MARINE MAMMAL MONITORING AND MITIGATION PLAN

for

Marine Seismic Surveys of Selected Lease Areas in the Alaskan Chukchi Sea in 2010

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ST10001 Marine Seismic Surveys

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Introduction

Statoil plans to conduct 3D (and potential some 2D) marine seismic surveys on and near existing lease holdings in the Chukchi Sea. One source vessel and 2 support/monitoring vessels will be used to complete the project during the 2010 open-water season. The Marine Mammal Monitoring and Mitigation Program (4MP) developed for Statoil's ST10001 Marine Seismic Survey is designed to protect the marine mammal resources in the area, fulfill reporting obligations to the Minerals Management Service (MMS), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS), and establish a means for gathering additional data on marine mammals for future operations planning.

Statoil's 4MP is a combination of active monitoring of the area of operations and the implementation of mitigation measures designed to minimize project impacts to marine resources. If marine mammals are observed within or about to enter specific safety radii around the proposed survey activities, mitigation will be initiated by vessel-based marine mammal observers (MMOs). The size of the 180 and 190 dB re 1 μPa (rms) safety radii were modeled and are described below in the section *Mitigation Measures during Survey Activities.* These radii will be used to initiate mitigation during initial survey activities at which time an acoustics contractor will measure underwater sound propagation from the airguns to empirically determine the size of the safety radii. These measured radii will be used for mitigation purposes as soon as they become available. An initial sound source analysis will be supplied to NMFS and the seismic survey operators within 120 hours of completion of the measurements. A more detailed report describing the sounds produced by the airguns will be provided to NMFS as part of the 90-day report following the end of the survey.

Visual monitoring by MMOs during airgun activity and periods when airguns are not active will provide information on the numbers of marine mammals potentially affected by the survey activities and facilitate real time mitigation to prevent impacts to marine mammals by industrial sounds or activities. Vessel-based MMOs onboard the survey vessel will record the numbers and species of marine mammals observed in the area and any observable reaction of marine mammals to the survey activities. An acoustic monitoring program, separate from the sound source measurements described above, will record the sounds produced by the airguns within the survey area, record marine mammal vocalizations, and to the extent possible localize those calls. The layout and location of the acoustic monitoring array relative to Statoil's lease holdings is intended to be consistent with similar arrays deployed on other lease holdings in the Chukchi Sea and consistent with future deployments during different activities.

Vessel-Based Marine Mammal Monitoring Program

Introduction

The vessel-based operations of Statoil's 4MP are designed to meet the requirements of Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) permits issued by NMFS and USFWS, respectively, and to meet any other stipulation agreements between Statoil and other agencies or groups. The objectives of the program will be:

- to ensure that disturbance to marine mammals and subsistence hunts is minimized and all permit stipulations are followed,
- to document the effects of the proposed survey activities on marine mammals, and
- to collect baseline data on the occurrence and distribution of marine mammals in the study area.

The 4MP will be implemented by a team of experienced MMOs, including both biologists and Inupiat personnel. MMOs will be stationed aboard the survey vessel through the duration of the seismic survey. Reporting of the results of the vessel-based monitoring program will include the estimation of the number of "takes" as stipulated in the IHA and LOA.

The vessel-based portion of Statoil's 4MP will be required to support the survey activities in the Chukchi Sea. The survey dates and specific operating areas will depend upon ice and weather conditions, along with Statoil's arrangements with agencies and stakeholders. Survey activities are expected to occur from August through October 2010.

The vessel-based work will provide:

- the basis for real-time mitigation, if necessary, as required by the various permits that Statoil receives,
- information needed to estimate the number of "takes" of marine mammals by harassment, which must be reported to NMFS and USFWS,
- data on the occurrence, distribution, and activities of marine mammals in the areas where the survey program is conducted,
- information to compare the distances, distributions, behavior, and movements of marine mammals relative to the survey vessel at times with and without airgun activity,
- a communication channel to coastal communities including Inupiat whalers and other subsistence users, and

The 4MP will be operated and administered consistent with monitoring programs conducted during seismic and shallow hazards surveys in 2006–2009 or such alternative requirements as may be specified in the IHA issued by NMFS for this project. Any other stipulation agreements between Statoil and agencies or groups such as MMS, USFWS, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) will also be fully incorporated. All MMOs will be provided training through a program approved by NMFS and Statoil, as described later. Details of the vessel-based marine mammal monitoring program are described below.

Mitigation Measures during Survey Activities

Statoil's planned seismic survey program incorporates both design features and operational procedures for minimizing potential impacts on marine mammals and on subsistence hunts. The design features and operational procedures have been described in the IHA and LOA applications submitted to NMFS and USFWS, respectively and are summarized below. Survey design features include:

- timing and locating survey activities to avoid interference with the annual fall bowhead whale hunt;
- identifying transit routes and timing to avoid other subsistence use areas and communicate with coastal communities before operating in or passing through these areas, and;
- limiting the size of the seismic array to minimize energy introduced into the marine environment and configuring it in such a way that it minimizes horizontal propagation;
- raising the source/receiver ratio (ie. number of hydrophone streamers per airgun array) to reduce the number of source shots required to complete the survey.
- conducting pre-season sound propagation modeling to establish the appropriate safety and behavioral radii.

The potential disturbance of marine mammals during survey operations will be minimized further through the implementation of several ship-based mitigation measures if mitigation becomes necessary.

Safety and Disturbance Zones

Under current NMFS guidelines (e.g., NMFS 2000), "safety radii" for marine mammals around industrial sound sources are customarily defined as the distances within which received sound levels are ≥180 dB re 1 µPa (rms) for cetaceans and ≥190 dB re 1 µPa (rms) for pinnipeds. These safety criteria are based on an assumption that sound energy received at lower received levels will not injure these animals or impair their hearing abilities, but that higher received 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 safety radii (Richardson et al. 1995).

Initial safety and disturbance radii for the sound levels produced by the survey activities have been estimated from measurements of similar seismic arrays used in the Chukchi Sea in previous years. These radii will be used for mitigation purposes until results of direct measurements are available early during the exploration activities. The 3D seismic data acquisition will be conducted from the M/V *Geo Celtic*. The M/V *Geo Celtic* will tow two identical airgun arrays at ~20 ft (6 m) depth and at a distance of ~902 ft (275 m) behind the vessel. Each array is composed of three strings for a total of 26 active G-guns (4×60 in^3, 8×70 in^3, 6×100 in^3, 4×150 in^3, and 4×250 in^3) with a total discharge volume of 3000 in^3. Each array also consists of 5 clusters of 10 inactive airguns that will be used as spares. One of the smallest guns in the array (60 in^3) will be used as the mitigation gun.

The basis for the estimation of distances to the four received sound levels from the proposed 3000 in^3 airgun array operating at a depth of 20 ft (6 m) are the 2006, 2007 and 2008 sound source verification (SSV) measurements in the Chukchi Sea of a similar array, towed at a similar depth. The measured airgun array had a total discharge volume of 3,147 in^3 and was composed of three identically-tuned Bolt airgun sub-arrays, totaling 24 airguns (6 clusters of 2 airguns and 12 single airguns). The proposed 3000 in^3 array is also composed of three strings with a total of 26 active airguns in 13 clusters. The difference in discharge volume would lead to an expected loss of less than 0.2 dB and is neglected in this assessment. The estimated source level for the full 3000 in^3 array is 245 dB re 1 µPA rms. Without measurement data for the specific site to be surveyed, it is reasonable to adopt the maximum distances obtained from a similar array during previous measurements in the Chukchi Sea. Table 1 summarizes the distances to received levels of 190, 180 160, and 120 dB re 1 µPa (rms) from SSV measurements of the 3,147 in^3 airgun array used in the Chukchi Sea during 2006–2008. Table 2 lists the pre-season distances that are adopted for the proposed survey. Distances for received levels of 120 dB are highly variable, in part because the bottom geoacoustic properties will have a major effect on received levels at such distances. It is estimated that the distances to received levels of 120 dB of the proposed array will fall within the ranges listed in Table 1.

To estimate the distances to various received levels from the 60 in^3 mitigation gun the data from previous measurements of a 30 in^3 gun were used. In general the pressure increase relative to a 30 in^3 gun can be derived by calculating the square root of (60/30), which is 1.41. This means that the dB levels for the sound pressure levels of a 60 in^3 will increase by ~3 dB (20Log[1.41]) compared to the 30 in^3 gun. The distances as summarized in Table 5 were derived by adding 3 dB to the constant term of the equation RL = 226.6 - 21.2log(R) - 0.00022R (Figure 3.17 in Funk et al. 2008). The estimated source level of this single 60 in^3 airgun is 230 dB re 1 µPa rms.

TABLE 1. Distances to received sound levels of ≥190, 180, 170, 160, and 120 dB re 1 µPa (rms) from the 3147 in^3 airgun array and the 30 in^3 mitigation gun used for "take calculations" during 2006, 2007 and 2008 seismic surveys in the Chukchi Sea as reported in the 90-day reports.

Received levels (dB re 1 μPa rms) [a]	Distance (m) 3147 in^3 airgun array			Distance (m) 30 in^3 mitigation airgun	
	2006[b]	2007[c]	2008[c]	2007[c]	2008[c]
190	460	550	610	10	10
180	1,400	2,470	2,000	24	10
160	8,000	8,100	13,000	1,360	1,900
120	82,890	66,000	120,000	41,100	47,000
Water depth (m)	42	--	37-43	--	37-43

[a] Received levels of airgun sounds are expressed in dB re 1 μPa (rms, averaged over pulse duration).
[b.] Blackwell et al. 2007
[c.] Funk et al. 2008
[d.] Hannay and Warner 2009

TABLE 2. Estimated distances to received sound levels ≥190, 180, 170, 160, and 120 dB re 1 μPa (rms) from the 3000 in^3 airgun array and the 60 in^3 mitigation gun of the proposed seismic survey. These distances are based on measurements in the Chukchi Sea from a similar airgun array (see Table 1).

Received levels (dB re 1 μPa rms) [a]	Distance (m)	
	3000 in^3 (full airgun array)	60 in^3 (mitigation gun)
190	700	75
180	2,500	220
160	13,000	1,800
120	70,000-120,000	50,000

[a] Received levels of airgun sounds are expressed in dB re 1 μPa (rms, averaged over pulse duration).

An acoustics contractor will perform the direct measurements of the received levels of underwater sound versus distance and direction from the energy source arrays using calibrated hydrophones. The acoustic data will be analyzed as quickly as reasonably practicable in the field and used to verify (and if necessary adjust) the safety distances. The field report will be made available to NMFS and the MMOs within 120 hrs of completing the measurements. The mitigation measures to be implemented at the 190 and 180 dB sound levels will include power downs and shut downs as described below.

Power Downs and Shut Downs

A power down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shut down is the immediate cessation of firing of all energy sources. The array will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable safety zone of the full array, but is outside the applicable safety zone of the single mitigation source. If a marine mammal is sighted within or about to enter the applicable safety zone of the single mitigation airgun, the entire array will be shut down (i.e., no sources firing).

Ramp Ups

A ramp up of an airgun array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The purpose of a ramp up (or "soft start") is to "warn" cetaceans and pinnipeds in the vicinity of the airguns and to

provide the time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

During the proposed seismic survey program, the seismic operator will ramp up the airgun arrays slowly. Full ramp ups (i.e., from a cold start after a shut down, when no airguns have been firing) will begin by firing a single airgun in the array. The minimum duration of a shut-down period, i.e., without air guns firing, which must be followed by a ramp up is typically the amount of time it would take the source vessel to cover the 180-dB safety radius. The actual time period depends on ship speed and the size of the 180-dB safety radius. We estimate that period to be about 15-20 minutes based on the modeling results described above and a survey speed of 4 kts.

A full ramp up, after a shut down, will not begin until there has been a minimum of 30 min of observation of the safety zone by MMOs to assure that no marine mammals are present. The entire safety zone must be visible during the 30-minute lead-in to a full ramp up. If the entire safety zone is not visible, then ramp up from a cold start cannot begin. If a marine mammal(s) is sighted within the safety zone during the 30-minute watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 minutes: 15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes.

During turns and transit between seismic transects, at least one airgun will remain operational. The ramp-up procedure will still be followed when increasing the source levels from one airgun to the full array. However, keeping one airgun firing will avoid the prohibition of a cold start during darkness or other periods of poor visibility. Through use of this approach, seismic operations can resume upon entry to a new transect without a full ramp up and the associated 30-minute lead-in observations. MMOs will be on duty whenever the airguns are firing during daylight, and during the 30-min periods prior to ramp-ups as well as during ramp-ups. Daylight will occur for 24 h/day until mid-August, so until that date MMOs will automatically be observing during the 30-minute period preceding a ramp up. Later in the season, MMOs will be called out at night to observe prior to and during any ramp up. The seismic operator and MMOs will maintain records of the times when ramp-ups start, and when the airgun arrays reach full power.

Marine Mammal Observers

Vessel-based monitoring for marine mammals will be done by trained MMOs throughout the period of survey activities and supplemented by the officers on duty, to comply with expected provisions in the IHA and LOA that Statoil receives. The observers will monitor the occurrence and behavior of marine mammals near the survey vessels during all daylight periods during operation, and during most daylight periods when airgun operations are not occurring. MMO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the survey operations; and documenting "take by harassment" as defined by NMFS.

Number of Observers

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

- 100% monitoring coverage during all periods of survey operations in daylight;
- maximum of 4 consecutive hours on watch per MMO;
- maximum of ~12 hours of watch time per day per MMO.

MMO teams will consist of Inupiat observers and experienced field biologists. An experienced field crew leader will supervise the MMO team onboard the survey vessels. The total number of MMOs

may decrease later in the season as the duration of daylight decreases assuming NMFS does not require continuous nighttime monitoring.

Crew Rotation

Statoil anticipates one crew change to occur approximately half-way through the season. During crew rotations detailed hand-over notes will be provided to the incoming crew leader by the outgoing leader. Other communications such as email, fax, and/or phone communication between the current and oncoming crew leaders during each rotation will also occur when possible. In the event of an unexpected crew change Statoil will facilitate such communications to insure monitoring consistency among shifts.

Observer Qualifications and Training

Crew leaders and most other biologists serving as observers in 2010 will be individuals with experience as observers during one or more of the 1996-2009 seismic or shallow hazards monitoring projects in Alaska, the Canadian Beaufort, or other offshore areas in recent years.

Biologist-observers will have previous marine mammal observation experience, and field crew leaders will be highly experienced with previous vessel-based marine mammal monitoring and mitigation projects. Resumés for those individuals will be provided to NMFS for review and acceptance of their qualifications. Inupiat observers will be experienced in the region, familiar with the marine mammals of the area, and complete a NMFS approved observer training course designed to familiarize individuals with monitoring and data collection procedures. A marine mammal observers' handbook, adapted for the specifics of the planned survey program will be prepared and distributed beforehand to all MMOs (see below).

Most observers, including Inupiat observers, will also complete a two or three-day training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the 2010 open-water season. Any exceptions will have or receive equivalent experience or training. The training session(s) will be conducted by qualified marine mammalogists with extensive crew-leader experience during previous vessel-based seismic monitoring programs.

Primary objectives of the training include:

- review of the marine mammal monitoring plan for this project, including any amendments specified by NMFS or USFWS in the IHA or LOA, by MMS, or by other agreements in which Statoil may elect to participate;
- review of marine mammal sighting, identification, and distance estimation methods;
- review of operation of specialized equipment (reticle binoculars, night vision devices, and GPS system);
- review of, and classroom practice with, data recording and data entry systems, including procedures for recording data on marine mammal sightings, monitoring operations, environmental conditions, and entry error control. These procedures will be implemented through use of a customized computer database and laptop computers;
- review of the specific tasks of the Inupiat Communicator.

MMO Handbook

A Marine Mammal Observers' Handbook will be prepared for Statoils' monitoring program. Handbooks contain maps, illustrations, and photographs, as well as text, and are intended to provide guidance and reference information to trained individuals who will participate as MMOs. The following topics will be covered in the MMO Handbook for the Statoil project:

- summary overview descriptions of the project, marine mammals and underwater noise, the marine mammal monitoring program (vessel-based, aerial, acoustic measurements), the NMFS IHA and USFWS LOA and other regulations/permits/agencies, the Marine Mammal Protection Act;
- monitoring and mitigation objectives and procedures, initial safety radii;
- responsibilities of staff and crew regarding the marine mammal monitoring plan;
- instructions for ship crew regarding the marine mammal monitoring plan;
- data recording procedures: codes and coding instructions, common coding mistakes, electronic database; navigational, marine physical, field data sheet;
- list of species that might be encountered: identification cues, natural history information;
- use of specialized field equipment (reticle binoculars, NVDs, laser rangefinders);
- reticle binocular distance scale;
- table of wind speed, Beaufort wind force, and sea state codes;
- data storage and backup procedures;
- safety precautions while onboard;
- crew and/or personnel discord; conflict resolution among MMOs and crew;
- drug and alcohol policy and testing;
- scheduling of cruises and watches;
- communication availability and procedures;
- list of field gear that will be provided;
- suggested list of personal items to pack;
- suggested literature, or literature cited; and
- copies of the NMFS IHA and USFWS LOA when available.

Monitoring Methodology

The observer(s) will watch for marine mammals from the best available vantage point on the survey vessels, typically the bridge. The observer(s) will scan systematically with the unaided eye and 7×50 reticle binoculars, supplemented during good visibility conditions with Fujinon 25x150 "Big-eye" binoculars mounted on a bride wing or flying bridge (seismic vessel only), and night-vision equipment when needed (see below). Personnel on the bridge will assist the marine mammal observer(s) in watching for marine mammals. Data from the infrared radar will be monitored in order to investigate if this could improve the detection and record keeping of mammals, especially during periods of low visibility .

Information to be recorded by marine mammal observers will include the same types of information that were recorded during recent monitoring programs associated with Industry activity in the Arctic (e.g., Ireland et al. 2009). When a mammal sighting is made, the following information about the sighting will be recorded:

- Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if determinable), bearing and distance from observer, apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and pace.
- Time, location, speed, and activity of the vessel, sea state, ice cover, visibility, and sun glare.
- The positions of other vessel(s) in the vicinity of the observer location.

The ship's position, speed of the vessel, water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

Distances to nearby marine mammals will be estimated with binoculars (Fujinon 7×50 binoculars) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon.

Observers may use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water. However, previous experience has shown that a Class 1 eye-safe device was not able to measure distances to seals more than about 70 m (230 ft) away. The device was very useful in improving the distance estimation abilities of the observers at distances up to about 600 m (1968 ft)—the maximum range at which the device could measure distances to highly reflective objects such as other vessels. Humans observing objects of more-or-less known size via a standard observation protocol, in this case from a standard height above water, quickly become able to estimate distances within about ±20% when given immediate feedback about actual distances during training.

When a marine mammal is seen within the safety radius applicable to that species, the geophysical crew will be notified immediately so that mitigation measures called for by the IHAs can be implemented. As in 2006–2009, it is expected that the airgun arrays will be shut down within several seconds—often before the next shot would be fired, and almost always before more than one additional shot is fired. The marine mammal observer will then maintain a watch to determine when the mammal(s) appear to be outside the safety zone such that airgun operations can resume.

Monitoring At Night and In Poor Visibility

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

A prototype infrared radar will be mounted on the source vessel in order to try to improve the visual observations during times of poor visibility. The infrared radar detects thermal contrasts and its ability to sense these differences is not dependent on daylight. It may therefore improve the ability to detect marine mammals during nighttime. The ability of the IR radar to detect marine mammals is not yet proven and the intent is to collect data that can help determine if it can be used as an effective monitoring tool in the future. However, if during the course of testing, a reliable detection of a marine mammal within a safety zone requiring a mitigation action is made using the radar system, the necessary actions will be taken by the MMOs. That is, even if the system is not entirely proven, reliable results made during testing that may provide protection to marine mammals will not be ignored. (http://www.rheinmetall-defence.com/index.php?fid=2859&lang=3&pdb=1).

Specialized Field Equipment

Statoil will provide or arrange for the following specialized field equipment for use by the onboard MMOs: reticle binoculars, Big-eye binoculars, GPS unit, laptop computers, night vision binoculars, digital still and possibly digital video cameras in addition to the above mentioned infrared radar.

Field Data-Recording, Verification, Handling, and Security

The observers will record their observations onto datasheets or directly into handheld computers. During periods between watches and periods when operations are suspended, those data will be entered into a laptop computer running a custom computer database. The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered, and by subsequent manual checking of the database printouts. These procedures will allow initial summaries of data to be prepared during and shortly after the field season, and will facilitate transfer of the data to statistical, graphical or other programs for further processing. Quality control of the data will be facilitated by (1) the start-of-season training session, (2) subsequent supervision by the onboard field crew leader, and (3) ongoing data checks during the field season.

The data will be backed up regularly onto CDs and/or USB disks, and stored at separate locations on the vessel. If possible, data sheets will be photocopied daily during the field season. Data will be secured further by having data sheets and backup data CDs carried back to the Anchorage office during crew rotations.

In addition to routine MMO duties, observers will use Traditional Knowledge and Natural History datasheets to record observations that are not captured by the sighting or effort data. Copies of these records will be available to observers for reference if they wish to prepare a statement about their observations. If prepared, this statement would be included in the 90-day and final reports documenting the monitoring work.

Field Reports

Throughout the survey program, the observers will prepare a report each day or at such other interval as the IHA, LOA, or Statoil may require summarizing the recent results of the monitoring program. The reports will summarize the species and numbers of marine mammals sighted. These reports will be provided to NMFS and to the survey operators.

Reporting

The results of the 2010 vessel-based monitoring, including estimates of "take by harassment", will be presented in the 90-day and final technical reports. Reporting will address the requirements established by NMFS in the IHA.

The technical report(s) will include:

- summaries of monitoring effort: total hours, total distances, and distribution of marine mammals through the study period accounting for sea state and other factors affecting visibility and detectability of marine mammals;
- analyses of the effects of various factors influencing detectability of marine mammals including sea state, number of observers, and fog/glare;
- species composition, occurrence, and distribution of marine mammal sightings including date, water depth, numbers, age/size/gender categories, group sizes, and ice cover;
- analyses of the effects of survey operations:
  - sighting rates of marine mammals during periods with and without airgun activities (and other variables that could affect detectability);
  - 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;
- estimates of "take by harassment".

Acoustic Monitoring Plan

Sound Source Measurements

As described above, previous measurements of airguns in the Chukchi Sea were used to estimate the distances at which received levels are likely to fall below 120, 160, 180, and 190 dB rms from the planned airgun sources. These modeled distances will be used as temporary safety radii until measurements of the airgun sound source are conducted. The measurements will be made at the beginning of the field season and the measured radii used for the remainder of the survey period. An acoustics contractor with experience in the Arctic conducting similar measurements in recent years will use their equipment to record and analyze the underwater sounds and write the summary reports as described below.

The objectives of the sound source verification measurements planned for 2010 in the Chukchi Sea will be (1) to measure the distances in the broadside and endfire directions at which broadband received levels reach 190, 180, 170, 160, and 120 dB_{rms} re 1 μPa for the energy source array combinations that may be used during the survey activities. The configurations will include at least the full array and the operation of a single mitigation source that will be used during power downs. The measurements of energy source array sounds will be made by an acoustics contractor at the beginning of the survey and the distances to the various radii will be reported as soon as possible after recovery of the equipment. The primary radii of concern will be the 190 and 180 dB safety radii for pinnipeds and cetaceans, respectively, and the 160 dB disturbance radii. In addition to reporting the radii of specific regulatory concern, nominal distances to other sound isopleths down to 120 dB_{rms} will be reported in increments of 10 dB.

Data will be previewed in the field immediately after download from the hydrophone instruments. An initial sound source analysis will be supplied to NMFS and the airgun operators within 120 hours of completion of the measurements, if possible. The report will indicate the distances to sound levels based on fits of empirical transmission loss formulae to data in the endfire and broadside directions. A more detailed report will be issued to NMFS as part of the 90-day report following completion of the acoustic program.

2010 Shared Science program

Statoil, Shell, and ConocoPhillips (CPAI) are jointly funding an extensive science program in the Chukchi Sea. This program will be carried out by Olgoonik-Fairweather LLC (OFJV) with the vessels Norseman II and Westward Wind during the in 2010 open water season. The science program is not part of the Statoil seismic program, but worth mentioning in this context due to the acoustic monitoring array deployed within the seismic survey area as shown in Fig 1 and 2. The science program components include:

- Acoustics Monitoring
- Fisheries Ecology
- Benthic Ecology
- Plankton Ecology
- Mammals
- Seabirds

- Physical Oceanography

The 2010 program continues the acoustic monitoring programs of 2006-2009 with a total of 44 acoustic recorders distributed both broadly across the Chukchi lease area and nearshore environment and intensively on the Statoil, Burger (Shell), and Klondike (CPAI) lease holdings. The tentative acoustic station locations are shown in **Error! Reference source not found.**. The recorders will be deployed in late July or early August and will be retrieved in early to mid-October, depending on ice conditions. The recorders will be AMAR and AURAL model acoustic buoys set to record at 16 kHz sample rate. These are the same recorder models and same sample rates that have been used for this program from 2006-2009. The broad area arrays are designed to capture both general background soundscape data, seismic survey sounds and marine mammal call data across the lease area. From these recordings we have been able to gain insight into large-scale distributions of marine mammals, identification of marine mammal species present, movement and migration patterns, and general abundance data.

The site specific focused arrays are designed to also support localization of marine mammal calls on and around the leaseholdings. In the case of the Statoil prospect, where Statoil intends to conduct seismic data acquisition in 2010, localized calls will enable investigators to understand response of marine mammals to survey operations both in terms of distribution around the operation and behavior (i.e. calling behavior). The site specific array will consist of 7 AMAR recorders deployed in a hexagonal configuration as shown in Figure 2, with inter-recorder spacing of 8 km. These recorders are the same type that were used successfully in the 2009 site-specific acoustic monitoring program on Shell and CPAI prospects. The recorded sample resolution is 24-bits and sample frequency is 16 kHz, which is sufficient to capture part or all of the sounds produced by the marine mammal species known to be present, with the exception of harbor porpoise. The recorders will be synchronized to support localization of calling bowhead whales. Other species' calls are typically detected from distances less than the 8 km recorder separation. Consequently the multi-sensor triangulation method, that is used for bowheads calls, will not be used to determine calling locations of other species; however, detection of other species' calls indicates the animal position within a circular region of radius equal to the maximum detection distances of a few kilometers.

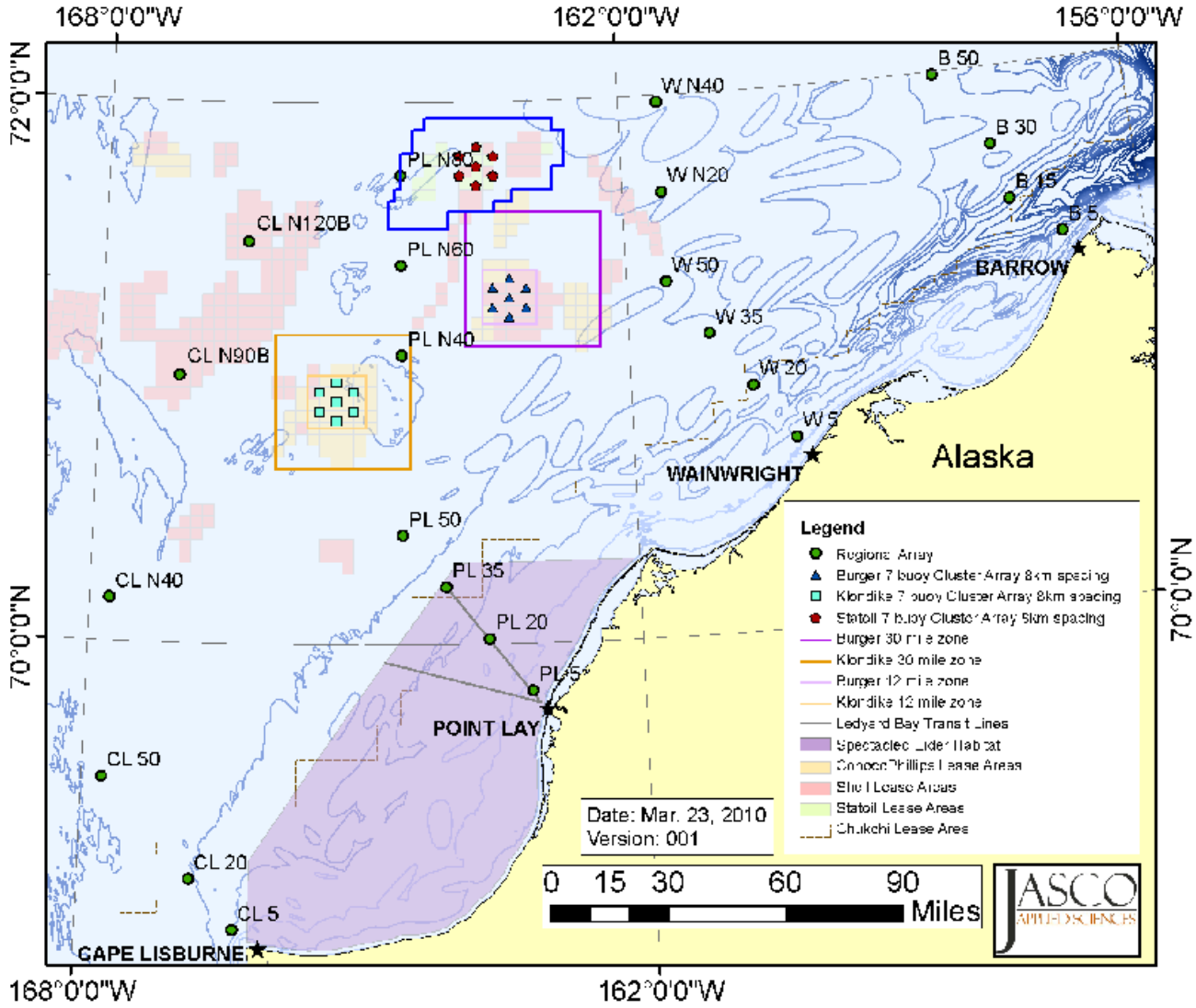

Figure 1: Regional and focused array set of 44 acoustic station locations

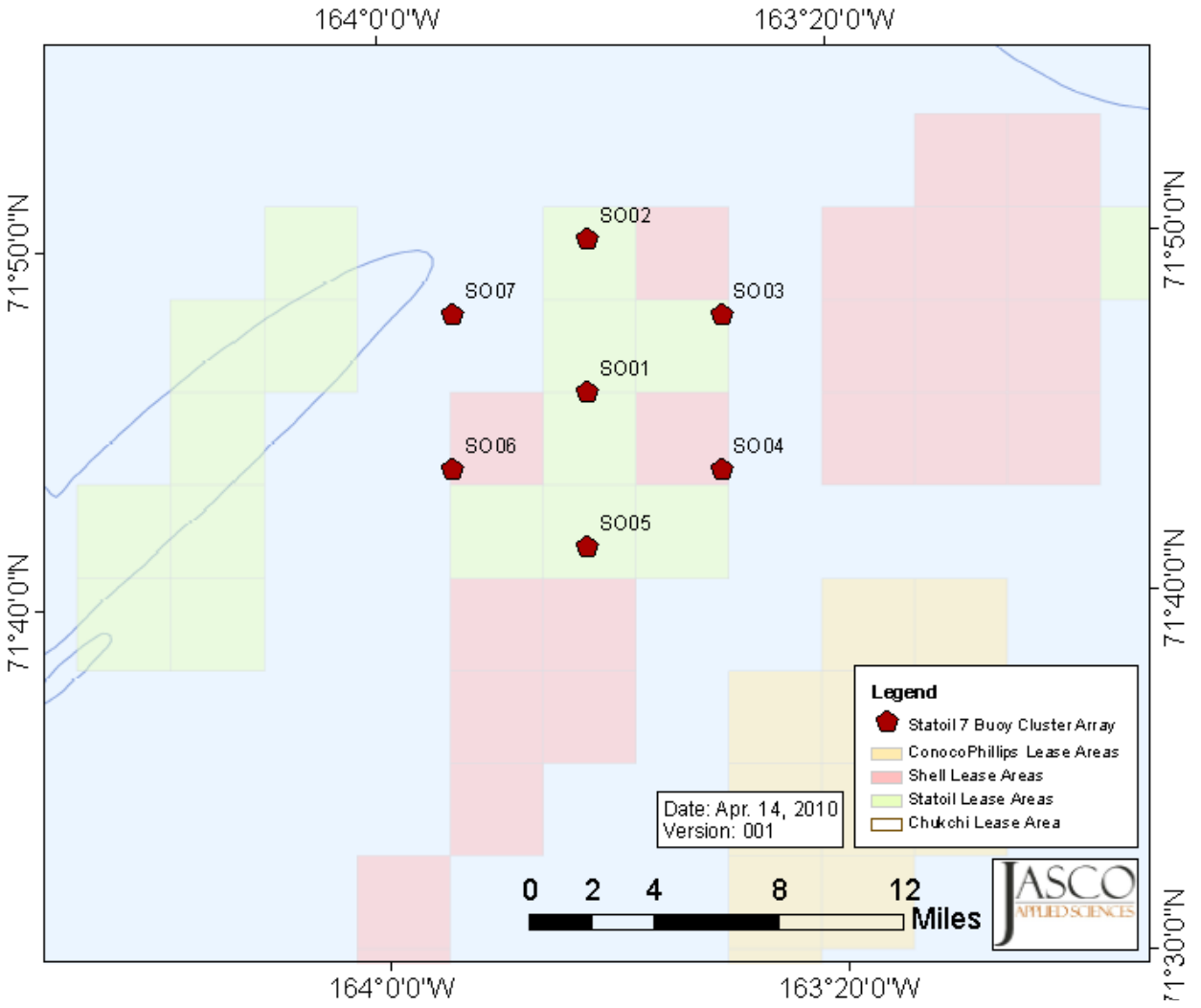

Figure 2: Acoustic station locations for Statoil's site-specific array of 7 AMAR recorders

Comprehensive Report on industry activities and marine Mammal monitoring efforts in the Beaufort and Chukchi Seas

Following the 2010 open-water season a comprehensive report describing the vessel-based, aerial, and acoustic monitoring programs will be prepared. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad based assessment of industry activities, and other activities that occur in the Beaufort and/or Chukchi seas, and their impacts on marine mammals during 2010. The report will help to establish long-term data sets that can assist with the evaluation of changes in the Chukchi and Beaufort sea ecosystems. The report will attempt to provide a regional synthesis of available data on industry activity in offshore areas of northern Alaska that may influence marine mammal density, distribution and behavior.

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