

**DEPARTMENT OF COMMERCE****National Oceanic and Atmospheric Administration**

RIN 0648–XD782

**Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Marine Seismic Survey in the Beaufort Sea, Alaska**

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

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

**SUMMARY:** NMFS has received an application from SAEExploration, Inc. (SAE) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to a marine 3-dimensional (3D) ocean bottom node (OBN) seismic surveys program in the state and federal waters of the Beaufort Sea, Alaska, during the open-water season of 2015. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to SAE to incidentally take, by Level A and Level B Harassments, marine mammals during the specified activity.

**DATES:** Comments and information must be received no later than May 14, 2015.

**ADDRESSES:** Comments on the application should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is [itp.guan@noaa.gov](mailto:itp.guan@noaa.gov). Comments sent via email, including all attachments, must not exceed a 25-megabyte file size. NMFS is not responsible for comments sent to addresses other than those provided here.

Instructions: All comments received are a part of the public record and will generally be posted to <http://www.nmfs.noaa.gov/pr/permits/incidental.htm> without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

An electronic copy of the application may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER**

**INFORMATION CONTACT**), or visiting the internet at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm>. The following associated documents are also available at the same internet address: Plan of Cooperation. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

NMFS is also preparing draft Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) and will consider comments submitted in response to this notice as part of that process. The draft EA will be posted at the foregoing internet site.

**FOR FURTHER INFORMATION CONTACT:** Shane Guan, Office of Protected Resources, NMFS, (301) 427–8401.

**SUPPLEMENTARY INFORMATION:****Background**

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce 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 Request**

On December 2, 2014, NMFS received an application from SAE for the taking of marine mammals incidental to a 3D ocean bottom node (OBN) seismic survey program in the Beaufort Sea. After receiving NMFS comments, SAE made revisions and updated its IHA application on December 5, 2014, January 21, 2015, January 29, 2015, and again on February 16, 2015. In addition, NMFS received the marine mammal mitigation and monitoring plan (4MP) from SAE on December 2, 2014, with an updated version on January 29, 2015. NMFS determined that the application and the 4MP were adequate and complete on February 17, 2015.

SAE proposes to conduct 3D OBN seismic surveys in the state and federal waters of the U.S. Beaufort Sea during the 2015 Arctic open-water season. The proposed activity would occur between July 1 and October 15, 2015. The actual seismic survey is expected to take approximately 70 days, dependent of weather. The following specific aspects of the proposed activities are likely to result in the take of marine mammals: seismic airgun operations and associated navigation sonar and vessel movements. Takes, by Level A and/or Level B Harassments, of individuals of six species of marine mammals are anticipated to result from the specified activity.

SAE also conducted OBN seismic surveys in the Beaufort Sea in the 2014 Arctic open-water season (79 FR 51963; September 2, 2014).

**Description of the Specified Activity****Overview**

On December 2, 2014, NMFS received an application from SAE requesting an authorization for the harassment of small numbers of marine mammals incidental to conducting an open-water 3D OBN seismic survey in the Beaufort Sea off Alaska. After addressing comments from NMFS and the peer-review panel, SAE modified its application and submitted revised applications on December 5, 2014, January 21, 2015, January 29, 2015, and again on February 16, 2015, with 4MP on December 2, 2014 and an updated version on January 29, 2015. SAE’s proposed activities discussed here are based on its February 17, 2015, IHA application, and January 29, 2015, 4MP.

**Dates and Duration**

The proposed 3D OBN seismic survey is planned for the 2015 open-water

season (July 1 to October 15). The actual data acquisition is expected to take approximately 70 days, dependent of weather. Based on past similar seismic shoots in the Beaufort Sea, SAE expects that effective shooting would occur over about 70% of the 70 days (or about 49 days).

#### *Specified Geographic Region*

SAE's planned 3D seismic survey would occur in the nearshore waters of the Beaufort Sea between Harrison Bay and the Sagavanirktok River delta. SAE plans to survey a maximum of 777 km<sup>2</sup> (300 mi<sup>2</sup>) in 2015, although the exact location is currently unknown other than it would occur somewhere within the 4,562-km<sup>2</sup> (1,761-mi<sup>2</sup>) box shown in Figure 1–1 of SAE's IHA application.

#### *Detailed Description of Activities*

### **I. Survey Design**

The proposed marine seismic operations will be based on a "recording patch" or similar approach. Patches are groups of six receiver lines and 32 source lines (Figure 1–2 of SAE's IHA application). Each receiver line has submersible marine sensor nodes tethered equidistant (50 m; 165 ft) from each other along the length of the line. Each node is a multicomponent system containing three velocity sensors and a hydrophone. Each receiver line is approximately 8 km (5 mi) in length, and are spaced approximately 402 m (1,320 ft) apart. Each receiver patch is 19.4 km<sup>2</sup> (7.5 mi<sup>2</sup>) in area. The receiver patch is oriented such that the receiver lines run parallel to the shoreline.

Source lines, 12 km (7.5 mi) long and spaced 502 m (1,650 ft) apart, run perpendicular to the receiver lines (and perpendicular to the coast) and, where possible, will extend approximately 5 km (3 mi) beyond the outside receiver lines and approximately 4 km (2.5 mi) beyond each of the ends of the receiver lines. The outside dimensions of the maximum shot area during a patch shoot will be 12 km by 16 m (7.5 mi by 10 mi) or 192 km<sup>2</sup> (75 mi<sup>2</sup>). It is expected to take three to five days to shoot a patch, or 49 km<sup>2</sup> (18.75 mi<sup>2</sup>) per day. Shot intervals along each source line will be 50 m (165 ft). All shot areas will be wholly contained within the 4,562-km<sup>2</sup> survey box (see Figure 1–1 in SAE's IHA application), and, because of the tremendous overlap in shot area between adjacent patches, no more than 777 km<sup>2</sup> (300 mi<sup>2</sup>) of actual area will be shot in 2015.

During recording of one patch, nodes from the previously surveyed patch will be retrieved, recharged, and data downloaded prior to redeployment of

the nodes to the next patch. As patches are recorded, receiver lines are moved side to side or end to end to the next patch location so that receiver lines have continuous coverage of the recording area.

Autonomous recording nodes lack cables but will be tethered together using a thin rope for ease of retrieval. This rope will lay on the seabed surface, as will the nodes, and will have no effect on marine traffic. Primary vessel positioning will be achieved using GPS with the antenna attached to the airgun array. Pingers deployed from the node vessels will be used for positioning of nodes. The geometry/patch could be modified as operations progress to improve sampling and operational efficiency.

### **II. Acoustical Sources**

The acoustic sources of primary concern are the airguns that will be deployed from the seismic source vessels. However, there are other noise sources to be addressed including the pingers and transponders associated with locating receiver nodes, as well as propeller noise from the vessel fleet.

#### *Seismic Source Array*

The primary seismic source for offshore recording consists of a 620-cubic-inch (in<sup>3</sup>), 8-cluster array, although a 2 x 620-in<sup>3</sup> array, totaling 1,240 in<sup>3</sup>, may be used in deeper waters (>15 m). For conservative purposes, exposure estimates are based on the sound pressure levels associated with the larger array. The arrays will be centered approximately 15 m (50 ft) behind the source vessel stern, at a depth of 4 m (12 ft), and towed along predetermined source lines at speeds between 7.4 and 9.3 km/hr (4 and 5 knots). Two vessels with full arrays will be operating simultaneously in an alternating shot mode; one vessel shooting while the other is recharging. Shot intervals are expected to be about 16 s for each array resulting in an overall shot interval of 8 s considering the two alternating arrays. Operations are expected to occur 24 hrs a day, with actual daily shooting to total about 12 hrs.

Based on manufacturer specifications, the 1,240-in<sup>3</sup> array has a zero-peak estimated sound source of 249 dB re 1 μPa @1 m (13.8 bar-m), with a root mean square (rms) sound source of 224 dB re 1 μPa, while for the 620-in<sup>3</sup> array the zero-peak is 237 dB re 1 μPa (rms) (6.96 bar-m) with an rms source level of 218 dB re 1 μPa.

#### *Mitigation Airgun*

A 10-in<sup>3</sup> mitigation airgun will be used during poor visibility conditions, and is intended to (a) alert marine mammals to the presence of airgun activity, and (b) retain the option of initiating a ramp-up to full operations under poor visibility conditions. The mitigation gun will be operated at approximately one shot per minute during these periods. The manufacturer specifications indicate a 214 dB re 1 μPa zero-peak (0.5 bar-m) sound source equating to a 195 dB re 1 μPa rms source.

#### *Pingers and Transponders*

An acoustical positioning (or pinger) system will be used to position and interpolate the location of the nodes. A vessel-mounted transceiver calculates the position of the nodes by measuring the range and bearing from the transceiver to a small acoustic transponder fitted to every third node. The transceiver uses sonar to interrogate the transponders, which respond with short pulses that are used in measuring the range and bearing. The system provides a precise location of every node as needed for accurate interpretation of the seismic data. The transceiver to be used is the Sonardyne Scout USBL, while transponders will be the Sonardyne TZ/OBC Type 7815–000–06. Because the transceiver and transponder communicate via sonar, they produce underwater sound levels. The Scout USBL transceiver has a transmission source level of 197 dB re 1 μPa @ 1 m and operates at frequencies between 35 and 55 kHz. The transponder produces short pulses of 184 to 187 dB re 1 μPa @ 1 m at frequencies also between 35 and 55 kHz.

Both transceivers and transponders produce noise levels just above or within the most sensitive hearing range of seals (10 to 30 kHz; Schusterman 1981) and odontocetes (12 to ~100 kHz; Wartzok and Ketten 1999), and the functional hearing range of baleen whales (20 Hz to 30 kHz; NRC 2003); although baleen whale hearing is probably most sensitive nearer 1 kHz (Richardson *et al.* 1995). However, given the low acoustical output, the range of acoustical harassment to marine mammals (for the 197 dB transceiver) is about 100 m (328 ft), or significantly less than the output from the airgun arrays, and is not loud enough to reach injury levels in marine mammals beyond 9 m (30 ft). Marine mammals are likely to respond to pinger systems similar to airgun pulses, but only when very close (a few meters) to the sources.

**Vessels**

Several offshore vessels will be required to support recording, shooting,

and housing in the marine and transition zone environments. The exact vessels that will be used have not yet

been determined. However, the types of vessels that will be used to fulfill these roles are found in Table 1.

TABLE 1—VESSELS TO BE USED DURING SAE'S 3D OBN SEISMIC SURVEYS

Vessel	Size (ft)	Activity and frequency	Source level (dB)
Source vessel 1 .....	120 x 25	Seismic data acquisition; 24 hr operation .....	179
Source vessel 2 .....	80 x 25	Seismic data acquisition; 24 hr operation .....	166
Node equipment vessel 1 .....	80 x 20	Deploying and retrieving nodes; 24 hr operation .....	165
Node equipment vessel 2 .....	80 x 20	Deploying and retrieving nodes; 24 hr operation .....	165
Mitigation/Housing vessel .....	90 x 20	House crew; 24 hr operation .....	200
Crew transport vessel .....	30 x 20	Transport crew; intermittent 8 hrs .....	192
Bow picker 1 .....	30 x 20	Deploying and retrieving nodes; intermittent operation .....	172
Bow picker 2 .....	30 x 20	Deploying and retrieving nodes; intermittent operation .....	172

Source Vessels—Source vessels will have the ability to deploy two arrays off the stern using large A-frames and winches and have a draft shallow enough to operate in waters less than 1.5 m (5 ft) deep. On the source vessels the airgun arrays are typically mounted on the stern deck with an umbilical that allow the arrays to be deployed and towed from the stern without having to re-rig or move arrays. A large bow deck will allow for sufficient space for source compressors and additional airgun equipment to be stored. The marine vessels likely to be used will be the same or similar to those that were acoustically measured by Aerts *et al.* (2008). The source vessels were found to have sound source levels of 179.0 dB re 1  $\mu$ Pa (rms) and 165.7 dB re 1  $\mu$ Pa (rms).

Recording Deployment and Retrieval Vessels—Jet driven shallow draft vessels and bow pickers will be used for the deployment and retrieval of the offshore

recording equipment. These vessels will be rigged with hydraulically driven deployment and retrieval squitters allowing for automated deployment and retrieval from the bow or stern of the vessel. These vessels will also carry the recording equipment on the deck in fish totes. Aerts *et al.* (2008) found the recording and deployment vessels to have a source level of approximately 165.3 dB re 1  $\mu$ Pa (rms), while the smaller bow pickers produce more cavitation resulting in source levels of 171.8 dB re 1  $\mu$ Pa (rms).

Housing and Transfer Vessels—Housing vessel(s) will be larger with sufficient berthing to house crews and management. The housing vessel will have ample office and bridge space to facilitate the role as the mother ship and central operations. Crew transfer vessels will be sufficiently large to safely transfer crew between vessels as needed. Aerts *et al.* (2008) found the

housing vessel to produce the loudest propeller noise of all the vessels in the fleet (200.1 dB re 1  $\mu$ Pa [rms]), but this vessel is mostly anchored up once it gets on site. The crew transfer vessel also travels only infrequently relative to other vessels, and is usually operated at different speeds. During higher speed runs to shore the vessel produces source noise levels of about 191.8 dB re 1  $\mu$ Pa (rms), while during slower on-site movements the vessel source levels are only 166.4 dB re 1  $\mu$ Pa (rms) (Aerts *et al.* 2008).

#### Description of Marine Mammals in the Area of the Specified Activity

The Beaufort Sea supports a diverse assemblage of marine mammals. Table 2 lists the 12 marine mammal species under NMFS jurisdiction with confirmed or possible occurrence in the proposed project area.

TABLE 2—MARINE MAMMAL SPECIES WITH CONFIRMED OR POSSIBLE OCCURRENCE IN THE PROPOSED SEISMIC SURVEY AREA

Common name	Scientific name	Status	Occurrence	Seasonality	Range	Abundance
<b>Odontocetes:</b>						
Beluga whale (Beaufort Sea stock).	<i>Delphinapterus leucas</i> .	.....	Common .....	Mostly spring and fall with some in summer.	Mostly Beaufort Sea.	39,258
Beluga whale (eastern Chukchi Sea stock).	.....	.....	Common .....	Mostly spring and fall with some in summer.	Mostly Chukchi Sea.	3,710
Killer whale .....	<i>Orcinus orca</i> .....	.....	Occasional/ Extralimital.	Mostly summer and early fall.	California to Alaska.	552
Harbor porpoise .....	<i>Phocoena phocoena</i> .	.....	Occasional/ Extralimital.	Mostly summer and early fall.	California to Alaska.	48,215
Narwhal .....	<i>Monodon monoceros</i> .	.....	.....	.....	.....	45,358
<b>Mysticetes:</b>						
Bowhead whale * .....	<i>Balaena mysticetus</i> .	Endangered; Depleted.	Common .....	Mostly spring and fall with some in summer.	Russia to Canada	19,534
Gray whale .....	<i>Eschrichtius robustus</i> .	.....	Somewhat common.	Mostly summer ...	Mexico to the U.S. Arctic Ocean.	19,126
Minke whale .....	<i>Balaenoptera acutorostrata</i> .	.....	.....	.....	.....	810–1,003

TABLE 2—MARINE MAMMAL SPECIES WITH CONFIRMED OR POSSIBLE OCCURRENCE IN THE PROPOSED SEISMIC SURVEY AREA—Continued

Common name	Scientific name	Status	Occurrence	Seasonality	Range	Abundance
Humpback whale (Central North Pacific stock) *.	<i>Megaptera novaeangliae</i> .	Endangered; Depleted.	.....	.....	.....	21,063
Pinnipeds:						
Bearded seal (Beringia distinct population segment).	<i>Erignathus barbatus</i>	Candidate .....	Common .....	Spring and summer.	Bering, Chukchi, and Beaufort Seas.	155,000
Ringed seal (Arctic stock) *.	<i>Phoca hispida</i> .....	Threatened; Depleted.	Common .....	Year round .....	Bering, Chukchi, and Beaufort Seas.	300,000
Spotted seal .....	<i>Phoca largha</i> .....	.....	Common .....	Summer .....	Japan to U.S. Arctic Ocean.	141,479
Ribbon seal .....	<i>Histiophoca fasciata</i> .	Species of concern.	Occasional ...	Summer .....	Russia to U.S. Arctic Ocean.	49,000

\* Endangered, threatened, or species of concern under the Endangered Species Act (ESA); Depleted under the MMPA.

The highlighted (grayed out) species in Table 2 are so rarely sighted in the proposed project area that take is unlikely. Minke whales are relatively common in the Bering and southern Chukchi Seas and have recently also been sighted in the northeastern Chukchi Sea (Aerts *et al.*, 2013; Clarke *et al.*, 2013). Minke whales are rare in the Beaufort Sea. They have not been reported in the Beaufort Sea during the Bowhead Whale Aerial Survey Project/ Aerial Surveys of Arctic Marine Mammals (BWASP/ASAMM) surveys (Clarke *et al.*, 2011, 2012; 2013; Monnet and Treacy, 2005), and there was only one observation in 2007 during vessel-based surveys in the region (Funk *et al.*, 2010). Humpback whales have not generally been found in the Arctic Ocean. However, subsistence hunters have spotted humpback whales in low numbers around Barrow, and there have been several confirmed sightings of humpback whales in the northeastern Chukchi Sea in recent years (Aerts *et al.*, 2013; Clarke *et al.*, 2013). The first confirmed sighting of a humpback whale in the Beaufort Sea was recorded in August 2007 (Hashagen *et al.*, 2009), when a cow and calf were observed 54 mi east of Point Barrow. No additional sightings have been documented in the Beaufort Sea. Narwhal are common in the waters of northern Canada, west Greenland, and in the European Arctic, but rarely occur in the Beaufort Sea (COSEWIC, 2004). Only a handful of sightings have occurred in Alaskan waters (Allen and Angliss, 2013). These three species are not considered further in this proposed IHA notice. Both the walrus and the polar bear could occur in the U.S. Beaufort Sea; however, these species are managed by the U.S. Fish and Wildlife Service (USFWS) and are

not considered further in this Notice of Proposed IHA.

The Beaufort Sea is a main corridor of the bowhead whale migration route. The main migration periods occur in spring from April to June and in fall from late August/early September through October to early November. During the fall migration, several locations in the U.S. Beaufort Sea serve as feeding grounds for bowhead whales. Small numbers of bowhead whales that remain in the U.S. Arctic Ocean during summer also feed in these areas. The U.S. Beaufort Sea is not a main feeding or calving area for any other cetacean species. Ringed seals breed and pup in the Beaufort Sea; however, this does not occur during the summer or early fall. Further information on the biology and local distribution of these species can be found in SAE's application (see ADDRESSES) and the NMFS Marine Mammal Stock Assessment Reports, which are available online at: <http://www.nmfs.noaa.gov/pr/species/>.

#### Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that the types of stressors associated with the specified activity (*e.g.*, seismic airgun and pinger operation, vessel movement) have been observed to or are thought to impact marine mammals. This section may include a discussion of known effects that do not rise to the level of an MMPA take (for example, with acoustics, we may include a discussion of studies that showed animals not reacting at all to sound or exhibiting barely measurable avoidance). The discussion may also include reactions that we consider to rise to the level of a take and those that we do not consider to rise to the level of a take. This section is intended as a background of potential effects and does

not consider either the specific manner in which this activity will be carried out or the mitigation that will be implemented or how either of those will shape the anticipated impacts from this specific activity. 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 Analysis" section will include the analysis of how this specific activity will impact marine mammals and will consider the content of this section, the "Estimated Take by Incidental Harassment" section, the "Mitigation" section, and the "Anticipated Effects on Marine Mammal Habitat" section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

#### Background on Sound

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

For air and water, these reference pressures are “re: 20  $\mu$ Pa” and “re: 1  $\mu$ Pa,” respectively. Root mean square (RMS) is the quadratic mean sound pressure over the duration of an impulse. RMS is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urlick, 1975). RMS accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels. This measurement is often used in the context of discussing behavioral effects, in part, because behavioral effects, which often result from auditory cues, may be better expressed through averaged units rather than by peak pressures.

#### Acoustic Impacts

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms have been derived using auditory evoked potentials, anatomical modeling, and other data, Southall *et al.* (2007) designate “functional hearing groups” for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency cetaceans (13 species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 30 kHz;
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High frequency cetaceans (eight species of true porpoises, six species of river dolphins, Kogia, the franciscana, and four species of cephalorhynchids): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz;
- Phocid pinnipeds in Water: Functional hearing is estimated to occur between approximately 75 Hz and 100 kHz; and
- Otariid pinnipeds in Water: Functional hearing is estimated to occur

between approximately 100 Hz and 40 kHz.

As mentioned previously in this document, nine marine mammal species (five cetaceans and four phocid pinnipeds) may occur in the proposed seismic survey area. Of the five cetacean species likely to occur in the proposed project area and for which take is requested, two are classified as low-frequency cetaceans (*i.e.*, bowhead and gray whales), two are classified as mid-frequency cetaceans (*i.e.*, beluga and killer whales), and one is classified as a high-frequency cetacean (*i.e.*, harbor porpoise) (Southall *et al.*, 2007). A species functional hearing group is a consideration when we analyze the effects of exposure to sound on marine mammals.

#### 1. Tolerance

Numerous studies have shown that underwater sounds from industry activities are often readily detectable by marine mammals in the water at distances of many kilometers. Numerous studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response to industry activities of various types (Miller *et al.*, 2005; Bain and Williams, 2006). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound such as airgun pulses or vessels under some conditions, at other times mammals of all three types have shown no overt reactions (*e.g.*, Malme *et al.*, 1986; Richardson *et al.*, 1995). Weir (2008) observed marine mammal responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in<sup>3</sup> or 3,147 in<sup>3</sup> in Angolan waters between August 2004 and May 2005. Weir recorded a total of 207 sightings of humpback whales ( $n = 66$ ), sperm whales ( $n = 124$ ), and Atlantic spotted dolphins ( $n = 17$ ) and reported that there were no significant differences in encounter rates (sightings/hr) for humpback and sperm whales according to the airgun array's operational status (*i.e.*, active versus silent). The airgun arrays used in the Weir (2008) study were much larger than the array proposed for use during this seismic survey (total discharge volumes of 620 to 1,240 in<sup>3</sup>). In general, pinnipeds and small odontocetes seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al.* (1995) found

that vessel noise does not seem to strongly affect pinnipeds that are already in the water. Richardson *et al.* (1995) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels.

#### 2. Masking

Masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, avoiding predators, and learning about their environment (Erbe and Farmer, 2000). Masking, or auditory interference, generally occurs when sounds in the environment are louder than, and of a similar frequency as, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

Masking occurs when anthropogenic sounds and signals (that the animal utilizes) overlap at both spectral and temporal scales. For the airgun sound generated from the proposed seismic survey, sound will consist of low frequency (under 500 Hz) pulses with extremely short durations (less than one second). Lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey noise. There is little concern regarding masking near the sound source due to the brief duration of these pulses and relatively longer silence between airgun shots (approximately 5–6 seconds). However, at long distances (over tens of kilometers away), due to multipath propagation and reverberation, the durations of airgun pulses can be “stretched” to seconds with long decays (Madsen *et al.*, 2006), although the intensity of the sound is greatly reduced.

This could affect communication signals used by low frequency mysticetes when they occur near the noise band and thus reduce the communication space of animals (*e.g.*, Clark *et al.*, 2009) and cause increased stress levels (*e.g.*, Foote *et al.*, 2004; Holt *et al.*, 2009). Marine mammals are

thought to be able to compensate for masking by adjusting their acoustic behavior by shifting call frequencies, and/or increasing call volume and vocalization rates. For example, blue whales are found to increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio and Clark, 2010). The North Atlantic right whales exposed to high shipping noise increase call frequency (Parks *et al.*, 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller *et al.*, 2000). Bowhead whale calls are frequently detected in the presence of seismic pulses, although the number of calls detected may sometimes be reduced (Richardson *et al.*, 1986), possibly because animals moved away from the sound source or ceased calling (Blackwell *et al.*, 2013). Additionally, beluga whales have been known to change their vocalizations in the presence of high background noise possibly to avoid masking calls (Lesage *et al.*, 1999; Scheifele *et al.*, 2005). Although some degree of masking is inevitable when high levels of manmade broadband sounds are introduced into the sea, marine mammals have evolved systems and behavior that function to reduce the impacts of masking. Structured signals, such as the echolocation click sequences of small toothed whales, may be readily detected even in the presence of strong background noise because their frequency content and temporal features usually differ strongly from those of the background noise (Au and Moore, 1990). The components of background noise that are similar in frequency to the sound signal in question primarily determine the degree of masking of that signal.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as the usual types of masking studies might suggest (Richardson *et al.*, 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio. In the cases of

higher frequency hearing by the bottlenose dolphin, beluga whale, and killer whale, empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the masking noise (Dubrovskiy, 1990; Bain and Dahlheim, 1994). Toothed whales, and probably other marine mammals as well, have additional capabilities besides directional hearing that can facilitate detection of sounds in the presence of background noise. There is evidence that some toothed whales can shift the dominant frequencies of their echolocation signals from a frequency range with a lot of ambient noise toward frequencies with less noise (Moore and Pawloski, 1990; Thomas and Turl, 1990; Romanenko and Kitain, 1992; Lesage *et al.*, 1999). A few marine mammal species are known to increase the source levels or alter the frequency of their calls in the presence of elevated sound levels (Dahlheim, 1987; Lesage *et al.*, 1999; Foote *et al.*, 2004; Parks *et al.*, 2007, 2009; Di Iorio and Clark, 2009; Holt *et al.*, 2009).

These data demonstrating adaptations for reduced masking pertain mainly to the very high frequency echolocation signals of toothed whales. There is less information about the existence of corresponding mechanisms at moderate or low frequencies or in other types of marine mammals. For example, Zaitseva *et al.* (1980) found that, for the bottlenose dolphin, the angular separation between a sound source and a masking noise source had little effect on the degree of masking when the sound frequency was 18 kHz, in contrast to the pronounced effect at higher frequencies. Directional hearing has been demonstrated at frequencies as low as 0.5–2 kHz in several marine mammals, including killer whales (Richardson *et al.*, 1995). This ability may be useful in reducing masking at these frequencies. In summary, high levels of sound generated by anthropogenic activities may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking may be more prominent for lower frequencies. For higher frequencies, such as that used in echolocation by toothed whales, several mechanisms are available that may allow them to reduce the effects of such masking.

### 3. Behavioral Disturbance

Marine mammals may behaviorally react when exposed to anthropogenic sound. These behavioral reactions are often shown as: Changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/

or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (*e.g.*, pinnipeds flushing into water from haulouts or rookeries).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification have the potential to be biologically significant if the change affects growth, survival, or reproduction. Examples of significant behavioral modifications include:

- Drastic change in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography, current activity, reproductive state) and is also difficult to predict (Gordon *et al.*, 2004; Southall *et al.*, 2007; Ellison *et al.*, 2011).

*Mysticetes*: Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much greater distances (Miller *et al.*, 2005). However, baleen whales exposed to strong noise pulses often react by deviating from their normal migration route (Richardson *et al.*, 1999). Migrating gray and bowhead whales were observed avoiding the sound source by displacing their migration route to varying degrees but within the natural boundaries of the migration corridors (Schick and Urban, 2000; Richardson *et al.*, 1999). Baleen whale responses to pulsed sound, however, may depend on the type of activity in which the whales are engaged. Some evidence suggests that feeding bowhead whales may be more tolerant of underwater sound than migrating bowheads (Miller *et al.*, 2005; Lyons *et al.*, 2009; Christie *et al.*, 2010).

Results of studies of gray, bowhead, and humpback whales have determined

that received levels of pulses in the 160–170 dB re 1  $\mu$ Pa rms range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed. In many areas, seismic pulses from large arrays of airguns diminish to those levels at distances ranging from 2.8–9 mi (4.5–14.5 km) from the source. For the much smaller airgun array used during SAE's proposed survey (total discharge volume of 640 in<sup>3</sup>), distances to received levels in the 160 dB re 1  $\mu$ Pa rms range are estimated to be 0.5–3 mi (0.8–5 km). Baleen whales within those distances may show avoidance or other strong disturbance reactions to the airgun array. Subtle behavioral changes sometimes become evident at somewhat lower received levels, and recent studies have shown that some species of baleen whales, notably bowhead and humpback whales, at times show strong avoidance at received levels lower than 160–170 dB re 1  $\mu$ Pa rms. Bowhead whales migrating west across the Alaskan Beaufort Sea in autumn, in particular, are unusually responsive, with avoidance occurring out to distances of 12.4–18.6 mi (20–30 km) from a medium-sized airgun source (Miller *et al.*, 1999; Richardson *et al.*, 1999). However, more recent research on bowhead whales (Miller *et al.*, 2005) corroborates earlier evidence that, during the summer feeding season, bowheads are not as sensitive to seismic sources. In summer, bowheads typically begin to show avoidance reactions at a received level of about 160–170 dB re 1  $\mu$ Pa rms (Richardson *et al.*, 1986; Ljungblad *et al.*, 1988; Miller *et al.*, 2005).

Malme *et al.* (1986) studied the responses of feeding eastern gray whales to pulses from a single 100 in<sup>3</sup> airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50% of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1  $\mu$ Pa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB. Those findings were generally consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast and on observations of the distribution of feeding Western Pacific gray whales off Sakhalin Island, Russia, during a seismic survey (Yazvenko *et al.*, 2007). Data on short-term reactions (or lack of reactions) of cetaceans to impulsive noises do not necessarily provide information about long-term effects. While it is not certain whether impulsive noises affect reproductive

rate or distribution and habitat use in subsequent days or years, certain species have continued to use areas ensounded by airguns and have continued to increase in number despite successive years of anthropogenic activity in the area. Gray whales continued to migrate annually along the west coast of North America despite intermittent seismic exploration and much ship traffic in that area for decades (Appendix A in Malme *et al.*, 1984). Bowhead whales continued to travel to the eastern Beaufort Sea each summer despite seismic exploration in their summer and autumn range for many years (Richardson *et al.*, 1987). Populations of both gray whales and bowhead whales grew substantially during this time. In any event, the proposed survey will occur in summer (July through late August) when most bowhead whales are commonly feeding in the Mackenzie River Delta, Canada.

During their study, Patenaude *et al.* (2002) observed one bowhead whale cow-calf pair during four passes totaling 2.8 hours of the helicopter and two pairs during Twin Otter overflights. All of the helicopter passes were at altitudes of 49–98 ft (15–30 m). The mother dove both times she was at the surface, and the calf dove once out of the four times it was at the surface. For the cow-calf pair sightings during Twin Otter overflights, the authors did not note any behaviors specific to those pairs. Rather, the reactions of the cow-calf pairs were lumped with the reactions of other groups that did not consist of calves.

Richardson *et al.* (1995) and Moore and Clarke (2002) reviewed a few studies that observed responses of gray whales to aircraft. Cow-calf pairs were quite sensitive to a turboprop survey flown at 1,000 ft (305 m) altitude on the Alaskan summering grounds. In that survey, adults were seen swimming over the calf, or the calf swam under the adult (Ljungblad *et al.*, 1983, cited in Richardson *et al.*, 1995 and Moore and Clarke, 2002). However, when the same aircraft circled for more than 10 minutes at 1,050 ft (320 m) altitude over a group of mating gray whales, no reactions were observed (Ljungblad *et al.*, 1987, cited in Moore and Clarke, 2002). Malme *et al.* (1984, cited in Richardson *et al.*, 1995 and Moore and Clarke, 2002) conducted playback experiments on migrating gray whales. They exposed the animals to underwater noise recorded from a Bell 212 helicopter (estimated altitude=328 ft [100 m]), at an average of three simulated passes per minute. The authors observed that whales changed their swimming course and sometimes slowed down in response to the playback sound but

proceeded to migrate past the transducer. Migrating gray whales did not react overtly to a Bell 212 helicopter at greater than 1,394 ft (425 m) altitude, occasionally reacted when the helicopter was at 1,000–1,198 ft (305–365 m), and usually reacted when it was below 825 ft (250 m; Southwest Research Associates, 1988, cited in Richardson *et al.*, 1995 and Moore and Clarke, 2002). Reactions noted in that study included abrupt turns or dives or both. Greene *et al.* (1992, cited in Richardson *et al.*, 1995) observed that migrating gray whales rarely exhibited noticeable reactions to a straight-line overflight by a Twin Otter at 197 ft (60 m) altitude.

*Odontocetes:* Few systematic data are available describing reactions of toothed whales to noise pulses. However, systematic work on sperm whales is underway, and there is an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone, 2003). Miller *et al.* (2009) conducted at-sea experiments where reactions of sperm whales were monitored through the use of controlled sound exposure experiments from large airgun arrays consisting of 20-guns and 31-guns. Of 8 sperm whales observed, none changed their behavior when exposed to either a ramp-up at 4–8 mi (7–13 km) or full array exposures at 0.6–8 mi (1–13 km).

Seismic operators and marine mammal observers sometimes see dolphins and other small toothed whales near operating airgun arrays, but, in general, there seems to be a tendency for most delphinids to show some limited avoidance of seismic vessels operating large airgun systems. However, some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing. Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (e.g., 1998; Stone, 2003). The beluga may be a species that (at least in certain geographic areas) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km (6.2–12.4 mi) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might have been avoiding the seismic operations at



distances of 10–20 km (6.2–12.4 mi) (Miller *et al.*, 2005).

Captive bottlenose dolphins and (of more relevance in this project) beluga whales exhibit changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.*, 2002, 2005). However, the animals tolerated high received levels of sound (pk–pk level >200 dB re 1  $\mu$ Pa) before exhibiting aversive behaviors.

Observers stationed on seismic vessels operating off the United Kingdom from 1997–2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone, 2003; Gordon *et al.*, 2004). Killer whales were found to be significantly farther from large airgun arrays during periods of shooting compared with periods of no shooting. The displacement of the median distance from the array was approximately 0.5 km (0.3 mi) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water.

Reactions of toothed whales to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for mysticetes. However, based on the limited existing evidence, belugas should not be grouped with delphinids in the “less responsive” category.

Patenaude *et al.* (2002) reported that beluga whales appeared to be more responsive to aircraft overflights than bowhead whales. Changes were observed in diving and respiration behavior, and some whales veered away when a helicopter passed at  $\leq 820$  ft (250 m) lateral distance at altitudes up to 492 ft (150 m). However, some belugas showed no reaction to the helicopter. Belugas appeared to show less response to fixed-wing aircraft than to helicopter overflights.

**Pinnipeds:** Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of Arctic ice seals exposed to seismic pulses (Harris *et al.*, 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in<sup>3</sup>. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings

tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson, 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to a few hundreds of meters, and many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Richardson *et al.*, 1995). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.*, 1998). Even if reactions of the species occurring in the present study area are as strong as those evident in the telemetry study, reactions are expected to be confined to relatively small distances and durations, with no long-term effects on pinniped individuals or populations.

Blackwell *et al.* (2004) observed 12 ringed seals during low-altitude overflights of a Bell 212 helicopter at Northstar in June and July 2000 (9 observations took place concurrent with pipe-driving activities). One seal showed no reaction to the aircraft while the remaining 11 (92%) reacted, either by looking at the helicopter ( $n=10$ ) or by departing from their basking site ( $n=1$ ). Blackwell *et al.* (2004) concluded that none of the reactions to helicopters were strong or long lasting, and that seals near Northstar in June and July 2000 probably had habituated to industrial sounds and visible activities that had occurred often during the preceding winter and spring. There have been few systematic studies of pinniped reactions to aircraft overflights, and most of the available data concern pinnipeds hauled out on land or ice rather than pinnipeds in the water (Richardson *et al.*, 1995; Born *et al.*, 1999).

#### 4. Threshold Shift (Noise-Induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity (*i.e.*, sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.*, there is complete recovery), can

occur in specific frequency ranges (*i.e.*, an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.*, 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals. Although in the case of the proposed seismic survey, animals are not expected to be exposed to sound levels high for a long enough period to result in PTS.

PTS is considered auditory injury (Southall *et al.*, 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.*, 2007).

Although the published body of scientific literature contains numerous



theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.*, 2000, 2002, 2003, 2005, 2007; Finneran and Schlundt, 2010; Lucke *et al.*, 2009; Mooney *et al.*, 2009; Popov *et al.*, 2011a, 2011b; Kastelein *et al.*, 2012a; Schlundt *et al.*, 2006; Nachtigall *et al.*, 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.*, 2005; Kastelein *et al.*, 2012b).

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 (similar to those discussed in auditory masking, above). 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. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.*, 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

##### 5. Non-Auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to strong underwater sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine

mammal species (*i.e.*, beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.*, 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical "fight or flight" response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with "stress." These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

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

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called "distress" (*sensu* Seyle, 1950) or "allostatic loading" (*sensu* McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.*, 1996; Hood *et al.*, 1998; Jessop *et al.*, 2003; Krausman *et al.*, 2004; Lankford *et al.*, 2005; Reneerkens *et al.*, 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals experience physiological stress responses and, perhaps, physiological responses that would be classified as "distress" upon exposure to anthropogenic sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (*e.g.*, elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute,

repetitive exposures to acoustic disturbance. Trimmer *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.*, goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, we assume that reducing a marine mammal's ability to gather information about its environment and communicate with other members of its species would induce stress, based on data that terrestrial animals exhibit those responses under similar conditions (NRC, 2003) and because marine mammals use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses. More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.*, 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses. Additionally, no beaked whale species occur in the proposed project area.

In general, very little is known about the potential for strong, anthropogenic

underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, which are not proposed for use during this program. In addition, marine mammals that show behavioral avoidance of industry activities, including bowheads, belugas, and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

#### 6. Stranding and Mortality

Marine mammals close to underwater detonations of high explosive can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten *et al.*, 1993; Ketten, 1995). Airgun pulses are less energetic and their peak amplitudes have slower rise times. To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays. Additionally, SAE's project will use small and medium sized airgun arrays in shallow water. NMFS does not expect any marine mammals will incur serious injury or mortality in the shallow waters off Beaufort Sea or strand as a result of the proposed seismic survey.

#### 7. Potential Effects From Pingers on Marine Mammals

Active acoustic sources other than the airguns have been proposed for SAE's 2015 seismic survey in Beaufort Sea, Alaska. In general, the potential effects of this equipment on marine mammals are similar to those from the airguns, except the magnitude of the impacts is expected to be much less due to the lower intensity of the source.

#### Vessel Impacts

Vessel activity and noise associated with vessel activity will temporarily increase in the action area during SAE's seismic survey as a result of the operation of about 8 vessels. To minimize the effects of vessels and noise associated with vessel activity, SAE will alter speed if a marine mammal gets too close to a vessel. In

addition, source vessels will be operating at slow speed (4–5 knots) when conducting surveys. Marine mammal monitoring observers will alert vessel captains as animals are detected to ensure safe and effective measures are applied to avoid coming into direct contact with marine mammals. Therefore, NMFS neither anticipates nor authorizes takes of marine mammals from ship strikes.

McCauley *et al.* (1996) reported several cases of humpback whales responding to vessels in Hervey Bay, Australia. Results indicated clear avoidance at received levels between 118 to 124 dB in three cases for which response and received levels were observed/measured.

Palka and Hammond (2001) analyzed line transect census data in which the orientation and distance off transect line were reported for large numbers of minke whales. The authors developed a method to account for effects of animal movement in response to sighting platforms. Minor changes in locomotion speed, direction, and/or diving profile were reported at ranges from 1,847 to 2,352 ft (563 to 717 m) at received levels of 110 to 120 dB.

Odontocetes, such as beluga whales, killer whales, and harbor porpoises, often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water, or were previously harassed by vessels (Richardson *et al.*, 1995). Beluga whale response to vessel noise varies greatly from tolerance to extreme sensitivity depending on the activity of the whale and previous experience with vessels (Richardson *et al.*, 1995). Reactions to vessels depend on whale activities and experience, habitat, boat type, and boat behavior (Richardson *et al.*, 1995) and may include behavioral responses, such as altered headings or avoidance (Blane and Jackson, 1994; Erbe and Farmer, 2000); fast swimming; changes in vocalizations (Lesage *et al.*, 1999; Scheifele *et al.*, 2005); and changes in dive, surfacing, and respiration patterns.

There are few data published on pinniped responses to vessel activity, and most of the information is anecdotal (Richardson *et al.*, 1995). Generally, sea lions in water show tolerance to close and frequently approaching vessels and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100–200 m (330–660 ft; reviewed in Richardson *et al.*, 1995).

The addition of the vessels and noise due to vessel operations associated with the seismic survey is not expected to

have effects that could cause significant or long-term consequences for individual marine mammals or their populations.

#### Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammal habitat and other marine species are associated with elevated sound levels produced by airguns and other active acoustic sources. However, other potential impacts to the surrounding habitat from physical disturbance are also possible. This section describes the potential impacts to marine mammal habitat from the specified activity. Because the marine mammals in the area feed on fish and/or invertebrates there is also information on the species typically preyed upon by the marine mammals in the area.

##### *Common Marine Mammal Prey in the Project Area*

All of the marine mammal species that may occur in the proposed project area prey on either marine fish or invertebrates. The ringed seal feeds on fish and a variety of benthic species, including crabs and shrimp. Bearded seals feed mainly on benthic organisms, primarily crabs, shrimp, and clams. Spotted seals feed on pelagic and demersal fish, as well as shrimp and cephalopods. They are known to feed on a variety of fish including herring, capelin, sand lance, Arctic cod, saffron cod, and sculpins. Ribbon seals feed primarily on pelagic fish and invertebrates, such as shrimp, crabs, squid, octopus, cod, sculpin, pollock, and capelin. Juveniles feed mostly on krill and shrimp.

Bowhead whales feed in the eastern Beaufort Sea during summer and early autumn but continue feeding to varying degrees while on their migration through the central and western Beaufort Sea in the late summer and fall (Richardson and Thomson [eds.], 2002). When feeding in relatively shallow areas, bowheads feed throughout the water column. However, feeding is concentrated at depths where zooplankton is concentrated (Wursig *et al.*, 1984, 1989; Richardson [ed.], 1987; Griffiths *et al.*, 2002). Lowry and Sheffield (2002) found that copepods and euphausiids were the most common prey found in stomach samples from bowhead whales harvested in the Kaktovik area from 1979 to 2000. Areas to the east of Barter Island (which is approximately 120 mi east of SAE's proposed seismic area) appear to be used regularly for feeding as bowhead whales migrate slowly westward across

the Beaufort Sea (Thomson and Richardson, 1987; Richardson and Thomson [eds.], 2002).

Recent articles and reports have noted bowhead whales feeding in several areas of the U.S. Beaufort Sea. The Barrow area is commonly used as a feeding area during spring and fall, with a higher proportion of photographed individuals displaying evidence of feeding in fall rather than spring (Mocklin, 2009). A bowhead whale feeding "hotspot" (Okkonen *et al.*, 2011) commonly forms on the western Beaufort Sea shelf off Point Barrow in late summer and fall. Favorable conditions concentrate euphausiids and copepods, and bowhead whales congregate to exploit the dense prey (Ashjian *et al.*, 2010; Moore *et al.*, 2010; Okkonen *et al.*, 2011). Surveys have also noted bowhead whales feeding in the Camden Bay area during the fall (Koski and Miller, 2009; Quakenbush *et al.*, 2010).

The 2006–2008 BWASP Final Report (Clarke *et al.*, 2011a) and the 2009 BWASP Final Report (Clarke *et al.*, 2011b) note sightings of feeding bowhead whales in the Beaufort Sea during the fall season. During that 4 year period, the largest groups of feeding whales were sighted between Smith Bay and Point Barrow (hundreds of miles to the west of Prudhoe Bay), and none were sighted feeding in Camden Bay (Clarke *et al.*, 2011a,b). Clarke and Ferguson (undated) examined the raw BWASP data from the years 2000–2009. They noted that feeding behavior was noted more often in September than October and that while bowheads were observed feeding throughout the study area (which includes the entire U.S. Beaufort Sea), sightings were less frequent in the central Alaskan Beaufort than they were east of Kaktovik and west of Smith Bay. Additionally, Clarke and Ferguson (undated) and Clarke *et al.* (2011b) refer to information from Ashjian *et al.* (2010), which describes the importance of wind-driven currents that produce favorable feeding conditions for bowhead whales in the area between Smith Bay and Point Barrow. Increased winds in that area may be increasing the incidence of upwelling, which in turn may be the reason for increased sightings of feeding bowheads in the area. Clarke and Ferguson (undated) also note that the incidence of feeding bowheads in the eastern Alaskan Beaufort Sea has decreased since the early 1980s.

Beluga whales feed on a variety of fish, shrimp, squid and octopus (Burns and Seaman, 1985). Very few beluga whales occur nearshore; their main migration route is much further

offshore. Like several of the other species in the area, harbor porpoise feed on demersal and benthic species, mainly schooling fish and cephalopods. Depending on the type of killer whale (transient or resident), they feed on fish and/or marine mammals. However, harbor porpoises and killer whales are not commonly found in Prudhoe Bay.

Gray whales are primarily bottom feeders, and benthic amphipods and isopods form the majority of their summer diet, at least in the main summering areas west of Alaska (Oliver *et al.*, 1983; Oliver and Slattery, 1985). Farther south, gray whales have also been observed feeding around kelp beds, presumably on mysid crustaceans, and on pelagic prey such as small schooling fish and crab larvae (Hatler and Darling, 1974). However, the central Beaufort Sea is not known to be a primary feeding ground for gray whales.

Two kinds of fish inhabit marine waters in the study area: (1) True marine fish that spend all of their lives in salt water, and (2) anadromous species that reproduce in fresh water and spend parts of their life cycles in salt water.

Most arctic marine fish species are small, benthic forms that do not feed high in the water column. The majority of these species are circumpolar and are found in habitats ranging from deep offshore water to water as shallow as 16.4–33 ft (5–10 m; Feckhelm *et al.*, 1995). The most important pelagic species, and the only abundant pelagic species, is the Arctic cod. The Arctic cod is a major vector for the transfer of energy from lower to higher trophic levels (Bradstreet *et al.*, 1986). In summer, Arctic cod can form very large schools in both nearshore and offshore waters (Craig *et al.*, 1982; Bradstreet *et al.*, 1986). Locations and areas frequented by large schools of Arctic cod cannot be predicted but can be almost anywhere. The Arctic cod is a major food source for beluga whales, ringed seals, and numerous species of seabirds (Frost and Lowry, 1984; Bradstreet *et al.*, 1986).

Anadromous Dolly Varden char and some species of whitefish winter in rivers and lakes, migrate to the sea in spring and summer, and return to fresh water in autumn. Anadromous fish form the basis of subsistence, commercial, and small regional sport fisheries. Dolly Varden char migrate to the sea from May through mid-June (Johnson, 1980) and spend about 1.5–2.5 months there (Craig, 1989). They return to rivers beginning in late July or early August with the peak return migration occurring between mid-August and early September (Johnson, 1980). At sea, most anadromous coregonids

(whitefish) remain in nearshore waters within several kilometers of shore (Craig, 1984, 1989). They are often termed "amphidromous" fish in that they make repeated annual migrations into marine waters to feed, returning each fall to overwinter in fresh water.

Benthic organisms are defined as bottom dwelling creatures. Infaunal organisms are benthic organisms that live within the substrate and are often sedentary or sessile (bivalves, polychaetes). Epibenthic organisms live on or near the bottom surface sediments and are mobile (amphipods, isopods, mysids, and some polychaetes). Epifauna, which live attached to hard substrates, are rare in the Beaufort Sea because hard substrates are scarce there. A small community of epifauna, the Boulder Patch, occurs in Stefansson Sound.

Many of the nearshore benthic marine invertebrates of the Arctic are circumpolar and are found over a wide range of water depths (Carey *et al.*, 1975). Species identified include polychaetes (*Spio filicornis*, *Chaetozone setosa*, *Eteone longa*), bivalves (*Cryptodaria kurriana*, *Nucula tenuis*, *Liocyma fluctuosa*), an isopod (*Saduria entomon*), and amphipods (*Pontoporeia femorata*, *P. affinis*).

Nearshore benthic fauna have been studied in Beaufort Sea lagoons and near the mouth of the Colville River (Kinney *et al.*, 1971, 1972; Crane and Cooney, 1975). The waters of Simpson Lagoon, Harrison Bay, and the nearshore region support a number of infaunal species including crustaceans, mollusks, and polychaetes. In areas influenced by river discharge, seasonal changes in salinity can greatly influence the distribution and abundance of benthic organisms. Large fluctuations in salinity and temperature that occur over a very short time period, or on a seasonal basis, allow only very adaptable, opportunistic species to survive (Alexander *et al.*, 1974). Since shorefast ice is present for many months, the distribution and abundance of most species depends on annual (or more frequent) recolonization from deeper offshore waters (Woodward Clyde Consultants, 1995). Due to ice scouring, particularly in water depths of less than 8 ft (2.4 m), infaunal communities tend to be patchily distributed. Diversity increases with water depth until the shear zone is reached at 49–82 ft (15–25 m; Carey, 1978). Biodiversity then declines due to ice gouging between the landfast ice and the polar pack ice (Woodward Clyde Consultants, 1995).

### Potential Impacts From Sound Generation

With regard to fish as a prey source for odontocetes and seals, fish are known to hear and react to sounds and to use sound to communicate (Tavolga *et al.*, 1981) and possibly avoid predators (Wilson and Dill, 2002). Experiments have shown that fish can sense both the strength and direction of sound (Hawkins, 1981). Primary factors determining whether a fish can sense a sound signal, and potentially react to it, are the frequency of the signal and the strength of the signal in relation to the natural background noise level.

Fishes produce sounds that are associated with behaviors that include territoriality, mate search, courtship, and aggression. It has also been speculated that sound production may provide the means for long distance communication and communication under poor underwater visibility conditions (Zelick *et al.*, 1999), although the fact that fish communicate at low-frequency sound levels where the masking effects of ambient noise are naturally highest suggests that very long distance communication would rarely be possible. Fishes have evolved a diversity of sound generating organs and acoustic signals of various temporal and spectral contents. Fish sounds vary in structure, depending on the mechanism used to produce them (Hawkins, 1993). Generally, fish sounds are predominantly composed of low frequencies (less than 3 kHz).

Since objects in the water scatter sound, fish are able to detect these objects through monitoring the ambient noise. Therefore, fish are probably able to detect prey, predators, conspecifics, and physical features by listening to environmental sounds (Hawkins, 1981). There are two sensory systems that enable fish to monitor the vibration-based information of their surroundings. The two sensory systems, the inner ear and the lateral line, constitute the acoustico-lateralis system.

Although the hearing sensitivities of very few fish species have been studied to date, it is becoming obvious that the intra- and inter-specific variability is considerable (Coombs, 1981). Nedwell *et al.* (2004) compiled and published available fish audiogram information. A noninvasive electrophysiological recording method known as auditory brainstem response is now commonly used in the production of fish audiograms (Yan, 2004). Generally, most fish have their best hearing in the low-frequency range (*i.e.*, less than 1 kHz). Even though some fish are able to detect sounds in the ultrasonic frequency

range, the thresholds at these higher frequencies tend to be considerably higher than those at the lower end of the auditory frequency range.

Literature relating to the impacts of sound on marine fish species can be divided into the following categories: (1) Pathological effects; (2) physiological effects; and (3) behavioral effects. Pathological effects include lethal and sub-lethal physical damage to fish; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors of fish. Behavioral changes might be a direct reaction to a detected sound or a result of the anthropogenic sound masking natural sounds that the fish normally detect and to which they respond. The three types of effects are often interrelated in complex ways. For example, some physiological and behavioral effects could potentially lead to the ultimate pathological effect of mortality. Hastings and Popper (2005) reviewed what is known about the effects of sound on fishes and identified studies needed to address areas of uncertainty relative to measurement of sound and the responses of fishes. Popper *et al.* (2003/2004) also published a paper that reviews the effects of anthropogenic sound on the behavior and physiology of fishes.

Potential effects of exposure to sound on marine fish include TTS, physical damage to the ear region, physiological stress responses, and behavioral responses such as startle response, alarm response, avoidance, and perhaps lack of response due to masking of acoustic cues. Most of these effects appear to be either temporary or intermittent and therefore probably do not significantly impact the fish at a population level. The studies that resulted in physical damage to the fish ears used noise exposure levels and durations that were far more extreme than would be encountered under conditions similar to those expected during SAE's proposed survey.

The level of sound at which a fish will react or alter its behavior is usually well above the detection level. Fish have been found to react to sounds when the sound level increased to about 20 dB above the detection level of 120 dB (Ona, 1988); however, the response threshold can depend on the time of year and the fish's physiological condition (Engas *et al.*, 1993). In general, fish react more strongly to pulses of sound rather than a continuous signal (Blaxter *et al.*, 1981), such as the type of sound that will be produced by the drillship, and a quicker alarm response is elicited when the

sound signal intensity rises rapidly compared to sound rising more slowly to the same level.

Investigations of fish behavior in relation to vessel noise (Olsen *et al.*, 1983; Ona, 1988; Ona and Godo, 1990) have shown that fish react when the sound from the engines and propeller exceeds a certain level. Avoidance reactions have been observed in fish such as cod and herring when vessels approached close enough that received sound levels are 110 dB to 130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988). However, other researchers have found that fish such as polar cod, herring, and capeline are often attracted to vessels (apparently by the noise) and swim toward the vessel (Rostad *et al.*, 2006). Typical sound source levels of vessel noise in the audible range for fish are 150 dB to 170 dB (Richardson *et al.*, 1995a). In calm weather, ambient noise levels in audible parts of the spectrum lie between 60 dB to 100 dB.

Short, sharp sounds can cause overt or subtle changes in fish behavior. Chapman and Hawkins (1969) tested the reactions of whiting (hake) in the field to an airgun. When the airgun was fired, the fish dove from 82 to 180 ft (25 to 55 m) depth and formed a compact layer. The whiting dove when received sound levels were higher than 178 dB re 1  $\mu$ Pa (Pearson *et al.*, 1992).

Pearson *et al.* (1992) conducted a controlled experiment to determine effects of strong noise pulses on several species of rockfish off the California coast. They used an airgun with a source level of 223 dB re 1  $\mu$ Pa. They noted:

- Startle responses at received levels of 200–205 dB re 1  $\mu$ Pa and above for two sensitive species, but not for two other species exposed to levels up to 207 dB;
- Alarm responses at 177–180 dB for the two sensitive species, and at 186 to 199 dB for other species;
- An overall threshold for the above behavioral response at about 180 dB;
- An extrapolated threshold of about 161 dB for subtle changes in the behavior of rockfish; and
- A return to pre-exposure behaviors within the 20–60 minute exposure period.

In summary, fish often react to sounds, especially strong and/or intermittent sounds of low frequency. Sound pulses at received levels of 160 dB re 1  $\mu$ Pa may cause subtle changes in behavior. Pulses at levels of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins, 1969; Pearson *et al.*, 1992; Skalski *et al.*, 1992). It also appears that fish often

habituate to repeated strong sounds rather rapidly, on time scales of minutes to an hour. However, the habituation does not endure, and resumption of the strong sound source may again elicit disturbance responses from the same fish.

Some of the fish species found in the Arctic are prey sources for odontocetes and pinnipeds. A reaction by fish to sounds produced by SAEs proposed survey would only be relevant to marine mammals if it caused concentrations of fish to vacate the area. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all. Impacts on fish behavior are predicted to be inconsequential. Thus, feeding odontocetes and pinnipeds would not be adversely affected by this minimal loss or scattering, if any, of reduced prey abundance.

Some mysticetes, including bowhead whales, feed on concentrations of zooplankton. Some feeding bowhead whales may occur in the Alaskan Beaufort Sea in July and August, but feeding bowheads are more likely to occur in the area after the cessation of airgun operations. Reactions of zooplankton to sound are, for the most part, not known. Their ability to move significant distances is limited or nil, depending on the type of zooplankton. Behavior of zooplankters is not expected to be affected by the survey. These animals have exoskeletons and no air bladders. Many crustaceans can make sounds, and some crustacea and other invertebrates have some type of sound receptor. A reaction by zooplankton to sounds produced by the seismic survey would only be relevant to whales if it caused concentrations of zooplankton to scatter. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only very close to the sound source, if any would occur at all. Impacts on zooplankton behavior are predicted to be inconsequential. Thus, feeding mysticetes would not be adversely affected by this minimal loss or scattering, if any, of reduced zooplankton abundance.

Based on the preceding discussion, the proposed activity is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations.

#### Proposed Mitigation

In order to issue an incidental take authorization (ITA) 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 (where relevant).

For the proposed SAE open-water 3D OBN seismic surveys in the Beaufort Sea, NMFS worked with SAE to propose the following mitigation measures to minimize the potential impacts to marine mammals in the project vicinity as a result of SAE's survey activities. The primary purpose of these mitigation measures is to detect marine mammals within, or about to enter, designated exclusion zones and to initiate immediate shutdown or power down of the airgun(s).

#### (1) Establishing Exclusion and Disturbance Zones

Under current NMFS guidelines, the "exclusion zone" for marine mammal exposure to impulse sources is customarily defined as the area within which received sound levels are  $\geq 180$  dB (rms) re 1  $\mu$ Pa for cetaceans and  $\geq 190$  dB (rms) re 1  $\mu$ Pa for pinnipeds. These safety criteria are based on an assumption that SPL received at levels lower than these will not injure these animals or impair their hearing abilities, but at higher levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur after exposure to sound at distances greater than the exclusion zones (Richardson *et al.* 1995). Currently, NMFS uses 160 dB (rms) re 1  $\mu$ Pa as the threshold for Level B behavioral harassment from impulse noise.

In 2014, Heath *et al.* (2014) conducted a sound source verification (SSV) of the very same 620-in<sup>3</sup> array SAE plans to use in 2015. The SSV was conducted in generally the same survey area of SAE's planned 2015 work. They empirically determined that the distances to the 190, 180, and 160 dB isopleths for sound pressure levels emanating from the 620-in<sup>3</sup> array was 195, 635, and 1,820 m, respectively (Table 3). Heath *et al.* (2014) also measured sound pressure levels from an active 10-in<sup>3</sup> gun during SAE's 2014 Beaufort operations and found noise levels exceeding 190 dB extended out 54 m, exceeding 180 dB out to 188 m, and exceeding 160 dB out to 1,050 m (Table 3).

Sound source studies have not been done for the 1,240-in<sup>3</sup> array; however, Austin and Warner (2013) conducted a sound source verification of a 1,200-in<sup>3</sup> array operated by SAE in Cook Inlet found the radius to the 190 dB isopleth

to be 250 m, to the 180 dB isopleth to be 910 m, and to the 160 dB isopleth to be 5,200 m. These are the distance values SAE intends to use before the

SSV for the 1,240 in<sup>3</sup> airgun arrays are obtained before the survey. If SAE plans to use the 1,240 in<sup>3</sup> airgun arrays, SSV of these zones will be empirically

measured before the 2015 open-water seismic survey for monitoring and mitigation measures.

TABLE 3—SUMMARY OF AIRGUN ARRAY SOURCE LEVELS AND PROPOSED EXCLUSION ZONE AND ZONES OF INFLUENCE RADII

Array size (in <sup>3</sup> )	Source level (dB)	190 dB radius (m)	180 dB radius (m)	160 dB radius (m)
10 .....	195	54	188	1,050
620 .....	218	195	635	1,820
1,240 * .....	224	250	910	5,200

\* Denotes modelled source level that need to be empirically measured before the seismic survey.

## (2) Vessel Related Mitigation Measures

These mitigation measures apply to all vessels that are part of SAE's Beaufort Sea seismic survey activities, including supporting vessels.

- Avoid concentrations or groups of whales. Operators of vessels should, at all times, conduct their activities at the maximum distance possible from such concentrations or groups of whales.

- If any vessel approaches within 1.6 km (1 mi) of observed whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the whales by taking one or more of the following actions, as appropriate:

- Reducing vessel speed to less than 5 knots within 300 yards (900 feet or 274 m) of the whale(s);

- Steering around the whale(s) if possible;

- Operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

- Operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

- Checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

- Reduce vessel speed, not to exceed 5 knots, when weather conditions require, such as when visibility drops, to avoid the likelihood of injury to whales.

## (3) Mitigation Measures for Airgun Operations

The primary requirements for airgun mitigation during the seismic surveys are to monitor marine mammals near the airgun array during all daylight airgun operations and during any nighttime start-up of the airguns and, if any marine mammals are observed, to adjust airgun operations, as necessary, according to the mitigation measures

described below. During the seismic surveys, PSOs will monitor the pre-established exclusion zones for the presence of marine mammals. When marine mammals are observed within, or about to enter, designated safety zones, PSOs have the authority to call for immediate power down (or shutdown) of airgun operations, as required by the situation. A summary of the procedures associated with each mitigation measure is provided below.

### Ramp Up Procedure

A ramp up of an airgun array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The purpose of a ramp up (or “soft start”) is to “warn” cetaceans and pinnipeds in the vicinity of the airguns and to provide time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

During the open-water survey program, the seismic operator will ramp up the airgun arrays slowly. Full ramp ups (*i.e.*, from a cold start after a shutdown, when no airguns have been firing) will begin by firing a single airgun in the array (*i.e.*, the mitigation airgun). A full ramp up, after a shutdown, will not begin until there has been a minimum of 30 minutes of observation of the safety zone by PSOs to assure that no marine mammals are present. The entire exclusion zone must be visible during the 30-minute lead-in to a full ramp up. If the entire exclusion zone is not visible, then ramp up from a cold start cannot begin. If a marine mammal is sighted within the exclusion zone during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal is sighted outside of the exclusion zone or the animal is not sighted for at least 15 minutes, for small odontocetes (harbor porpoise) and pinnipeds, or 30 minutes, for baleen whales and large odontocetes

(including beluga and killer whales and narwhal).

### Use of a Small-Volume Airgun During Turns and Transits

Throughout the seismic survey, during turning movements and short transits, SAE will employ the use of the smallest-volume airgun (*i.e.*, “mitigation airgun”) to deter marine mammals from being within the immediate area of the seismic operations. The mitigation airgun will be operated at approximately one shot per minute and will not be operated for longer than three hours in duration (turns may last two to three hours for the project).

During turns or brief transits (*i.e.*, less than three hours) between seismic tracklines, one mitigation airgun will continue operating. The ramp up procedures described above will be followed when increasing the source levels from the one mitigation airgun to the full airgun array. However, keeping one airgun firing during turns and brief transits will allow SAE to resume seismic surveys using the full array without having to ramp up from a “cold start,” which requires a 30-minute observation period of the full exclusion zone and is prohibited during darkness or other periods of poor visibility. PSOs will be on duty whenever the airguns are firing during daylight and during the 30-minute periods prior to ramp-ups from a “cold start.”

### Power Down and Shutdown Procedures

A power down is the immediate reduction in the number of operating energy sources from all firing to some smaller number (*e.g.*, a single mitigation airgun). A shutdown is the immediate cessation of firing of all energy sources. The array will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable exclusion zone of the full array, but is outside the applicable exclusion zone of the single mitigation airgun. If a marine mammal is sighted

within or about to enter the applicable exclusion zone of the single mitigation airgun, the entire array will be shut down (*i.e.*, no sources firing). In addition, SAE will implement shutdown measures when aggregations of bowhead whales or gray whales that appear to be engaged in non-migratory significant biological behavior (*e.g.*, feeding, socializing) are observed within the 160-dB harassment zone around the seismic operations.

#### *Poor Visibility Conditions*

SAE plans to conduct 24-hour operations. PSOs will not be on duty during ongoing seismic operations during darkness, given the very limited effectiveness of visual observation at night (there will be no periods of darkness in the survey area until mid-August). The provisions associated with operations at night or in periods of poor visibility include the following:

- If during foggy conditions, heavy snow or rain, or darkness (which may be encountered starting in late August), the full 180 dB exclusion zone is not visible, the airguns cannot commence a ramp-up procedure from a full shutdown.

- If one or more airguns have been operational before nightfall or before the onset of poor visibility conditions, they can remain operational throughout the night or poor visibility conditions. In this case ramp-up procedures can be initiated, even though the exclusion zone may not be visible, on the assumption that marine mammals will be alerted by the sounds from the single airgun and have moved away.

#### *Mitigation Conclusions*

NMFS has carefully evaluated SAE's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting 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:

- The manner in which, and the degree to which, the successful implementation of the measures are expected to minimize adverse impacts to marine mammals;
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and
- The practicability of the measure for applicant implementation.

Any mitigation measure(s) prescribed by NMFS 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 numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of seismic airguns, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

3. A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of seismic airguns or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

4. A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of seismic airguns or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing the severity of harassment takes only).

5. Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/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 the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. Proposed measures to ensure availability of such species or stock for taking for certain subsistence uses are discussed later in this document (see "Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses" section).

#### **Proposed Monitoring and Reporting**

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth, "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. SAE submitted a marine mammal monitoring plan as part of the IHA application. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period or from the peer review panel (see the "Monitoring Plan Peer Review" section later in this document).

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

1. An increase in our understanding of the likely occurrence of marine mammal species in the vicinity of the action, *i.e.*, presence, abundance, distribution, and/or density of species.

2. An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (*e.g.* sound or visual stimuli), through better understanding of one or more of the following: the action itself and its environment (*e.g.* sound source characterization, propagation, and ambient noise levels); the affected species (*e.g.* life history or dive pattern); the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects; and/or the likely biological or behavioral context of exposure to the stressor for the marine mammal (*e.g.* age class of exposed animals or known pupping, calving or feeding areas).

3. An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, *e.g.*, at what distance or received level).

4. An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: the long-term fitness and survival of an individual; or the population, species, or stock (*e.g.*



through effects on annual rates of recruitment or survival).

5. An increase in our understanding of how the activity affects marine mammal habitat, such as through effects on prey sources or acoustic habitat (e.g., through characterization of longer-term contributions of multiple sound sources to rising ambient noise levels and assessment of the potential chronic effects on marine mammals).

6. An increase in understanding of the impacts of the activity on marine mammals in combination with the impacts of other anthropogenic activities or natural factors occurring in the region.

7. An increase in our understanding of the effectiveness of mitigation and monitoring measures.

8. An increase in the probability of detecting marine mammals (through improved technology or methodology), both specifically within the safety zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.

#### *Proposed Monitoring Measures*

Monitoring will provide information on the numbers of marine mammals potentially affected by the exploration operations and facilitate real-time mitigation to prevent injury of marine mammals by industrial sounds or activities. These goals will be accomplished in the Beaufort Sea during 2015 by conducting vessel-based monitoring and passive acoustic monitoring to document marine mammal presence and distribution in the vicinity of the survey area.

Visual monitoring by Protected Species Observers (PSOs) during seismic survey operations, and periods when these surveys are not occurring, will provide information on the numbers of marine mammals potentially affected by these activities and facilitate real-time mitigation to prevent impacts to marine mammals by industrial sounds or operations. Vessel-based PSOs onboard the survey vessels and mitigation vessel will record the numbers and species of marine mammals observed in the area and any observable reaction of marine mammals to the survey activities in the Beaufort Sea.

#### *Visual-Based PSOs*

The visual-based marine mammal monitoring will be implemented by a team of experienced PSOs, including both biologists and Inupiat personnel. PSOs will be stationed aboard both survey vessels through the duration of the project. The vessel-based marine

mammal monitoring will provide the basis for real-time mitigation measures as discussed in the Mitigation Measures section. In addition, monitoring results of the vessel-based monitoring program will include the estimation of the number of "takes" as stipulated in the IHA.

#### (1) PSOs

Vessel-based monitoring for marine mammals will be done by trained PSOs throughout the period of survey activities. The observers will monitor the occurrence of marine mammals near the survey vessel during all daylight periods during operation, and during most daylight periods when operations are not occurring. PSO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the survey operations; and documenting "take by harassment."

A sufficient number of PSOs will be required onboard each survey vessel to meet the following criteria:

- 100% Monitoring coverage during all periods of survey operations in daylight;
- Maximum of 4 consecutive hours on watch per PSO; and
- Maximum of 12 hours of watch time per day per PSO.

PSO teams will consist of Inupiat observers and experienced field biologists. Each vessel will have an experienced field crew leader to supervise the PSO team. The total number of PSOs may decrease later in the season as the duration of daylight decreases.

#### (2) PSO Role and Responsibilities

When onboard the seismic and support vessels, there are three major parts to the PSO position:

- Observe and record sensitive wildlife species;
- Ensure mitigation procedures are followed accordingly; and
- Follow monitoring and data collection procedures.

The main roles of the PSO and the monitoring program are to ensure compliance with regulations set in place by NMFS to ensure that disturbance of marine mammals is minimized, and potential effects on marine mammals are documented. The PSOs will implement the monitoring and mitigation measures specified in the IHA (if issued). The primary purposes of the PSOs on board of the vessels are:

- Mitigation: Implement mitigation clearing and ramp up measures, observe for and detect marine mammals within, or about to enter the applicable safety zone and implement necessary shut

down, power down and speed/course alteration mitigation procedures when applicable. Advise marine crew of mitigation procedures.

- Monitoring: Observe for marine mammals and determine numbers of marine mammals exposed to sound pulses and their reactions (where applicable) and document those as required.

#### (3) Observer Qualifications and Training

Crew leaders and most PSOs will be individuals with experience as observers during recent seismic, site clearance and shallow hazards, and other monitoring projects in Alaska or other offshore areas in recent years. New or inexperienced PSOs will be paired with an experienced PSO or experienced field biologist so that the quality of marine mammal observations and data recording is kept consistent.

Biologist-observers will have previous marine mammal observation experience, and field crew leaders will be highly experienced with previous vessel-based marine mammal monitoring and mitigation projects. Resumes for those individuals will be provided to NMFS for review and acceptance of their qualifications. Inupiat observers will be experienced in the region and familiar with the marine mammals of the area. All observers will complete a NMFS-approved observer training course designed to familiarize individuals with monitoring and data collection procedures.

PSOs will complete a 2-day or 3-day training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2015 open-water season. Any exceptions will have or receive equivalent experience or training. The training session(s) will be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based seismic monitoring programs.

#### (4) Marine Mammal Observer Protocol

Source vessels will employ PSOs to identify marine mammals during all hours of airgun operations. To better observe the exclusion zone, a lead PSO, one or two PSOs, and an Inupiaq communicator will be on primary source vessel and two PSOs will be stationed aboard the secondary source vessel. (The total number of observers is limited by available berthing space aboard the vessels.) The three to four total observers aboard the primary source vessel will allow two observers simultaneously on watch during daylight hours.

The PSOs will watch for marine mammals during all periods of source operations and for a minimum of 30 minutes prior to the planned start of airgun or pinger operations after an extended shutdown. Marine mammal monitoring shall continue throughout airgun operations and last for 30 minutes after the finish of airgun firing. SAE vessel crew and operations personnel will also watch for marine mammals, as practical, to assist and alert the PSOs for the airgun(s) to be shut down if marine mammals are observed in or about to enter the exclusion zone.

The PSOs will watch for marine mammals from the best available vantage point on the survey vessels, typically the bridge. The PSOs will scan the area around the vessel systematically with reticle binoculars (e.g., 7 × 50 and 16–40 × 80) and with the naked eye. Laser range finders (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation.

The observers will give particular attention to the areas within the marine mammal exclusion zones around the source vessels. These zones are the maximum distances within which received levels may exceed 180 dB (rms) re 1 µPa (rms) for cetaceans, or 190 dB (rms) re 1 µPa for pinnipeds.

When a marine mammal is seen approaching or within the exclusion zone applicable to that species, the seismic survey crew will be notified immediately so that mitigation measures called for in the applicable authorization(s) can be implemented.

Night-vision equipment (Generation 3 binocular image intensifiers or equivalent units) will be available for use if and when needed. Past experience with night-vision devices (NVDs) in the Beaufort Sea and elsewhere has indicated that NVDs are not nearly as effective as visual observation during daylight hours (e.g., Harris *et al.* 1997, 1998; Moulton and Lawson 2002).

#### (5) Field Data-Recording

The PSOs will record field observation data and information about marine mammal sightings that include:

- Species, group size, age/size/sex categories (if determinable);
- Physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Behavior when first sighted and after initial sighting, heading (if consistent);
- Bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling,

etc.), closest point of approach, and behavioral pace;

- Time, location, speed, and activity of the source and mitigation vessels, sea state, ice cover, visibility, and sun glare; and
- Positions of other vessel(s) in the vicinity.

#### Acoustic Monitoring

##### (1) Sound Source Measurements

Since the same airgun array of 620 in<sup>3</sup> and a single mitigation airgun of 10 in<sup>3</sup> to be used were empirically measured in the generally same seismic survey vicinity in 2014 (Heath 2014), NMFS does not think additional SSV tests for this array and a single airgun is necessary for the 2015 seismic survey. However, if SAE decides to use the 1,240 in<sup>3</sup> airgun arrays for deeper water, SSV on these arrays is required before the commencement of the surveys. Results of the acoustic characterization and SSV will be used to establish the 190 dB, 180 dB, 170 dB, and 160 dB isopleths for the 1,240 in<sup>3</sup> airgun arrays.

The results of the SSV will be submitted to NMFS within five days after completing the measurements, followed by a report to be submitted within 14 days after completion of the measurements. A more detailed report will be provided to NMFS as part of the required 90-day report following completion of the acoustic program.

##### (2) Passive Acoustic Monitoring

SAE proposes to conduct Passive Acoustical Monitoring (PAM) using specialized autonomous passive acoustical recorders. These recorders will be deployed on the seabed and will record continuously. The recorders will sit directly on the seabed and will be attached to a ground line with a small weight at its end. Each recorder will be retrieved by using a grapple to catch the ground line and recover the unit.

#### PAM Deployment

Passive acoustic recorders will be deployed in an arrangement surrounding the survey area for the purposes of PAM. The data collected will be used for post-season analysis of marine mammal vocalization detections to help inform an assessment of potential disturbance effects. The PAM data will also provide information about the long-range propagation of the airgun noise.

#### Data Analysis

PAM recordings will be processed at the end of the season using marine mammal detection and classification software capable of detecting vocalizations from marine mammals.

Particular attention will be given to the detection of bowhead whale vocalizations since this is a species of particular concern due to its importance for local subsistence hunting.

PAM recordings will also be used to detect and quantify airgun pulses from the survey as recorded on the PAM recorders, to provide information about the long-range propagation of the survey noise.

#### Monitoring Plan Peer Review

The MMPA requires that monitoring plans be independently peer reviewed “where the proposed activity may affect the availability of a species or stock for taking for subsistence uses” (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS’ implementing regulations state, “Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan” (50 CFR 216.108(d)).

NMFS has established an independent peer review panel to review SAE’s 4MP for the proposed seismic survey in the Beaufort Sea. The panel has met in early March 2015, and will provide comments to NMFS in April 2015. After completion of the peer review, NMFS will consider all recommendations made by the panel, incorporate appropriate changes into the monitoring requirements of the IHA (if issued), and publish the panel’s findings and recommendations in the final IHA notice of issuance or denial document.

#### Reporting Measures

##### (1) Sound Source Verification Report

As discussed earlier, if SAE plans to use the 1,240 in<sup>3</sup> airgun arrays, SSV tests on these arrays will be required. A report on the preliminary results of the sound source verification measurements, including the measured 190, 180, 170, and 160 dB (rms) radii of the 1,240 in<sup>3</sup> airgun array, would be submitted within 14 days after collection of those measurements at the start of the field season. This report will specify the distances of the exclusion zones that were adopted for the survey.

##### (2) Weekly Reports

SAE will submit weekly reports to NMFS no later than the close of business (Alaska Time) each Thursday during the weeks when seismic surveys take place. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-

water activities, and the number of marine mammals exposed to harassment level noise.

### (3) Monthly Reports

SAE will submit monthly reports to NMFS for all months during which seismic surveys take place. The monthly reports will contain and summarize the following information:

- Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort Sea state and wind force), and associated activities during the seismic survey and marine mammal sightings.
- Species, number, location, distance from the vessel, and behavior of any sighted marine mammals, as well as associated surveys (number of shutdowns), observed throughout all monitoring activities.
- An estimate of the number (by species) of: (i) Pinnipeds that have been exposed to the seismic surveys (based on visual observation) at received levels greater than or equal to 160 dB re 1  $\mu$ Pa (rms) and/or 190 dB re 1  $\mu$ Pa (rms) with a discussion of any specific behaviors those individuals exhibited; and (ii) cetaceans that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1  $\mu$ Pa (rms) and/or 180 dB re 1  $\mu$ Pa (rms) with a discussion of any specific behaviors those individuals exhibited.

### (4) Technical Report

The results of SAE's 2015 vessel-based monitoring, including estimates of "take" by harassment, will be presented first in a "90-day" draft Technical Report, to be submitted to NMFS within 90 days after the end of the seismic survey, and then in a final Technical Report, which will address any comments NMFS had on the draft. The Technical Report will include:

- (a) Summaries of monitoring effort (*e.g.*, total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);
- (b) Analyses of the effects of various factors influencing detectability of marine mammals (*e.g.*, sea state, number of observers, and fog/glare);
- (c) Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover;
- (d) Data analysis separated into periods when a seismic airgun array (or a single mitigation airgun) is operating

and when it is not, to better assess impacts to marine mammals—the final and comprehensive report to NMFS should summarize and plot:

- Data for periods when a seismic array is active and when it is not; and
- The respective predicted received sound conditions over fairly large areas (tens of km) around operations;
- (e) Sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability), such as:
  - Initial sighting distances versus airgun activity state;
  - Closest point of approach versus airgun activity state;
  - Observed behaviors and types of movements versus airgun activity state;
  - Numbers of sightings/individuals seen versus airgun activity state;
  - Distribution around the survey vessel versus airgun activity state; and
  - Estimates of take by harassment;
- (f) Results from all hypothesis tests, including estimates of the associated statistical power, when practicable;
- (g) Estimates of uncertainty in all take estimates, with uncertainty expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, or another applicable method, with the exact approach to be selected based on the sampling method and data available;
- (h) A clear comparison of authorized takes and the level of actual estimated takes; and

### (5) Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA, such as a serious injury, or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), SAE would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the Alaska Regional Stranding Coordinators. The report would include the following information:

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

- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the prohibited take. NMFS would work with SAE to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. SAE would not be able to resume its activities until notified by NMFS via letter, email, or telephone.

In the event that SAE discovers a dead marine mammal, and the lead PSO determines that the cause of the death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), SAE would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with SAE to determine whether modifications in the activities are appropriate.

In the event that SAE discovers a dead marine mammal, and the lead PSO determines that the death is not associated with or related to the activities authorized in the IHA (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), SAE would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. SAE would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. SAE can continue its operations under such a case.

### Monitoring Results From Previously Authorized Activities

SAE was issued an IHA for a 3D OBN seismic survey in the same area of the proposed 2015 seismic survey in the Beaufort Sea during the 2014 Arctic open-water season. SAE conducted the seismic survey between August 25 and September 30, 2014. The technical report (90-day report) submitted by SAE indicates that one beluga whale and 2

spotted seals were observed within the 180-dB exclusion zones during the survey that prompted immediate shutdown. Two additional spotted seals were detected within the zone of influence when the airgun arrays were firing. Post-activity analysis based on total sighting data concluded that up to approximately 5 beluga whales and 264 pinnipeds (likely all spotted seals due to their large numbers) could be exposed to received levels above 160-dB re 1  $\mu$ Pa. Some of these could be exposed to levels that may have Level A harassment which was not authorized under the previous IHA. Nevertheless, take of Level B harassment were under the take limits allowed by the IHA issued to SAE.

Based on the monitoring results from SAE's 2014 seismic survey, NMFS is re-evaluating the potential effects on marine mammals and requested SAE to conduct analysis on potential Level A takes (see "Estimated Take by Incidental Harassment" section below).

#### Estimated Take by Incidental Harassment

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, breaching, nursing, breeding, feeding, or sheltering [Level B harassment].

Takes by Level A and Level B harassments of some species are anticipated as a result of SAE's proposed 3D seismic survey. NMFS expects marine mammal takes could result from noise propagation from operation of seismic airguns. NMFS does not expect marine mammals would be taken by collision with seismic and support vessels, because the vessels will be moving at low speeds, and PSOs on the survey vessels and the mitigation vessel will be monitoring for marine mammals and will be able to alert the vessels to avoid any marine mammals in the area.

For impulse sounds, such as those produced by the airguns proposed to be used in SAE's 3D OBN seismic surveys, NMFS uses the 180 and 190 dB (rms) re 1  $\mu$ Pa isopleth to indicate the onset of Level A harassment for cetaceans and pinnipeds, respectively; and the 160 dB (rms) re 1  $\mu$ Pa isopleth for Level B harassment of all marine mammals. SAE provided calculations of the 190-,

180-, and 160-dB isopleths expected to be produced by the proposed seismic surveys and then used those isopleths to estimate takes by harassment. NMFS used those calculations to make the necessary MMPA findings. SAE provided a full description of the methodology used to estimate takes by harassment in its IHA application, which is also provided in the following sections.

#### Acoustic Footprint

The acoustical footprint that could cause harassment (Levels A and B) was determined by placing a 160-dB isopleth buffer around the area that would be surveyed (shot) during the 2015 open water season (777 km<sup>2</sup>). SAE stated that for the majority of its proposed 2015 seismic survey, a 620 in<sup>3</sup> airgun array would be used. However, to make conservative impact analysis, SAE uses the acoustic footprint of a large 1,240 in<sup>3</sup> array for this analysis.

There are no precise estimates for the 1,240-in<sup>3</sup> array. The estimated distances to the 160 dB isopleth for the 1,240-in<sup>3</sup> array is based on the sound source measurements from Austin and Warner (2012) for a 1,200-in<sup>3</sup> array in Cook Inlet. The results showed a measured distance of 5.2 km to the 160 dB isopleths (Table 3). Placing a 5.2-km buffer around the 777 km<sup>2</sup> maximum shot area results in an estimated annual ZOI of 1,463 km<sup>2</sup> (565 mi<sup>2</sup>), which is the ZOI value used in the exposure estimate calculations.

Because the exact location of the 2015 shoot area is currently unknown, the distribution of marine mammal habitat within the shoot area is unknown. However, within the 4,562 km<sup>2</sup> potential survey box, 18% (860 km<sup>2</sup>) falls within the 0 to 1.5 m water depth range, 17% (753 km<sup>2</sup>) falls within the 1.5 to 5 m range, 36% (1,635 km<sup>2</sup>) within the 5 to 15 m range, and 30 percent% (1,348 km<sup>2</sup>) within waters greater than 15 m deep (bowhead migration corridor). Thus, not all the area that could be surveyed in 2015 constitutes bowhead summer (>5 m depth) or fall migrating (>15 m depth) habitat. Further, few of the lease areas that could be shot in 2015 extend into the deeper waters of the potential survey box. The distribution of these depth ranges is found in Figure 6–1 of SAE's IHA application.

#### Marine Mammal Densities

Density estimates were derived for bowhead whales, beluga whales, ringed seals, spotted seals, and bearded seals as described below and shown in Table 4. There are no available Beaufort Sea density estimates for gray whales, or

extralimital species such as humpback whales, narwhals, and ribbon seals. Encountering these animals during the seismic program would be unexpected. The density derivations for the five species presented in Table 4 are provided in the discussions below.

TABLE 4—MARINE MAMMAL DENSITIES (#/km<sup>2</sup>) IN THE BEAUFORT SEA

Species	Summer	Fall
Bowhead whale .....	0.0049	0.0066
Beluga whale .....	0.0020	0.0057
Ringed seal .....	0.3547	0.2510
Spotted seal .....	0.0177	0.0125
Bearded seal .....	0.0177	0.0125

**Bowhead Whale:** The summer density estimate for bowhead whales was derived from July and August aerial survey data collected in the Beaufort Sea during the Aerial Surveys of Arctic Marine Mammals (ASAMM) program in 2012 and 2013. During this period, 276 bowhead whales were record along 24,560 km of transect line, or 0.0112 whales per km of transect line. Applying an effective strip half-width (ESW) of 1.15 (Ferguson and Clarke 2013), results in an uncorrected density of 0.0049. This is a much higher density than previous estimates (*e.g.*, Brandon *et al.* 2011) due to relatively high numbers of whales recorded in the Beaufort Sea in August 2013. In 2013, 205 whales were recorded along 9,758 km of transect line, with 78% of the sightings (160 whales) recorded the eastern most blocks 4, 5, 6, and 7. In contrast, 26 of the 71 whales (37%) recorded on-transect during summer 2012 were at or near Barrow Canyon (Block 12), or the western extreme of the Alaskan Beaufort Sea, while another 26 (37%) were recorded at the eastern extreme (Blocks 4, 5, 6, and 7). During these years lesser numbers were observed in Blocks 1 and 3 where the actual seismic survey is planned.

Fall density estimate was determined from September and October ASAMM data collected from 2006 to 2013. The Western Arctic stock of bowhead whale has grown considerably since the late 1970s; thus, data collected prior to 2006 probably does not well represent current whale densities. From 2006 to 2013, 1,286 bowhead whales were recorded along 84,400 km of transect line, or 0.1524 per km. Using an ESW of 1.15 results in an uncorrected density of 0.0066.

ASAMM aerial survey data was collected during summer and fall 2014, and is available to view as daily reports ([http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights\\_2014.php](http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_2014.php)), but

because this data has not yet been fully vetted, it is not yet appropriate for use in estimating bowhead densities in the Beaufort Sea (SAE, 2015). Nevertheless, the daily reports do indicate unusual nearshore concentrations of (Beaufort Sea) bowheads in both late August and late September of 2014.

**Beluga Whale:** There is little information on summer use by beluga whales in the Beaufort Sea. Moore *et al.* (2000) reported that only nine beluga whales were recorded in waters less than 50 m deep during 11,985 km of transect survey effort, or about 0.00057 whales per km. Assuming an ESW of 0.614, the derived corrected density would be 0.00046 whales per square mile. The same data did show much higher beluga numbers in deeper waters.

During the summer aerial surveys conducted during the 2012 and 2013 ASAMM program (Clarke *et al.* 2013, 2014), six beluga whales were observed along 2,497 km of transect in waters less than 20 m deep and between longitudes 140 °W and 154 °W (the area within which the seismic survey would fall). This equates to 0.0024 whales per km of trackline and an uncorrected density of 0.0020 assuming an ESW of 0.614.

Calculated fall beluga densities are approximately twice as high as summer. Between 2006 and 2013, 2,356 beluga were recorded along 83,631 km of transect line flown during September and October, or 0.0281 beluga per km of transect. Assuming an ESW of 0.614 gives an uncorrected density of 0.0229. However, unlike in summer, almost none of the fall migrating belugas were recorded in waters less than 20 m deep. For years where depth data is available (2006, 2009–2013), only 11 of 1,605 (1%) recorded belugas were found in waters less than 20 m during the fall. To take into account this bias in distribution, but to remain conservative, the corrected density estimate is reduced to 25%, or 0.0057.

Summer and fall beluga data was also collected in 2014, but as with the bowhead data mentioned above, it has

not yet been checked for accuracy and, therefore, is not yet appropriate for estimating density (SAE, 2015). Regardless, the data that is available from online daily reports ([http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights\\_2014.php](http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_2014.php)) indicates that a number of belugas were observed near shore in 2014, especially during the summer.

**Spotted Seal:** Surveys for ringed seals have been recently conducted in the Beaufort Sea by Kingsley (1986), Frost *et al.* (2002), Moulton and Lawson (2002), Green and Negri (2005), and Green *et al.* (2006, 2007). The shipboard monitoring surveys by Green and Negri (2005) and Green *et al.* (2006, 2007) were not systematically based, but are useful in estimating the general composition of pinnipeds in the Beaufort nearshore, including the Colville River Delta. Frost *et al.*'s aerial surveys were conducted during ice coverage and do not fully represent the summer and fall conditions under which the Beaufort surveys will occur. Moulton and Lawson (2002) conducted summer shipboard-based surveys for pinnipeds along the nearshore Beaufort Sea coast and developed seasonal average and maximum densities representative of SAE's Beaufort summer seismic project, while the Kingsley (1986) conducted surveys along the ice margin representing fall conditions.

Green and Negri (2005) and Green *et al.* (2006, 2007) recorded pinnipeds during barging activity between West Dock and Cape Simpson, and found high numbers of ringed seal in Harrison Bay, and peaks in spotted seal numbers off the Colville River Delta where haulout sites are located. Approximately 5% of all phocid sightings recorded by Green and Negri (2005) and Green *et al.* (2006, 2007) were spotted seals, which provide a estimate of the proportion of ringed seals versus spotted seals in the Colville River Delta and Harrison Bay. Thus, the estimated densities of spotted seals in the seismic survey area were derived by multiplying the ringed seal

densities from Moulton and Lawson (2002) and Kingsley (1986) by 0.05. However, monitoring conducted by Lomac-MacNair *et al.* (2014a) of SAE's 2014 seismic program near the Colville River Delta showed higher than expected spotted seal use of the potential seismic survey area, probably due to repeated sightings of local spotted seals closer to the Delta haul out sites. This information was used to adjust the take requests.

**Bearded Seal:** Bearded seals were also recorded in Harrison Bay and the Colville River Delta by Green and Negri (2005) and Green *et al.* (2006, 2007), but at lower proportions to ringed seals than spotted seals. However, estimating bearded seal densities based on the proportion of bearded seals observed during the barge-based surveys results in densities estimates that appear unrealistically low given density estimates from other studies, especially given that nearby Thetis Island is used as a base for annually hunting this seal (densities are seasonally high enough for focused hunting). For conservative purposes, the bearded seal density values used in this application are derived from Stirling *et al.*'s (1982) observations that the proportion of eastern Beaufort Sea bearded seals is 5% that of ringed seals, similar as was done for spotted seals.

#### Level B Exposure Calculations

The estimated potential harassment take of local marine mammals by the SAE's Beaufort seismic project was determined by multiplying the seasonal animal densities in Table 4 with the seasonal area that would be ensonified by seismic-generated noise greater than 160 dB re 1  $\mu$ Pa (rms). The total area that would be ensonified during 2015 is 1,463 km<sup>2</sup> (565 mi<sup>2</sup>). Assuming that half this area would be ensonified in summer and half in fall, the seasonal ZOI would be half 1,463 km<sup>2</sup>, or 731.5 km<sup>2</sup> (282.5 mi<sup>2</sup>). The resulting exposure calculations are found in Table 5.

TABLE 5—THE ESTIMATED NUMBER OF MARINE MAMMALS POTENTIALLY EXPOSED TO RECEIVED SOUND LEVELS GREATER THAN 160 dB

Species	Seasonal ZOI (km <sup>2</sup> )	Summer density	Summer exposure	Fall density	Fall exposure	Total
Bowhead Whale .....	731.5	0.0049	4	0.0066	5	9
Beluga Whale .....	731.5	0.0020	1	0.0057	4	7
Ringed Seal .....	731.5	0.3547	259	0.2510	184	443
Spotted Seal .....	731.5	0.0177	13	0.0125	9	22
Bearded Seal .....	731.5	0.0177	13	0.0125	9	22

The requested take authorization is found in Table 6, and includes requested authorization for gray whales in which the estimated take is zero, but for which records for the Alaskan Beaufort Sea occur. The requested take authorization for ringed seals and spotted seals has also been adjusted based on observations during SAE’s 2014 seismic operations immediately east of the Colville River Delta (Lomac-MacNair *et al.* 2014a). Lomac-MacNair *et al.* (2014a) only observed 5 confirmed sightings of ringed seals, none of which were observed during active seismic activity. But they also observed 40 spotted seals (4 during active seismic) and an additional 28 seals (also 4 during active seismic) that were either a ringed or spotted seal. Given only 88 km<sup>2</sup> (34 mi<sup>2</sup>) were shot in 2014, this would extrapolate to about 353 spotted seals potential observed and 35 spotted seals observed during seismic activity, during the planned 777 km<sup>2</sup> (300 mi<sup>2</sup>) of

operation planned in 2015. If 80% of the ringed/spotted seal sightings were actually spotted seals, then an additional 200 spotted seals would be observed and an additional 28 observed during seismic activity. Given the nearshore location of the planned seismic activities and proximity to Colville River Delta spotted seal haulout sites, and likelihood that a number of seals that were exposed to seismic noise exceeding 160 dB were not observed, the requested take authorization for spotted seals has been increased to 500.

Level A Exposure Calculations

As discussed earlier in this section, NMFS considers that exposures to pinnipeds at noise levels above 190 dB and cetaceans at noise levels above 180 dB constitute Level A takes under the MMPA. Although brief exposure of marine mammals at these levels are not likely to cause TTS or PTS (Southall *et al.* 2007), this consideration is a

precaution NMFS takes for its effect analysis.

The methods used in estimate Level A exposure is the same for Level B estimates, *i.e.*, multiplying the total amount of area that could be seasonally ensonified by noise levels exceeding 190 and 180 dB by density of each species. Because the radii to both the 190 dB (250 m) and 180 dB (910 m) are essentially equal to or larger than the mid-point (250 m) between the seismic source lines, the entire 777-km<sup>2</sup> seismic maximum source area would be ensonified, plus protective buffers of 250 m and 910 m around the source area. Thus, the 190 dB ZOI relative to pinnipeds would be 805 km<sup>2</sup>, or 402.5 km<sup>2</sup> for each the summer and fall season, while the 180 dB ZOI would be 883 km<sup>2</sup>, or 441.5 km<sup>2</sup> each season. Multiplying these values by the animal densities provides the Level A exposure estimates shown in Table 6.

TABLE 6—THE ESTIMATED LEVEL A AND LEVEL B HARASSMENTS AND REQUESTED TAKE OF MARINE MAMMALS

Species	Stock abundance	Estimated level B exposures	Level B take requested	Estimated level A exposure	Percent of take by stock
Bowhead whale .....	19,534	9	15	5	0.10
Beluga whale (Beaufort Sea stock) .....	39,258	7	15	4	0.05
Beluga whale (E. Chukchi Sea stock) .....	3,710	7	15	4	0.51
Gray whale .....	19,126	0	2	0	0.00
Ringed seal .....	300,000	443	500	246	0.25
Spotted seal .....	141,479	22	500	12	0.36
Bearded seal .....	155,000	22	25	12	0.02

The estimated Level A and Level B takes as a percentage of the marine mammal stock are 0.11% and 0.40% or less, respectively, in all cases (Table 6). The highest percent of population estimated to be taken is 0.11% for Level A and 0.40% for Level B harassments for the East Chukchi Sea stock of beluga whale. However, that percentage assumes that all beluga whales taken are from that population. Similarly, the 0.01% potential Level A and 0.04% Level B take percentage for the Beaufort Sea stock of beluga whale assumes that all 15 beluga whales are taken from the Beaufort Sea stock. Most likely, some beluga whales would be taken from each stock, meaning fewer than 15 beluga whales would be taken from either individual stock. Therefore, the Level A take of beluga whales as a percentage of populations would likely be below 0.11 and 0.01% for the Beaufort Sea and East Chukchi Sea stocks, respectively. The Level B takes of beluga whales as a percentage of populations would likely be below 0.40 and 0.04% for the Beaufort Sea and East Chukchi Sea stocks, respectively. However, the

estimated numbers of Level A harassment do not take into consideration either avoidance or mitigation effectiveness. The actual takes are expected to be lower as animals will avoid areas where noise is intense. In addition, the prescribed mitigation measure will further reduce the number of animals being exposed to noise levels that constitute a Level A, thus further reducing Level A harassment.

The total takes represent less than 0.51% of any stocks of marine mammals in the vicinity of the action area (Table 6).

Analysis and Preliminary Determinations

Negligible Impact

Negligible impact is “an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival” (50 CFR 216.103). A negligible impact finding is based on the lack of likely

adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of Level B harassment 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 behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, effects on habitat, and the status of the species.

No serious injuries or mortalities are anticipated to occur as a result of SAE’s proposed 3D seismic survey, and none are proposed to be authorized. The takes that are anticipated and authorized are expected to be limited to short-term Level B behavioral harassment, and limited Level A harassment in terms of potential hearing threshold shifts. While the airguns are expected to be operated

for approximately 49 days within a 70-day period, the project timeframe will occur when cetacean species are typically not found in the project area or are found only in low numbers. While pinnipeds are likely to be found in the proposed project area more frequently, their distribution is dispersed enough that they likely will not be in the Level A or Level B harassment zone continuously. As mentioned previously in this document, pinnipeds appear to be more tolerant of anthropogenic sound than mysticetes.

Most of the bowhead whales encountered will likely show overt disturbance (avoidance) only if they receive airgun sounds with levels  $\geq 160$  dB re 1  $\mu$ Pa. Odontocete reactions to seismic airgun pulses are generally assumed to be limited to shorter distances from the airgun than are those of mysticetes, in part because odontocete low-frequency hearing is assumed to be less sensitive than that of mysticetes. However, at least when in the Canadian Beaufort Sea in summer, belugas appear to be fairly responsive to seismic energy, with few being sighted within 6–12 mi (10–20 km) of seismic vessels during aerial surveys (Miller *et al.* 2005). Belugas will likely occur in small numbers in the Beaufort Sea during the survey period and few will likely be affected by the survey activity.

As noted, elevated background noise level from the seismic airgun reverberant field could cause acoustic masking to marine mammals and reduce their communication space. However, even though the decay of the signal is extended, the fact that pulses are separated by approximately 8 to 10 seconds for each individual source vessel (or 4 to 5 seconds when taking into account the two separate source vessels stationed 300 to 335 m apart) means that overall received levels at distance are expected to be much lower, thus resulting in less acoustic masking.

Most cetaceans (and particularly Arctic cetaceans) show relatively high levels of avoidance when received sound pulse levels exceed 160 dB re 1  $\mu$ Pa (rms), and it is uncommon to sight Arctic cetaceans within the 180 dB radius, especially for prolonged duration. Results from monitoring programs associated with seismic activities in the Arctic indicate that cetaceans respond in different ways to sound levels lower than 180 dB. These results have been used by agencies to support monitoring requirements within distances where received levels fall below 160 dB and even 120 dB. Thus, very few animals would be exposed to sound levels of 180 dB re 1  $\mu$ Pa (rms) regardless of detectability by PSOs.

Avoidance varies among individuals and depends on their activities or reasons for being in the area, and occasionally a few individual Arctic cetaceans will tolerate sound levels above 160 dB. Tolerance of levels above 180 dB is infrequent regardless of the circumstances, and marine mammals exposed to levels this high are expected to avoid the source, thereby minimizing the probability of TTS. Therefore, a calculation of the number of cetaceans potentially exposed to  $>180$  dB that is based simply on density would be a gross overestimate of the numbers expected to be exposed to 180 dB. Such calculations would be misleading unless avoidance response behaviors were taken into account to estimate what fraction of those originally present within the soon-to-be ensounded to  $>180$  dB zone (as estimated from density) would still be there by the time levels reach 180 dB.

It is estimated that up to 5 bowhead whales and 4 beluga whales could be exposed to received noise levels above 180 dB re 1  $\mu$ Pa (rms), and 246 ringed seals and 12 bearded and spotted seals could be exposed to received noise levels above 190 dB re 1  $\mu$ Pa (rms) for durations long enough to cause TTS if the animals do not avoid area for some reason and are not detected in time to have mitigation measures implemented (or even PTS if such exposures occurred repeatedly). None of the other species are expected to be exposed to received sound levels anticipated to cause TTS or PTS. However, the actual Level A takes are likely to be lower due to animals avoiding the injury zone and the mitigation implementation. The Level A takes estimated do not take into consideration either avoidance or mitigation effectiveness.

Marine mammals that are taken by TTS are expected to receive minor (in the order of several dBs) and brief (minutes to hours) temporary hearing impairment because (1) animals are not likely to remain for prolonged periods within high intensity sound fields, and (2) both the seismic vessel and the animals are constantly moving, and it is unlikely that the animal will be moving along with the vessel during the survey. Although repeated experience to TTS could result in PTS (Level A harassment), for the same reasons discussed above, even if marine mammals experience PTS, the degree of PTS is expected to be mild, resulting in a few dB elevation of hearing threshold. Therefore, even if a few marine mammals receive TTS or PTS, the degree of these effects are expected to be minor and, in the case of TTS, brief, and

are not expected to be biologically significant for the population or species.

Taking into account the mitigation measures that are planned, effects on marine mammals are generally expected to be restricted to avoidance of a limited area around SAE's proposed open-water activities and short-term changes in behavior, falling within the MMPA definition of "Level A and Level B harassments." The many reported cases of apparent tolerance by cetaceans to seismic exploration, vessel traffic, and some other human activities show that co-existence is possible. Mitigation measures, such as controlled vessel speed, dedicated marine mammal observers, non-pursuit, ramp up procedures, and shut downs or power downs when marine mammals are seen within defined ranges, will further reduce short-term reactions and minimize any effects on hearing sensitivity. In all cases, the effects are expected to be short-term, with no lasting biological consequence.

Of the marine mammal species or stocks likely to occur in the proposed seismic survey area, two are listed under the ESA: The bowhead whale and ringed seal. Those two species are also designated as "depleted" under the MMPA. Despite these designations, the Bering-Chukchi-Beaufort stock of bowheads has been increasing at a rate of 3.4% annually for nearly a decade (Allen and Angliss, 2011), even in the face of ongoing industrial activity. Additionally, during the 2001 census, 121 calves were counted, which was the highest yet recorded. The calf count provides corroborating evidence for a healthy and increasing population (Allen and Angliss, 2011). Certain stocks or populations of gray and beluga whales and spotted seals are listed as endangered or are proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. Ringed seals were recently listed under the ESA as threatened species, and are considered depleted under the MMPA. On July 25, 2014, the U.S. District Court for the District of Alaska vacated NMFS' rule listing the Beringia bearded seal DPS as threatened and remanded the rule to NMFS to correct the deficiencies identified in the opinion. None of the other species that may occur in the project area is listed as threatened or endangered under the ESA or designated as depleted under the MMPA. There is currently no established critical habitat in the proposed project area for any of these species.

Potential impacts to marine mammal habitat were discussed previously in



this document (see the “*Anticipated Effects on Habitat*” section). Although some disturbance of food sources of marine mammals is possible, any impacts are anticipated to be minor enough as to not affect rates of recruitment or survival of marine mammals in the area. The marine survey activities would occur in a localized area, and given the vast area of the Arctic Ocean where feeding by marine mammals occurs, any missed feeding opportunities in the direct project area could be offset by feeding opportunities in other available feeding areas.

In addition, no important feeding or reproductive areas are known in the vicinity of SAE’s proposed seismic surveys at the time the proposed surveys are to take place. No critical habitat of ESA-listed marine mammal species occurs in the Beaufort Sea.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from SAE’s proposed 3D seismic survey in the Beaufort Sea, Alaska, will have a negligible impact on the affected marine mammal species or stocks.

#### *Small Numbers*

The requested takes proposed to be authorized represent less than 0.4% for Level B harassment and 0.11% for Level A harassment of all populations or stocks potentially impacted (see Table 6 in this document). These take estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once. The numbers of marine mammals estimated to be taken are small proportions of the total populations of the affected species or stocks. In addition, the mitigation and monitoring measures (described previously in this document) proposed for inclusion in the IHA (if issued) are expected to reduce even further any potential disturbance and injuries to marine mammals.

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 mitigation and monitoring measures, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

#### **Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses**

##### *Relevant Subsistence Uses*

The proposed seismic activities will occur within the marine subsistence area used by the village of Nuiqsut. Nuiqsut was established in 1973 at a traditional location on the Colville River providing equal access to upland (e.g., caribou, Dall sheep) and marine (e.g., whales, seals, and eiders) resources (Brown 1979). Although Nuiqsut is located 40 km (25 mi) inland, bowhead whales are still a major fall subsistence resource. Although bowhead whales have been harvested in the past all along the barrier islands, Cross Island is the site currently used as the fall whaling base, as it includes cabins and equipment for butchering whales. However, whalers must travel about 160 km (100 mi) to annually reach the Cross Island whaling camp, which is located in a direct line over 110 direct km (70 mi) from Nuiqsut. Whaling activity usually begins in late August with the arrival whales migrating from the Canadian Beaufort Sea, and may occur as late as early October, depending on ice conditions and quota fulfillment. Most whaling occurs relatively near (<16 km or <10 mi) the island, largely to prevent meat spoilage that can occur with a longer tow back to Cross Island. Since 1993, Cross Island hunters have harvested one to four whales annually, averaging three.

Cross Island is located 70 km (44 mi) east of the eastern boundary of the seismic survey box. (Point Barrow is over 180 km [110 mi] outside the potential survey box.) Seismic activities are unlikely to affect Barrow or Cross Island based whaling, especially if the seismic operations temporarily cease during the fall bowhead whale hunt.

Although Nuiqsut whalers may incidentally harvest beluga whales while hunting bowheads, these whales are rarely seen and are not actively pursued. Any harvest that would occur would most likely be in association with Cross Island.

The potential seismic survey area is also used by Nuiqsut villagers for hunting seals. All three seal species that are likely to be taken—ringed, spotted, and bearded—are hunted. Sealing begins in April and May when villagers hunt seals at breathing holes in Harrison Bay. In early June, hunting is concentrated at the mouth of the Colville River, where ice breakup flooding results in the ice thinning and seals becoming more visible.

Once the ice is clear of the Delta (late June), hunters will hunt in open boats

along the ice edge from Harrison Bay to Thetis Island in a route called “round the world.” Thetis Island is important as it provides a weather refuge and a base for hunting bearded seals. During July and August, ringed and spotted seals are hunted in the lower 65 km (40 mi) of the Colville River proper.

In terms of pounds, approximately one-third of the village of Nuiqsut’s annual subsistence harvest is marine mammals (fish and caribou dominate the rest), of which bowhead whales contribute by far the most (Fuller and George 1999). Seals contribute only 2 to 3% of annual subsistence harvest (Brower and Opie 1997, Brower and Hepa 1998, Fuller and George 1999). Fuller and George (1999) estimated that 46 seals were harvested in 1992. The more common ringed seals appear to dominate the harvest, although the larger and thicker-skinned bearded seals are probably preferred. Spotted seals occur in the Colville River Delta in small numbers, which is reflected in the harvest.

Available harvest records suggest that most seal harvest occurs in the months preceding the proposed August start of the seismic survey, when waning ice conditions provide the best opportunity to approach and kill hauled out seals. Much of the late summer seal harvest occurs in the Colville River as the seals follow fish runs upstream. Still, open-water seal hunting could occur coincident with the seismic surveys, especially bearded seal hunts based from Thetis Island. In general, however, given the relatively low contribution of seals to the Nuiqsut subsistence, and the greater opportunity to hunt seals earlier in the season, any potential impact by the seismic survey on seal hunting is likely remote.

##### *Potential Impacts to Subsistence Uses*

NMFS has defined “unmitigable adverse impact” in 50 CFR 216.103 as: “an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Noise and general activity during SAE’s proposed 3D OBN seismic survey have the potential to impact marine mammals hunted by Native Alaskans. In the case of cetaceans, the most common

reaction to anthropogenic sounds (as noted previously) is avoidance of the ensonified area. In the case of bowhead whales, this often means that the animals divert from their normal migratory path by several kilometers. Additionally, general vessel presence in the vicinity of traditional hunting areas could negatively impact a hunt. Native knowledge indicates that bowhead whales become increasingly "skittish" in the presence of seismic noise. Whales are more wary around the hunters and tend to expose a much smaller portion of their back when surfacing, which makes harvesting more difficult. Additionally, natives report that bowheads exhibit angry behaviors, such as tail-slapping, in the presence of seismic activity, which translate to danger for nearby subsistence harvesters.

Responses of seals to seismic airguns are expected to be negligible. Bain and Williams (2006) studied the responses of harbor seals, California sea lions, and Steller sea lions to seismic airguns and found that seals at exposure levels above 170 dB re 1  $\mu$ Pa (peak-peak) often showed avoidance behavior, including generally staying at the surface and keeping their heads out of the water, but that the responses were not overt, and there were no detectable responses at low exposure levels.

#### *Plan of Cooperation or Measures to Minimize Impacts to Subsistence Hunts*

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a Plan of Cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes.

SAE has prepared a draft POC, which was developed by identifying and evaluating any potential effects the proposed seismic survey might have on seasonal abundance that is relied upon for subsistence use. For the proposed project, SAE states that it is working closely with the North Slope Borough (NSB) and its partner Kuukpik Corporation, to identify subsistence communities and activities that may take place within or near the project area. The draft POC is attached to SAE's IHA application.

As a joint venture partner with Kuukpik, SAE will be working closely with them and the communities on the North Slope to plan operations that will include measures that are environmentally suitable and that do not impact local subsistence use. A Conflict Avoidance Agreement (CAA)

will be developed that will include such measures.

SAE adopted a three-stage process to develop its POC:

*Stage 1:* To open communications SAE has presented the program description to the AEWC during their quarterly meeting in December, 2014. SAE will also be presenting the project at the open water meeting in March 2015 in Anchorage. Collaboration meetings will be held in March and April 2015 with Kuukpik Corporation leaders. Kuukpik Corporation is a joint venture partner in the project. Permits to all federal, state and local government agencies will be submitted in the spring of 2015. Ongoing discussions and meeting with these agencies have been occurring in order to meet our operational window in the project area.

Prior to offshore activities, SAE will meet and consult with nearby communities, namely the North Slope Borough (NSB) planning department and the NSB Fish and Wildlife division. SAE will also present its project during a community meeting in the villages of Nuiqsut, and Kaktovik to discuss the planned activities. The discussions will include the project description, the Plan of Cooperation, resolution of potential conflicts, and proposed operational window. These meetings will help to identify any subsistence conflicts. These meetings will allow SAE to understand community concerns, and requests for communication or mitigation. Additional communications will continue throughout the project.

*Stage 2:* SAE will document results of all meetings and incorporate to mitigate concerns into the POC. There shall be a review of permit stipulations and a permit matrix developed for the crews. The means of communications and contacts list will be developed and implemented into operations. The use of scientific and Inupiat PSOs/Communicators on board the vessels will ensure that appropriate precautions are taken to avoid harassment of marine mammals, including whales, seals, walruses, or polar bears. SAE will coordinate the timing and location of operations with the Com-Centers in Deadhorse and Kaktovik to minimize impact to the subsistence activities or the Nuiqsut/Kaktovik bowhead whale hunt.

*Stage 3:* If a conflict does occur with project activities and subsistence hunting, the SAs will immediately contact the project manager and the Com Center. If avoidance is not possible, the project manager will initiate communication with a representative from the impacted subsistence hunter group(s) to resolve

the issue and to plan an alternative course of action (which may include ceasing operations during the whale hunt).

In addition, the following mitigation measures will be imposed in order to effect the least practicable adverse impact on the availability of marine mammal species for subsistence uses:

(i) Establishment and operations of Communication and Call Centers (Com-Center) Program

- For the purposes of reducing or eliminating conflicts between subsistence whaling activities and SAE's survey program, SAE will participate with other operators in the Com-Center Program. Com-Centers will be operated to facilitate communication of information between SAE and subsistence whalers. The Com-Centers will be operated 24 hours/day during the 2015 fall subsistence bowhead whale hunt.

- All vessels shall report to the appropriate Com-Center at least once every six hours, commencing each day with a call at approximately 06:00 hours.

- The appropriate Com-Center shall be notified if there is any significant change in plans, such as an unannounced start-up of operations or significant deviations from announced course, and that Com-Center shall notify all whalers of such changes. The appropriate Com-Center also shall be called regarding any unsafe or unanticipated ice conditions.

(ii) SAE shall monitor the positions of all of its vessels and exercise due care in avoiding any areas where subsistence activity is active.

(iii) Routing barge and transit vessels:

- Vessels transiting in the Beaufort Sea east of Bullen Point to the Canadian border shall remain at least 5 miles offshore during transit along the coast, provided ice and sea conditions allow. During transit in the Chukchi Sea, vessels shall remain as far offshore as weather and ice conditions allow, and at all times at least 5 miles offshore.

- From August 31 to October 31, vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea, unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement. This condition shall not apply to vessels actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

- Vessels shall be operated at speeds necessary to ensure no physical contact

with whales occurs, and to make any other potential conflicts with bowheads or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

- If any vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

- reducing vessel speed to less than 5 knots within 900 feet of the whale(s);
  - steering around the whale(s) if possible;

- operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

- operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and
  - checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(iv) Limitation on seismic surveys in the Beaufort Sea

- Kaktovik: No seismic survey from the Canadian Border to the Canning River from around August 25 to close of the fall bowhead whale hunt in Kaktovik and Nuiqsut, based on the actual hunt dates. From around August 10 to August 25, based on the actual hunt dates, SAE will communicate and collaborate with the Alaska Eskimo Whaling Commission (AEWC) on any planned vessel movement in and around Kaktovik and Cross Island to avoid impacts to whale hunting.

- Nuiqsut:

- Pt. Storkerson to Thetis Island: No seismic survey prior to July 25 inside the Barrier Islands. No seismic survey from around August 25 to close of fall bowhead whale hunting outside the Barrier Island in Nuiqsut, based on the actual hunt dates.

- Canning River to Pt. Storkerson: No seismic survey from around August 25 to the close of bowhead whale subsistence hunting in Nuiqsut, based on the actual hunt dates.

- Barrow: No seismic survey from Pitt Point on the east side of Smith Bay to a location about half way between Barrow and Peard Bay from September 15 to the close of the fall bowhead whale hunt in Barrow.

(v) SAE shall complete operations in time to allow such vessels to complete transit through the Bering Strait to a point south of 59 degrees North latitude

no later than November 15, 2015. Any vessel that encounters weather or ice that will prevent compliance with this date shall coordinate its transit through the Bering Strait to a point south of 59 degrees North latitude with the appropriate Com-Centers. SAE vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 10 miles from the shore of St. Lawrence Island.

Finally, SAE plans to sign a Conflict Avoidance Agreement (CAA) with the Alaska whaling communities to further ensure that its proposed open-water seismic survey activities in the Beaufort Sea will not have unmitigable impacts to subsistence activities.

#### *Unmitigable Adverse Impact Analysis and Preliminary Determination*

SAE has adopted a spatial and temporal strategy for its 3D OBN seismic survey that should minimize impacts to subsistence hunters and ensure the sufficient availability of species for hunters to meet subsistence needs. SAE will temporarily cease seismic activities during the fall bowhead whale hunt, which will allow the hunt to occur without any adverse impact from SAE's activities. Although some seal hunting co-occurs temporally with SAE's proposed seismic survey, the locations do not overlap, so SAE's activities will not impact the hunting areas and will not directly displace sealers or place physical barriers between the sealers and the seals. In addition, SAE is conducting the seismic surveys in a joint partnership agreement with Kuukpiik Corporation, which allows SAE to work closely with the native communities on the North Slope to plan operations that include measures that are environmentally suitable and that do not impact local subsistence use, and to adjust the operations, if necessary, to minimize any potential impacts that might arise. Based on the description of the specified activity, the measures described to minimize adverse effects on the availability of marine mammals for subsistence purposes, and the proposed mitigation and monitoring measures, NMFS has preliminarily determined that there will not be an unmitigable adverse impact on subsistence uses from SAE's proposed activities.

#### **Endangered Species Act (ESA)**

Within the project area, the bowhead whale is listed as endangered and the ringed seal is listed as threatened under the ESA. NMFS' Permits and Conservation Division has initiated consultation with staff in NMFS' Alaska Region Protected Resources Division

under section 7 of the ESA on the issuance of an IHA to SAE under section 101(a)(5)(D) of the MMPA for this activity. Consultation will be concluded prior to a determination on the issuance of an IHA.

#### **National Environmental Policy Act (NEPA)**

NMFS is preparing an Environmental Assessment (EA), pursuant to NEPA, to determine whether the issuance of an IHA to SAE for its 3D seismic survey in the Beaufort Sea during the 2015 Arctic open-water season may have a significant impact on the human environment. NMFS has released a draft of the EA for public comment along with this proposed IHA.

#### **Proposed Authorization**

As a result of these preliminary determinations, NMFS proposes to issue an IHA to SAE for conducting a 3D OBN seismic survey in Beaufort Sea during the 2015 Arctic open-water season, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

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

(1) This Authorization is valid from July 1, 2015, through October 15, 2015.

(2) This Authorization is valid only for activities associated with open-water 3D seismic surveys and related activities in the Beaufort Sea. The specific areas where SAE's surveys will be conducted are within the Beaufort Sea, Alaska, as shown in Figure 1–1 of SAE's IHA application.

(3)(a) The species authorized for incidental harassment takings, Level A and Level B harassment, are: beluga whales (*Delphinapterus leucas*); bowhead whales (*Balaena mysticetus*); gray whales (*Eschrichtius robustus*); bearded seals (*Erignathus barbatus*); spotted seals (*Phoca largha*); and ringed seals (*P. hispida*) (Table 6).

(3)(b) The authorization for taking by harassment is limited to the following acoustic sources and from the following activities:

(i) 620-in<sup>3</sup> and 1,240-in<sup>3</sup> airgun arrays and other acoustic sources for 3D open-water seismic surveys; and

(ii) Vessel activities related to open-water seismic surveys listed in (i).

(3)(c) The taking of any marine mammal in a manner prohibited under this Authorization must be reported within 24 hours of the taking to the Alaska Regional Administrator (907–586–7221) or his designee in Anchorage

(907–271–3023), National Marine Fisheries Service (NMFS) and the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at (301) 427–8401, or her designee (301–427–8418).

(4) The holder of this Authorization must notify the Chief of the Permits and Conservation Division, Office of Protected Resources, at least 48 hours prior to the start of collecting seismic data (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible).

(5) Prohibitions

(a) The taking, by incidental harassment only, is limited to the species listed under condition 3(a) above and by the numbers listed in Table 6. The taking by serious injury or death of these species or the taking by harassment, injury or death of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this Authorization.

(b) The taking of any marine mammal is prohibited whenever the required source vessel protected species observers (PSOs), required by condition 7(a)(i), are not onboard in conformance with condition 7(a)(i) of this Authorization.

(6) Mitigation

(a) Establishing Exclusion and Disturbance Zones

(i) Establish and monitor with trained PSOs exclusion zones surrounding the 10 in<sup>3</sup> and 620 in<sup>3</sup> airgun arrays on the source vessel where the received level would be 180 and 190 dB (rms) re 1 µPa for cetaceans and pinnipeds, respectively. The sizes of these zones are provided in Table 3.

(ii) Establish and monitor with trained PSOs preliminary exclusion zones surrounding the 1,240 in<sup>3</sup> airgun arrays on the source vessel where the received level would be 180 and 190 dB (rms) re 1 µPa for cetaceans and pinnipeds, respectively. For purposes of the field verification test, described in condition 7(e)(i), these zones are estimated to be 250 m and 910 m from the seismic source for 190 and 180 dB (rms) re 1 µPa, respectively.

(iii) Establish zones of influence (ZOIs) surrounding the 10 in<sup>3</sup> and 620 in<sup>3</sup> airgun arrays on the source vessel where the received level would be 160 (rms) re 1 µPa. The sizes of these zones are provided in Table 3.

(iv) Establish the ZOI surrounding the 1,240 in<sup>3</sup> airgun arrays on the source vessel where the received level would be 160 dB (rms) re 1 µPa for marine mammals. For purposes of the field verification test, described in condition

7(e)(i), the zone is estimated to be 5,200 m from the source.

(v) Immediately upon completion of data analysis of the field verification measurements required under condition 7(e)(i) below, the new 160-dB, 180-dB, and 190-dB marine mammal ZOI and exclusion zones for the 1,240 in<sup>3</sup> airgun array shall be established based on the sound source verification.

(b) Vessel Movement Mitigation:

(i) Avoid concentrations or groups of whales by all vessels under the direction of SAE. Operators of support vessels should, at all times, conduct their activities at the maximum distance possible from such concentrations or groups of whales.

(ii) If any vessel approaches within 1.6 km (1 mi) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

(A) Reducing vessel speed to less than 5 knots within 300 yards (900 feet or 274 m) of the whale(s);

(B) Steering around the whale(s) if possible;

(C) Operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

(D) Operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

(E) Checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(iii) When weather conditions require, such as when visibility drops, adjust vessel speed accordingly, but not to exceed 5 knots, to avoid the likelihood of injury to whales.

(c) Mitigation Measures for Airgun Operations

(i) Ramp-up:

(A) A ramp up, following a cold start, can be applied if the exclusion zone has been free of marine mammals for a consecutive 30-minute period. The entire exclusion zone must have been visible during these 30 minutes. If the entire exclusion zone is not visible, then ramp up from a cold start cannot begin.

(B) If a marine mammal(s) is sighted within the exclusion zone during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the exclusion zone or the animal(s) is not sighted for at least 15 minutes for pinnipeds, or 30 minutes for cetaceans.

(C) If, for any reason, electrical power to the airgun array has been discontinued for a period of 10 minutes or more, ramp-up procedures shall be implemented. If the PSO watch has been suspended during that time, a 30-minute clearance of the exclusion zone is required prior to commencing ramp-up. Discontinuation of airgun activity for less than 10 minutes does not require a ramp-up.

(D) The seismic operator and PSOs shall maintain records of the times when ramp-ups start and when the airgun arrays reach full power.

(ii) Power-down/Shutdown:

(A) The airgun array shall be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable exclusion zone of the full array, but is outside the applicable exclusion zone of the single mitigation airgun.

(B) If a marine mammal is already within or is about to enter the exclusion zone when first detected, the airguns shall be powered down immediately.

(C) Following a power-down, firing of the full airgun array shall not resume until the marine mammal has cleared the exclusion zone. The animal will be considered to have cleared the exclusion zone if it is visually observed to have left the exclusion zone of the full array, or has not been seen within the zone for 15 minutes for pinnipeds, or 30 minutes for cetaceans.

(D) If a marine mammal is sighted within or about to enter the 190 or 180 dB (rms) applicable exclusion zone of the single mitigation airgun, the airgun array shall be shutdown.

(E) Firing of the full airgun array or the mitigation gun shall not resume until the marine mammal has cleared the exclusion zone of the full array or mitigation gun, respectively. The animal will be considered to have cleared the exclusion zone as described above under ramp up procedures.

(iii) Poor Visibility Conditions:

(A) If during foggy conditions, heavy snow or rain, or darkness, the full 180 dB exclusion zone is not visible, the airguns cannot commence a ramp-up procedure from a full shut-down.

(B) If one or more airguns have been operational before nightfall or before the onset of poor visibility conditions, they can remain operational throughout the night or poor visibility conditions. In this case ramp-up procedures can be initiated, even though the exclusion zone may not be visible, on the assumption that marine mammals will be alerted by the sounds from the single airgun and have moved away.

(iv) Use of a Small-volume Airgun During Turns and Transits

(A) Throughout the seismic survey, during turning movements and short transits, SAE will employ the use of the smallest-volume airgun (*i.e.*, “mitigation airgun”) to deter marine mammals from being within the immediate area of the seismic operations. The mitigation airgun would be operated at approximately one shot per minute and would not be operated for longer than three hours in duration (turns may last two to three hours for the proposed project).

(B) During turns or brief transits (*i.e.*, less than three hours) between seismic tracklines, one mitigation airgun will continue operating. The ramp up procedures described above will be followed when increasing the source levels from the one mitigation airgun to the full airgun array. However, keeping one airgun firing during turns and brief transits allow SAE to resume seismic surveys using the full array without having to ramp up from a “cold start,” which requires a 30-minute observation period of the full exclusion zone and is prohibited during darkness or other periods of poor visibility. PSOs will be on duty whenever the airguns are firing during daylight and during the 30-minute periods prior to ramp-ups from a “cold start.”

(d) Mitigation Measures for Subsistence Activities:

(i) For the purposes of reducing or eliminating conflicts between subsistence whaling activities and SAE’s survey program, the holder of this Authorization will participate with other operators in the Communication and Call Centers (Com-Center) Program. Com-Centers will be operated to facilitate communication of information between SAE and subsistence whalers. The Com-Centers will be operated 24 hours/day during the 2015 fall subsistence bowhead whale hunt.

(ii) All vessels shall report to the appropriate Com-Center at least once every six hours, commencing each day with a call at approximately 06:00 hours.

(iii) The appropriate Com-Center shall be notified if there is any significant change in plans. The appropriate Com-Center also shall be called regarding any unsafe or unanticipated ice conditions.

(iv) Upon notification by a Com-Center operator of an at-sea emergency, the holder of this Authorization shall provide such assistance as necessary to prevent the loss of life, if conditions allow the holder of this Authorization to safely do so.

(v) SAE shall monitor the positions of all of its vessels and exercise due care in avoiding any areas where subsistence activity is active.

(vi) Routing barge and transit vessels:

(A) Vessels transiting in the Beaufort Sea east of Bullen Point to the Canadian border shall remain at least 5 miles offshore during transit along the coast, provided ice and sea conditions allow. During transit in the Chukchi Sea, vessels shall remain as far offshore as weather and ice conditions allow, and at all times at least 5 miles offshore.

(B) From August 31 to October 31, vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea, unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement. This condition shall not apply to vessels actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

(C) Vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs, and to make any other potential conflicts with bowheads or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

(D) If any vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

- Reducing vessel speed to less than 5 knots within 900 feet of the whale(s);
- Steering around the whale(s) if possible;
- Operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;
- Operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and
- Checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(vii) Limitation on seismic surveys in the Beaufort Sea

(A) Kaktovik: No seismic survey from the Canadian Border to the Canning River from August 25 to close of the fall bowhead whale hunt in Kaktovik and Nuiqsut. From around August 10 to August 25, based on the actual hunt date, SAE will communicate and collaborate with the Alaska Eskimo Whaling Commission (AEWC) on any planned vessel movement in and

around Kaktovik and Cross Island to avoid impacts to whale hunting.

(B) Nuiqsut:

- Pt. Storkerson to Thetis Island: No seismic survey prior to July 25 inside the Barrier Islands. No seismic survey from around August 25 to close of fall bowhead whale hunting outside the Barrier Island in Nuiqsut, based on actual hunt dates.

- Canning River to Pt. Storkerson: No seismic survey from around August 25 to the close of bowhead whale subsistence hunting in Nuiqsut, based on actual hunt dates.

(C) Barrow: No seismic survey from Pitt Point on the east side of Smith Bay to a location about half way between Barrow and Peard Bay from September 15 to the close of the fall bowhead whale hunt in Barrow.

(viii) SAE shall complete operations in time to allow such vessels to complete transit through the Bering Strait to a point south of 59 degrees North latitude no later than November 15, 2015. Any vessel that encounters weather or ice that will prevent compliance with this date shall coordinate its transit through the Bering Strait to a point south of 59 degrees North latitude with the appropriate Com-Centers. SAE vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 10 miles from the shore of St. Lawrence Island.

(7) Monitoring:

(a) Vessel-based Visual Monitoring:

(i) Vessel-based visual monitoring for marine mammals shall be conducted by NMFS-approved PSOs throughout the period of survey activities.

(ii) PSOs shall be stationed aboard the seismic survey vessels and mitigation vessel through the duration of the surveys.

(iii) A sufficient number of PSOs shall be onboard the survey vessel to meet the following criteria:

(A) 100% monitoring coverage during all periods of survey operations in daylight;

(B) maximum of 4 consecutive hours on watch per PSO; and

(C) maximum of 12 hours of watch time per day per PSO.

(iv) The vessel-based marine mammal monitoring shall provide the basis for real-time mitigation measures as described in (6)(c) above.

(v) Results of the vessel-based marine mammal monitoring shall be used to calculate the estimation of the number of “takes” from the marine surveys and equipment recovery and maintenance program.

(b) Protected Species Observers and Training

(i) PSO teams shall consist of Inupiat observers and NMFS-approved field biologists.

(ii) Experienced field crew leaders shall supervise the PSO teams in the field. New PSOs shall be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations.

(iii) Crew leaders and most other biologists serving as observers in 2015 shall be individuals with experience as observers during recent seismic or shallow hazards monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.

(iv) Resumes for PSO candidates shall be provided to NMFS for review and acceptance of their qualifications. Inupiat observers shall be experienced in the region and familiar with the marine mammals of the area.

(v) All observers shall complete a NMFS-approved observer training course designed to familiarize individuals with monitoring and data collection procedures. The training course shall be completed before the anticipated start of the 2015 open-water season. The training session(s) shall be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based monitoring programs.

(vi) Training for both Alaska native PSOs and biologist PSOs shall be conducted at the same time in the same room. There shall not be separate training courses for the different PSOs.

(vii) Crew members should not be used as primary PSOs because they have other duties and generally do not have the same level of expertise, experience, or training as PSOs, but they could be stationed on the fantail of the vessel to observe the near field, especially the area around the airgun array, and implement a power-down or shutdown if a marine mammal enters the safety zone (or exclusion zone).

(viii) If crew members are to be used as PSOs, they shall go through some basic training consistent with the functions they will be asked to perform. The best approach would be for crew members and PSOs to go through the same training together.

(ix) PSOs shall be trained using visual aids (e.g., videos, photos), to help them identify the species that they are likely to encounter in the conditions under which the animals will likely be seen.

(x) SAE shall train its PSOs to follow a scanning schedule that consistently distributes scanning effort according to the purpose and need for observations. All PSOs should follow the same schedule to ensure consistency in their scanning efforts.

(xi) PSOs shall be trained in documenting the behaviors of marine mammals. PSOs should record the primary behavioral state (*i.e.*, traveling, socializing, feeding, resting, approaching or moving away from vessels) and relative location of the observed marine mammals.

(c) Marine Mammal Observation Protocol

(i) PSOs shall watch for marine mammals from the best available vantage point on the survey vessels, typically the bridge.

(ii) Observations by the PSOs on marine mammal presence and activity shall begin a minimum of 30 minutes prior to the estimated time that the seismic source is to be turned on and/or ramped-up. Monitoring shall continue during the airgun operations and last until 30 minutes after airgun array stops firing.

(iii) For comparison purposes, PSOs shall also document marine mammal occurrence, density, and behavior during at least some periods when airguns are not operating

(iv) PSOs shall scan systematically with the unaided eye and 7 × 50 reticle binoculars, supplemented with 20 × 60 image-stabilized binoculars or 25 × 150 binoculars, and night-vision equipment when needed.

(v) Personnel on the bridge shall assist the marine mammal observer(s) in watching for marine mammals.

(vi) PSOs aboard the marine survey vessel shall give particular attention to the areas within the marine mammal exclusion zones around the source vessel, as noted in (6)(a)(i) and (ii). They shall avoid the tendency to spend too much time evaluating animal behavior or entering data on forms, both of which detract from their primary purpose of monitoring the exclusion zone.

(vii) Monitoring shall consist of recording of the following information:

(A) The species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from seismic vessel, sighting cue, behavioral pace, and apparent reaction of all marine mammals seen near the seismic vessel and/or its airgun array (*e.g.*, none, avoidance, approach, paralleling, etc);

(B) The time, location, heading, speed, and activity of the vessel (shooting or not), along with sea state, visibility, cloud cover and sun glare at (I) any time a marine mammal is sighted (including pinnipeds hauled out on barrier islands), (II) at the start and end of each watch, and (III) during a watch (whenever there is a change in one or more variable);

(C) The identification of all vessels that are visible within 5 km of the seismic vessel whenever a marine mammal is sighted and the time observed;

(D) Any identifiable marine mammal behavioral response (sighting data should be collected in a manner that will not detract from the PSO's ability to detect marine mammals);

(E) Any adjustments made to operating procedures; and

(F) Visibility during observation periods so that total estimates of take can be corrected accordingly.

(vii) Distances to nearby marine mammals will be estimated with binoculars (7 × 50 binoculars) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon. Observers may use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water.

(viii) PSOs shall understand the importance of classifying marine mammals as "unknown" or "unidentified" if they cannot identify the animals to species with confidence. In those cases, they shall note any information that might aid in the identification of the marine mammal sighted. For example, for an unidentified mysticete whale, the observers should record whether the animal had a dorsal fin.

(ix) Additional details about unidentified marine mammal sightings, such as "blow only," mysticete with (or without) a dorsal fin, "seal splash," etc., shall be recorded.

(x) When a marine mammal is seen approaching or within the exclusion zone applicable to that species, the marine survey crew shall be notified immediately so that mitigation measures described in (6) can be promptly implemented.

(xi) SAE shall use the best available technology to improve detection capability during periods of fog and other types of inclement weather. Such technology might include night-vision goggles or binoculars as well as other instruments that incorporate infrared technology.

(d) Field Data-Recording and Verification

(i) PSOs aboard the vessels shall maintain a digital log of seismic surveys, noting the date and time of all changes in seismic activity (ramp-up, power-down, changes in the active seismic source, shutdowns, etc.) and any corresponding changes in monitoring radii in a software spreadsheet.

(ii) PSOs shall utilize a standardized format to record all marine mammal observations and mitigation actions (seismic source power-downs, shut-downs, and ramp-ups).

(iii) Information collected during marine mammal observations shall include the following:

(A) Vessel speed, position, and activity

(B) Date, time, and location of each marine mammal sighting

(C) Number of marine mammals observed, and group size, sex, and age categories

(D) Observer's name and contact information

(E) Weather, visibility, and ice conditions at the time of observation

(F) Estimated distance of marine mammals at closest approach

(G) Activity at the time of observation, including possible attractants present

(H) Animal behavior

(I) Description of the encounter

(J) Duration of encounter

(K) Mitigation action taken

(iv) Data shall be recorded directly into handheld computers or as a back-up, transferred from hard-copy data sheets into an electronic database.

(v) A system for quality control and verification of data shall be facilitated by the pre-season training, supervision by the lead PSOs, and in-season data checks, and shall be built into the software.

(vi) Computerized data validity checks shall also be conducted, and the data shall be managed in such a way that it is easily summarized during and after the field program and transferred into statistical, graphical, or other programs for further processing.

(e) Passive Acoustic Monitoring

(i) Sound Source Measurements: Using a hydrophone system, the holder of this Authorization is required to conduct sound source verification tests for the 1,240 in<sup>3</sup> seismic airgun array, if this array is involved in the open-water seismic surveys.

(A) Sound source verification shall consist of distances where broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB (rms) re 1  $\mu$ Pa for the airgun array(s).

(B) The test results shall be reported to NMFS within 5 days of completing the test.

(ii) SAE shall conduct passive acoustic monitoring using fixed hydrophone(s) to

(A) Collect information on the occurrence and distribution of marine mammals that may be available to subsistence hunters near villages located on the Beaufort Sea coast and to

document their relative abundance, habitat use, and migratory patterns; and

(B) Measure the ambient soundscape throughout the Beaufort Sea coast and to record received levels of sounds from industry and other activities

(g) SAE shall engage in consultation and coordination with other oil and gas companies and with federal, state, and borough agencies to ensure that they have the most up-to-date information and can take advantage of other monitoring efforts.

(8) Data Analysis and Presentation in Reports:

(a) Estimation of potential takes or exposures shall be improved for times with low visibility (such as during fog or darkness) through interpolation or possibly using a probability approach. Those data could be used to interpolate possible takes during periods of restricted visibility.

(b) SAE shall provide a database of the information collected, plus a number of summary analyses and graphics to help NMFS assess the potential impacts of SAE's survey. Specific summaries/analyses/graphics would include:

(i) Sound verification results, including isopleths of sound pressure levels plotted geographically;

(ii) A table or other summary of survey activities (*i.e.*, did the survey proceed as planned);

(iii) A table of sightings by time, location, species, and distance from the survey vessel;

(iv) A geographic depiction of sightings for each species by area and month;

(v) A table and/or graphic summarizing behaviors observed by species;

(vi) A table and/or graphic summarizing observed responses to the survey by species;

(vii) A table of mitigation measures (*e.g.*, power-downs, shutdowns) taken by date, location, and species;

(viii) A graphic of sightings by distance for each species and location;

(ix) A table or graphic illustrating sightings during the survey versus sightings when the airguns were silent; and

(x) A summary of times when the survey was interrupted because of interactions with marine mammals.

(c) To help evaluate the effectiveness of PSOs and more effectively estimate take, if appropriate data are available, SAE shall perform analysis of sightability curves (detection functions) for distance-based analyses.

(d) SAE shall collaborate with other industrial operators in the area to integrate and synthesize monitoring

results as much as possible (such as submitting "sightings" from their monitoring projects to an online data archive, such as OBIS-SEAMAP) and archive and make the complete databases available upon request.

(9) Reporting:

(a) Sound Source Verification Report: A report on the preliminary results of the sound source verification measurements, including the measured 190, 180, 160, and 120 dB (rms) radii of the 1,240 in<sup>3</sup> airgun array, shall be submitted within 14 days after collection of those measurements at the start of the field season. This report will specify the distances of the exclusion zones that were adopted for the survey.

(b) Throughout the survey program, PSOs shall prepare a report each day, or at such other interval as is necessary, summarizing the recent results of the monitoring program. The reports shall summarize the species and numbers of marine mammals sighted. These reports shall be provided to NMFS.

(c) Weekly Reports: SAE will submit weekly reports to NMFS no later than the close of business (Alaska Time) each Thursday during the weeks when seismic surveys take place. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-water activities, and the number of marine mammals exposed to harassment level noise.

(d) Monthly Reports: SAE will submit monthly reports to NMFS for all months during which seismic surveys take place. The monthly reports will contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort Sea state and wind force), and associated activities during the seismic survey and marine mammal sightings.

(ii) Species, number, location, distance from the vessel, and behavior of any sighted marine mammals, as well as associated surveys (number of shutdowns), observed throughout all monitoring activities.

(iii) An estimate of the number (by species) of:

(A) Pinnipeds that have been exposed to the seismic surveys (based on visual observation) at received levels greater than or equal to 160 dB re 1  $\mu$ Pa (rms) and/or 190 dB re 1  $\mu$ Pa (rms) with a discussion of any specific behaviors those individuals exhibited; and

(B) Cetaceans that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1  $\mu$ Pa (rms) and/or 180 dB re 1  $\mu$ Pa (rms) with



a discussion of any specific behaviors those individuals exhibited.

(e) Seismic Vessel Monitoring Program: A draft report will be submitted to the Director, Office of Protected Resources, NMFS, within 90 days after the end of SAE's 2015 open-water seismic surveys in the Beaufort Sea. The report will describe in detail:

(i) Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(ii) Summaries that represent an initial level of interpretation of the efficacy, measurements, and observations, rather than raw data, fully processed analyses, or a summary of operations and important observations;

(iii) Summaries of all mitigation measures (e.g., operational shutdowns if they occur) and an assessment of the efficacy of the monitoring methods;

(iv) Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

(v) Species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover;

(vi) Data analysis separated into periods when an airgun array (or a single airgun) is operating and when it is not, to better assess impacts to marine mammals;

(vii) Sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability), such as:

(A) Initial sighting distances versus airgun activity state;

(B) Closest point of approach versus airgun activity state;

(C) Observed behaviors and types of movements versus airgun activity state;

(D) Numbers of sightings/individuals seen versus airgun activity state;

(E) Distribution around the survey vessel versus airgun activity state; and

(F) Estimates of take by harassment;

(viii) Reported results from all hypothesis tests, including estimates of the associated statistical power, when practicable;

(ix) Estimates of uncertainty in all take estimates, with uncertainty expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, or another applicable method, with the exact approach to be selected based on the sampling method and data available;

(x) A clear comparison of authorized takes and the level of actual estimated takes; and

(xi) A complete characterization of the acoustic footprint resulting from various activity states.

(d) The draft report shall be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. The draft report will be considered the final report for this activity under this Authorization if NMFS has not provided comments and recommendations within 90 days of receipt of the draft report.

(10) (a) In the unanticipated event that survey operations clearly cause the take of a marine mammal in a manner prohibited by this Authorization, such as an serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), SAE shall immediately cease survey operations and immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to [Jolie.Harrison@noaa.gov](mailto:Jolie.Harrison@noaa.gov) and [Shane.Guan@noaa.gov](mailto:Shane.Guan@noaa.gov) and the Alaska Regional Stranding Coordinators ([Aleria.Jensen@noaa.gov](mailto:Aleria.Jensen@noaa.gov) and [Barbara.Mahoney@noaa.gov](mailto:Barbara.Mahoney@noaa.gov)). The report must include the following information:

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

(ii) The name and type of vessel involved;

(iii) The vessel's speed during and leading up to the incident;

(iv) Description of the incident;

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

(vi) Water depth;

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

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

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

(x) The fate of the animal(s); and

(xi) Photographs or video footage of the animal (if equipment is available).

(b) Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with SAE to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. SAE may not resume their activities until notified by NMFS via letter, email, or telephone.

(c) In the event that SAE 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 described in the next paragraph), SAE will immediately report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to [Jolie.Harrison@noaa.gov](mailto:Jolie.Harrison@noaa.gov) and [Shane.Guan@noaa.gov](mailto:Shane.Guan@noaa.gov) and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators ([Aleria.Jensen@noaa.gov](mailto:Aleria.Jensen@noaa.gov) and [Barbara.Mahoney@noaa.gov](mailto:Barbara.Mahoney@noaa.gov)). The report must include the same information identified in Condition 10(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with SAE to determine whether modifications in the activities are appropriate.

(d) In the event that SAE 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 activities authorized in Condition 3 of this Authorization (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), SAE shall report the incident to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to [Jolie.Harrison@noaa.gov](mailto:Jolie.Harrison@noaa.gov) and [Shane.Guan@noaa.gov](mailto:Shane.Guan@noaa.gov) and the NMFS Alaska Stranding Hotline (1-877-925-7773) and/or by email to the Alaska Regional Stranding Coordinators ([Aleria.Jensen@noaa.gov](mailto:Aleria.Jensen@noaa.gov) and [Barbara.Mahoney@noaa.gov](mailto:Barbara.Mahoney@noaa.gov)), within 24 hours of the discovery. SAE shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. SAE can continue its operations under such a case.

(11) Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

(12) The Plan of Cooperation outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses, must be implemented.

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

is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

(14) A copy of this Authorization and the Incidental Take Statement must be in the possession of each seismic vessel operator taking marine mammals under the authority of this Incidental Harassment Authorization.

(15) SAE is required to comply with the Terms and Conditions of the

Incidental Take Statement corresponding to NMFS' Biological Opinion.

#### **Request for Public Comments**

NMFS requests comment on our analysis, the draft authorization, and any other aspect of the Notice of Proposed IHA for SAE's proposed 3D seismic survey in the Beaufort Sea. Please include with your comments any

supporting data or literature citations to help inform our final decision on SAE's request for an MMPA authorization.

Dated: April 8, 2015.

**Wanda Cain,**

*Acting Director, Office of Protected Resources,  
National Marine Fisheries Service.*

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