

DEPARTMENT OF COMMERCE**National Oceanic and Atmospheric Administration****RIN 0648-XY11****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 received an application from BP Exploration (Alaska), Inc. (BP) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment only, incidental to a proposed 3-dimensional (3D) ocean bottom cable (OBC) seismic survey in the Simpson Lagoon area of the Alaskan Beaufort Sea during the open water season of 2012. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to BP to take, by Level B harassment, 11 species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than May 31, 2012.

ADDRESSES: Comments on the application should be addressed to Tammy Adams, Acting 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*. NMFS is not responsible for email comments sent to addresses other than the one provided here. Comments sent via email, including all attachments, must not exceed a 10-megabyte file size.

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#applications> 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.

A copy of the application used in this document 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#applications>. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

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.

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."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization.

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

NMFS received an application on December 20, 2011, from BP for the taking, by harassment, of marine mammals incidental to a 3D OBC seismic survey in the Simpson Lagoon area of the Alaskan Beaufort Sea during the open water season of 2012.

Description of the Specified Activity

The proposed seismic survey utilizes receivers (hydrophones and geophones) connected to a cable that would be deployed from a vessel to the seabed or would be inserted in the seabed in very shallow water areas near the shoreline. The generation of 3D seismic images requires the deployment of many parallel cables spaced close together over the area of interest. Therefore, OBC seismic surveys require the use of multiple vessels for cable deployment and recovery, data recording, airgun operation, re-supply, and support. The proposed 3D OBC seismic survey in Simpson Lagoon would be conducted by CGGVeritas.

Seismic Source Arrays

A total of three seismic source vessels (two main source vessels and one mini source vessel) would be used during the proposed survey. The sources would be arrays of sleeve airguns. Each main source vessel would carry an array that consists of two sub-arrays. Each sub-array contains eight 40 in³ airguns, totaling 16 guns per main source vessel with a total discharge volume of 2 × 320 in³, or 640 in³. This 640 in³ array has an estimated source level of ~223 dB re 1 µPa (rms). The mini source vessel would contain one array with eight 40 in³ airguns for a total discharge volume of 320 in³. The estimated source level of this 320 in³ array is 212 dB re 1 µPa (rms).

The arrays of the main source vessels would be towed at a distance of ~30 feet (ft, or 10 m) from the stern at 6 ft (2 m) depth, which is remotely adjustable if needed. The array of the mini source vessel would be towed at a distance of ~20 ft (7 m) from the stern at 3 ft (1 m) depth, also remotely adjustable when needed. The source vessels will travel along pre-determined lines with a speed varying from ~1 to 5 knots, mainly depending on the water depth. To limit the duration of the total survey, the source vessels would be operating in a flip-flop mode, with the operating source vessels alternating shots; this

means that one vessel discharges airguns when the other vessel is recharging. Outside the barrier islands, the two main source vessels would be operating with expected shot intervals of 8 to 10 seconds, resulting in a shot every 4 to 5 seconds due to the flip-flop mode of operation. Inside the barrier islands all three vessels (the two main source vessels and the mini vessel) may be operating at the same time in this manner. The exact shot intervals would depend on the compressor capacity, which determines the time needed for the airguns to be recharged. Seismic data acquisition would be conducted 24 hours per day.

Receivers and Recording Units

The survey area in Simpson Lagoon has water depths of 0 to 9 ft (0 to 3 m) between the shore and barrier islands and 3 to 45 ft (1 to 15 m) depths north of the barrier islands. Because different types of receivers would be used for different habitats, the survey area is categorized by the terms onshore, islands, surf-zone and offshore. Onshore is the area from the coastline inland. Islands are the barrier islands. Surf zone is the 0 to 6 ft (0 to 2 m) water depths along the onshore coastline. Offshore is defined as depths of 3 ft (1 m) or more. There is a zone between 3 and 6 ft (1 and 2 m) which may be categorized both as surf zone and as offshore.

The receivers that would be deployed in water consist of multiple hydrophones and recorder units (Field Digitizing Units or FDUs) placed on Sercel ULS cables. Approximately 5,000 hydrophones would be connected to the ULS cable at a minimum of 82.5 ft (27.5 m) intervals and secured to the ocean bottom cable. Surface markers and acoustic pingers will be attached to the cable at various intervals to ensure that the battery packs can be located and retrieved when needed and to determine exact positions for the hydrophones. This equipment would be deployed and retrieved with cable boats. The data

received at each FDU would be transmitted through the cables to a recorder for further processing. This recorder will be installed on a boat-barge combination and positioned close to the area where data are being acquired. While recording, the boat-barge combination is stationary and expected to utilize a two or four point anchoring system.

In the surf-zone, receivers (hydrophones or geophones) would be bored or flushed up to 12 ft (4 m) below the seabed. These receivers will transmit data through a cable (as described above) and have an attached line to facilitate retrieval after recording is completed.

Autonomous recorders (nodes) would be used onshore and on the islands. The node is located on the ground and its geophone would be inserted into the ground by hand with the use of a planting pole. Deployment of the autonomous receiver units would be done by a lay-out crew on the ground using helicopters for personnel and equipment transport and/or approved summer travel vehicles (onshore) and a support boat (for the islands). Data from nodes can be remotely retrieved from a distance (up to a kilometer). Retrieval of data may be from a boat or a helicopter. Equipment would be picked up after recording is complete.

Survey Design

The total area of the proposed seismic survey is approximately 110 mi², which includes onshore, surf-zone, barrier islands, and offshore (see Figure 1.2 of the BP's IHA application). For the proposed survey, the receiver cables with hydrophones and recording units would be oriented in an east-west direction. A total of approximately 44 receiver lines would be deployed at the seafloor with 1,100–1,650 ft (367–550 m) line spacing. Total receiver line length would be approximately 500 miles (825 km). The source vessel would travel perpendicular over the offshore receiver cables along lines

oriented in a north-south direction. These lines would have a length of approximately 3.75 miles (6.2 km) and a minimum spacing of 660 ft (220 m). The total length of all source lines is approximately 4,000 miles (6,600 km), including line turns.

The position of each receiver deployed onshore, in the surf zone and on the barrier islands will be determined using Global Positioning System (GPS) positioning units. Due to the variable bathymetry of the survey area, determining positions of receivers deployed in water may require more than one technique. A combination of Ocean Bottom Receiver Location (OBRL), GPS and acoustic pingers will be used. For OBRL, the source vessel fires a precisely positioned single energy source multiple times along either side of the receiver cables. Production data may also be used instead of dedicated OBRL acquisition. Multiple energy sources are used to triangulate a given receiver position. In addition, Sonardyne acoustical pingers would be located at predetermined intervals on the receiver lines. The pingers are located on the ULS cables and transmit a signal to a transponder mounted on a vessel. This allows for an interpolation of the receiver locations between the acoustical pingers on the ULS cable and also serves as a verification of the OBRL method. The Sonardyne pingers transmit at 19–36 kHz and have a source level of 188–193 dB re μPa at 1m.

Vessels and Other Equipment

The proposed Simpson Lagoon OBC seismic survey would involve 14 to 16 vessels, as listed in Table 1 below. The contracting of vessels has not been finalized to date. However, BP states it would contract vessels with parameters similar to those described in this table. If contracted vessels differ significantly from those described, BP would submit an amendment to address these changes where required.

TABLE 1—SUMMARY OF NUMBER AND TYPE OF VESSELS INVOLVED IN THE PROPOSED SIMPSON LAGOON OBC SEISMIC SURVEY

[The dimensions provided are approximate]

Vessel type	Number	Dimensions	Main activity	Frequency
Source Vessel: Main	2	71 × 20 ft	Seismic data acquisition inside and outside barrier islands.	24-hr operation.
Source Vessel: Mini	1	55 × 15 ft	Seismic data acquisition inside barrier islands ..	24-hr operation.
Recorder barge with tug boat.	1	116.5 × 24 ft (barge); ... 23 × 15 ft (tug)	Seismic data recording	24-hr operation.
Cable boats	5–6	42.6 × 13 ft	Deploy and retrieve receiver cables (with hydrophones/geophones).	24-hr operation.
Crew transport vessels	2	44 × 14 ft	Transport crew and supplies to and from the working vessels.	Intermittently, minimum every 8 hours.

TABLE 1—SUMMARY OF NUMBER AND TYPE OF VESSELS INVOLVED IN THE PROPOSED SIMPSON LAGOON OBC SEISMIC SURVEY—Continued

[The dimensions provided are approximate]

Vessel type	Number	Dimensions	Main activity	Frequency
Shallow water crew and support boats.	2–3	34 × 10.5 ft	Transport 2–5 people and small amounts of gear for the boats operating in the shallower parts of the survey area.	Intermittently.
HSSE vessel	1	38 × 15 ft	Support SSV measurements, HSSE (health, safety, security, and environmental) compliance.	As required.

To deploy and retrieve receivers in water depths less than those accessible by the cable boats (surf-zone), equipment such as airboats, buggies or an Arktos (amphibious craft) and/or Jon boats may be used. Helicopters and/or approved tundra travel vehicles would be used for deployment of receiver units onshore as well on the barrier islands. In the case of helicopters being used, the flight altitude would be at 1,500 feet for 3 to 6 times each day during gear deployment and retrieval on barrier islands and on shore (i.e., for about 14 days in late July and early August for deployment and for about 14 days probably after the Cross Island hunt, which typically ends around September 10).

Vessels and other equipment would be transported to the North Slope in late May/early June by trucks. Equipment would be staged at the CGGVeritas pad for preparation. Vessel preparation would include assembly of navigation and source equipment, cable deployment and retrieval systems and safety equipment. Once assembled, vessels would be launched at either West Dock or Milne Point. Deployment, retrieval, navigation and source systems will then be tested near West Dock or in the project area prior to commencement of operations.

Crew Housing and Transfer

The total number of people that would be involved is about 220, including crew on boats, camp personnel, mechanics, and management. There are no accommodations available on the source vessels or cable boats for the crew directly involved in the seismic operations, so crews would be changed out every 8 to 12 hours. Two vessels would be used for crew transfers.

The recorder barge/boat (*M/V Alaganik* and *Hook Point*) may accommodate up to 10 people. The barge portion is dedicated to recording and staging of cables, hydrophones and batteries and fuelling operations.

Refueling of vessels would be via other vessels at sea, and from land based

sources located at West Dock and Milne Point Unit following approved U.S. Coast Guard procedures. Sea states and the vessel's function will be the determining factors on which method is used.

Dates, Duration and Action Area

BP seeks an incidental harassment authorization for the period July 1 to October 15, 2012. Anticipated duration of seismic data acquisition is approximately 50 days, depending on weather and other circumstances. Transportation of vessels to West Dock would occur by road in late May/early June. It is not anticipated that vessels would need to transit by sea; however, in case this does occur the transit would take place when ice conditions allow and in consideration of the spring beluga and bowhead hunt in the Chukchi Sea.

The project area encompasses 110 mi² in Simpson Lagoon, Beaufort Sea, Alaska. The approximate boundaries of the total surface area are between 70°28' N and 70°39' N and between 149°24'W and 149°55' W (Figure 1.2 of BP's IHA application). About 46 mi² (41.8%) of the survey area is located inside the barrier islands in water depths of 0 to 9 ft (0 to 3 m), and 36 mi² (32.7%) outside the barrier islands in water depths of 3 to 45 ft (1 to 15 m). The remaining 28 mi² (25.5%) of the survey area is located on land (onshore and barrier islands), which is solely being used for deployment of the receivers. The planned start date of seismic data acquisition offshore of the barrier islands is July 1, 2012, depending on the presence of ice. Open water seismic operations can only start when the project area is ice free (i.e. < 10% ice coverage), which in this area normally occurs around mid-July (+/– 14 days). Limited layout of receiver cables might be possible on land and barrier islands before the ice has cleared. To limit potential impacts to the bowhead whale migration and the subsistence hunt, no airgun operations would take place in the area north of the barrier islands after August 25, 2012.

Surf zone geophone retrieval may continue for a brief period after airgun operations are complete.

Description of Marine Mammals in the Area of the Specified Activity

The marine mammal species under NMFS jurisdiction most likely to occur in the seismic survey area include three cetacean species, beluga (*Delphinapterus leucas*), bowhead whales (*Balaena mysticetus*), and gray whales (*Eschrichtius robustus*), and three pinniped species, ringed (*Phoca hispida*), spotted (*P. largha*), and bearded seals (*Erignathus barbatus*).

Five additional cetacean species: Harbor porpoise (*Phocoena phocoena*), narwhal (*Monodon monoceros*), killer whale (*Orcinus orca*), humpback whale (*Megaptera novaeangliae*), and minke whale (*Balaenoptera acutorostrata*) could also occur in the project area. However, these cetacean species are rare or extralimital to the Beaufort Sea and less likely to be encountered in the Simpson Lagoon area. BP did not request take for narwhal as it is very unlikely that this species would be encountered during the BP's proposed seismic survey.

Ribbon seals (*Histriophoca fasciata*) occur mainly in the western part of the Beaufort Sea and are rare in the proposed action area in the Simpson Lagoon of the Beaufort Sea.

The bowhead whale is listed as “endangered” under the Endangered Species Act (ESA) and as depleted under the MMPA. Certain stocks or populations of gray and beluga whales and spotted seals are listed as endangered or proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. Additionally, the ribbon seal is considered a “species of concern”, meaning that NMFS has some concerns regarding status and threats of this species, but for which insufficient information is available to indicate a need to list the species under the ESA. Bearded and ringed seals are “candidate species” under the ESA, meaning they

are currently being considered for listing.

The Alaska stock of bearded seals, part of the Beringia distinct population segment (DPS), has been proposed by NMFS for listing as threatened under the ESA (75 FR 77496; December 10, 2011).

The Alaska stock of ringed seals is not currently listed as endangered, and is not classified as a strategic stock by NMFS. However, there is increasing concern about the future of the ringed seal due to receding ice conditions and potential habitat loss. NMFS conducted a status review for the ringed seal (Kelly *et al.* 2010a), and has proposed to list the Arctic stock of ringed seals as threatened under the ESA due to threats from global warming (75 FR 77476; December 10, 2011).

The final decisions for listing are expected to be made in summer 2012.

BP's application contains information on the status, distribution, seasonal distribution, and abundance of each of the species under NMFS jurisdiction mentioned in this document. Please refer to the application for that information (see **ADDRESSES**). Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2011 SAR is available at: <http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2011.pdf>.

Potential Effects of the Specified Activity on Marine Mammals

Operating active acoustic sources such as airgun arrays, pinger systems, and vessel activities have the potential for adverse effects on marine mammals.

Potential Effects of Airgun Sounds on Marine Mammals

The effects of sounds from airgun pulses might include one or more of the following: Tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects (Richardson *et al.* 1995). As outlined in previous NMFS documents, the effects of noise on marine mammals are highly variable, and can be categorized as follows (based on Richardson *et al.* 1995):

(1) Behavioral Disturbance

Marine mammals may behaviorally react to sound when exposed to anthropogenic noise. 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 noise 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 could be expected to be biologically significant if the change affects growth, survival, and reproduction. Some of these potential 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
- Cease feeding or social interaction.

For example, at the Guerreo Negro Lagoon in Baja California, Mexico, which is one of the important breeding grounds for Pacific gray whales, shipping and dredging associated with a salt works may have induced gray whales to abandon the area through most of the 1960s (Bryant *et al.* 1984). After these activities stopped, the lagoon was reoccupied, first by single whales and later by cow-calf pairs.

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) and is also difficult to predict (Southall *et al.* 2007).

Currently NMFS uses 160 dB re 1 μ Pa (rms) at received level for impulse noises (such as airgun pulses) as the threshold for the onset of marine mammal behavioral harassment.

In addition, behavioral disturbance is also expressed as the change in vocal activities of animals. For example, there is one recent summary report indicating that calling fin whales distributed in one part of the North Atlantic went silent for an extended period starting soon after the onset of a seismic survey in the area (Clark and Gagnon 2006). It is not clear from that preliminary paper whether the whales ceased calling because of masking, or whether this was a behavioral response not directly involving masking (i.e., important biological signals for marine mammals being "masked" by anthropogenic noise; see below). Also, bowhead whales in the Beaufort Sea may decrease their call rates in response to seismic operations, although movement out of the area

might also have contributed to the lower call detection rate (Blackwell *et al.* 2009a; 2009b). Some of the changes in marine mammal vocal communication are thought to be used to compensate for acoustic masking resulting from increased anthropogenic noise (see below). 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 2009). The North Atlantic right whales (*Eubalaena glacialis*) exposed to high shipping noise increase call frequency (Parks *et al.* 2007) and intensity (Parks *et al.* 2010), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller *et al.* 2000). These behavioral responses could also have adverse effects on marine mammals.

Mysticete: Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales are often reported to show no overt reactions to airgun pulses at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances (reviewed in Richardson *et al.* 1995; Gordon *et al.* 2004). However, studies done since the late 1990s of migrating humpback and migrating bowhead whales show reactions, including avoidance, that sometimes extend to greater distances than documented earlier. Therefore, it appears that behavioral disturbance can vary greatly depending on context, and not just received levels alone.

Avoidance distances often exceed the distances at which boat-based observers can see whales, so observations from the source vessel can be biased.

Observations over broader areas may be needed to determine the range of potential effects of some large-source seismic surveys where effects on cetaceans may extend to considerable distances (Richardson *et al.* 1999; Moore and Angliss 2006). Longer-range observations, when required, can sometimes be obtained via systematic aerial surveys or aircraft-based observations of behavior (e.g., Richardson *et al.* 1986, 1999; Miller *et al.* 1999, 2005; Yazvenko *et al.* 2007a, 2007b) or by use of observers on one or more support vessels operating in coordination with the seismic vessel (e.g., Smulter *et al.* 2004; Johnson *et al.* 2007). However, the presence of other vessels near the source vessel can, at least at times, reduce sightability of cetaceans from the source vessel (Beland *et al.* 2009), thus complicating interpretation of sighting data.

Some baleen whales show considerable tolerance of seismic

pulses. However, when the pulses are strong enough, avoidance or other behavioral changes become evident. Because the responses become less obvious with diminishing received sound level, it has been difficult to determine the maximum distance (or minimum received sound level) at which reactions to seismic activity become evident and, hence, how many whales are affected.

Studies of gray, bowhead, and humpback whales have determined that received levels of pulses in the 160–170 dB re 1 μ Pa (rms) range seem to cause obvious avoidance behavior in a substantial fraction of the animals exposed (McCauley *et al.* 1998, 1999, 2000). In many areas, seismic pulses diminish to these levels at distances ranging from 4–15 km from the source. A substantial proportion of the baleen whales within such distances may show avoidance or other strong disturbance reactions to the operating airgun array. Some extreme examples including migrating bowhead whales avoiding considerably larger distances (20–30 km) and lower received sound levels (120–130 dB re 1 μ Pa (rms)) when exposed to airguns from seismic surveys. Also, even in cases where there is no conspicuous avoidance or change in activity upon exposure to sound pulses from distant seismic operations, there are sometimes subtle changes in behavior (e.g., surfacing–respiration–dive cycles) that are only evident through detailed statistical analysis (e.g., Richardson *et al.* 1986; Gailey *et al.* 2007).

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. It is not known whether impulsive sounds affect reproductive rate or distribution and habitat use in subsequent days or years. However, gray whales have 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; Richardson *et al.* 1995), and there has been a substantial increase in the population over recent decades (Allen and Angliss 2010). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a prior year (Johnson *et al.* 2007). Similarly, bowhead whales have 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), and their numbers have increased notably (Allen and Angliss 2010).

Bowheads also have been observed over periods of days or weeks in areas ensonified repeatedly by seismic pulses (Richardson *et al.* 1987; Harris *et al.* 2007). However, it is generally not known whether the same individual bowheads were involved in these repeated observations (within and between years) in strongly ensonified areas.

Odontocete: Little systematic information is available about reactions of toothed whales to airgun pulses. Few studies similar to the more extensive baleen whale/seismic pulse work summarized above have been reported for toothed whales. However, there are recent systematic data on sperm whales (e.g., Gordon *et al.* 2006; Madsen *et al.* 2006; Winsor and Mate 2006; Jochens *et al.* 2008; Miller *et al.* 2009). There is also an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (e.g., Stone 2003; Smulter *et al.* 2004; Moulton and Miller 2005; Holst *et al.* 2006; Stone and Tasker 2006; Potter *et al.* 2007; Hauser *et al.* 2008; Holst and Smulter 2008; Weir 2008; Barkaszi *et al.* 2009; Richardson *et al.* 2009).

Dolphins and porpoises are often seen by observers on active seismic vessels, occasionally at close distances (e.g., bow riding). Marine mammal monitoring data during seismic surveys often show that animal detection rates drop during the firing of seismic airguns, indicating that animals may be avoiding the vicinity of the seismic area (Smulter *et al.* 2004; Holst *et al.* 2006; Hauser *et al.* 2008; Holst and Smulter 2008; Richardson *et al.* 2009). Also, belugas summering in the Canadian Beaufort Sea showed larger-scale avoidance, tending to avoid waters out to 10–20 km from operating seismic vessels. In contrast, recent studies show little evidence of conspicuous reactions by sperm whales to airgun pulses, contrary to earlier indications (e.g., Gordon *et al.* 2006; Stone and Tasker 2006; Winsor and Mate 2006; Jochens *et al.* 2008), except the lower buzz (echolocation signals) rates that were detected during exposure of airgun pulses (Miller *et al.* 2009).

There are almost no specific data on responses of beaked whales to seismic surveys, but it is likely that most if not all species show strong avoidance. There is increasing evidence that some beaked whales may strand after exposure to strong noise from tactical military mid-frequency sonars. Whether they ever do so in response to seismic survey noise is unknown. Northern bottlenose whales seem to continue to

call when exposed to pulses from distant seismic vessels.

For delphinids, and possibly the Dall's porpoise, the available data suggest that a ≥ 170 dB re 1 μ Pa (rms) disturbance criterion (rather than ≥ 160 dB) would be appropriate. With a medium-to-large airgun array, received levels typically diminish to 170 dB within 1–4 km, whereas levels typically remain above 160 dB out to 4–15 km (e.g., Tolstoy *et al.* 2009). Reaction distances for delphinids are more consistent with the typical 170 dB re 1 μ Pa (rms) distances. Stone (2003) and Stone and Tasker (2006) reported that all small odontocetes (including killer whales) observed during seismic surveys in UK waters remained significantly further from the source during periods of shooting on surveys with large volume airgun arrays than during periods without airgun shooting.

Due to their relatively higher frequency hearing ranges when compared to mysticetes, odontocetes may have stronger responses to mid- and high-frequency sources such as sub-bottom profilers, side scan sonar, and echo sounders than mysticetes (Richardson *et al.* 1995; Southall *et al.* 2007).

Pinnipeds: Few studies of the reactions of pinnipeds to noise from open-water seismic exploration have been published (for review of the early literature, see Richardson *et al.* 1995). However, pinnipeds have been observed during a number of seismic monitoring studies. Monitoring in the Beaufort Sea during 1996–2002 provided a substantial amount of information on avoidance responses (or lack thereof) and associated behavior. Additional monitoring of that type has been done in the Beaufort and Chukchi Seas in 2006–2009. Pinnipeds exposed to seismic surveys have also been observed during seismic surveys along the U.S. west coast. Also, there are data on the reactions of pinnipeds to various other related types of impulsive sounds.

Early observations provided considerable evidence that pinnipeds are often quite tolerant of strong pulsed sounds. During seismic exploration off Nova Scotia, gray seals exposed to noise from airguns and linear explosive charges reportedly did not react strongly (J. Parsons in Greene *et al.* 1985). An airgun caused an initial startle reaction among South African fur seals but was ineffective in scaring them away from fishing gear. Pinnipeds in both water and air sometimes tolerate strong noise pulses from non-explosive and explosive scaring devices, especially if attracted to the area for feeding or reproduction (Mate and Harvey 1987;

Reeves *et al.* 1996). Thus, pinnipeds are expected to be rather tolerant of, or to habituate to, repeated underwater sounds from distant seismic sources, at least when the animals are strongly attracted to the area.

In summary, visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds, and only slight (if any) changes in behavior. These studies show that many pinnipeds do not avoid the area within a few hundred meters of an operating airgun array. However, based on the studies with large sample size, or observations from a separate monitoring vessel, or radio telemetry, it is apparent that some phocid seals do show localized avoidance of operating airguns. The limited nature of this tendency for avoidance is a concern. It suggests that one cannot rely on pinnipeds to move away, or to move very far away, before received levels of sound from an approaching seismic survey vessel approach those that may cause hearing impairment.

(2) Masking

Chronic exposure to excessive, though not high-intensity, noise could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Since marine mammals depend on acoustic cues for vital biological functions, such as orientation, communication, finding prey, and avoiding predators, marine mammals that experience severe (intensity and duration) acoustic masking could potentially suffer reduced fitness, which could lead to adverse effects on survival and reproduction.

Masking occurs when noise and signals (that animal utilizes) overlap at both spectral and temporal scales. For the airgun noise generated from the proposed marine seismic survey, these are low frequency (under 1 kHz) pulses with extremely short durations (in the scale of milliseconds). Lower frequency man-made noises 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 due to the brief duration of these pulses and relatively longer silence between airgun shots (9–12 seconds) near the noise source, however, at long distances (over tens of kilometers away) in deep water, due to multipath propagation and

reverberation, the durations of airgun pulses can be “stretched” to seconds with long decays (Madsen *et al.* 2006; Clark and Gagnon 2006). Therefore it 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.* 2009a, 2009b) and affect their vocal behavior (e.g., Foote *et al.* 2004; Holt *et al.* 2009). Further, in areas of shallow water, multipath propagation of airgun pulses could be more profound, thus affecting communication signals from marine mammals even at close distances. Average ambient noise in areas where received seismic noises are heard can be elevated. At long distances, however, the intensity of the noise is greatly reduced. Nevertheless, partial informational and energetic masking of different degrees could affect signal receiving in some marine mammals within the ensonified areas. Additional research is needed to further address these effects.

Although masking effects of pulsed sounds on marine mammal calls and other natural sounds are expected to be limited, there are few specific studies on this. Some whales continue calling in the presence of seismic pulses and whale calls often can be heard between the seismic pulses (e.g., Richardson *et al.* 1986; McDonald *et al.* 1995; Greene *et al.* 1999a, 1999b; Nieukirk *et al.* 2004; Smulter *et al.* 2004; Holst *et al.* 2005a, 2005b, 2006; Dunn and Hernandez 2009).

Among the odontocetes, there has been one report that sperm whales ceased calling when exposed to pulses from a very distant seismic ship (Bowles *et al.* 1994). However, more recent studies of sperm whales found that they continued calling in the presence of seismic pulses (Madsen *et al.* 2002; Tyack *et al.* 2003; Smulter *et al.* 2004; Holst *et al.* 2006; Jochens *et al.* 2008). Madsen *et al.* (2006) noted that airgun sounds would not be expected to mask sperm whale calls given the intermittent nature of airgun pulses. Dolphins and porpoises are also commonly heard calling while airguns are operating (Gordon *et al.* 2004; Smulter *et al.* 2004; Holst *et al.* 2005a, 2005b; Potter *et al.* 2007). Masking effects of seismic pulses are expected to be negligible in the case of the smaller odontocetes, given the intermittent nature of seismic pulses plus the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds.

Pinnipeds have best hearing sensitivity and/or produce most of their sounds at frequencies higher than the

dominant components of airgun sound, but there is some overlap in the frequencies of the airgun pulses and the calls. However, the intermittent nature of airgun pulses presumably reduces the potential for masking.

Marine mammals are thought to be able to compensate for masking by adjusting their acoustic behavior such as shifting call frequencies, and increasing call volume and vocalization rates, as discussed earlier (e.g., Miller *et al.* 2000; Parks *et al.* 2007; Di Lorio and Clark 2009; Parks *et al.* 2010); the biological significance of these modifications is still unknown.

(3) Hearing Impairment

Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2002; 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is unrecoverable, or temporary (TTS), in which case the animal's hearing threshold will recover over time (Southall *et al.* 2007). Marine mammals that experience TTS or PTS will have reduced sensitivity at the frequency band of the TS, which may affect their capability of communication, orientation, or prey detection. The degree of TS depends on the intensity of the received levels the animal is exposed to, and the frequency at which TS occurs depends on the frequency of the received noise. It has been shown that in most cases, TS occurs at the frequencies approximately one-octave above that of the received noise. Repeated noise exposure that leads to TTS could cause PTS. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound.

TTS

TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. It is a temporary phenomenon, and (especially when mild) is not considered to represent physical damage or “injury” (Southall *et al.* 2007). Rather, the onset of TTS is an indicator that, if the animal is exposed to higher levels of that sound, physical damage is ultimately a possibility.

The magnitude of TTS depends on the level and duration of noise exposure, and to some degree on frequency, among other considerations (Kryter

1985; Richardson *et al.* 1995; Southall *et al.* 2007). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity recovers rapidly after exposure to the noise ends. In terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days. Only a few data have been obtained on sound levels and durations necessary to elicit mild TTS in marine mammals (none in mysticetes), and none of the published data concern TTS elicited by exposure to multiple pulses of sound during operational seismic surveys (Southall *et al.* 2007).

For toothed whales, experiments on a bottlenose dolphin (*Tursiops truncates*) and beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (or 30 psi) peak-to-peak (p-p), which is equivalent to 228 dB re 1 μ Pa (p-p), resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within 4 minutes of the exposure (Finneran *et al.* 2002). No TTS was observed in the bottlenose dolphin.

Finneran *et al.* (2005) further examined the effects of tone duration on TTS in bottlenose dolphins. Bottlenose dolphins were exposed to 3 kHz tones (non-impulsive) for periods of 1, 2, 4 or 8 seconds (s), with hearing tested at 4.5 kHz. For 1-s exposures, TTS occurred with SELs of 197 dB, and for exposures >1 s, SEL >195 dB resulted in TTS (SEL is equivalent to energy flux, in dB re 1 μ Pa²-s). At an SEL of 195 dB, the mean TTS (4 min after exposure) was 2.8 dB. Finneran *et al.* (2005) suggested that an SEL of 195 dB is the likely threshold for the onset of TTS in dolphins and belugas exposed to tones of durations 1–8 s (i.e., TTS onset occurs at a near-constant SEL, independent of exposure duration). That implies that, at least for non-impulsive tones, a doubling of exposure time results in a 3 dB lower TTS threshold.

However, the assumption that, in marine mammals, the occurrence and magnitude of TTS is a function of cumulative acoustic energy (SEL) is probably an oversimplification. Kastak *et al.* (2005) reported preliminary evidence from pinnipeds that, for prolonged non-impulse noise, higher SELs were required to elicit a given TTS if exposure duration was short than if it was longer, i.e., the results were not fully consistent with an equal-energy model to predict TTS onset. Mooney *et al.* (2009a) showed this in a bottlenose dolphin exposed to octave-band non-impulse noise ranging from 4 to 8 kHz at SPLs of 130 to 178 dB re 1 μ Pa for periods of 1.88 to 30 minutes (min).

Higher SELs were required to induce a given TTS if exposure duration was short than if it was longer. Exposure of the aforementioned bottlenose dolphin to a sequence of brief sonar signals showed that, with those brief (but non-impulse) sounds, the received energy (SEL) necessary to elicit TTS was higher than was the case with exposure to the more prolonged octave-band noise (Mooney *et al.* 2009b). Those authors concluded that, when using (non-impulse) acoustic signals of duration ~0.5 s, SEL must be at least 210–214 dB re 1 μ Pa²-s to induce TTS in the bottlenose dolphin. The most recent studies conducted by Finneran *et al.* also support the notion that exposure duration has a more significant influence compared to SPL as the duration increases, and that TTS growth data are better represented as functions of SPL and duration rather than SEL alone (Finneran *et al.* 2010a, 2010b). In addition, Finneran *et al.* (2010b) conclude that when animals are exposed to intermittent noises, there is recovery of hearing during the quiet intervals between exposures through the accumulation of TTS across multiple exposures. Such findings suggest that when exposed to multiple seismic pulses, partial hearing recovery also occurs during the seismic pulse intervals.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those to which odontocetes are most sensitive, and natural ambient noise levels at those low frequencies tend to be higher (Urick 1983). As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales. However, no cases of TTS are expected given the small size of the airguns proposed to be used and the strong likelihood that baleen whales (especially migrating bowheads) would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes

exposed for similar durations (Kastak *et al.* 1999; 2005). However, more recent indications are that TTS onset in the most sensitive pinniped species studied (harbor seal, which is closely related to the ringed seal) may occur at a similar SEL as in odontocetes (Kastak *et al.* 2004).

Most cetaceans show some degree of avoidance of seismic vessels operating an airgun array (see above). It is unlikely that these cetaceans would be exposed to airgun pulses at a sufficiently high level for a sufficiently long period to cause more than mild TTS, given the relative movement of the vessel and the marine mammal. TTS would be more likely in any odontocetes that bow- or wake-ride or otherwise linger near the airguns. However, while bow- or wake-riding, odontocetes would be at the surface and thus not exposed to strong sound pulses given the pressure release and Lloyd Mirror effects at the surface. But if bow- or wake-riding animals were to dive intermittently near airguns, they would be exposed to strong sound pulses, possibly repeatedly.

If some cetaceans did incur mild or moderate TTS through exposure to airgun sounds in this manner, this would very likely be a temporary and reversible phenomenon. However, even a temporary reduction in hearing sensitivity could be deleterious in the event that, during that period of reduced sensitivity, a marine mammal needed its full hearing sensitivity to detect approaching predators, or for some other reason.

Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent as those of cetaceans. Pinnipeds occasionally seem to be attracted to operating seismic vessels. There are no specific data on TTS thresholds of pinnipeds exposed to single or multiple low-frequency pulses. However, given the indirect indications of a lower TTS threshold for the harbor seal than for odontocetes exposed to impulse sound (see above), it is possible that some pinnipeds close to a large airgun array could incur TTS.

NMFS currently typically includes mitigation requirements to ensure that cetaceans and pinnipeds are not exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μ Pa (rms). The 180/190 dB acoustic criteria were taken from recommendations by an expert panel of the High Energy Seismic Survey (HESS) Team that performed an assessment on noise impacts by seismic airguns to marine mammals in 1997, although the HESS Team recommended a 180-dB limit for pinnipeds in California (HESS

1999). The 180 and 190 dB re 1 μ Pa (rms) levels have not been considered to be the levels above which TTS might occur. Rather, they were the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized above, data that are now available imply that TTS is unlikely to occur in various odontocetes (and probably mysticetes as well) unless they are exposed to a sequence of several airgun pulses stronger than 190 dB re 1 μ Pa (rms). On the other hand, for the harbor seal, harbor porpoise, and perhaps some other species, TTS may occur upon exposure to one or more airgun pulses whose received level equals the NMFS "do not exceed" value of 190 dB re 1 μ Pa (rms). That criterion corresponds to a single-pulse SEL of 175–180 dB re 1 μ Pa²-s in typical conditions, whereas TTS is suspected to be possible in harbor seals and harbor porpoises with a cumulative SEL of ~171 and ~164 dB re 1 μ Pa²-s, respectively.

It has been shown that most large whales and many smaller odontocetes (especially the harbor porpoise) show at least localized avoidance of ships and/or seismic operations. Even when avoidance is limited to the area within a few hundred meters of an airgun array, that should usually be sufficient to avoid TTS based on what is currently known about thresholds for TTS onset in cetaceans. In addition, ramping up airgun arrays, which is standard operational protocol for many seismic operators, may allow cetaceans near the airguns at the time of startup (if the sounds are aversive) to move away from the seismic source and to avoid being exposed to the full acoustic output of the airgun array. Thus, most baleen whales likely will not be exposed to high levels of airgun sounds provided the ramp-up procedure is applied. Likewise, many odontocetes close to the trackline are likely to move away before the sounds from an approaching seismic vessel become sufficiently strong for there to be any potential for TTS or other hearing impairment. Hence, there is little potential for baleen whales or odontocetes that show avoidance of ships or airguns to be close enough to an airgun array to experience TTS. Nevertheless, even if marine mammals were to experience TTS, the magnitude of the TTS is expected to be mild and brief, only in a few decibels for minutes.

PTS

When PTS occurs, there is physical damage to the sound receptors in the ear. In some cases, there can be total or partial deafness, whereas in other cases, the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Physical damage to a mammal's hearing apparatus can occur if it is exposed to sound impulses that have very high peak pressures, especially if they have very short rise times. (Rise time is the interval required for sound pressure to increase from the baseline pressure to peak pressure.)

There is no specific evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns. However, given the likelihood that some mammals close to an airgun array might incur at least mild TTS (see above), there has been further speculation about the possibility that some individuals occurring very close to airguns might incur PTS (e.g., Richardson *et al.* 1995; Gedamke *et al.* 2008). Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, but are assumed to be similar to those in humans and other terrestrial mammals (Southall *et al.* 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as airgun pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis, and probably >6 dB higher (Southall *et al.* 2007). The low-to-moderate levels of TTS that have been induced in captive odontocetes and pinnipeds during controlled studies of TTS have been confirmed to be temporary, with no measurable residual PTS (Kastak *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2002; 2005; Nachtigall *et al.* 2003; 2004). However, very prolonged exposure to sound 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 (Kryter 1985). In terrestrial mammals, the received sound level from a single non-impulsive sound exposure must be far above the TTS threshold for any risk of permanent hearing damage (Kryter 1994; Richardson *et al.* 1995; Southall *et al.* 2007). However, there is special concern about strong sounds whose pulses have very rapid rise times. In terrestrial mammals, there are situations

when pulses with rapid rise times (e.g., from explosions) can result in PTS even though their peak levels are only a few dB higher than the level causing slight TTS. The rise time of airgun pulses is fast, but not as fast as that of an explosion.

Some factors that contribute to onset of PTS, at least in terrestrial mammals, are as follows:

- Exposure to a single very intense sound,
- Fast rise time from baseline to peak pressure,
- Repetitive exposure to intense sounds that individually cause TTS but not PTS, and
- Recurrent ear infections or (in captive animals) exposure to certain drugs.

Cavanagh (2000) reviewed the thresholds used to define TTS and PTS. Based on this review and SACLANT (1998), it is reasonable to assume that PTS might occur at a received sound level 20 dB or more above that inducing mild TTS. However, for PTS to occur at a received level only 20 dB above the TTS threshold, the animal probably would have to be exposed to a strong sound for an extended period, or to a strong sound with a rather rapid rise time.

More recently, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB, on an SEL basis, for there to be risk of PTS. Thus, for cetaceans exposed to a sequence of sound pulses, they estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of ~198 dB re 1 μ Pa²-s. Additional assumptions had to be made to derive a corresponding estimate for pinnipeds, as the only available data on TTS-thresholds in pinnipeds pertained to nonimpulse sound (see above). Southall *et al.* (2007) estimated that the PTS threshold could be a cumulative SEL of ~186 dB re 1 μ Pa²-s in the case of a harbor seal exposed to impulse sound. The PTS threshold for the California sea lion and northern elephant seal would probably be higher given the higher TTS thresholds in those species. Southall *et al.* (2007) also note that, regardless of the SEL, there is concern about the possibility of PTS if a cetacean or pinniped received one or more pulses with peak pressure exceeding 230 or 218 dB re 1 μ Pa, respectively. Thus, PTS might be expected upon exposure of cetaceans to either SEL \geq 198 dB re 1 μ Pa²-s or peak pressure \geq 230 dB re 1 μ Pa. Corresponding proposed dual criteria for pinnipeds (at least harbor seals) are \geq 186 dB SEL and \geq 218 dB peak pressure (Southall *et al.* 2007).

These estimates are all first approximations, given the limited underlying data, assumptions, species differences, and evidence that the “equal energy” model may not be entirely correct.

Sound impulse duration, peak amplitude, rise time, number of pulses, and inter-pulse interval are the main factors thought to determine the onset and extent of PTS. Ketten (1994) has noted that the criteria for differentiating the sound pressure levels that result in PTS (or TTS) are location and species specific. PTS effects may also be influenced strongly by the health of the receiver’s ear.

As described above for TTS, in estimating the amount of sound energy required to elicit the onset of TTS (and PTS), it is assumed that the auditory effect of a given cumulative SEL from a series of pulses is the same as if that amount of sound energy were received as a single strong sound. There are no data from marine mammals concerning the occurrence or magnitude of a potential partial recovery effect between pulses. In deriving the estimates of PTS (and TTS) thresholds quoted here, Southall *et al.* (2007) made the precautionary assumption that no recovery would occur between pulses.

It is unlikely that an odontocete would remain close enough to a large airgun array for sufficiently long to incur PTS. There is some concern about bowriding odontocetes, but for animals at or near the surface, auditory effects are reduced by Lloyd’s mirror and surface release effects. The presence of the vessel between the airgun array and bow-riding odontocetes could also, in some but probably not all cases, reduce the levels received by bow-riding animals (e.g., Gabriele and Kipple 2009). The TTS (and thus PTS) thresholds of baleen whales are unknown but, as an interim measure, assumed to be no lower than those of odontocetes. Also, baleen whales generally avoid the immediate area around operating seismic vessels, so it is unlikely that a baleen whale could incur PTS from exposure to airgun pulses. The TTS (and thus PTS) thresholds of some pinnipeds (e.g., harbor seal) as well as the harbor porpoise may be lower (Kastak *et al.* 2005; Southall *et al.* 2007; Lucke *et al.* 2009). If so, TTS and potentially PTS may extend to a somewhat greater distance for those animals. Again, Lloyd’s mirror and surface release effects will ameliorate the effects for animals at or near the surface.

(4) Non-Auditory Physical Effects

Non-auditory physical effects might occur in marine mammals exposed to

strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include 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 intense sounds. However, there is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns, and beaked whales do not occur in the proposed project area. In addition, marine mammals that show behavioral avoidance of seismic vessels, including most baleen whales, some odontocetes (including belugas), and some pinnipeds, are especially unlikely to incur non-auditory impairment or other physical effects.

Therefore, it is unlikely that such effects would occur during BPXA’s proposed surveys given the brief duration of exposure and the planned monitoring and mitigation measures described later in this document.

Additional non-auditory effects include elevated levels of stress response (Wright *et al.* 2007; Wright and Highfill 2007). Although not many studies have been done on noise-induced stress in marine mammals, extrapolation of information regarding stress responses in other species seems applicable because the responses are highly consistent among all species in which they have been examined to date (Wright *et al.* 2007). Therefore, it is reasonable to conclude that noise acts as a stressor to marine mammals. Furthermore, given that marine mammals will likely respond in a manner consistent with other species studied, repeated and prolonged exposures to stressors (including or induced by noise) could potentially be problematic for marine mammals of all ages. Wright *et al.* (2007) state that a range of issues may arise from an extended stress response including, but not limited to, suppression of reproduction (physiologically and behaviorally), accelerated aging and sickness-like symptoms. However, as mentioned above, BPXA’s proposed activity is not expected to result in these severe effects due to the nature of the potential sound exposure.

(5) Stranding and Mortality

Marine mammals close to underwater detonations 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, while stranding and mortality events would include other energy sources (acoustical or shock wave) far beyond just seismic airguns. 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.

However, in numerous past IHA notices for seismic surveys, commenters have referenced two stranding events allegedly associated with seismic activities, one off Baja California and a second off Brazil. NMFS has addressed this concern several times, and, without new information, does not believe that this issue warrants further discussion. For information relevant to strandings of marine mammals, readers are encouraged to review NMFS’ response to comments on this matter found in 69 FR 74906 (December 14, 2004), 71 FR 43112 (July 31, 2006), 71 FR 50027 (August 24, 2006), and 71 FR 49418 (August 23, 2006).

It should be noted that strandings related to sound exposure have not been recorded for marine mammal species in the Beaufort Sea. NMFS notes that in the Beaufort Sea, aerial surveys have been conducted by MMS and industry during periods of industrial activity (and by MMS during times with no activity). No strandings or marine mammals in distress have been observed during these surveys and none have been reported by North Slope Borough inhabitants. In addition, there are very few instances that seismic surveys in general have been linked to marine mammal strandings, other than those mentioned above. As a result, NMFS does not expect any marine mammals will incur serious injury or mortality in the Arctic Ocean or strand as a result of the proposed seismic survey.

Potential Effects of Pinger Signals

A pinger system (Sonardyne Acoustical Pingers) and acoustic releases/transponders would be used during seismic operations to position the receivers and locate and retrieve the batteries. Sounds transmitted by these pingers are characterized by very short pulses. The Sonardyne pinger has a source level ranging from ~188–193 dB re 1 µPa at 1 m in a frequency range of 19–36 kHz and the transponder has source levels ~192 dB re 1 µPa at 1 m in a frequency range of 7–15 kHz. Pulses are emitted on command from the operator aboard the source vessel.

The pinger produces sounds within the frequency range that could be detected by some seals (functional

underwater hearing estimated at 75 Hz to 75 kHz), baleen whales (hearing sensitivity from few tens of Hz to ~10 kHz), and beluga whales (peak sensitivity at ~10–15 kHz) (Southall *et al.* 2007). However, marine mammal communications will not be masked appreciably by the pinger signals because of the relatively low power output, low duty cycle, and brief period when an individual mammal is likely to be within the area where they could potentially be exposed.

Marine mammal behavioral reactions to pulsed sound sources such as airguns are discussed above, and responses to pinger sounds are likely similar if received at the same levels. However, the pulsed signals from the pinger are much weaker than those from the airgun and will propagate over shorter distances. Therefore, behavioral responses are not expected unless marine mammals are very close (within tens of meters) to the source. The maximum reaction that might be expected would be a startle reaction or other short-term response.

Source levels of the pinger are much lower than those of the airguns, which are discussed above. It is unlikely that the pinger produces pulse levels strong enough to cause temporary hearing impairment or (especially) physical injuries even in an animal that is (briefly) in a position near the source.

Vessel Sounds

In addition to the noise generated from seismic airguns, various types of vessels will be used in the operations, including source vessels, recorder/cable vessels, and various support vessels. Sounds from boats and vessels have been reported extensively (Greene and Moore 1995; Blackwell and Greene 2002; 2005; 2006). Numerous measurements of underwater vessel sound have been performed in support of recent industry activity in the Chukchi and Beaufort Seas. Results of these measurements have been reported in various 90-day and comprehensive reports since 2007 (e.g., Aerts *et al.* 2008; Hauser *et al.* 2008; Brueggeman 2009; Ireland *et al.* 2009; Hartin *et al.* 2011). For example, Garner and Hannay (2009) estimated sound pressure levels of 100 dB at distances ranging from approximately 1.5 to 2.3 mi (2.4 to 3.7 km) from various types of barges. MacDonald *et al.* (2008) estimated higher underwater SPLs from the seismic vessel *Gilavar* of 120 dB at approximately 13 mi (21 km) from the source, although the sound level was only 150 dB at 85 ft (26 m) from the vessel. Compared to airgun pulses,

underwater sound from vessels is generally at relatively low frequencies.

The primary sources of sounds from all vessel classes are propeller cavitation, propeller singing, and propulsion or other machinery. Propeller cavitation is usually the dominant noise source for vessels (Ross 1976). Propeller cavitation and singing are produced outside the hull, whereas propulsion or other machinery noise originates inside the hull. There are additional sounds produced by vessel activity, such as pumps, generators, flow noise from water passing over the hull, and bubbles breaking in the wake.

Anticipated Effects on Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by airguns and vessels operating in the area. However, other potential impacts to the surrounding habitat from physical disturbance are also possible.

Potential Impacts on Prey Species

With regard to fish as a prey source for cetaceans and pinnipeds, 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.

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 non-pulse signals (such as noise from vessels) (Blaxter *et al.* 1981), 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 capelin 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.* 1995).

Further, during the seismic survey only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species would be short-term and fish would return to their pre-disturbance behavior once the seismic activity ceases (McCauley *et al.* 2000a, 2000b; Santulli *et al.* 1999; Pearson *et al.* 1992). Thus, the proposed survey would have little, if any, impact on the abilities of marine mammals to feed in the area where seismic work is planned.

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, and others feed intermittently during their westward migration in September and October (Richardson and Thomson [eds.] 2002; Lowry *et al.* 2004). A reaction by zooplankton to a seismic impulse 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 source. Impacts on zooplankton behavior are predicted to be negligible, and that would translate into negligible impacts on feeding mysticetes. Thus, the proposed activity is not expected to have any habitat-related effects on prey species that could cause significant or long-term consequences for individual marine mammals or their populations.

Potential Impacts on Availability of Affected Species or Stock for Taking for Subsistence Uses

Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives and represent between 60% and 80% of their total subsistence harvest. The species regularly harvested by subsistence hunters in and around the Beaufort Sea are bowhead and beluga whales, ringed, spotted, and bearded seals, and polar bears. The latter is not discussed in this section, as polar bears do not fall under the jurisdiction of NMFS. The importance of each of the subsistence species varies among the communities and is mainly based on availability and season.

The communities closest to the project area are, from west to east, the villages of Barrow, Nuiqsut, and Kaktovik. Barrow is located about 180 miles west from the survey area. It is the largest community on the Alaska's Beaufort Sea coast with a population of 4,351 in 2004 (DCED 2005). Important marine subsistence resources for Barrow include bowhead and beluga whales, ice seals, polar bears, and walrus. Nuiqsut is located near the mouth of the Colville River, about 35 miles southwest of the project area and had a population of 430 in 2004 (DCED 2005). The most important marine subsistence resource for Nuiqsut is the bowhead whale, and to a lesser extent beluga whales, polar bears and seals. Nuiqsut hunters use Cross Island as a base to hunt for bowhead whales during the fall migration and have historically hunted bowhead whales as far east as Flaxman Island. Kaktovik is located on Barter Island, about 150 miles east of the project area and had a population of 284 in 2004 (DCED 2005). Major marine subsistence resources include bowhead and beluga whales, seals, and polar bears. Approximately 50% of Kaktovik households participate in fall whaling (Fuller and George 1999).

(1) Bowhead Whales

The bowhead whale is a critical subsistence and cultural resource for the North Slope communities of Barrow, Nuiqsut and Kaktovik. Contemporary whaling in Kaktovik dates from 1964 and in Nuiqsut from 1973 (EDAW/AECOM 2007; Galginaitis and Koski 2002). The number of boats used or owned in 2011 by the subsistence whaling crew of the villages of Kaktovik, Nuiqsut, and Barrow was 8, 12, and 40, respectively. These numbers presumably change from year to year.

Bowhead harvesting in Barrow occurs both during the spring (April–May) and fall (September–October) when the whales migrate relatively close to shore (ADNR 2009). During spring bowheads migrate through open ice leads close to shore. The hunt takes place from the ice using umiaks (bearded seal skin boats). During the fall, whaling is shore-based and boats may travel up to 30 miles a day (EDAW/AECOM 2007). Although in Barrow historically most whales were taken during spring whaling, the efficiency of the spring harvest tends to be lower than the autumn harvest due to ice and weather conditions as well as struck whales escaping under the ice (Suydam *et al.* 2010). In the past few years the bowhead fall hunt has become increasingly important. Between 1993–2010, Barrow landed an average of 22 bowhead whales per year.

Nuiqsut and Kaktovik hunters harvest bowhead whales only during the fall. The bowhead spring migration in the Beaufort Sea occurs too far from shore for hunting because ice leads do not open up nearshore (ADNR 2009). In Nuiqsut, whaling takes place from early September through mid-to-late September as the whales migrate west (EDAW/AECOM 2007). Three to five whaling crews base themselves at Cross Island, a barrier island approximately 35 miles east of the Simpson Lagoon survey area. Nuiqsut whalers harvest an average of 3 bowheads each year.

Whaling from Kaktovik also occurs in the fall, primarily from late August through late September or early October (EDAW/AECOM 2007). Kaktovik whalers hunt from the Okpilak and Hulahula rivers east to Tapkaurak Point (ADNR 2009). Whaling activities are staged from the community rather than remote camps; most whaling takes place within 12 miles of the community (ADNR 2009). Kaktovik whalers harvest an average of 3 bowhead whales each year.

(2) Beluga Whales

The harvest of beluga whales is managed cooperatively through an agreement between NMFS and the Alaska Beluga Whale Committee (ABWC). From 2002–2006, 5–43 beluga whales were harvested annually from the Beaufort Sea stock (Allen and Angliss 2010), with a mean annual take of 25.4 animals. Few beluga whales are harvested by either Nuiqsut or Kaktovik.

(3) Ice Seals

Seals represent an important subsistence resource for the North Slope communities. Harvest of bearded seals usually takes place during the spring and summer open water season from Barrow (EDAW/AECOM 2007) with only a few animals taken by hunters from Kaktovik or Nuiqsut. Seals are also taken during the ice-covered season, with peak hunting occurring in February (ADNR 2009). In 2003, Barrow-based hunters harvested 776 bearded seals, 413 ringed seals and 12 spotted seals (ADNR 2009). Nuiqsut hunters harvest seals in an area from Cape Halkett to Foggy Island Bay. For the period 2000–2001, Nuiqsut hunters harvested one bearded seal and 25 ringed seals (ADNR 2009). Kaktovik hunters also hunt seals year-round. In 2002–2003, hunters harvested 8 bearded seals and 17 ringed seals.

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.

Seismic surveys 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 in this document) is avoidance of the ensonified area. In the case of bowhead whales, this often means that the animals could divert from their normal migratory path by up several kilometers. Additionally, general vessel presence in the vicinity of traditional hunting areas could negatively impact a hunt.

In the case of subsistence hunts for bowhead whales in the Beaufort Sea, there could be an adverse impact on the hunt if the whales were deflected seaward (further from shore) in traditional hunting areas. The impact would be that whaling crews would have to travel greater distances to intercept westward migrating whales, thereby creating a safety hazard for whaling crews and/or limiting chances of successfully striking and landing bowheads.

The proposed seismic survey would take place between July and September. The project area is located approximately 35 miles northeast from Nuiqsut, 35 miles west from Cross Island, 150 miles west from Kaktovik and 180 miles east from Barrow. Potential impact from the planned activities is expected mainly from sounds generated by the vessel and during active airgun deployment. Due to the timing of the project and the distance from the surrounding communities, it is anticipated to have no effects on spring harvesting and little or no effects on the occasional summer harvest of beluga whale, subsistence seal hunts (ringed and spotted seals are primarily harvested in winter while bearded seals are hunted during July–September in the Beaufort Sea), or the fall bowhead hunt. The community of Nuiqsut may begin fall whaling activities in late August to early September from Cross Island (east of the survey area), and their efforts are typically focused on whales approaching Cross Island so that any harvest would occur before whales approached the survey area. As part of

the planned mitigation measures (see below), BP plans to complete those portions of the survey area outside of the barrier islands prior to August 25, 2012. All seismic activities after this date would take place inshore of the barrier islands, thus avoiding subsistence bowhead hunt in the area.

Finally, BP has signed a Conflict Avoidance Agreement (CAA) and will prepare a Plan of Cooperation under 50 CFR 216.104 Article 12 of the MMPA to address potential impacts on subsistence seal hunting activities. The CAA identifies what measures have been or will be taken to minimize adverse impacts of the planned activities on subsistence harvesting (see below for more details). BP will meet with the AEWG and communities' Whaling Captains' Associations as part of the CAA development, to establish avoidance guidelines and other mitigation measures to be followed where the proposed activities may have an impact on subsistence.

Proposed Mitigation

In order to issue an incidental take authorization 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 adverse 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.

For the proposed BP open-water seismic survey in the Beaufort Sea, BP worked with NMFS and proposed the following mitigation measures to minimize the potential impacts to marine mammals in the project vicinity as a result of the marine seismic survey activities.

The proposed mitigation measures are divided into the following major groups: (1) Sound source measurements, (2) Establishing exclusion and disturbance zones, (3) Vessel and helicopter related

mitigation measures, and (4) Mitigation measures for airgun operations. 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), therefore it's very unlikely potential injury or TTS to marine mammals would occur, and Level B behavioral of marine mammals would be reduced to the lowest level practicable.

(1) Sound Source Measurements

The acoustic monitoring program has two objectives: (1) To verify the modeled distances to the exclusion and disturbance zones from the 640 in³ and 320 in³ airgun arrays and to provide corrected distances to the PSOs; and (2) to measure vessel sounds (i.e., received levels referenced to 1 m from the sound source) of each representative vessel of the seismic fleet, to obtain information on the sounds produced by these vessels.

Verification and Establishment of Exclusion and Disturbance Zones

Acoustic measurements to calculate received sound levels as a function of distance from the airgun sound source will be conducted within 72 hours of initiation of the seismic survey. These measurements will be conducted according to a standard protocol for the 640 in³ array, the 320 in³ array and the 40 in³ gun, both inside and outside the barrier islands. The results of these acoustic measurements will be used to re-define, if needed, the distances to received levels of 190, 180, 160 and 120 dB. The distances of the received levels as a function of the different sound sources (varying discharge volumes) will be used to guide power-down and ramp-up procedures. A preliminary report describing the methodology and results of the verification for at least the 190 dB and 180 dB (rms) exclusion zones will be submitted to NMFS within

14 days of completion of the measurements.

Measurements of Vessel Sounds

BP intends to measure vessel sounds of each representative vessel. The exact scope of the source level measurements (back-calculated as received levels at 1 m from the source) will follow a pre-defined protocol to eliminate the complex interplay of factors that underlie such measurements, such as bathymetry, vessel activity, location, season, etc. Where possible and practical the monitoring protocol will be developed in alignment with other existing vessel source level measurements.

(2) 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 ≥ 180 dB re 1 μ Pa (rms) for cetaceans and ≥ 190 dB re 1 μ Pa (rms) 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 that 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).

An acoustic propagation model, i.e., JASCO's Marine Operations Noise Model (MONM), was used to estimate the distances to received sound levels of 190, 180, 170, 160, and 120 dB re 1 μ Pa (rms) for pulsed sounds from the 640 in³ and 320 in³ airgun arrays. Modeling methodology and results are described in detail in the appendix of the BP's IHA application (Warner and Hipsey 2011). Table 2 summarizes the distances from the source to specific received sound levels based on MONM modeling.

TABLE 2—ESTIMATED DISTANCES TO SPECIFIED RECEIVED SPL (RMS) FROM AIRGUN ARRAYS WITH A TOTAL DISCHARGE VOLUME OF 640 IN³, 320 IN³, AND 40 IN³

Received levels (dB re 1 μ Pa rms)	Distance in meters (inside barrier islands)			Distance in meters (outside barrier islands)	
	640 in ³	320 in ³	40 in ³	640 in ³	40 in ³
190	310	160	16	120	<50
180	750	480	59	950	<50
170	1,200	930	300	2,500	120
160	1,800	1,500	700	5,500	810
120	6,400	5,700	3,700	44,000	16,000

Note: Values are based on 2 m tow depth for the 640 in³ and 40 in³ array, and a 1 m tow depth for the 320 in³ array.

The distances to received sound levels of 160 dB re 1 μ Pa (rms) of the 640 in³ airgun array were used to calculate the numbers of marine mammals potentially harassed by the activities. The distances to received levels of 180 dB and 190 dB re 1 μ Pa (rms) are mainly relevant as exclusion radii to avoid level A harassment of marine mammals through implementation of shut down and power down measures (see details below).

(3) Vessel and Helicopter Related Mitigation Measures

This proposed mitigation measures apply to all vessels that are part of the Simpson Lagoon seismic survey, including crew transfer vessels.

- Vessel operators shall avoid concentrations or groups of whales and vessels shall not be operated in a way that separates members of a group. In proximity of feeding whales or aggregations, vessel speed shall be less than 10 knots.
- When within 900 feet (300 m) of whales vessel operators shall take every effort and precaution to avoid harassment of these animals by:
 - Reducing speed and steering around (groups of) whales if circumstances allow, but never cutting off a whale's travel path;
 - Avoiding multiple changes in direction and speed.
- Vessel operators shall check the waters immediately adjacent to a vessel to ensure that no marine mammals will be injured when the vessel's propellers (or screws) are engaged.
- To minimize collision risk with marine mammals, vessels shall not be operated at speeds that would make collisions with whales likely. When weather conditions require, such as when visibility drops, vessels shall adjust speed accordingly to avoid the likelihood of injury to whales.
- Sightings of dead marine mammals would be reported immediately to the BP representative. BP is responsible for ensuring reporting of the sightings according to the guidelines provided by NMFS.
- In the event that any aircraft (such as helicopters) are used to support the planned survey, the mitigation measures below would apply:
 - Under no circumstances, other than an emergency, shall aircraft be operated at an altitude lower than 1,000 feet above sea level (ASL) when within 0.3 mile (0.5 km) of groups of whales.
 - Helicopters shall not hover or circle

above or within 0.3 mile (0.5 km) of groups of whales.

(4) Mitigation Measures for Airgun Operations

The primary role for airgun mitigation during seismic survey is to monitor marine mammals near the seismic source vessel during all daylight airgun operations and during any nighttime start-up of the airguns. During the seismic survey 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

Ramp up procedures for an airgun array involve a step-wise increase in the number of operating airguns until the required discharge volume is achieved. The purpose of a ramp up (sometimes also referred to as soft start) is to provide marine mammals in the vicinity of the activity the opportunity to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

The rate of ramp up shall be no more than 6 dB of source level per 5 min period. A common procedure is to double the number of operating airguns at 5-min intervals, starting with the smallest gun in the array. BP states that it intends to double the number of airguns operating at 5 minute intervals during ramp up. For the 640 cu in airgun array of the Simpson Lagoon seismic survey this is estimated to take 20 minutes, and for the 320 in³ array 15 minutes. During ramp up, the safety zone for the full airgun array will be observed. The ramp up procedures will be applied as follows:

- 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.
- Ramp up procedures from a cold start will be delayed if a marine mammal is sighted within the exclusion zone during the 30-minute period prior to the ramp up. The delay will last until the marine mammal(s) has been observed to leave the exclusion zone or until the animal(s) is not sighted for at least 15 or 30 minutes. The 15 minutes applies to small toothed whales and

pinnipeds, while a 30 minute observation period applies to baleen whales and large toothed whales.

- A ramp up, following a shutdown, can be applied if the marine mammal(s) for which the shutdown occurred has been observed to leave the exclusion zone or until the animal(s) is not sighted for at least 15 minutes (small toothed whales and pinnipeds) or 30 minutes (baleen whales and large toothed whales). This assumes there was a continuous observation effort prior to the shutdown and the entire exclusion zone is visible.

- If, for any reason, electrical power to the airgun array has been discontinued for a period of 10 minutes or more, ramp-up procedures need to be implemented. Only if the PSO watch has been suspended, 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.

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

Power-Down Procedures

A power down is the immediate reduction in the number of operating airguns such that the radii of the 190 dB and 180 dB (rms) zones are decreased to the extent that an observed marine mammal is not in the applicable safety zone of the full array. During a power down, one airgun (or some other number of airguns less than the full airgun array) continues firing. The continued operation of one airgun 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 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.

- If a marine mammal is already within the exclusion zone when first detected, the airguns will be powered down immediately.

- Following a power-down, ramp up to the full airgun array will 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 (pinnipeds or

small toothed whales) or 30 minutes (baleen whales or large toothed whales).

Shutdown Procedures

- The operating airgun(s) will be shutdown completely if a marine mammal approaches or enters the 190 or 180 dB (rms) exclusion zone of the smallest airgun.

- Airgun activity will not resume until the marine mammal has cleared the exclusion zone of the full array. The animal will be considered to have cleared the exclusion zone as described above under ramp up procedures.

Poor Visibility Conditions

BP 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 proposed 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.

In addition, NMFS proposes the following additional protective mitigation and monitoring during the periods of darkness or low visibility. Specifically, NMFS does not recommend keeping one airgun (the so called "mitigation gun" in past IHAs) firing for long periods of time with no seismic operation ongoing during darkness or other periods of poor visibility on the previous assumption that marine mammals will be alerted by the sounds from the single airgun so that a cold start with pre-survey monitoring could be avoided, since there is no scientific evidence that such technique works (Tyack 2009). On the contrary, keeping an airgun firing unnecessarily for long periods of time would only introduce more noise into the water. Therefore, for seismic surveys that would start during night time and low visibility, NMFS proposes to

require that PSOs use vessel lights, night vision devices (NVDs), and/or forward looking infrared (FLIR) to observe as much as possible for 30 minutes before ramping up the airgun array. PSOs will be called up to observe at nighttime during the 30-min periods prior to ramp-ups as well as during ramp-ups.

Mitigation Measures for Subsistence Activities

(1) Subsistence Mitigation Measures

To limit potential impacts to the bowhead whale migration and the subsistence hunt, BP would not conduct airgun operations in the area north of the barrier islands after 25 August.

(2) Plan of Cooperation (POC) and Conflict Avoidance Agreement (CAA)

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a 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.

BP has signed a Conflict Avoidance Agreement (CAA) with the Alaska Eskimo Whaling Commission (AEWC) and communities' Whaling Captains' Association for the proposed 2012 Simpson Lagoon OBV seismic survey. The main purpose of the CAA is to provide (1) equipment and procedures for communications between subsistence participants and industry participants; (2) avoidance guidelines and other mitigation measures to be followed by the industry participants working in or transiting the vicinity of active subsistence hunters, in areas where subsistence hunters anticipate hunting, or in areas that are in sufficient proximity to areas expected to be used for subsistence hunting that the planned activities could potentially adversely affect the subsistence bowhead whale hunt through effects on bowhead whales; and (3) measures to be taken in the event of an emergency occurring during the term of the CAA.

In the CAA, BP agrees to employ a Marine Mammal Observer/Inupiat Communiton (MMO/IC) on board each primary sound source vessel owned or operated by BP in the Beaufort Sea, and that native residents of the eleven villages represented by the AEWC shall be given preference in hiring for MMO/IC positions.

The CAA states that all vessels (operated by BP) shall report to the appropriate Communication Center (Com-Center) at least once every six hours commencing 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 such Com-Center shall notify all whalers of such changes.

The CAA further states that each Com-Center shall have an Inupiat operator ("Com-Center operator") on duty 24 hours per day from August 15, or one week before the start of the fall bowhead whale hunt in each respective village, until the end of the bowhead whale subsistence hunt.

The CAA also states that following the end of the fall 2012 bowhead whale subsistence hunt and prior to the 2013 pre-season introduction meetings, the industry participant that establishes the Deadhorse and Kaktovik Com Center will offer to the AEWC Chairman to host a joint meeting with all whaling captains of the villages of Nuiqsut, Kaktovik, and Barrow, the Marien Mammal Observer/Inupiat Communicators stationed on the industry participants' vessels in the Beaufort Sea, and with the Chairman and Executive Director of the AEWC, at a mutually agreed upon time and place on North Slope of Alaska, to review the results of the 2012 Beaufort Sea open water season.

In addition, BP is developing a "Plan of Cooperation" (POC) for the proposed 2012 seismic survey in the Simpson Lagoon of the Alaskan Beaufort Sea in consultation with representatives of communities along the Beaufort Sea coast at Barrow, Nuiqsut, and Kaktovik, on issues related to subsistence seal hunt. Mitigation measures similar to those listed in the CAA will be identified in the POC, and a final draft of the POC will be delivered to NMFS and other regulatory agencies.

Mitigation Conclusions

NMFS has carefully evaluated the applicant'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 measure is expected to minimize adverse impacts to marine mammals; and
- The practicability of the measure for applicant implementation.

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 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.

(1) Proposed Monitoring Measures

The monitoring plan proposed by BP can be found in its IHA application. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period. A summary of the primary components of the plan follows.

There will be two vessel-based monitoring programs during the Simpson Lagoon OBC seismic survey. One program involves the presence of protected species observers (PSOs) on the seismic source vessels during the entire seismic survey period. The other vessel-based program involves two PSOs on a monitoring vessel outside the barrier islands after 25 August.

Visual Monitoring From Source Vessels

Two PSOs will be present on each seismic source vessel. Of these two PSOs, one will be on watch at all times during daylight hours to monitor the 190 and 180 dB exclusion zones for the presence of marine mammals during airgun operations. During the fall bowhead whale migration season the 160 dB disturbance zone will also be monitored for the presence of groups of 12 or more baleen whales. The 120 dB disturbance zone for bowhead cow/calf pairs will be monitored from another vessel (see section "Visual Monitoring Outside the Barrier Islands"). The main objectives of the vessel-based marine mammal monitoring program from the source vessels are as follows:

- To implement mitigation measures during seismic operations (e.g. course alteration, airgun power-down, shut-down and ramp-up);
- To record all marine mammal data needed to estimate the number of marine mammals potentially affected, which must be reported to NMFS within 90 days after the survey;
- To compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity; and
- To obtain data on the behavior and movement patterns of marine mammals observed and compare those at times with and without seismic activity.

Marine Mammal Observer Protocol

BP intends to work with experienced PSOs that have had previous experience working on seismic survey vessels, which will be especially important for the lead PSO on the source vessels. At least one Alaska Native resident, who is knowledgeable about Arctic marine mammals and the subsistence hunt, is expected to be included as one of the team members aboard the vessels. Before the start of the seismic survey the crew of the seismic source vessels will be briefed on the function of the PSOs, their monitoring protocol, and mitigation measures to be implemented. They will also be aware of the monitoring objectives of the dedicated monitoring vessel, and how their observations can affect the operations.

On all source vessels, at least one observer will monitor for marine mammals at any time during daylight hours (there will be no periods of total darkness until mid-August). PSOs will be on duty in shifts of a maximum of 4 hours at a time, although the exact shift schedule will be established by the lead PSO in consultation with the other PSOs.

The three source vessels will offer suitable platforms for PSOs. Observations will be made from locations where PSOs have the best view around the vessel. During daytime, the PSO(s) will scan the area around the vessel systematically with reticle binoculars (e.g., 7 × 50 Fujinon) and with the naked eye. Laser range-finding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation, using other vessels in the area as targets. Laser range finding binoculars are generally not useful in measuring distances to animals directly.

Communication Procedures

When marine mammals in the water are detected within or about to enter the designated safety zones, the airgun(s)

power-down or shut-down procedures will be implemented immediately. To assure prompt implementation of power-downs and shut-downs, multiple channels of communication between the PSOs and the airgun technicians will be established. During the power-down and shut-down, the PSO(s) will continue to maintain watch to determine when the animal(s) are outside the safety radius. Airgun operations can be resumed with a ramp-up procedure (depending on the extent of the power down) if the observers have visually confirmed that the animal(s) moved outside the exclusion zone, or if the animal(s) were not observed within the safety zone for 15 minutes (pinnipeds and small toothed whales) or for 30 minutes (for baleen whales and large toothed whales). Direct communication with the airgun operator will be maintained throughout these procedures.

Data Recording

All marine mammal observations and any airgun power-down, shut-down and ramp-up will be recorded in a standardized format. Data will be entered into a custom database using a notebook computer. The accuracy of the data entry will be verified by computerized validity data checks as the data are entered and by subsequent manual checking of the database after each day. These procedures will allow initial summaries of data to be prepared during and shortly after the field program, and will facilitate transfer of the data to statistical, graphical, or other programs for further processing and archiving.

Visual Monitoring Outside the Barrier Islands

The main purpose of the PSOs on the monitoring vessel that will operate outside the barrier islands is to monitor the 120 dB disturbance zone during daylight hours for the presence of four or more bowhead cow/calf pairs. The predicted distances to received levels of 120 dB are 6.4 km for the 640 in³ array and 5.7 km for the 320 in³ array. The distance to the 160 dB disturbance zone is small enough (1.8 km for the 640 in³ and 1.5 km for the 320 in³ array) to be covered by the PSOs on the source vessels. Of the two PSOs on the monitoring vessel, one will be on watch at all times during daylight hours to monitor the disturbance zones and to communicate any sightings of four bowhead cow/calf pairs to the PSOs on the source vessels. The shift schedule and observer protocol will be similar to that of the PSOs on the source vessels.

Channels of communication between the lead PSOs on the source vessels and the dedicated monitoring vessel will also be established. If four or more bowhead cow/calf pairs are observed within or entering the 120 dB disturbance zone the lead PSO on monitoring vessel will immediately contact the lead PSO on the source vessel, who will ensure prompt implementation of airgun power downs or shutdowns. The lead PSO of the monitoring vessel will continue monitoring the 120 dB zone and notify the PSO on the source vessel when the cow/calf pairs have left the safety zone or when they haven't been observed within the safety zone for 30 minutes. Under these conditions ramp-up can be initiated.

These vessel based surveys outside the barrier islands will be conducted up to 3 days per week, weather depending. Anticipated start date is August 25, 2012, and these surveys will be continuing until the end of the data acquisition period. During this period data acquisition will take place only inside the barrier islands. The vessel will follow transect lines within the 120 dB zone that are designed in such a way that the area ensonified by 120 dB or more will be covered. The exact start and end point will depend on the area to be covered by the source vessels during that particular day.

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 convened an independent peer review panel to review BP's mitigation and monitoring plan in its IHA application for taking marine mammals incidental to the proposed OBC seismic survey in the Simpson Lagoon of the Alaskan Beaufort Sea, during 2012. The panel met on January 5 and 6, 2012, and provided their final report to NMFS on February 29, 2012. The full panel report can be viewed at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications>.

NMFS provided the panel with BP's monitoring and mitigation plan and

asked the panel to address the following questions and issues for BP's plan:

- Will the applicant's stated objectives effectively further the understanding of the impacts of their activities on marine mammals and otherwise accomplish the goals stated above? If not, how should the objectives be modified to better accomplish the goals above?
- Can the applicant achieve the stated objectives based on the methods described in the plan?
- Are there technical modifications to the proposed monitoring techniques and methodologies proposed by the applicant that should be considered to better accomplish their stated objectives?
- Are there techniques not proposed by the applicant (i.e., additional monitoring techniques or methodologies) that should be considered for inclusion in the applicant's monitoring program to better accomplish their stated objectives? And
- What is the best way for an applicant to present their data and results (formatting, metrics, graphics, etc.) in the required reports that are to be submitted to NMFS (i.e., 90-day report and comprehensive report)?

The peer review panel report contains recommendations that the panel members felt were applicable to the BP's monitoring plans. Specifically the panel commented on issues related to: (1) Vessel-based marine mammal observers (MMOs), (2) MMO training, (3) Data recording, (4) Data analysis, and (5) Acoustical monitoring.

NMFS has reviewed the report and evaluated all recommendations made by the panel. NMFS has determined that there are several measures that BP can incorporate into its 2012 OBC seismic survey. Additionally, there are other recommendations that NMFS has determined would also result in better data collection, and could potentially be implemented by oil and gas industry applicants, but which likely could not be implemented for the 2012 open water season due to technical issues (see below). While it may not be possible to implement those changes this year, NMFS believes that they are worthwhile and appropriate suggestions that may require a bit more time to implement, and BP should consider incorporating them into future monitoring plans should BP decide to apply for IHAs in the future.

The following subsections lay out measures that NMFS recommends for implementation as part of the 2012 OBC seismic survey by BP and those that are recommended for future programs.

Recommendations for Inclusion in the 2012 Monitoring Plan

The peer review panel's report contains several recommendations regarding vessel-based marine mammal observers, marine mammal monitor (MMO) training, data recording, data analysis and presentation of data in reports, and acoustic monitoring, which NMFS agrees that BP should incorporate:

(1) Vessel-Based Marine Mammal Observers

- Utilize crew members to assist the MMOs. Crew members should not be used as primary MMOs because they have other duties and generally do not have the same level of expertise, experience, or training as MMOs, 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 rampdown or shutdown if a marine mammal enters the safety zone (or exclusion zone).

• If crew members are to be used as MMOs, they should go through some basic training consistent with the functions they will be asked to perform. The best approach would be for crew members and MMOs to go through the same training together.

- As BP plans to have a marine mammal survey vessel outside the barrier islands after 25 August, the panel recommends BP use MMOs on the vessel to monitor for the presence and behavior of marine mammals in the offshore area projected to be exposed to seismic sounds.

(2) MMO Training

- BP could improve its MMO training by implementing panel recommendations from previous years (on other seismic survey programs). These recommendations include:

- Observers should 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.

- Observer teams should include Alaska Natives, and all observers should be trained together. Whenever possible, new observers should be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations.

- Observers should 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 should 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.

- Observers should use the best possible positions for observing (e.g., outside and as high on the vessel as possible), taking into account weather and other working conditions.

- BP should train its MMOs to follow a scanning schedule that consistently distributes scanning effort according to the purpose and need for observations. For example, the schedule might call for 60 percent of scanning effort to be directed toward the near field and 40 percent at the far field. All MMOs should follow the same schedule to ensure consistency in their scanning efforts.

- MMOs also need training in documenting the behaviors of marine mammals. MMOs should simply 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.

(3) Data Recording

- MMOs should record observations of marine mammals hauled out on barrier islands. Because of the location of BP's proposed survey, most (if not all) of the marine mammals observed in the lagoon will be pinnipeds. It is feasible that the surveys may alter the hauling out patterns of pinnipeds, so observations of them should be recorded.

- BP should work with its observers to develop a means for recording data that does not reduce observation time significantly. Possible options include the use of a voice recorder during observations followed by later transcriptions, or well-designed software programs that minimize the time required to enter data. Other techniques also may be suitable.

(4) Data Analysis and Presentation of Data in Reports

- Estimation of potential takes or exposures should be improved for times with low visibility (such as during fog or darkness) through interpolation or possibly using a probability approach. For instance, for periods of fog or darkness one could use marine mammal observations obtained during a specified period of time before or after the time when visibility was restricted. Those data could be used to interpolate possible takes during periods of restricted visibility.

- Simpson Lagoon is relatively shallow, and marine mammal

distribution likely will be closely linked to water depth. To account for this confounding factor, depth should be continuously recorded by the vessel and for each marine mammal sighting. Water depth should be accounted for in the analysis of take estimates.

- BP should be very clear in their report about what periods are considered "non-seismic" for analyses.
- BP should examine data from BWASP and other such programs to assess possible impacts from their seismic survey.

- The panel states that it believes the best ways to present data and results are described in peer-review reports from previous years. These recommendations include:

- To better assess impacts to marine mammals, data analysis should be separated into periods when a seismic airgun array (or a single mitigation airgun) is operating and when it is not. Final and comprehensive reports 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.

- To help evaluate the effectiveness of MMOs and more effectively estimate take, reports should include sightability curves (detection functions) for distance-based analyses.

- To better understand the potential effects of oil and gas activities on marine mammals and to facilitate integration among companies and other researchers, the following data should be obtained and provided electronically in the 90-day report:

- The location and time of each aerial or vessel-based sighting or acoustic detection;

- Position of the sighting or acoustic detection relative to ongoing operations (i.e., distance from sightings to seismic operation, drilling ship, support ship, etc.), if known;

- The nature of activities at the time (e.g., seismic on/off);

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

- Adjustments made to operating procedures.

- BP should improve take estimates and statistical inference into effects of the activities by incorporating the following measures:

- Reported results from all hypothesis tests should include estimates of the associated statistical power.

- Estimate and report uncertainty in all take estimates. Uncertainty could be

expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, etc.; the exact approach would be selected based on the sampling method and data available.

(5) Acoustical Monitoring

- BP should also use the offshore vessel to monitor (periodically) the propagation of airgun sounds from within the lagoon into offshore areas during its marine mammal survey using a dipping hydrophone.

- To help verify the propagation model results, the panel also recommends additional acoustic monitoring with bottom mounted recorders. Recorders should be deployed throughout the seismic survey. One suggestion is to deploy instruments including: one at the cut, or break, between Leavitt and Spy islands at about the 5 m isobath; one north of the center of Leavitt Island at the 10 m isobath; and one off the east end of Pingok Island at the 10 m isobath.

Recommendations To Be Considered for Future Monitoring Plans

In addition, the panelists recommended that (1) BP continue to develop and test observational aids to assist with visibility during night, poor light conditions, inclement weather, etc.; and (2) BP conduct additional acoustic monitoring with bottom mounted recorders to monitor for calling marine mammals. It may be possible to evaluate calling rates relative to seismic operations or received levels of seismic sounds. Additionally, Shell will have several acoustic arrays in the general area. Those arrays will provide a basis for determining locations of calling marine mammals. NMFS should encourage BP to request data from Shell to help examine impacts of the seismic survey on the distribution of calling bowheads and other marine mammals.

After discussion with BP, NMFS decided not to implement these two recommendations for BP's 2012 OBC seismic survey because most of BP's survey would occur during the time when there will be very short low-light hours. As for the second recommendation, NMFS realized that given the complexity in marine mammal passive acoustic localization, BP will not have the time to implement this recommendation for its 2012 survey.

(2) Reporting Measures

Sound Source Verification Reports

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 airgun sources, 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.

Technical Reports

The results of BP's 2012 vessel-based monitoring, including estimates of "take" by harassment, would be presented in the "90-day" and Final Technical reports, if the IHA is issued and the proposed OBC seismic survey is conducted. The Technical Reports should be submitted to NMFS within 90 days after the end of the seismic survey. The Technical Reports 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) To better assess impacts to marine mammals, data analysis should be separated into periods when a seismic airgun array (or a single mitigation airgun) is operating and when it is not. Final and comprehensive reports 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) Reported results from all hypothesis tests should include estimates of the associated statistical power when practicable;

(g) Estimate and report uncertainty in all take estimates. Uncertainty could be

expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, etc.; the exact approach would be selected based on the sampling method and data available;

(h) The report should clearly compare authorized takes to the level of actual estimated takes; and

Notification of Injured or Dead Marine Mammals

In addition, NMFS would require BP to notify NMFS' Office of Protected Resources and NMFS' Stranding Network within 48 hours of sighting an injured or dead marine mammal in the vicinity of marine survey operations. BP shall provide NMFS with the species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

In the event that an injured or dead marine mammal is found by BP that is not in the vicinity of the proposed open-water marine survey program, BP would report the same information as listed above as soon as operationally feasible to NMFS.

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, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Only take by Level B behavioral harassment is anticipated as a result of the proposed open water marine survey program. Anticipated impacts to marine mammals are associated with noise propagation from the survey airgun(s) used in the shallow hazards survey.

The full suite of potential impacts to marine mammals was described in detail in the "Potential Effects of the Specified Activity on Marine Mammals" section found earlier in this document. The potential effects of sound from the proposed open water marine survey programs might include one or more of the following: Masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at least in theory, temporary or permanent hearing impairment (Richardson *et al.* 1995). As

discussed earlier in this document, the most common impact will likely be from behavioral disturbance, including avoidance of the ensonified area or changes in speed, direction, and/or diving profile of the animal. For reasons discussed previously in this document, hearing impairment (TTS and PTS) are highly unlikely to occur based on the proposed mitigation and monitoring measures that would preclude marine mammals being exposed to noise levels high enough to cause hearing impairment.

For impulse sounds, such as those produced by airgun(s) used in the seismic survey, NMFS uses the 160 dB (rms) re 1 μ Pa isopleth to indicate the onset of Level B harassment. BP provided calculations for the 160- and 120-dB isopleths produced by these activities and then used those isopleths to estimate takes by harassment. NMFS used the calculations to make the necessary MMPA preliminary findings. BP provided a full description of the methodology used to estimate takes by harassment in its IHA application (see ADDRESSES), which is also provided in the following sections.

BP has requested an authorization to take 11 marine mammal species by Level B harassment. These 11 marine mammal species are: beluga whale (*Delphinapterus leucas*), killer whale (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), bowhead whale (*Balaena mysticetus*), gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), minke whale (*Balaenoptera acutorostrata*), bearded seal (*Ereignathus barbatus*), ringed seal (*Phoca hispida*), spotted seal (*P. largha*), and ribbon seal (*Histriophoca fasciata*). BP did not request take of narwhal because the occurrence of this species is extremely rare in the proposed action area, and it is very unlikely to be encountered during the BP's proposed seismic surveys.

Basis for Estimating "Take by Harassment"

As stated previously, it is current NMFS practice to estimate take by Level A harassment for received levels above 180 dB re 1 μ Pa (rms) for cetaceans and 190 dB re 1 μ Pa (rms) for pinnipeds, and take by Level B harassment for all marine mammals under NMFS jurisdiction by impulse sounds at a received level above 160 dB re 1 μ Pa (rms) and by non-impulse sounds at a received level above 120 dB re 1 μ Pa (rms). However, not all animals are equally affected by the same received noise levels and, as described earlier, in most cases marine mammals are not

likely to be taken by Level A harassment (injury) when exposed to received levels higher than 180 dB for a brief period of time.

For behavioral harassment, marine mammals will likely not show strong reactions (and in some cases any reaction) until sounds are much stronger than 160 or 120 dB (for impulse and continuous sounds, respectively). Southall *et al.* (2007) provide a severity scale for ranking observed behavioral responses of both free-ranging marine mammals and laboratory subjects to various types of anthropogenic sound (see Table 4 in Southall *et al.* (2007). Tables 7, 9, and 11 in Southall *et al.* (2007) outline the numbers of low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds in water, respectively, reported as having behavioral responses to multi-pulses in 10-dB received level increments. These tables illustrate that the more severe reactions did not occur until sounds were much higher than 160 dB re 1 μ Pa (rms).

As described earlier in the document, two main source vessels and a mini source vessel would be used to conduct the OBC seismic surveys in the Simpson Lagoon. Each of the main source vessels would be equipped with two subarrays containing eight 40 in³ airguns, with a total volume displacement of 640 in³. The mini source vessel would be equipped with one subarray containing eight 40 in³ airguns, with a total displacement volume of 320 in³. Modeling results show that the 160 dB isopleths for the 640 in³, 320 in³, and 40 in³ airgun arrays inside the barrier islands are approximately 1,800 m, 1,500 m, and 700 m from the source, respectively; the 160 dB isopleths for the 640 in³ and 40 in³ airgun arrays outside the barrier islands are approximately 5,500 m and 810 m from the source, respectively (Please see above for detailed description of the exclusion and disturbance zones).

The radii associated with received sound levels of 160 dB re 1 μ Pa (rms) or higher are used to calculate the number of potential marine mammal "exposures" to airgun sounds. The potential number of each species that might be exposed to received pulsed sound levels of \geq 160 dB re 1 μ Pa (rms) is calculated by multiplying the expected species density with the anticipated area to be ensonified to that level during airgun operations. Bowhead and beluga whales are migrating through the area, so every encounter likely involves a new individual. Although seal species are also known to cover large distances, they are expected to linger longer within

a certain area, and so one individual might be exposed multiple times.

The area expected to be ensonified was determined by entering the seismic survey lines into a MapInfo Geographic Information System (GIS). GIS was then used to identify the relevant areas by "drawing" the applicable 160-dB buffer of the 640 in³ array around each seismic source line and calculating the total area within the buffers. This was done for the survey area outside the barrier islands and inside the barrier islands separately. The area ensonified with pulsed sound levels of \geq 160 dB re 1 μ Pa (rms) from airgun operations outside the barrier islands is estimated as 197.5 mi² (512 km²) and from airgun operations inside the barrier islands 105 mi² (272 km²).

Summer density (see below) estimates of marine mammals will be applied to all (100%) survey effort outside the barrier islands and to 60% survey effort inside the barrier islands. Fall densities are not applied to the outside barrier islands survey effort, since no survey effort is planned after August 25. Fall densities are applied to 100% survey effort inside the barrier islands activity, because some of the source lines will be rerun in order to image the full fold area adequately.

Marine Mammal Density Estimates

Because most cetacean species show a distinct seasonal distribution, density estimates for the central Beaufort Sea have been derived for the summer period (covering July and August) and the fall period (covering September and October). Animal densities encountered in the Beaufort Sea during both of these time periods will further depend on the presence of ice. However, if ice cover within or close to the seismic survey area is more than approximately 10%, seismic survey activities may not start or be halted. Cetacean and pinniped densities related to ice conditions are therefore not included in BP's IHA application. Pinniped species in the Beaufort Sea do not show a distinct seasonal distribution during the period July–early October and as such density estimates derived for seal species are used for both the summer and fall periods.

In addition to seasonal variation in densities, spatial differentiation is an important factor for marine mammal densities, both in latitudinal and longitudinal gradient. Taking into account the size and location of the proposed seismic survey area and the associated area of influence, only the nearshore zone (defined as the area between the shoreline and the 50 m [164 ft] bathymetry line) of the Beaufort Sea

was considered to be relevant for the calculation of densities.

Density estimates are based on best available scientific data. In cases where the best available data were collected in regions, habitats, or seasons that differ from the proposed survey activities, information from monitoring results collected in similar habitats, regions or seasons was used. Some sources from which densities were used include correction factors to account for perception and availability bias in the reported densities. Perception bias is associated with diminishing probability of sighting with increasing lateral distance from the trackline, where an animal is present at the surface but could be missed. Availability bias refers to the fact that the animal might be present but is not available at the surface. The uncorrected number of marine mammals observed is therefore always lower than the actual numbers present. Unfortunately, for most marine mammals not enough information is available to calculate these two correction factors. The density estimates provided in the BP's IHA request are therefore based on uncorrected data, unless mentioned otherwise.

Because the available density data is not always representative for the area of interest, and correction factors were not always known, there is some uncertainty in the data and assumptions used in the density calculations. To provide allowance for these uncertainties, maximum density estimates have been provided in addition to average density estimates. The marine mammal densities presented are believed to be close to, and in most cases higher than, the densities that are expected to be encountered during the proposed survey.

(1) Cetacean Densities

Beluga Whale: Summer beluga density estimates for the Alaskan Beaufort Sea are derived from aerial survey data over the period 1982–1986 as analyzed by Moore *et al.* (2000b). During the summer season, beluga whales were observed mostly in continental slope habitat (water depths of 201–2,000 m [660–6562 ft]) and infrequently in inner shelf habitat (< 50 m [164 ft]). Most applicable to the proposed OBC seismic survey are the data collected in water depths of less than 164 ft. Along 7,447 mi (11,985 km) of on-transect effort in July–August there were a total of nine beluga sightings (Moore *et al.* 2000). No correction was applied to this data for the purpose of this IHA request for two reasons: (1) All nine sightings were

observed offshore of the 164 ft (50 m) bathymetry line and the proposed survey, including the contour of the 160 dB sound level, occurs in shallower water depths, and (2) the majority of beluga sightings occurred farther to the east and there were no sightings at the longitude of Simpson Lagoon Bay. A density of 0.0008 whales/km² was used as the average summer density for beluga whales.

Fall densities for beluga whales were calculated using data derived from Bowhead Whale Aerial Survey Project (BWASP) aerial surveys collected in 2006–2008 (Clarke *et al.* 2011). Generally, beluga whales selected water on the outer shelf and slope with moderate to heavy ice during the westward migration, however, ice cover in the period 2006–2008 was relatively low compared to historical years and beluga whales were often observed in ice free waters. Based on aerial survey data (Moore *et al.* 2000, Clarke *et al.* 2011) few beluga whales are expected to be encountered in the central part of the Beaufort Sea, especially shoreward of the barrier islands.

The fall beluga whale density was calculated by using the total transect effort and number of belugas observed during fall of 2006, 2007, and 2008 (Clarke *et al.* 2011). A value of 2.841 to correct for animals missed, and a value of 0.58 to correct for animals not available at the surface from Harwood *et al.* (1996) were applied to derive corrected density estimates. Transect effort in the fall of 2006 was 12,393 km during which a total of 525 belugas observed. A corrected density of 0.1038 whales/km² was derived from this data. In fall 2007, a total of 117 belugas were sighted along 6,294 km of transect effort, from which a corrected density of 0.0455 whales/km² was calculated. The density for 2008 was the lowest with 15 belugas along 10,856 km of transect effort (corrected density of 0.0034 whales/km²). The average value over these three years was 0.0545 whales/km². This was calculated by dividing the total number of belugas sighted with the total 2006–2008 transect effort and applying the correction factors. The 2006 fall density was used as the maximum value. Because most sightings were observed offshore of the 50 m bathymetry line and the proposed survey takes place in water depths of less than 15 m (of which a majority inside the barrier islands), the densities used for the purpose of this IHA request were assumed to be 25% of the average density provided here.

Bowhead Whale: Bowheads in the eastern Alaskan and Canadian Beaufort Sea occur in offshore habitats during the

summer. Starting late August–early September whales are leaving their feeding grounds and migrate westward in shallower habitats during years with moderate and light ice-cover and in deeper waters in years with heavy ice-cover. During the summer period (July–August) relatively few bowhead whales are expected to be present in the nearshore zone of the central Beaufort Sea. Bowhead sightings become more common there when whales start their westward migration in August, with peak sighting rates occurring in September.

The bowhead whale summer density estimates were derived from 2008 aerial survey data in Camden Bay (Christie *et al.* 2010) and the 2010 aerial survey in Harrison Bay (Brandon *et al.* 2011) conducted as part of a marine mammal monitoring program for seismic and shallow hazard surveys. Because these data sets cover the summer season (July–August) it was considered to be the most representative information available. The 2008 Camden Bay survey area covered water depths between 20–200 m. The average density over the period July 6–August 18 was estimated to be 0.009 whales/km², and included correction factors from Thomas *et al.* (2002). This density was based on data collected on the three days that bowhead whales were sighted (July 7, 9, and 12), during periods without operational airguns. The 2010 Harrison Bay aerial survey covered the area just offshore of the barrier islands to 100 m water depth. The average density over the period July 16–August 13 was 0.004 whales/km², including correction factors from Thomas *et al.* (2002). This density was based on data collected before seismic operations started during which one bowhead was observed on August 3. For the purpose of this IHA request, the average summer density was derived from these two values (0.0065 whales/km²).

The bowhead whale fall density estimates used in this IHA request are derived from the BWASP aerial surveys, which contain the best available and most current information of bowhead whale distribution and abundance in the Beaufort Sea. These surveys started in 1979 and have been repeated annually, resulting in a large multi-year dataset. Clarke and Ferguson (2010) present an update of this aerial survey effort, summarizing data from the period 2000–2009, and comparing those with results from data prior to 2000. Since the Simpson Lagoon OBC seismic project takes place around 148° longitude in waters of less than 50 ft (15 m), densities of bowhead whales provided by Clarke and Ferguson (2010)

for the eastern Beaufort Sea (defined as east of 154° longitude) in the 0–20 m depth zone were considered to be most representative of the proposed survey area. Clarke and Ferguson (2010) reported 96 animals during 9,933 km of on transect aerial survey effort in September and 42 animals during 6,143 km of on transect effort in October. Correction factors from Thomas *et al.* (2002) were applied to these numbers; this is a value of 2 to correct for animals available at the surface but not detected and a value of 0.07 for animals present but not available at the surface. This resulted in a density of 0.1381 whales/km² for September and 0.0977 whales/km² for October. The combined September–October value (0.1226 whales/km²) is used as the average density and the September value as the maximum density.

Other Cetacean Species: No densities have been estimated for gray whales and for cetacean species that are rare or extralimital to the Beaufort Sea (humpback whale, minke whale, killer whale, harbor porpoise, narwhal), because sightings of these animals have been very infrequent. Gray whales may be encountered in small numbers throughout the summer and fall, especially in the nearshore areas. Small numbers of harbor porpoises may be encountered as well. During an aerial survey offshore of Oliktok Point in 2008, just west of the proposed survey area, two harbor porpoises were sighted offshore of the barrier islands, one on August 25 and the other on September 10 (Hauser *et al.* 2008). The first confirmed sighting of a humpback whale with calf was documented on August 1, 2007, about 54 mile (87 km) east of Point Barrow (Hashagen *et al.* 2009), so an occasional sighting could occur. Therefore, for the purpose of this IHA request, BP requested that “takes” be authorized to cover chance encountering of these animals during the proposed seismic survey.

(2) Pinniped Densities

Pinnipeds in the polar regions are mostly associated with sea ice and most census methods count pinnipeds when they are hauled out on the ice. To account for the proportion of animals present but not hauled out (availability bias) or seals present on the ice but missed (detection bias), a correction factor should be applied to the “raw” counts. This correction factor is dependent on the behavior of each species. To estimate what proportion of ringed seals were generally visible resting on the sea ice, radio tags were placed on seals during spring 1999–2003 (Kelly *et al.* 2006). The probability

that seals were visible, derived from the satellite data, was applied to seal abundance data from past aerial surveys and indicated that the proportion of seals visible varied from less than 0.40 to more than 0.75 between survey years. The environmental factors that are important in explaining the availability of seals to be counted were found to be time of day, date, wind speed, air temperature, and days from snow melt (Kelly *et al.* 2006). Besides the uncertainty in the correction factor, using counts of basking seals from spring surveys to predict seal abundance in the open-water period is further complicated by the fact that seal movements differ substantially between these two seasons (Kelly *et al.* 2010b). Data from nine ringed seals that were tracked from one subnivean period (early winter through mid-May or early June) to the next showed that ringed seals covered large distances during the open water foraging period (Kelly *et al.* 2010b). Ringed seals tagged in 2011 close to Barrow also show long distance travel during the open water season.

To estimate densities for ringed, bearded and spotted seals, data were used from three surveys conducted as part of shallow water OBC seismic surveys in the Beaufort Sea (Harris *et al.* 2001, Aerts *et al.* 2008, Hauser *et al.* 2008). Habitat and survey specifics are very similar to the proposed survey, therefore these data were considered to be the more representative than basking seal densities from spring aerial survey data (e.g., Moulton *et al.* 2002, Frost *et al.* 2002, 2004).

No distinction is made in density of pinnipeds between summer and autumn season. Also, no correction factors have been applied to the seal densities reported here. Instead, a multiplier was applied to the estimated densities to account for variability in seal abundance.

Ringed seals are the most common seal species in the Beaufort Sea, followed by the bearded seal. Spotted seals also occur, specifically in the nearshore zone, but are not as frequently observed as the other two species. During the 1996 OBC survey, 92% of all seal species identified were ringed seals, 7% bearded seals and 1% spotted seals (Harris *et al.* 2001). This 1996 survey occurred in two habitats, one about 19 mile east of Prudhoe Bay near the

McClure Islands, mainly inshore of the barrier islands in water depths of 10 to 26 ft and the other 6 to 30 miles northwest of Prudhoe Bay, about 0 to 8 mile offshore of the barrier islands in water depths of 10 to 56 ft (Harris *et al.* 2001). Because it is often difficult to identify seals to species, a large proportion of seal sightings were unidentified in all three surveys. The total seal sighting rate was therefore used to calculate densities for each species, using the ratio of 92%, 7%, and 1% for ringed, bearded and spotted seals as mentioned above.

During the 1996 OBC survey (Harris *et al.* 2001) the sighting rate for all seals during periods when airguns were not operating was 0.63 seals/hour. The sighting rate during non- seismic periods was 0.046 seals/hour for the survey in Foggy Island Bay, just east of Prudhoe Bay (Aerts *et al.* 2008). The OBC survey that took place at Oliktok Point, adjacent to the proposed survey in Simpson Lagoon, recorded 0.0671 seals/hour when airguns were not operating (Hauser *et al.* 2008). The survey effort in kilometers or miles is only reported for the survey at Oliktok Point.

The total source line miles that will be travelled during the proposed OBC seismic survey is approximately 4,000 miles (6,440 km). The average vessel speed during the survey will be ~3 knots (or 3.4 miles/hour), calculated based on a 40 ft distance traveled during the 8-second shot interval. Applying the average vessel speed of 3.4 miles/hour, it will take about 1176 hours to complete data acquisition along these source lines, which is equivalent to about 49 days. The total number of seals expected to be observed in the area is 741 (based on 0.63 seals/hour), 54 (based on 0.046 seals/hour), and 79 (based on 0.067 seals/hour). The average of these three values is 291 seals, and the maximum 741 seals.

Ringed Seal: The average density for ringed seals is expected to be 0.0420 seals/km², based on a ratio of 92% and a total of 6,440 km [(291 × 0.92)/6,440]. To account for variability in seal abundance the average density was multiplied by a factor 4.

Bearded Seal: The average density for bearded seals is expected to be 0.0031 seals/km², based on a ratio of 7% and a total of 6,440 km [(291 × 0.07)/6,440].

To account for variability in seal abundance the average density was multiplied by a factor 4.

Spotted Seal: The average density for ringed seals is expected to be 0.0005 seals/km², based on a ratio of 1% and a total of 6,440 km [(291 × 0.01)/6,440]. To account for variability in seal abundance the average density was multiplied by 4.

Table 3 lists a summary of marine mammal densities used for calculating the estimated takes.

TABLE 3—EXPECTED DENSITIES OF MARINE MAMMALS IN THE SIMPSON LAGOON SURVEY AREA

Species	Summer densities (#/km ²)	Autumn densities (#/km ²)
Bowhead whale	0.0065	0.1226
Beluga whale	0.0008	0.0136
Ringed seal	0.1680	0.1680
Bearded seal	0.0124	0.0124
Spotted seal	0.0020	0.0020

Potential Number of Takes by Harassment

Numbers of marine mammals that might be present and potentially taken are summarized in Table 4 based on available data about mammal distribution and densities at different locations and times of the year as described above.

Some of the animals estimated to be exposed, particularly migrating bowhead whales, might show avoidance reactions before being exposed to ≥160 dB re 1 μPa (rms). Thus, these calculations actually estimate the number of individuals potentially exposed to ≥160 dB (rms) that would occur if there were no avoidance of the area ensonified to that level.

For beluga whales and spotted seals that may form groups, additional takes were requested on top of the density-based take calculation in the event a large group is encountered during the survey. For marine mammal species that are extralimital and for which no density estimates are available in the vicinity of the proposed project area (such as gray, humpback, minke, and killer whales, harbor porpoise, and ribbon seal), a small number of takes have been requested in case they are encountered (Table 4).

TABLE 4—ESTIMATES OF THE POSSIBLE NUMBERS OF MARINE MAMMALS TAKEN BY LEVEL B HARASSMENT (EXPOSED TO ≥ 160 dB re 1 μ Pa (rms)) DURING BP'S PROPOSED SEISMIC PROGRAM IN THE BEAUFORT SEAS, JULY–OCTOBER 2012

Species	Outside barrier islands	Inside barrier islands		Total estimated takes
		Summer	Autumn	
Bowhead whale	3	1	33	37
Beluga whale	0	0	4	* 50
Gray whale .....	.....	.....	.....	3
Humpback whale .....	.....	.....	.....	2
Minke whale .....	.....	.....	.....	2
Killer whale .....	.....	.....	.....	3
Harbor porpoise .....	.....	.....	.....	3
Ringed seal	60	19	32	111
Bearded seal	9	3	5	17
Spotted seal	1	0	1	* 20
Ribbon seal .....	.....	.....	.....	3

* Additional takes were requested in the event that a large group of beluga whales is encountered.

Estimated Take Conclusions

Cetaceans—Effects on cetaceans are generally expected to be restricted to avoidance of an area around the seismic survey and short-term changes in behavior, falling within the MMPA definition of “Level B harassment”.

Using the 160 dB criterion, the average estimates of the numbers of individual cetaceans exposed to sounds ≥ 160 dB (rms) re 1 μ Pa represent varying proportions of the populations of each species in the Beaufort Sea and adjacent waters. For species listed as “Endangered” under the ESA, the estimates include approximately 37 bowheads. This number is approximately 0.24% of the Bering-Chukchi-Beaufort population of over 15,232 assuming 3.4% annual population growth from the estimate of over 10,545 animals (Zeh and Punt 2005). For other cetaceans that might occur in the vicinity of the Simpson Lagoon survey area, they also represent a very small proportion of their respective populations. The average estimates of the number of belugas (with additional takes to count for chance encounter of a large group) that might be exposed to ≥ 160 dB re 1 μ Pa is 50, which represents 0.13% of the Beaufort Sea population (or 1.35% of the Eastern Chukchi Sea population, or a mix between these two populations) of the beluga whales. In addition, the average estimates of gray, humpback, minke, and killer whales, and harbor porpoise that might be exposed to ≥ 160 dB re 1 μ Pa are 3, 2, 2, 3, and 3. These numbers represent 0.02%, 0.21%, 0.20%, 0.96%, and 0.0062% of these species of their respective populations in the proposed action area.

Seals—A few seal species are likely to be encountered in the study area, but ringed seal is by far the most abundant in this area. The average estimates of the

numbers of individuals exposed to sounds at received levels ≥ 160 dB (rms) re 1 μ Pa during the proposed shallow hazards survey are as follows: ringed seals (111), bearded seals (17), spotted seals (20, with additional takes to count for chance encounter of a group), and ribbon seals (2). These numbers represent 0.05%, 0.01%, 0.03%, and 0.0033% of Alaska stocks of ringed, bearded, spotted, and ribbon seals, respectively.

Negligible Impact and Small Numbers Analysis and Preliminary Determination

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.” In making a negligible impact determination, NMFS considers a variety of factors, including but not limited to: (1) The number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the takes occur.

No injuries or mortalities are anticipated to occur as a result of BP's proposed 2012 OBC seismic survey in the Simpson Lagoon of the Alaskan Beaufort Sea, and none are proposed to be authorized. In addition, these surveys would use relatively small 640 in³ airgun arrays, which have much less acoustic power outputs compared to conventional airgun arrays with displacement volume in the range of thousands cubic inches. Additionally, the survey areas are in shallow waters, with approximately 42% of the survey area located inside the barrier islands (depth: 0–9 ft, or 0–3 m) and 33%

located outside the barrier islands (depth: 3–45 ft, or 1–15 m), where horizontal sound propagation of low frequency airgun pulses is severely limited. For the seismic survey inside the barrier islands, the islands provide a natural barrier that would effectively reduce sound propagation out to the open ocean, if not completely eliminate its propagation. The modeled isopleths at 160 dB within the barrier islands is expected to be approximately 1.8 km, and 5.5 km outside barrier islands, from an airgun array of 640 in³ (see discussion earlier). Additionally, animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-auditory physiological effects. Takes will be limited to Level B behavioral harassment. Although it is possible that some individuals of marine mammals may be exposed to sounds from the proposed seismic survey activities more than once, the expanse of these multi-exposures are expected to be less extensive since both the animals and the survey vessels will be moving constantly in and out of the survey areas.

Most of the bowhead whales encountered during the summer will likely show overt disturbance (avoidance) only if they receive airgun sounds with levels ≥ 160 dB re 1 μ Pa. Odontocete reactions to seismic energy pulses are usually assumed to be limited to shorter distances from the airgun(s) than are those of mysticetes, probably 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. In addition, due to the constant moving of the survey vessel, the duration of the noise exposure by cetaceans to seismic impulse would be brief. For the same reason, it is unlikely that any individual animal would be exposed to high received levels multiple times.

Taking into account the mitigation measures that are planned, effects on cetaceans are generally expected to be restricted to avoidance of a limited area around the survey operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". The many reported cases of apparent tolerance by cetaceans of 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, 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 eleven marine mammal species likely to occur in the proposed marine survey area, only the bowhead and humpback whales are listed as endangered under the ESA. These 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 percent annually for nearly a decade (Allen and Angliss 2010). 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 2010). The occurrence of humpback whales in the proposed marine survey areas is considered very rare. There is no critical habitat designated in the U.S. Arctic for the bowhead, fin, and humpback whale. The Alaska stock of bearded seals, part of the Beringia distinct population segment (DPS), and the Arctic stock of ringed seals, have been proposed by NMFS for listing as threatened under the ESA (bearded seals: 75 FR 77496; December 10, 2011; ringed seal: 75 FR 77476; December 10, 2011). None of the other species that may occur in the project area are listed as threatened or endangered under the ESA or designated as depleted under the MMPA.

Potential impacts to marine mammal habitat were discussed previously in

this document (see the "Anticipated Effects on Habitat" section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor enough as to not affect rates of recruitment or survival of marine mammals in the area. Based on the vast size of the Arctic Ocean where feeding by marine mammals occurs versus the localized area of the marine survey activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere.

The estimated takes proposed to be authorized represent 0.13% of the Beaufort Sea population of approximately 39,258 beluga whales (or 1.35% of the Eastern Chukchi Sea population of approximately 3,710 beluga whales, or a mix of each population; Allen and Angliss 2010), 1.59% of Aleutian Island and Bering Sea stock of approximately 314 killer whales, 0.004% of Bering Sea stock of approximately 48,215 harbor porpoises, 0.02% of the Eastern North Pacific stock of approximately 19,126 gray whales, 0.24% of the Bering-Chukchi-Beaufort population of 15,232 bowhead whales assuming 3.4 percent annual population growth from the estimate of 10,545 animals (Zeh and Punt, 2005), 0.21% of the Western North Pacific stock of approximately 938 humpback whales, and 0.20% of the Alaska stock of approximately 1,003 minke whales. The take estimates presented for bearded, ringed, spotted, and ribbon seals represent 0.01, 0.05, 0.03, and 0.0033% of U.S. Arctic stocks of each species, respectively. These 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. 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 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 BP's proposed 2012 OBC seismic survey in the Simpson Lagoon of the Alaskan Beaufort Sea may result in the incidental take of small numbers of marine mammals, by Level B harassment only, and that the total taking from the marine surveys will have a negligible impact on the affected species or stocks.

Unmitigable Adverse Impact Analysis and Preliminary Determination

NMFS has preliminarily determined that BP's proposed 2012 OBC seismic survey in the Beaufort Sea will not have an unmitigable adverse impact on the availability of species or stocks for taking for subsistence uses. This preliminary determination is supported by information contained in this document and BP's CAA and draft POC. BP has adopted a spatial and temporal strategy for its Simpson Lagoon operations that should minimize impacts to subsistence hunters. Specifically, the BP's proposed Simpson Lagoon OBC seismic survey would occur between July and October open water season, and would terminate its operations outside the barrier islands after August 25 before the fall bowhead whale hunt. Due to the timing of the project and the distance from the surrounding communities (approximately 35 miles northeast from Nuiqsut, 35 miles west from Cross Island, 150 miles west from Kaktovik and 180 miles east from Barrow), it is anticipated to have no effects on spring harvesting and little or no effects on the occasional summer harvest of beluga whale, subsistence seal hunts (ringed and spotted seals are primarily harvested in winter while bearded seals are hunted during July–September in the Beaufort Sea), or the fall bowhead hunt.

In addition, based on the measures described in BP's Draft POC and CAA, the proposed mitigation and monitoring measures (described earlier in this document), and the project design itself, NMFS has determined preliminarily that there will not be an unmitigable adverse impact on subsistence uses from BP's OBC seismic survey in the Simpson Lagoon of the Beaufort Sea.

Proposed Incidental Harassment Authorization

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, 2012, through October 30, 2012.

(2) This Authorization is valid only for activities associated with open-water OBC seismic surveys and related activities in the Beaufort Sea. The specific areas where BP's surveys will be conducted are within the Simpson Lagoon Area, Beaufort Sea, Alaska, as shown in Figure 1.2 of BP's IHA application.

(3)(a) The species authorized for incidental harassment takings, Level B harassment only, are: Beluga whales

(*Delphinapterus leucas*); harbor porpoises (*Phocoena phocoena*); killer whales (*Orcinus orca*); bowhead whales (*Balaena mysticetus*); gray whales (*Eschrichtius robustus*); humpback whales (*Megaptera novaeangliae*); minke whales (*Balaenoptera acutorostrata*); bearded seals (*Erignathus barbatus*); spotted seals (*Phoca largha*); ringed seals (*P. hispida*); and ribbon seals (*P. fasciata*).

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

- (i) 640 in³ airgun arrays for each of the two main source vessels;
- (ii) 320 in³ airgun array for one mini source vessels; and
- (iii) Vessel activities related to the OBC seismic surveys.

(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 his 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 1 (attached). The taking by Level A harassment, 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) Seismic Operation Mitigation:

(i) Whenever a marine mammal is detected outside the exclusion zone radius and based on its position and motion relative to the ship track is likely to enter the exclusion radius, calculate and implement an alternative ship

speed or track or de-energize the airgun array, as described in condition 6(b)(iv) below.

(ii) Exclusion Zones:

(A) Establish and monitor with trained PSOs a preliminary exclusion zone for cetaceans surrounding the airgun array on the source vessel where the received level would be 180 dB re 1 µPa rms. For purposes of the field verification test, described in condition 7(b), this radius is estimated to be 750 m (2,460 ft) from the seismic source for the 640 in³ airgun arrays, 480 m (1,574 ft) for the 320 in³ airgun array, and 59 m (194 ft) for a single 40 in³ airgun for surveys conducted inside barrier islands; and 950 m (3,116 ft) for 640 in³ airgun arrays and less than 50 m (164 ft) for a single 40 in³ airgun for surveys conducted outside barrier islands.

(B) Establish and monitor with trained PSOs a preliminary exclusion zone for pinnipeds surrounding the airgun array on the source vessel where the received level would be 190 dB re 1 µPa rms. For purposes of the field verification test described in condition 7(b), this radius is estimated to be 310 m (1,017 ft) from the seismic source for the 640 in³ airgun arrays, 160 m (525 ft) for the 320 in³ airgun array, and 16 m (53 ft) for the single 40 in³ airgun for surveys conducted inside barrier islands; and 120 m (394 ft) for 640 in³ airgun arrays and less than 50 m (164 ft) for a single 40 in³ airgun for surveys conducted outside barrier islands.

(C) A 120-dB vessel monitoring zone for four or more bowhead cow/calf pairs will be established and monitored after August 25, 2012, from a monitoring vessel outside the barrier islands during all daytime seismic surveys, as described in 7(a)(iv) below. For purposes of the field verification test described in condition 7(b), this radius is estimated to be 6,400 m (20,992 ft) from the seismic source for the 640 in³ airgun arrays, 5,700 m (18,700 ft) for the 320 in³ airgun array, and 3,700 m (12,140 ft) for the single 40 in³ airgun for surveys conducted inside barrier islands.

(D) Immediately upon completion of data analysis of the field verification measurements required under condition 7(b) below, the new 180-dB and 190-dB marine mammal exclusion zones shall be established based on the sound source verification.

(iii) 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) Ramp up procedures from a cold start shall be delayed if a marine mammal is sighted within the exclusion zone during the 30-minute period prior to the ramp up. The delay shall last until the marine mammal(s) has been observed to leave the exclusion zone or until the animal(s) is not sighted for at least 15 or 30 minutes. The 15 minutes applies to small toothed whales and pinnipeds, while a 30 minute observation period applies to baleen whales and large toothed whales.

(C) A ramp up, following a shutdown, can be applied if the marine mammal(s) for which the shutdown occurred has been observed to leave the exclusion zone or until the animal(s) is not sighted for at least 15 minutes (small toothed whales and pinnipeds) or 30 minutes (baleen whales and large toothed whales).

(D) 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. Only if the PSO watch has been suspended, 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.

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

(iv) 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 the exclusion zone when first detected, the airguns shall be powered down immediately.

(C) Following a power-down, ramp up to 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 (pinnipeds or small toothed whales) or 30 minutes (baleen whales or large toothed whales).

(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) Whenever more than four or more bowhead cow/calf pairs are observed

within or entering the 120 dB disturbance zone the lead PSO on the monitoring vessel will immediately contact the lead PSO on the source vessel, who will ensure prompt implementation of airgun power downs or shut-downs.

(F) Airgun activity shall not resume until the marine mammal has cleared the exclusion zone of the full array. The animal will be considered to have cleared the exclusion zone as described above under ramp up procedures.

(iv) 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.

(C) When seismic survey is not underway, BP shall not keep an airgun (the so called "mitigation gun" in past IHAs) firing for long periods of time during darkness or other periods of poor visibility on the assumption that marine mammals will be alerted by the sounds from the single airgun so that a cold start with pre survey monitoring could be avoided.

(b) Vessel and Helicopter Movement Mitigation:

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

(ii) Transit and cable laying vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs. If any barge or transit 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 to avoid the likelihood of injury to whales.

(iv) In the event that any aircraft (such as helicopters) are used to support the planned survey, the mitigation measures below would apply:

(A) Under no circumstances, other than an emergency, shall aircraft be operated at an altitude lower than 1,000 feet above sea level (ASL) when within 0.3 mile (0.5 km) of groups of whales.

(B) Helicopters shall not hover or circle above or within 0.3 mile (0.5 km) of groups of whales.

(c) Mitigation Measures for Subsistence Activities:

(i) No seismic surveys with airgun operations shall be conducted in the area north of the barrier islands after 25 August, 2012.

(ii) Fully implement the following measures, consistent with the 2012 Conflict Avoidance Agreement (CAA) and Plan of Cooperation (COP), in order to avoid having an unmitigable adverse impact on the availability of marine mammal species or stocks for taking for subsistence uses:

(A) For the purposes of reducing or eliminating conflicts between subsistence whaling activities and BP's survey program, the holder of this Authorization will participate with other operators in the Communication and Call Centers (Com-Center) Program. The Com-Centers will be operated 24 hours/day during the 2012 fall subsistence bowhead whale hunt.

(B) BP shall routinely call the Com-Center according to the established protocol in the CAA while in the Beaufort Sea.

(C) 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.

(D) 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.

(E) Post-season Review: Following the end of the fall 2012 bowhead whale subsistence hunt and prior to the 2013

pre-season introduction meetings, BP shall offer to the Alaska Eskimo Whaling Commission (AEWC) Chairman to host a joint meeting with all whaling captains of the Villages of Nuiqsut, Kaktovik, and Barrow, the Marine Mammal Observer/Inupiat

Communicators stations on BP's vessels in the Beaufort Sea, and with the Chairman and Executive Director of the AEWC, at a mutually agreed upon time and place on the North Slope of Alaska, to review the results of the 2012 Beaufort Sea open-water season, unless it is agreed by all designated individuals or their representatives that such a meeting is not necessary.

(7) Monitoring:

(a) Vessel Monitoring:

(i) The holder of this Authorization must designate biologically-trained, on-site individuals (PSOs) to be onboard the source vessel and monitoring vessels outside the barrier islands, who are approved in advance by NMFS, to conduct the visual monitoring programs required under this Authorization and to record the effects of seismic surveys and the resulting noise on marine mammals.

(A) PSO teams shall consist of Inupiat observers and experienced field biologists. An experienced field crew leader will supervise the PSO team onboard the survey vessel. New observers shall be paired with experienced observers to avoid situations where lack of experience impairs the quality of observations.

(B) Crew leaders and most other biologists serving as observers in 2012 will 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.

(C) PSOs shall complete a two or three-day training session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2012 open-water season. The training session(s) will be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based monitoring programs. A marine mammal observers' handbook, adapted for the specifics of the planned survey program, will be reviewed as part of the training.

(D) If there are Alaska Native PSOs, the PSO training that is conducted prior to the start of the survey activities shall be conducted with both Alaska Native PSOs and biologist PSOs being trained at the same time in the same room. There shall not be separate training courses for the different PSOs.

(E) 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 rampdown or shutdown if a marine mammal enters the safety zone (or exclusion zone).

(F) 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.

(G) 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.

(H) BP shall train its PSOs to follow a scanning schedule that consistently distributes scanning effort according to the purpose and need for observations. For example, the schedule might call for 60% of scanning effort to be directed toward the near field and 40% at the far field. All PSOs should follow the same schedule to ensure consistency in their scanning efforts.

(I) PSOs shall be trained in documenting the behaviors of marine mammals. PSOs should simply 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.

(ii) To the extent possible, PSOs should be on duty for four (4) consecutive hours or less, although more than one four-hour shift per day is acceptable.

(iii) Monitoring is to be conducted by the PSOs onboard the active seismic vessel, to (A) ensure that no marine mammals enter the appropriate exclusion zone whenever the seismic acoustic sources are on, and (B) to record marine mammal activity as described in condition 7(a)(vii) below. Two PSOs will be present on each seismic source vessel. At least one PSO shall monitor for marine mammals at any time during daylight hours.

(iv) Monitoring vessel based surveys outside the barrier islands will be conducted up to 3 days per week, weather depending, after August 25, 2012, and continue until the end of the data acquisition period. One PSO will be present on the monitoring vessel. The monitoring effort will be aided by the skipper of the monitoring vessel.

(v) At all times, the crew must be instructed to keep watch for marine mammals. If any are sighted, the bridge watch-stander must immediately notify

the PSO(s) on-watch. If a marine mammal is within or closely approaching its designated exclusion zone, the seismic acoustic sources must be immediately powered down or shut down (in accordance with condition 6(a)(iv) above).

(vi) Observations by the PSOs on marine mammal presence and activity will begin a minimum of 30 minutes prior to the estimated time that the seismic source is to be turned on and/or ramped up.

(vii) All marine mammal observations and any airgun power-down, shut-down and ramp-up will be recorded in a standardized format. Data will be entered into a custom database using a notebook computer. The accuracy of the data entry will be verified by computerized validity data checks as the data are entered and by subsequent manual checking of the database after each day. These procedures will allow initial summaries of data to be prepared during and shortly after the field program, and will facilitate transfer of the data to statistical, graphical, or other programs for further processing and archiving.

(viii) Monitoring shall consist of recording: (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, bearing, distance, heading, speed and activity of the other vessel(s); (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.

(ix) BP shall work with its observers to develop a means for recording data that does not reduce observation time significantly.

(x) PSOs shall use the best possible positions for observing (e.g., outside and as high on the vessel as possible), taking into account weather and other working conditions. PSOs shall carefully document visibility during observation periods so that total estimates of take can be corrected accordingly.

(xi) PSOs shall scan systematically with the unaided eye and 7 x 50 reticle binoculars, supplemented with 20 x 60 image-stabilized Zeiss Binoculars or Fujinon 25 x 150 "Big-eye" binoculars and night-vision equipment ("Generation 3") when needed.

(xii) PSOs shall attempt to maximize the time spent looking at the water and guarding the exclusion radii. 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.

(xiii) Night-vision equipment (Generation 3 binocular image intensifiers, or equivalent units) shall be available for use during low light hours.

(xiv) 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.

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

(xvi) PSOs on monitoring vessels outside barrier islands shall also monitor for the presence and behavior of marine mammals in the offshore area projected to be exposed to seismic sounds.

(b) Sound Source Verification: Using a hydrophone system, the holder of this Authorization is required to conduct sound source verification tests for seismic airgun array(s) and vessels that are involved in the OBC seismic surveys.

(i) 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 re 1 μ Pa (rms) for the airgun array(s). The configurations of airgun arrays shall include at least the full array and the operation of a single source that will be used during power downs.

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

(c) Acoustic Monitoring:

(i) BP shall use the offshore monitoring vessel to monitor (periodically) the propagation of airgun sounds from within the lagoon into offshore areas during its marine mammal survey using a dipping hydrophone.

(ii) BP shall use additional acoustic monitoring with bottom mounted recorders to verify noise propagation model results. Recorders shall be deployed throughout the entire duration of the seismic survey.

(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) Water depth should be continuously recorded by the vessel and for each marine mammal sighting. Water depth should be accounted for in the analysis of take estimates.

(c) BP shall be very clear in their report about what periods are considered "non-seismic" for analyses.

(d) BP shall examine data from Bowhead Whale Aerial Survey Program and other such programs to assess possible impacts from their seismic survey.

(e) To better assess impacts to marine mammals, data analysis shall be separated into periods when a seismic airgun array (or a single mitigation airgun) is operating and when it is not. Final and comprehensive reports to NMFS should summarize and plot:

(i) Data for periods when a seismic array is active and when it is not; and

(ii) The respective predicted received sound conditions over fairly large areas (tens of km) around operations.

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

(g) To better understand the potential effects of oil and gas activities on marine mammals and to facilitate integration among companies and other researchers, the following data should be obtained and provided electronically in the 90-day report:

(i) The location and time of each aerial or vessel-based sighting or acoustic detection;

(ii) Position of the sighting or acoustic detection relative to ongoing operations (i.e., distance from sightings to seismic operation, drilling ship, support ship, etc.), if known;

(iii) The nature of activities at the time (e.g., seismic on/off);

(iv) 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); and

(v) Adjustments made to operating procedures.

(h) BP should improve take estimates and statistical inference into effects of the activities by incorporating the following measures:

(i) Reported results from all hypothesis tests should include estimates of the associated statistical power when practicable.

(ii) Estimate and report uncertainty in all take estimates. Uncertainty could be expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, etc.; the exact approach would be selected based on the sampling method and data available.

(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 airgun sources, 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) *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 BP's 2012 open water OBC seismic surveys in the Beaufort Seas. 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) Analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

(iii) 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;

(iv) To better assess impacts to marine mammals, data analysis should be

separated into periods when a seismic airgun array (or a single airgun) is operating and when it is not. Final and comprehensive reports to NMFS should summarize and plot: (A) Data for periods when a seismic array is active and when it is not; and (B) The respective predicted received sound conditions over fairly large areas (tens of km) around operations.

(v) 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.

(vi) Reported results from all hypothesis tests should include estimates of the associated statistical power when practicable.

(vii) Estimate and report uncertainty in all take estimates. Uncertainty could be expressed by the presentation of confidence limits, a minimum-maximum, posterior probability distribution, etc.; the exact approach would be selected based on the sampling method and data available.

(viii) The report should clearly compare authorized takes to the level of actual estimated takes.

(c) The draft report will 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 injury (Level A harassment), serious injury or mortality (e.g., ship-strike, gear interaction, and/or entanglement), BP shall immediately cease survey operations and immediately report the incident to the Supervisor of Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to *Jolie.Harrison@noaa.gov* and *Shane.Guan@noaa.gov* and the Alaska Regional Stranding Coordinators (*Aleria.Jensen@noaa.gov* and *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).

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

(b) In the event that BP 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), BP will immediately report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to *Jolie.Harrison@noaa.gov* and *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* and *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 BP to determine whether modifications in the activities are appropriate.

(c) In the event that BP 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), BP shall report the incident to the Supervisor of the Incidental Take Program, Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401, and/or by email to *Jolie.Harrison@noaa.gov* and *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* and *Barbara.Mahoney@noaa.gov*), within 24 hours of the discovery. BP shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. BP 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 Conflict Avoidance Agreement and 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) BP is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS' Biological Opinion.

Endangered Species Act (ESA)

The bowhead whale and humpback whale are the only marine mammal species currently listed as endangered under the ESA that could occur during BP's proposed OBC seismic survey during the Arctic open-water season. The Beringia DPS of the Alaska stock of bearded seals and the Arctic stock of ringed seals are proposed for listing as threatened under the ESA. Final decisions concerning the listing of these species are expected to be made in summer 2012.

NMFS' Permits and Conservation Division has initiated consultation with NMFS' Protected Resources Division under section 7 of the ESA on the issuance of an IHA to BP 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 currently preparing an Environmental Assessment, pursuant to NEPA, to determine whether or not this proposed activity may have a significant effect on the human environment. This analysis will be completed prior to the issuance or denial of the IHA.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to authorize the take of marine mammals incidental to BP's 2012 OBC seismic survey in the Simpson Lagoon of the Alaskan Beaufort Sea, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: April 25, 2012.

Helen Golde,

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

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