addition, regardless of impact rating, the consideration of likely consequences and contextual factors leads us to conclude that targeted mitigation is important to support a finding that the effects of the proposed survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have proposed shutdown of the acoustic source upon observation of a beaked whale at any distance from the source vessel. In consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have proposed shutdown of the acoustic source upon observation of *Kogia* spp. at any distance from the source vessel. In consideration of these factors—likely population increase and proposed mitigation—we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on *Kogia* spp.

Despite medium to high magnitude ratings (with the exception of the Clymene dolphin), remaining delphinid species receive low to moderate impact ratings due to a lack of propensity for behavioral disruption due to geophysical survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the proposed survey area would likely be little affected at the population level by the proposed activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2016; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our proposed mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin, and provides substantial benefit to the on-shelf portion of the Atlantic spotted dolphin population. We also expect that meaningful subsidiary benefit will accrue to certain species from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and proposed mitigation—we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, common dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on the humpback whale, minke whale, Clymene dolphin, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from Western's proposed survey activities will have a negligible impact on all affected marine mammal species or stocks.

CGG—CGG proposes an approximately 155-day survey program, or 42 percent of the year (approximately two seasons). However, the proposed survey would cover a large spatial extent (*i.e.,* a majority of the mid- and south Atlantic; see Figure 3 of CGG's application). Therefore, although the survey would be long-term (*i.e.,* greater than one season) in total duration, we would not expect the duration of effect to be greater than moderate and intermittent in any given area. Table 18 displays relevant information leading to impact ratings for each species resulting from CGG's proposed survey. In general, we note that although the temporal and spatial scale of the proposed survey activity is large, the fact that this mobile acoustic source would be moving across large areas (as compared with geophysical surveys with different objectives that may require focused effort over long periods of time in smaller areas) means that many individuals may receive limited exposure to survey noise. The nature of such potentially transitory exposure means that the potential significance of behavioral disruption and potential for longer-term avoidance of important areas is limited.

TABLE 18—MAGNITUDE AND IMPACT RATINGS, CGG

Species	Amount	Spatial extent	Magnitude rating	Consequences	Impact rating
North Atlantic right whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Humpback whale	De minimis	Low-Moderate	De minimis	n/a	De minimis.
Minke whale	De minimis	Low-High	De minimis	n/a	De minimis.
Fin whale	De minimis	Low	De minimis	n/a	De minimis.
Sperm whale	High	Moderate	High	Medium	High.
Kogia spp	Low	High	High	Low	Moderate.
Beaked whales	High	Moderate	High	High	High.
Rough-toothed dolphin	High	High	High	Low	Moderate.
Common bottlenose dolphin	Low	High	High	Low	Moderate.
Clymene dolphin	High	High	High	Low	Moderate.
Atlantic spotted dolphin	Low	Moderate	Medium	Low	Low.
Pantropical spotted dolphin	High	High	High	Low	Moderate.
Striped dolphin	Low	Low	Medium	Low	Low.
Short-beaked common dolphin	De minimis	Low-moderate	De minimis	n/a	De minimis.
Risso's dolphin	Low	Low-moderate	Medium	Low	Low.
Pilot whales	Low	Moderate	Medium	Medium	Moderate.
Harbor porpoise	De minimis	Low	De minimis	n/a	De minimis.

The North Atlantic right whale is endangered, has a very low population size, and faces significant additional stressors. Therefore, regardless of impact rating, we believe that the proposed mitigation described previously is important in order for us to make the necessary finding and, in consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on the North Atlantic right whale.

Magnitude ratings for the sperm whale and beaked whales are high and, further, consequence factors reinforce high impact ratings for both. Magnitude rating for pilot whales is medium but, similar to beaked whales, we expect that compensatory ability will be low due to presumed residency in areas targeted by the proposed survey—leading to a moderate impact rating. However, regardless of impact rating, the consideration of likely consequences and contextual factors leads us to conclude that targeted mitigation is important to support a finding that the effects of the proposed survey will have a negligible impact on these species. As described previously, sperm whales are an endangered species with particular susceptibility to disruption of foraging behavior, beaked whales are particularly acoustically sensitive (with presumed low compensatory ability), and pilot whales are sensitive to additional stressors due to a high degree of mortality in commercial fisheries (and also with low compensatory ability). Finally, due to their acoustic sensitivity, we have proposed shutdown of the acoustic source upon observation of a beaked whale at any distance from the source vessel. In consideration of the proposed mitigation, we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on the sperm whale, beaked whales (*i.e., Ziphius cavirostris* and *Mesoplodon* spp.), and pilot whales (*i.e., Globicephala* spp.).

Kogia spp. receive a moderate impact rating. However, although NMFS does not currently identify a trend for these populations, recent survey effort and stranding data show a simultaneous increase in at-sea abundance and strandings, suggesting growing *Kogia* spp. abundance (NMFS, 2011; 2013a; Waring *et al.,* 2007; 2013). Finally, we expect that *Kogia* spp. will receive subsidiary benefit from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales and, although minimally effective due to the difficulty of at-sea observation of *Kogia* spp., we have proposed shutdown of the acoustic source upon observation of *Kogia* spp. at any distance from the source vessel. In consideration of these factors—likely population increase and proposed mitigation—we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on *Kogia* spp.

Despite medium to high magnitude ratings (with the exception of the short-beaked common dolphin), remaining delphinid species receive low to moderate impact ratings due to a lack of propensity for behavioral disruption due to geophysical survey activity and our expectation that these species would generally have relatively high compensatory ability. In addition, these species do not have significant issues relating to population status or context. Many oceanic delphinid species are generally more associated with dynamic oceanographic characteristics rather than static physical features, and those species (such as common dolphin) with substantial distribution to the north of the proposed survey area would likely be little affected at the population level by the proposed activity. For example, both species of spotted dolphin and the offshore stock of bottlenose dolphin range widely over slope and abyssal waters (*e.g.,* Waring *et al.,* 2016; Roberts *et al.,* 2016), while the rough-toothed dolphin does not appear bound by water depth in its range (Ritter, 2002; Wells *et al.,* 2008). Our proposed mitigation largely eliminates potential effects to depleted coastal stocks of bottlenose dolphin. We also expect that meaningful subsidiary benefit will accrue to certain species from the proposed mitigation targeted for sperm whales, beaked whales, and pilot whales, most notably to species presumed to have greater association with shelf break waters north of Cape Hatteras (*e.g.,* offshore bottlenose dolphins, common dolphins, and Risso's dolphins). In consideration of these factors—overall impact ratings and proposed mitigation—we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on remaining delphinid species (*i.e.,* all stocks of bottlenose dolphin, two species of spotted dolphin, rough-toothed dolphin, striped dolphin, Clymene dolphin, and Risso's dolphin).

For those species with de minimis impact ratings we believe that, absent additional relevant concerns related to population status or context, the rating implies that a negligible impact should be expected as a result of the specified activity. No such concerns exist for these species, and we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on the humpback whale, minke whale, fin whale, short-beaked common dolphin, and harbor porpoise.

In summary, based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that the total marine mammal take from CGG's proposed survey activities will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers Analyses

Please see Tables 10 and 11 and the related text for information relating to the basis for our small numbers analyses. Table 10 provides the numbers of predicted exposures above specified received levels, while Table 11 provides numbers of take by Level A and Level B harassment proposed for authorization. The latter is what we consider for purposes of small numbers analysis for each proposed IHA. For the sei whale, Bryde's whale, blue whale, northern bottlenose whale, Fraser's dolphin, melon-headed whale, false killer whale, pygmy killer whale, killer whale, spinner dolphin, and white-sided dolphin, we propose to authorize take resulting from a single exposure of one group of each species or stock, as appropriate (using average group size), for each applicant. We believe that a single incident of take of one group of any of these species represents take of small numbers for that species. Therefore, for each applicant, based on the analyses contained herein of their specified activity, we preliminarily find that small numbers of marine mammals will be taken for each of these 11 affected species or stocks for each specified activity. We do not discuss these 11 species further in the applicant-specific analyses that follow.

As discussed previously, the MMPA does not define small numbers. NMFS compares the estimated numbers of individuals expected to be taken to the most appropriate estimation of the relevant species or stock size in our determination of whether an authorization is limited to small numbers of marine mammals. In that regard, NMFS proposes to limit its authorization of take to 30 percent of the most appropriate stock abundance estimate, assuming no other relevant factors that provide more context for the estimate, *e.g.,* information that the take numbers represent instances of multiple exposures of the same animals. For these proposed IHAs, the proposed take authorizations (Table 11) have been limited to a threshold of 30 percent. In order to limit actual take to this proportion of estimated stock abundance, we propose to require monthly reporting from those applicants with predicted exposures of any species exceeding this threshold (*i.e.,* Spectrum, TGS, CGG, and Western). These interim reports would include amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals ''taken.'' Upon reaching the pre-determined take threshold, any issued IHA would be withdrawn. This proposed mechanism to limit actual take is discussed further under ''Proposed Monitoring and Reporting.''

In addition, we have proposed time-area restrictions targeted at certain species (see ''Proposed Mitigation''). In particular, one such proposed restriction is targeted towards on-shelf Atlantic spotted dolphins specifically to reduce the likely number of individuals taken. This measure is proposed for implementation for Spectrum, TGS, and Western, due to the uniformly high number of predicted exposures of Atlantic spotted dolphins across all three applicants. In addition, we have proposed time-area restrictions targeted towards sperm whales, beaked whales, and pilot whales. While these restrictions are primarily intended to provide protections important to our preliminary negligible impact findings for each applicant, they would also be expected to reduce the total number of individuals taken (of the three target species/guilds as well as other species likely to be present in those areas). While we are unable to quantify the likely reduction in individuals taken as a result of the proposed mitigation, we believe that the combination of the proposed mitigation and the controls on taking through proposed monitoring and reporting requirements will be effective in limiting the taking of individuals of any species to small numbers. Applicant-specific analyses follow.

Spectrum—The total amount of taking proposed for authorization for a majority of affected stocks ranges from 1 to 24 percent of the most appropriate population abundance estimate. The total amount of taking proposed for authorization for remaining stocks (*i.e.,* rough-toothed dolphin, bottlenose dolphin, Clymene dolphin, Atlantic spotted dolphin, and pantropical spotted dolphin) is limited to 30 percent of the most appropriate population abundance estimate, through mitigation and monitoring mechanisms described previously.

Based on the analysis contained herein of Spectrum's specified activity, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that small numbers of marine mammals will be taken relative to each of the affected species or stocks.

TGS—The total amount of taking proposed for authorization for the harbor porpoise, North Atlantic right whale, humpback whale, minke whale, and Clymene dolphin ranges from one to nine percent of the most appropriate population abundance estimate. The total amount of taking proposed for authorization for all remaining stocks is limited to 30 percent of the most appropriate population abundance estimate, through mitigation and monitoring mechanisms described previously.

Based on the analysis contained herein of TGS's specified activity, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that small numbers of marine mammals will be taken relative to each of the affected species or stocks.

ION—The total amount of taking proposed for authorization for all affected stocks ranges from less than one to four percent of the most appropriate population abundance estimate. Therefore, based on the analysis contained herein of ION's specified activity, we preliminarily find that small numbers of marine mammals will be taken relative to each of the affected species or stocks.

Western—The total amount of taking proposed for authorization for a majority of affected stocks ranges from less than 1 to 25 percent of the most appropriate population abundance estimate. The total amount of taking proposed for authorization for remaining stocks (*i.e.,* sperm whale, beaked whales, and Atlantic spotted dolphin) is limited to 30 percent of the most appropriate population abundance estimate, through mitigation and monitoring mechanisms described previously.

Based on the analysis contained herein of Western's specified activity, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that small numbers of marine mammals will be taken relative to each of the affected species or stocks.

CGG—The total amount of taking proposed for authorization for a majority of affected stocks ranges from less than 1 to 26 percent of the most appropriate population abundance estimate. The total amount of taking proposed for authorization for remaining stocks (*i.e.,* rough-toothed dolphin, Clymene dolphin, and pantropical spotted dolphin) is limited to 30 percent of the most appropriate population abundance estimate, through mitigation and monitoring mechanisms described previously.

Based on the analysis contained herein of CGG's specified activity, and taking into consideration the implementation of the proposed monitoring and mitigation measures, we preliminarily find that small numbers of marine mammals will be taken relative to each of the affected species or stocks.

Proposed Monitoring and Reporting

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

Any monitoring requirement we prescribe should improve our understanding of one or more of the following:

- Occurrence of marine mammal species in action area (*e.g.,* presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) Action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving or feeding areas).
- Individual responses to acute stressors, or impacts of chronic exposures (behavioral or physiological).
- How anticipated responses to stressors impact either: (1) Long-term fitness and survival of an individual; or (2) population, species, or stock.
- Effects on marine mammal habitat and resultant impacts to marine mammals.
- Mitigation and monitoring effectiveness.

Proposed monitoring requirements are the same for all applicants (except as noted), and a single discussion is provided here.

PSO Eligibility and Qualifications

All PSO resumes must be submitted to NMFS and PSOs must be approved by NMFS after a review of their qualifications. PSOs should provide a current resume and information related to PSO training, if available. The latter should include (1) a course information packet that includes the name and qualifications (*e.g.,* experience, training, or education) of the instructor(s), the course outline or syllabus, and course reference material; and (2) a document stating successful completion of the course. PSOs must be trained biologists, with the following minimum qualifications:

- A bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics;
- Experience and ability to conduct field observations and collect data according to assigned protocols (may include academic experience; required for visual PSOs only) and experience with data entry on computers;
- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target (required for visual PSOs only);
- Experience or training in the field identification of marine mammals, including the identification of behaviors (required for visual PSOs only);
- Sufficient training, orientation, or experience with the survey operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; marine mammal behavior; and descriptions of activity conducted and implementation of mitigation;
- Ability to communicate orally, by radio or in person, with survey personnel to provide real-time information on marine mammals observed in the area as necessary; and
- Successful completion of relevant training (described below), including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification, and prospective PSOs granted waivers must satisfy training requirements described below. Alternate experience that may be considered includes, but is not limited to, the following:

- Secondary education and/or experience comparable to PSO duties.
- Previous work experience conducting academic, commercial, or

government-sponsored marine mammal surveys.

- Previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

Training—NMFS does not currently approve specific training programs; however, acceptable training may include training previously approved by BSEE, or training that adheres generally to the recommendations provided by Baker *et al.* (2013). Those recommendations include the following topics for training programs:

- Life at sea, duties, and authorities;
- Ethics, conflicts of interest, standards of conduct, and data confidentiality;
- Offshore survival and safety training;
- Overview of oil and gas activities (including geophysical data acquisition operations, theory, and principles) and types of relevant sound source technology and equipment;
- Overview of the MMPA and ESA as they relate to protection of marine mammals;
- Mitigation, monitoring, and reporting requirements as they pertain to geophysical surveys;
- Marine mammal identification, biology and behavior;
- Background on underwater sound;
- Visual surveying protocols, distance calculations and determination, cues, and search methods for locating and tracking different marine mammal species (visual PSOs only);
- Optimized deployment and configuration of PAM equipment to ensure effective detections of cetaceans for mitigation purposes (PAM operators only);
- Detection and identification of vocalizing species or cetacean groups (PAM operators only);
- Measuring distance and bearing of vocalizing cetaceans while accounting for vessel movement (PAM operators only);
- Data recording and protocols, including standard forms and reports, determining range, distance, direction, and bearing of marine mammals and vessels; recording GPS location coordinates, weather conditions, Beaufort wind force and sea state, etc.;
- Proficiency with relevant software tools;
- Field communication/support with appropriate personnel, and using communication devices (*e.g.,* two-way radios, satellite phones, Internet, email, facsimile);
- Reporting of violations, noncompliance, and coercion; and
- Conflict resolution.

PAM operators should regularly refresh their detection skills through practice with simulation-modelling software, and should keep up to date with training on the latest software/hardware advances.

Visual Monitoring

The lead PSO is responsible for establishing and maintaining clear lines of communication with vessel crew. The vessel operator shall work with the lead PSO to accomplish this and shall ensure any necessary briefings are provided for vessel crew to understand mitigation requirements and protocols. While on duty, PSOs would continually scan the water surface in all directions around the acoustic source and vessel for presence of marine mammals, using a combination of the naked eye and high-quality binoculars, from optimum vantage points for unimpaired visual observations with minimum distractions. PSOs would collect observational data for all marine mammals observed, regardless of distance from the vessel, including species, group size, presence of calves, distance from vessel and direction of travel, and any observed behavior (including an assessment of behavioral responses to survey activity). Upon observation of marine mammal(s), a PSO would record the observation and monitor the animal's position (including latitude/longitude of the vessel and relative bearing and estimated distance to the animal) until the animal dives or moves out of visual range of the observer, and a PSO would continue to observe the area to watch for the animal to resurface or for additional animals that may surface in the area. PSOs would also record environmental conditions at the beginning and end of the observation period and at the time of any observations, as well as whenever conditions change significantly in the judgment of the PSO on duty.

The vessel operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These should be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. NVDs may include night vision binoculars or monocular or forward-looking infrared device (*e.g.,* Exelis PVS–7 night vision goggles; Night Optics D–300 night vision monocular; FLIR M324XP thermal imaging camera or equivalents). At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations. Other required equipment, which should be made available to PSOs by the third-party observer provider, includes reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform the tasks described above, including accurate determination of distance and bearing to observed marine mammals.

Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. Monitoring biologists will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to protocol will be coordinated between NMFS and the applicant.

Acoustic Monitoring

Monitoring of a towed PAM system is required at all times, from 30 minutes prior to ramp-up and throughout all use of the acoustic source. Towed PAM systems generally consist of hardware (*e.g.,* hydrophone array, cables) and software (*e.g.,* data processing and monitoring system). While not required, we recommend use of industry standard software (*e.g.,* PAMguard, which is open source). Hydrophone signals are processed for output to the PAM operator with software designed to detect marine mammal vocalizations. Current PAM technology has some limitations (*e.g.,* limited directional capabilities and detection range, masking of signals due to noise from the vessel, source, and/or flow, localization) and there are no formal guidelines currently in place regarding specifications for hardware, software, or operator training requirements. However, a working group (led by A.M. Thode) is developing formal standards under the auspices of the Acoustical Society of America's (ASA) Accredited Standards Committee on Animal Bioacoustics (ANSI S3/SC1/WG3; ''Towed Array Passive Acoustic Operations for Bioacoustics Applications''). While no formal standards have yet been completed, a ''roadmap'' was developed during a 2016 workshop held for the express purpose of continuing development of such standards. A workshop report (Thode *et al.,* 2017) provides a highly detailed preview of what the scope and structure of the standard would be, including operator training, planning, hardware, real-time operations, localization, and performance validation. NMFS will review this document, and recommends that applicants do the same in developing or refining their PAM plans, as appropriate.

Our requirement to use PAM refers to the use of calibrated hydrophone arrays with full system redundancy to detect, identify and estimate distance and bearing to vocalizing cetaceans, to the extent possible. With regard to calibration, the PAM system should have at least one calibrated hydrophone, sufficient for determining whether background noise levels on the towed PAM system are sufficiently low to meet performance expectations. Additionally, if multiple hydrophone types occur in a system (*i.e.,* monitor different bandwidths), then one hydrophone from each such type should be calibrated, and whenever sets of hydrophones (of the same type) are sufficiently spatially separated such that they would be expected to experience ambient noise environments that differ by 6 dB or more across any integrated species cluster bandwidth, then at least one hydrophone from each set should be calibrated. The arrays should incorporate appropriate hydrophone elements (1 Hz to 180 kHz range) and sound data acquisition card technology for sampling relevant frequencies (*i.e.,* to 360 kHz). This hardware should be coupled with appropriate software to aid monitoring and listening by a PAM operator skilled in bioacoustics analysis and computer system specifications capable of running appropriate software. In the absence of a formally defined set of prescriptions addressing any of these three facets of PAM technology, all applicants must provide a description of the hardware and software proposed for use prior to proceeding with any BOEM-permitted survey. Applicant-specific PAM plans are available for review online at: *www.nmfs.noaa.gov/pr/permits/incidental/oilgas.htm.* Spectrum and ION submitted separate plans, while TGS and Western included their plans in Section 11 of their respective applications. CGG discusses PAM in Section 13 of their application. As noted above, we recommend that each applicant produce a revised plan prior to a final decision on these requests. As recommended by Thode *et al.* (2017), the revised plans should, at minimum, adequately address and describe (1) the hardware and software planned for use, including a hardware performance diagram demonstrating that the sensitivity and dynamic range of the hardware is appropriate for the operation; (2) deployment methodology, including target depth/tow distance; (3) definitions of expected operational conditions, used to summarize background noise statistics; (4) proposed detection-classification-localization methodology, including anticipated species clusters (using a cluster definition table), target minimum detection range for each cluster, and the proposed localization method for each cluster; (5) operation plans, including the background noise sampling schedule; and (6) cluster-specific details regarding which real-time displays and automated detectors the operator would monitor.

In coordination with vessel crew, the lead PAM operator should be responsible for deployment, retrieval, and testing and optimization of the hydrophone array. While on duty, the PAM operator should diligently listen to received signals and/or monitoring display screens in order to detect vocalizing cetaceans, except as required to attend to PAM equipment. The PAM operator should use appropriate sample analysis and filtering techniques and, as described below, must report all cetacean detections. While not required prior to development of formal standards for PAM use, we recommend that vessel self-noise assessments are undertaken during mobilization in order to optimize PAM array configuration according to the specific noise characteristics of the vessel and equipment involved, and to refine expectations for distance/bearing estimations for cetacean species during the survey. Copies of any vessel self-noise assessment reports should be included with the summary trip report.

Data Collection

PSOs must use standardized data forms, whether hard copy or electronic. PSOs will record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

- Vessel names (source vessel and other vessels associated with survey) and call signs
- PSO names and affiliations
- Dates of departures and returns to port with port name
- Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort
- Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts
- Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change
- Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon
- Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.,* vessel traffic, equipment malfunctions)
- Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)
- If a marine mammal is sighted, the following information should be recorded:
  - Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform)
  - PSO who sighted the animal
  - Time of sighting
  - Vessel location at time of sighting
  - Water depth
  - Direction of vessel's travel (compass direction)
  - Direction of animal's travel relative to the vessel
  - Pace of the animal
  - Estimated distance to the animal and its heading relative to vessel at initial sighting
  - Identification of the animal (*e.g.,* genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species
  - Estimated number of animals (high/low/best)
  - Estimated number of animals by cohort (adults, yearlings, juveniles,

calves, group composition, etc.)
  - Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)
  - Detailed behavior observations (*e.g.,* number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior)
  - Animal's closest point of approach (CPA) and/or closest distance from the center point of the acoustic source;
  - Platform activity at time of sighting (*e.g.,* deploying, recovering, testing, shooting, data acquisition, other)
  - Description of any actions implemented in response to the sighting (*e.g.,* delays, shutdown, ramp-up, speed or course alteration, etc.); time and location of the action should also be recorded
- If a marine mammal is detected while using the PAM system, the following information should be recorded:
  - An acoustic encounter identification number, and whether the detection was linked with a visual sighting
  - Time when first and last heard
  - Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)
  - Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

Reporting

PSO effort, survey details, and sightings data should be recorded continuously during surveys and reports prepared each day during which survey effort is conducted. As described previously, applicants with predicted exposures of any species exceeding the 30-percent threshold (*i.e.,* Spectrum, TGS, CGG, and Western) must submit regular interim reports. These interim reports would include amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals ''taken.'' We propose submission of such interim reports to NMFS on a monthly basis.

There are multiple reasons why marine mammals may be present and yet be undetected by observers. Animals are missed because they are underwater (availability bias) or because they are available to be seen, but are missed by observers (perception and detection biases) (*e.g.,* Marsh and Sinclair, 1989). Negative bias on perception or detection of an available animal may result from environmental conditions, limitations inherent to the observation platform, or observer ability. In this case, we do not have prior knowledge of any potential negative bias on detection probability due to observation platform or observer ability. Therefore, observational data corrections must be made with respect to assumed species-specific detection probability as evaluated through consideration of environmental factors (*e.g.,* $f(0)$). We propose that corrections be made using detection probabilities found in Carr *et al.* (2011), which are based on $f(0)$ values from line-transect survey studies described in Koski *et al.* (1998), Barlow (1999), and Thomas *et al.* (2002). Carr *et al.* (2011) derived detection probabilities (shown in Table 19) as follows:

- $1/f(0)$ is the effective strip width.
- The effective strip width was divided by the truncation distance used to calculate $f(0)$.
- This value is detection probability or the average probability that an animal would be seen within the truncation distance from the vessel.
- For cryptic species where only sea states 0 to 2 were used to calculate $f(0)$, detection probability was arbitrarily divided by 3 to account for the higher probability that animals would be missed during the survey whenever sea states were greater than 2.
- Different detection probability values were calculated for groups with 1–16, 17–60 and greater than 60 individuals based on the different $f(0)$ values for those group sizes.
- The mean group size for the species or guild determined the appropriate detection probability that was used for that species or guild.

TABLE 19—DETECTION PROBABILITIES

Common name	Detection probability	Assumed group size
Mysticete whales (except minke whale)	0.259	1–16
Minke whale	0.244	1–16
Sperm whale	0.259	1–16
Kogia spp.	0.055	1–16
Beaked whales	0.244	1–16
Small delphinids, medium group size (all but common, spinner, and Fraser's dolphin)	0.524	17–60
Small delphinids, large group size	0.926	>60
Large delphinids, small group size (all but Risso's dolphin and killer whale)	0.309	1–16
Large delphinids, medium group size	0.524	17–60
Harbor porpoise	0.055	1–16

Adapted from Table B–6, Carr *et al.* (2011).

A draft comprehensive report would be submitted to NMFS within 90 days of the completion of survey effort, and must include all information described above under ''Data Collection.'' The report will describe the operations conducted and sightings of marine mammals near the operations. The report will provide full documentation of methods, results, and interpretation pertaining to all monitoring. The report will summarize the dates and locations of survey operations, and all marine mammal sightings (dates, times, locations, activities, associated survey activities); geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. This report must also include a validation document concerning the use of PAM, which should include necessary noise validation diagrams and demonstrate whether background noise levels on the PAM deployment limited achievement of the planned detection goals.

The report will also include estimates of the number of takes based on the observations and in consideration of the detectability of the marine mammal species observed (*e.g.,* in consideration of *f*(0)). Applicants must provide an estimate of the number (by species) of marine mammals that may have been exposed (based on observational data and accounting for animals present but unavailable for sighting (*i.e., f*(0) values)) to the survey activity at received levels greater than or equal to the harassment threshold (*i.e.,* 160 dB rms). The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report. A final report must be submitted within 30 days following resolution of any comments on the draft report.

In the event that the specified activity clearly causes the take of a marine mammal in a manner not permitted by the authorization (if issued), such as a serious injury or mortality, the applicant shall immediately cease the specified activities and immediately report the take to NMFS. The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

The applicant shall not resume its activities until NMFS is able to review the circumstances of the prohibited take. NMFS would work with the applicant to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The applicant may not resume their activities until notified by NMFS.

In the event that the applicant discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.,* in less than a moderate state of decomposition as we describe in the next paragraph), the applicant will immediately report the incident to NMFS. The report must include the same information identified in the paragraph above this section. Activities may continue while NMFS reviews the circumstances of the incident. NMFS would work with the applicant to determine whether modifications to the activities are appropriate.

In the event that the applicant discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the applicant would report the incident to NMFS within 24 hours of the discovery. The applicant would provide photographs or video footage (if available) or other documentation of the animal to NMFS.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by these actions. Therefore, relevant to the Spectrum, TGS, ION, CGG, and Western proposed IHAs, we have determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

There are six marine mammal species listed as endangered under the ESA that may occur in the proposed survey areas. Under section 7 of the ESA, BOEM requested initiation of formal consultation (on behalf of itself and BSEE) in 2012 with NMFS's Office of Protected Resources, Endangered Species Act Interagency Cooperation Division (Interagency Cooperation Division) on the proposed authorization of geological and geophysical survey activities under its oil and gas, renewable energy and marine minerals programs. These activities were described in BOEM's Draft PEIS for Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas. NMFS concluded formal consultation by issuing a final Biological Opinion to BOEM and BSEE on July 19, 2013, determining that the proposed activities were not likely to jeopardize the continued existence of threatened or endangered species nor destroy or adversely modify designated critical habitat under NMFS's jurisdiction. On October 16, 2015, BOEM and BSEE reinitiated consultation with NMFS.

NMFS's Office of Protected Resources, Permits and Conservation Division will also consult internally with Interagency Cooperation Division on the proposed issuance of authorizations under section 101(a)(5)(D) of the MMPA. NMFS will conclude the consultation prior to reaching a determination regarding the proposed issuance of the authorizations.

National Environmental Policy Act

In 2014, the BOEM produced a PEIS to evaluate potential significant environmental effects of G&G activities on the Mid- and South Atlantic OCS, pursuant to requirements of NEPA. These activities include geophysical surveys in support of hydrocarbon exploration, as are proposed in the MMPA applications before NMFS. The PEIS is available at: *www.boem.gov/Atlantic-G-G-PEIS/*. NMFS participated in development of the PEIS as a cooperating agency and believes it appropriate to adopt the analysis in order to assess the impacts to the human environment of issuance of the subject IHAs. Information in the IHA applications, BOEM's PEIS, and this notice collectively provide the environmental information related to proposed issuance of these IHAs for public review and comment. We will review all comments submitted in response to this notice as we complete the NEPA process, including a final decision of whether to adopt BOEM's PEIS and sign a Record of Decision related to issuance of IHAs, prior to a final decision on the incidental take authorization requests.

Proposed Authorizations

As a result of these preliminary determinations, we propose to issue five separate IHAs to the aforementioned applicant companies for conducting the described geophysical survey activities in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. Specific language from the proposed IHAs is provided next.

This section contains drafts of the IHAs. The wording contained in this section is proposed for inclusion in the IHAs (if issued).

Spectrum

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

2. This IHA is valid only for marine geophysical survey activity, as specified in Spectrum's IHA application and using an array with characteristics specified in the application, in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas.

3. General Conditions

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

(b) The species authorized for taking are listed in Table 11. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 11.

(c) The taking by serious injury or death of any of the species listed in Table 11 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 11 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) Spectrum shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations. Spectrum shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team, and shall ensure that relevant vessel personnel and protected species monitoring team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations.

(e) During use of the acoustic source, if the source vessel encounters any marine mammal species that are not listed in Table 11, then the acoustic source must be shut down to avoid unauthorized take.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) Spectrum must use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than eighteen months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One ''experienced'' visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that ''experienced'' PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to acoustic PSOs, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(vi) Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, shall be relayed to the source vessel and to the PSO team.

(vii) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation

(i) The source vessel must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(iv) Survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding small delphinoids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(e) Buffer Zone and Exclusion Zone—The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance).

(f) Ramp-up—A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. Ramp-up may not be initiated if any marine mammal is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs would monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone. Ramp-up may occur at times of poor visibility if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups shall be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(g) Shutdown Requirements

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

(ii) Upon completion of ramp-up, if a marine mammal appears within, enters, or appears on a course to enter the exclusion zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the acoustic PSO is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement.

(A) This shutdown requirement is waived for dolphins of the following genera: *Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus.* The shutdown waiver only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement applies. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented.

(iii) Shutdown of the acoustic source is required upon observation of a right whale at any distance.

(iv) Shutdown of the acoustic source is required upon observation of a whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(v) Shutdown of the acoustic source is required upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel.

(vi) Shutdown of the acoustic source is required upon observation (visual or acoustic) of a beaked whale or *Kogia* spp. at any distance.

(vii) Shutdown of the acoustic source is required upon observation of an aggregation (*i.e.,* six or more animals) of marine mammals of any species that does not appear to be traveling.

(viii) Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdown due to observation of a right whale), a 30-minute clearance period must be observed following the last observation of the animal(s).

(ix) If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. For any longer shutdown, pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

(h) Miscellaneous Protocols

(i) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up).

Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

(i) Closure Areas

(i) No use of the acoustic source may occur within 30 km of the coast.

(ii) From November 1 through April 30, no use of the acoustic source may occur within an area bounded by the greater of three distinct components at any location: (1) A 47-km wide coastal strip throughout the entire Mid- and South Atlantic OCS planning areas; (2) Unit 2 of designated critical habitat for the North Atlantic right whale, buffered by 10 km; and (3) the designated southeastern seasonal management area (SMA) for the North Atlantic right whale, buffered by 10 km. North Atlantic right whale dynamic management areas (DMA; buffered by 10 km) are also closed to use of the acoustic source when in effect. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

(iii) No use of the acoustic source may occur within the areas designated by coordinates in Table 3 during applicable time periods. Area #1 is in effect from June 1 through August 31. Areas #2–4 are in effect year-round. Area #5 is in effect from July 1 through September 30.

(j) Vessel Strike Avoidance

(i) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

(ii) All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15).

(iii) Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

(iv) All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

(A) While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

(B) If a whale is spotted in the path of a vessel or within 100 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 100 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

(v) All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

(A) The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(vi) All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(k) All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.,* 25 × 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.,* 7 × 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection—PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) Vessel names (source vessel and other vessels associated with survey) and call signs

(ii) PSO names and affiliations

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

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

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

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

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

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

(ix) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

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

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

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

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

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

(H) Pace of the animal

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

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

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

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

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

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

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

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

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

(xi) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) Spectrum shall submit monthly interim reports detailing the amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals ''taken,'' using correction factors given in Table 19.

(b) Spectrum shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as required under condition 5(d) of this IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(c) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, Spectrum shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

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

(B) Name and type of vessel involved;

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

(D) Description of the incident;

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

(F) Water depth;

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

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

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

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

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

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take.

NMFS will work with Spectrum to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Spectrum may not resume their activities until notified by NMFS.

(ii) In the event that Spectrum discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), Spectrum shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(c)(1) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Spectrum to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that Spectrum discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Spectrum shall report the incident to NMFS within 24 hours of the discovery. Spectrum shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

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

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

2. This IHA is valid only for marine geophysical survey activity, as specified in TGS's IHA application and using an array with characteristics specified in the application, in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas.

3. General Conditions

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

(b) The species authorized for taking are listed in Table 11. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 11.

(c) The taking by serious injury or death of any of the species listed in Table 11 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 11 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) TGS shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations. TGS shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team, and shall ensure that relevant vessel personnel and protected species monitoring team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations.

(e) During use of the acoustic source, if the source vessel encounters any marine mammal species that are not listed in Table 11, then the acoustic source must be shut down to avoid unauthorized take.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) TGS must use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One ''experienced'' visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that ''experienced'' PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to acoustic PSOs, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(vi) Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, shall be relayed to the source vessel and to the PSO team.

(vii) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation

(i) The source vessel must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(iv) Survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding small delphinoids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(e) Buffer Zone and Exclusion Zone—The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance).

(f) Ramp-up—A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. Ramp-up may not be initiated if any marine mammal is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs would monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone. Ramp-up may occur at times of poor visibility if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups shall be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(g) Shutdown Requirements

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

(ii) Upon completion of ramp-up, if a marine mammal appears within, enters, or appears on a course to enter the exclusion zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the acoustic PSO is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement.

(A) This shutdown requirement is waived for dolphins of the following genera: *Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus.* The shutdown waiver only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement applies. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented.

(iii) Shutdown of the acoustic source is required upon observation of a right whale or fin whale at any distance.

(iv) Shutdown of the acoustic source is required upon observation of a whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(v) Shutdown of the acoustic source is required upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel.

(vi) Shutdown of the acoustic source is required upon observation (visual or acoustic) of a beaked whale or *Kogia* spp. at any distance.

(vii) Shutdown of the acoustic source is required upon observation of an aggregation (*i.e.,* six or more animals) of marine mammals of any species that does not appear to be traveling.

(viii) Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdown due to observation of a right whale), a 30-minute clearance period must be observed following the last observation of the animal(s).

(ix) If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. For any longer shutdown, pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

(h) Miscellaneous Protocols

(i) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

(i) Closure Areas

(i) No use of the acoustic source may occur within 30 km of the coast.

(ii) From November 1 through April 30, no use of the acoustic source may occur within an area bounded by the greater of three distinct components at any location: (1) A 47-km wide coastal strip throughout the entire Mid- and South Atlantic OCS planning areas; (2) Unit 2 of designated critical habitat for the North Atlantic right whale, buffered by 10 km; and (3) the designated southeastern seasonal management area (SMA) for the North Atlantic right whale, buffered by 10 km. North Atlantic right whale dynamic management areas (DMA; buffered by 10 km) are also closed to use of the acoustic source when in effect. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

(iii) No use of the acoustic source may occur within the areas designated by coordinates in Table 3 during applicable time periods. Area #1 is in effect from June 1 through August 31. Areas #2–4 are in effect year-round. Area #5 is in effect from July 1 through September 30.

(j) Vessel Strike Avoidance

(i) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

(ii) All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15).

(iii) Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

(iv) All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

(A) While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

(B) If a whale is spotted in the path of a vessel or within 100 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 100 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

(v) All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

(A) The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(vi) All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(k) All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection—PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) Vessel names (source vessel and other vessels associated with survey) and call signs

(ii) PSO names and affiliations

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

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

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

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

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

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

(ix) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

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

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

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

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

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

(H) Pace of the animal

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

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

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

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

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

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

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

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

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

(xi) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) TGS shall submit monthly interim reports detailing the amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals ''taken,'' using correction factors given in Table 19.

(b) TGS shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as required under condition 5(d) of this IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(c) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, TGS shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

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

(B) Name and type of vessel involved;

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

(D) Description of the incident;

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

(F) Water depth;

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

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

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

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

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

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with TGS to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. TGS may not resume their activities until notified by NMFS.

(ii) In the event that TGS discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), TGS shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(c)(1) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with TGS to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that TGS discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), TGS shall report the incident to NMFS within 24 hours of the discovery. TGS shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

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

ION

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

2. This IHA is valid only for marine geophysical survey activity, as specified in ION's IHA application and using an array with characteristics specified in the application, in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas.

3. General Conditions

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

(b) The species authorized for taking are listed in Table 11. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 11.

(c) The taking by serious injury or death of any of the species listed in Table 11 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 11 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) ION shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations. ION shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team, and shall ensure that relevant vessel personnel and protected species monitoring team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations.

(e) During use of the acoustic source, if the source vessel encounters any marine mammal species that are not listed in Table 11, then the acoustic source must be shut down to avoid unauthorized take.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) ION must use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One ''experienced'' visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that ''experienced'' PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to acoustic PSOs, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(vi) Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, shall be relayed to the source vessel and to the PSO team.

(vii) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation

(i) The source vessel must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(iv) Survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding small delphinoids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(e) Buffer Zone and Exclusion Zone—The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance).

(f) Ramp-up—A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. Ramp-up may not be initiated if any marine mammal is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs would monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone. Ramp-up may occur at times of poor visibility if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups shall be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(g) Shutdown Requirements

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

(ii) Upon completion of ramp-up, if a marine mammal appears within, enters, or appears on a course to enter the exclusion zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the acoustic PSO is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement.

(A) This shutdown requirement is waived for dolphins of the following genera: *Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus.* The shutdown waiver only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement applies. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented.

(iii) Shutdown of the acoustic source is required upon observation of a right whale at any distance.

(iv) Shutdown of the acoustic source is required upon observation of a whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(v) Shutdown of the acoustic source is required upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel.

(vi) Shutdown of the acoustic source is required upon observation (visual or acoustic) of a beaked whale or *Kogia* spp. at any distance.

(vii) Shutdown of the acoustic source is required upon observation of an aggregation (*i.e.,* six or more animals) of marine mammals of any species that does not appear to be traveling.

(viii) Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdown due to observation of a right whale), a 30-minute clearance period must be observed following the last observation of the animal(s).

(ix) If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. For any longer shutdown, pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

(h) Miscellaneous Protocols

(i) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

(i) Closure Areas

(i) No use of the acoustic source may occur within 30 km of the coast.

(ii) From November 1 through April 30, no use of the acoustic source may occur within an area bounded by the greater of three distinct components at any location: (1) A 47-km wide coastal strip throughout the entire Mid- and South Atlantic OCS planning areas; (2) Unit 2 of designated critical habitat for the North Atlantic right whale, buffered by 10 km; and (3) the designated southeastern seasonal management area (SMA) for the North Atlantic right whale, buffered by 10 km. North Atlantic right whale dynamic management areas (DMA; buffered by 10 km) are also closed to use of the acoustic source when in effect. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

(iii) No use of the acoustic source may occur within Areas #2–5, as designated by coordinates in Table 3 during applicable time periods. Areas #2–4 are in effect year-round. Area #5 is in effect from July 1 through September 30.

(j) Vessel Strike Avoidance

(i) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

(ii) All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15).

(iii) Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

(iv) All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

(A) While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

(B) If a whale is spotted in the path of a vessel or within 100 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 100 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

(v) All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

(A) The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(vi) All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(k) All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection—PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) Vessel names (source vessel and other vessels associated with survey) and call signs

(ii) PSO names and affiliations

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

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

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

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

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

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

(ix) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

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

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

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

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

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

(H) Pace of the animal

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

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

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

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

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

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

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

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

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

(xi) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) ION shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize data collected as required under condition 5(d) of this IHA and must provide corrected numbers of marine mammals ''taken,'' using correction factors given in Table 19. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(b) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, ION shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

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

(B) Name and type of vessel involved;

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

(D) Description of the incident;

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

(F) Water depth;

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

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

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

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

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

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with ION to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. ION may not resume their activities until notified by NMFS.

(ii) In the event that ION discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), ION shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(b)(1) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with ION to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that ION discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), ION shall report the incident to NMFS within 24 hours of the discovery. ION shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

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

Western

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

2. This IHA is valid only for marine geophysical survey activity, as specified in Western's IHA application and using an array with characteristics specified in the application, in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas.

3. General Conditions

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

(b) The species authorized for taking are listed in Table 11. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 11.

(c) The taking by serious injury or death of any of the species listed in Table 11 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 11 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) Western shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations. Western shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team, and shall ensure that relevant vessel personnel and protected species monitoring team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations.

(e) During use of the acoustic source, if the source vessel encounters any marine mammal species that are not listed in Table 11, then the acoustic source must be shut down to avoid unauthorized take.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) Western must use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than 18 months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One ''experienced'' visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that ''experienced'' PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to acoustic PSOs, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(vi) Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, shall be relayed to the source vessel and to the PSO team.

(vii) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation

(i) The source vessel must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(iv) Survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding small delphinoids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(e) Buffer Zone and Exclusion Zone—The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance).

(f) Ramp-up—A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. Ramp-up may not be initiated if any marine mammal is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs would monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone. Ramp-up may occur at times of poor visibility if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups shall be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(g) Shutdown Requirements

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

(ii) Upon completion of ramp-up, if a marine mammal appears within, enters, or appears on a course to enter the exclusion zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the acoustic PSO is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement.

(A) This shutdown requirement is waived for dolphins of the following genera: *Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus.* The shutdown waiver only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement applies. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented.

(iii) Shutdown of the acoustic source is required upon observation of a right whale at any distance.

(iv) Shutdown of the acoustic source is required upon observation of a whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(v) Shutdown of the acoustic source is required upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel.

(vi) Shutdown of the acoustic source is required upon observation (visual or acoustic) of a beaked whale or *Kogia* spp. at any distance.

(vii) Shutdown of the acoustic source is required upon observation of an aggregation (*i.e.,* six or more animals) of marine mammals of any species that does not appear to be traveling.

(viii) Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdown due to observation of a right whale), a 30-minute clearance period must be observed following the last observation of the animal(s).

(ix) If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. For any longer shutdown, pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

(h) Miscellaneous Protocols

(i) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

(i) Closure Areas

(i) No use of the acoustic source may occur within 30 km of the coast.

(ii) From November 1 through April 30, no use of the acoustic source may occur within an area bounded by the greater of three distinct components at any location: (1) A 47-km wide coastal strip throughout the entire Mid- and South Atlantic OCS planning areas; (2) Unit 2 of designated critical habitat for the North Atlantic right whale, buffered by 10 km; and (3) the designated southeastern seasonal management area (SMA) for the North Atlantic right whale, buffered by 10 km. North Atlantic right whale dynamic management areas (DMA; buffered by 10 km) are also closed to use of the acoustic source when in effect. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

(iii) No use of the acoustic source may occur within the areas designated by coordinates in Table 3 during applicable time periods. Area #1 is in effect from June 1 through August 31. Areas #2–4 are in effect year-round. Area #5 is in effect from July 1 through September 30.

(j) Vessel Strike Avoidance

(i) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

(ii) All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15).

(iii) Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

(iv) All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

(A) While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

(B) If a whale is spotted in the path of a vessel or within 100 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 100 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

(v) All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

(A) The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(vi) All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(k) All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection—PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) Vessel names (source vessel and other vessels associated with survey) and call signs

(ii) PSO names and affiliations

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

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

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

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

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

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

(ix) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

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

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

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

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

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

(H) Pace of the animal

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

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

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

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

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

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

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

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

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

(xi) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) Western shall submit monthly interim reports detailing the amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals "taken," using correction factors given in Table 19.

(b) Western shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as required under condition 5(d) of this IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(c) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, Western shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

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

(B) Name and type of vessel involved;

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

(D) Description of the incident;

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

(F) Water depth;

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

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

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

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

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

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with Western to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. Western may not resume their activities until notified by NMFS.

(ii) In the event that Western discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), Western shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(c)(1) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with Western to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that Western discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), Western shall report the incident to NMFS within 24 hours of the discovery. Western shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if

NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

CGG

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

2. This IHA is valid only for marine geophysical survey activity, as specified in CGG's IHA application and using an array with characteristics specified in the application, in the Atlantic Ocean within BOEM's Mid- and South Atlantic OCS planning areas.

3. General Conditions

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

(b) The species authorized for taking are listed in Table 11. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 11.

(c) The taking by serious injury or death of any of the species listed in Table 11 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 11 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) CGG shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations. CGG shall instruct relevant vessel personnel with regard to the authority of the protected species monitoring team, and shall ensure that relevant vessel personnel and protected species monitoring team participate in a joint onboard briefing led by the vessel operator and lead PSO to ensure that responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements are clearly understood. This briefing must be repeated when relevant new personnel join the survey operations.

(e) During use of the acoustic source, if the source vessel encounters any marine mammal species that are not listed in Table 11, then the acoustic source must be shut down to avoid unauthorized take.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) CGG must use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider, may have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course. NMFS must review and approve PSO resumes accompanied by a relevant training course information packet that includes the name and qualifications (*i.e.,* experience, training completed, or educational background) of the instructor(s), the course outline or syllabus, and course reference material as well as a document stating successful completion of the course.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than eighteen months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One ''experienced'' visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that ''experienced'' PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.,* any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), a minimum of two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.,* from 30 minutes prior to sunrise through 30 minutes following sunset) and 30 minutes prior to and during nighttime ramp-ups of the airgun array.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to acoustic PSOs, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of two consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(vi) Any observations of marine mammals by crew members aboard any vessel associated with the survey, including chase vessels, shall be relayed to the source vessel and to the PSO team.

(vii) During good conditions (*e.g.,* daylight hours; Beaufort sea state (BSS) 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation

(i) The source vessel must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Acoustic PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours observation per 24-hour period.

(iv) Survey activity may continue for brief periods of time when the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to BSS 4;

(B) No marine mammals (excluding small delphinoids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24-hour period.

(e) Buffer Zone and Exclusion Zone—The PSOs shall establish and monitor a 500-m exclusion zone and a 1,000-m buffer zone. These zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) shall be communicated to the operator to prepare for the potential shutdown of the acoustic source. PSOs must monitor the buffer zone for a minimum of 30 minutes prior to ramp-up (*i.e.,* pre-clearance).

(f) Ramp-up—A ramp-up procedure, involving a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved, is required at all times as part of the activation of the acoustic source. Ramp-up may not be initiated if any marine mammal is within the designated buffer zone. If a marine mammal is observed within the buffer zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.,* 15 minutes for small odontocetes and 30 minutes for all other species). PSOs would monitor the buffer zone during ramp-up, and ramp-up must cease and the source shut down upon observation of marine mammals within or approaching the buffer zone. Ramp-up may occur at times of poor visibility if appropriate acoustic monitoring has occurred with no detections in the 30 minutes prior to beginning ramp-up. Acoustic source activation may only occur at times of poor visibility where operational planning cannot reasonably avoid such circumstances. The operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. Total duration should be approximately 20 minutes. The operator must provide information to the PSO documenting that appropriate procedures were followed. Ramp-ups shall be scheduled so as to minimize the time spent with source activated prior to reaching the designated run-in.

(g) Shutdown Requirements

(i) Any PSO on duty has the authority to delay the start of survey operations or to call for shutdown of the acoustic source (visual PSOs on duty should be in agreement on the need for delay or shutdown before requiring such action). When shutdown is called for by a PSO, the acoustic source must be immediately deactivated and any dispute resolved only following deactivation. The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the acoustic source to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary. When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately. When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the acoustic source must be shut down as a precaution.

(ii) Upon completion of ramp-up, if a marine mammal appears within, enters, or appears on a course to enter the exclusion zone, the acoustic source must be shut down (*i.e.,* power to the acoustic source must be immediately turned off). If a marine mammal is detected acoustically, the acoustic source must be shut down, unless the acoustic PSO is confident that the animal detected is outside the exclusion zone or that the detected species is not subject to the shutdown requirement.

(A) This shutdown requirement is waived for dolphins of the following genera: *Steno, Tursiops, Stenella, Delphinus, Lagenodelphis,* and *Lagenorhynchus.* The shutdown waiver only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement applies. If there is uncertainty regarding identification (*i.e.,* whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, shutdown must be implemented.

(iii) Shutdown of the acoustic source is required upon observation of a right whale at any distance.

(iv) Shutdown of the acoustic source is required upon observation of a whale (*i.e.,* sperm whale or any baleen whale) with calf at any distance, with ''calf'' defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(v) Shutdown of the acoustic source is required upon observation of a diving sperm whale at any distance centered on the forward track of the source vessel.

(vi) Shutdown of the acoustic source is required upon observation (visual or acoustic) of a beaked whale or *Kogia* spp. at any distance.

(vii) Shutdown of the acoustic source is required upon observation of an aggregation (*i.e.,* six or more animals) of marine mammals of any species that does not appear to be traveling.

(viii) Upon implementation of shutdown, the source may be reactivated after the animal(s) has been observed exiting the exclusion zone or following a 30-minute clearance period with no further observation of the animal(s). Where there is no relevant zone (*e.g.,* shutdown due to observation of a right whale), a 30-minute clearance period must be observed following the last observation of the animal(s).

(ix) If the acoustic source is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for brief periods (*i.e.,* less than 30 minutes), it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the exclusion zone and no acoustic detections have occurred. For any longer shutdown, pre-clearance watch and ramp-up are required. For any shutdown at night or in periods of poor visibility (*e.g.,* BSS 4 or greater), ramp-up is required but if the shutdown period was brief and constant observation maintained, pre-clearance watch is not required.

(h) Miscellaneous Protocols

(i) The acoustic source must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided.

Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.,* ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

(i) Closure Areas

(i) No use of the acoustic source may occur within 30 km of the coast.

(ii) From November 1 through April 30, no use of the acoustic source may occur within an area bounded by the greater of three distinct components at any location: (1) A 47-km wide coastal strip throughout the entire Mid- and South Atlantic OCS planning areas; (2) Unit 2 of designated critical habitat for the North Atlantic right whale, buffered by 10 km; and (3) the designated southeastern seasonal management area (SMA) for the North Atlantic right whale, buffered by 10 km. North Atlantic right whale dynamic management areas (DMA; buffered by 10 km) are also closed to use of the acoustic source when in effect. It is the responsibility of the survey operators to monitor appropriate media and to be aware of designated DMAs.

(iii) No use of the acoustic source may occur within Areas #2–5, as designated by coordinates in Table 3 during applicable time periods. Areas #2–4 are in effect year-round. Area #5 is in effect from July 1 through September 30.

(j) Vessel Strike Avoidance

(i) Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down or stop their vessel or alter course, as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a right whale, other whale, or other marine mammal (*i.e.,* non-whale cetacean or pinniped). In this context, ''other whales'' includes sperm whales and all baleen whales other than right whales.

(ii) All vessels, regardless of size, must observe the 10 kn speed restriction in DMAs, the Mid-Atlantic SMA (from November 1 through April 30), and critical habitat and the Southeast SMA (from November 15 through April 15).

(iii) Vessel speeds must also be reduced to 10 kn or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

(iv) All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action. The following avoidance measures must be taken if a right whale is within 500 m of any vessel:

(A) While underway, the vessel operator must steer a course away from the whale at 10 kn or less until the minimum separation distance has been established.

(B) If a whale is spotted in the path of a vessel or within 100 m of a vessel underway, the operator shall reduce speed and shift engines to neutral. The operator shall re-engage engines only after the whale has moved out of the path of the vessel and is more than 100 m away. If the whale is still within 500 m of the vessel, the vessel must select a course away from the whale's course at a speed of 10 kn or less. This procedure must also be followed if a whale is spotted while a vessel is stationary. Whenever possible, a vessel should remain parallel to the whale's course while maintaining the 500-m distance as it travels, avoiding abrupt changes in direction until the whale is no longer in the area.

(v) All vessels must maintain a minimum separation distance of 100 m from other whales. The following avoidance measures must be taken if a whale other than a right whale is within 100 m of any vessel:

(A) The vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If a vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(vi) All vessels must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for those animals that approach the vessel. If an animal is encountered during transit, a vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(k) All vessels associated with survey activity (*e.g.,* source vessels, chase vessels, supply vessels) must have a functioning Automatic Identification System (AIS) onboard and operating at all times, regardless of whether AIS would otherwise be required. Vessel names and call signs must be provided to NMFS, and applicants must notify NMFS when survey vessels are operating.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.,* Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.,* 7 x 50) of appropriate quality (*i.e.,* Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.,* Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must successfully complete relevant training, including completion of all required coursework and passing (80 percent or greater) a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection—PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) Vessel names (source vessel and other vessels associated with survey) and call signs

(ii) PSO names and affiliations

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

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

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

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

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

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

(ix) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.,* pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

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

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

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

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

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

(H) Pace of the animal

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

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

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

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

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

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

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

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

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

(xi) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.,* clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) CGG shall submit monthly interim reports detailing the amount and location of line-kms surveyed, all marine mammal observations with closest approach distance, and corrected numbers of marine mammals ''taken,'' using correction factors given in Table 19.

(b) CGG shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities). Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the information submitted in interim monthly reports as well as additional data collected as required under condition 5(d) of this IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments on the draft report.

(c) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, CGG shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

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

(B) Name and type of vessel involved;

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

(D) Description of the incident;

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

(F) Water depth;

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

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

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

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

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

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with CGG to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. CGG may not resume their activities until notified by NMFS.

(ii) In the event that CGG discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), CGG shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(c)(1) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with CGG to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that CGG discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), CGG shall report the incident to NMFS within 24 hours of the discovery. CGG shall provide photographs or video footage or other documentation of the stranded animal sighting to NMFS.

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

Request for Public Comments

We request comment on our analyses, the draft authorizations, and any other aspect of this Notice of Proposed IHAs for the proposed geophysical survey activities. Please include with your comments any supporting data or literature citations to help inform our final decision on the individual requests for MMPA authorization.

Donna S. Wieting,

Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2017–11542 Filed 6–5–17; 8:45 am]

BILLING CODE 3510–22–P