

APPENDIX J

MARINE MAMMAL AND SEABIRD OBSERVATION AND PASSIVE ACOUSTIC MONITORING PLANS



12 March 2012

MAERSK OIL KALAALLIT NUNNAT A/S

Marine Mammal and Seabird Observation (MMSO) and Passive Acoustic Monitoring (PAM) for 3D- Seismic and Hydrographic Survey in Tooq Block

Submitted to:
Golder Associates A/S Copenhagen
Golder Associates Ltd. Calgary

REPORT



Report Number: 1113340071





Table of Contents

1.0 INTRODUCTION	1
2.0 MARINE MAMMAL MITIGATION	1
2.1 Survey Design	2
2.1.1 Marine Mammal and Seabird Observer (MMSO) Program	2
2.1.1.1 Number of Observers and Watch Schedule	3
2.1.1.2 Observer Qualifications and Training	6
2.1.1.3 MMSO Manual	6
2.1.1.4 Communication Plan	7
3.0 ON-BOARD MITIGATION	7
3.1 Seismic Survey (Polarcus <i>Asima</i>)	8
3.1.1 Safety Zones	8
3.1.2 Ramp-ups / Soft-starts	8
3.1.3 Pre-shooting Search	8
3.1.4 Shut-downs	9
3.1.5 Breaks in Seismic Activity	9
3.1.6 Airgun Testing	9
3.1.7 Line Changes	10
3.1.8 Passive Acoustic Monitoring (PAM)	10
3.2 Hydrographic Program (RV Strait Hunter or RV Strait Explorer)	11
3.2.1 Safety Zones	11
3.2.2 Ramp-ups / Soft-starts	11
3.2.3 Pre-shooting Search	11
3.2.4 Shut-downs	11
3.2.5 Breaks in Activity	11
3.2.6 Airgun Testing	11
3.2.7 Line Changes	11
3.3 Data Collection and Survey Equipment	12
3.3.1 Data Entry and Back-up	12
3.4 Vessel Traffic	13
4.0 REPORTING	13



5.0 LITERATURE CITED..... 13

TABLES

Table 1: Example 1 of MMSO Schedule for Seismic Operations in the Tooq Block 4
Table 2: Example 2 of MMSO Schedule for a Systematic Marine Mammal Survey in Support of Seismic
Operations in the Tooq Block 5

ATTACHMENTS

- Attachment A 3-Day Activity Report Template
- Attachment B Weekly Activity Report Template
- Attachment C Completion Report Template



1.0 INTRODUCTION

Maersk Oil Kalaallit Nunnat A/S (MOKN) plans to conduct a 3D seismic survey in the northeast part of Block 9 (Tooq) of the Baffin Bay licensing area, and a hydrographic survey in the seismic survey region and other parts of Block 9, during the 2012 open-water season (the Project). One seismic survey vessel (*Polarcus Asima*), four support vessels (*MV Arctic Star*, *FV Stalbas*, *MV Sigma* and *Vardolm*) and one hydrographic vessel (the *RV Strait Explorer* or the *RV Strait Hunter*) will be used to complete the Project. This document has been developed to meet the requirements outlined in the “BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (excluding drilling) in Greenland” (BMP 2011a) issued by the Government of Greenland’s Bureau of Minerals and petroleum (BMP) in December 2011; and “Guidelines to environmental impact assessment of seismic activities in Greenland waters” issued by the Danish Center for Environment and Energy (DCE) in December 2011 (DCE 2011).

The document combines a vessel-based Marine Mammal and Seabird Observer (MMSO) program and a Passive Acoustic Monitoring (PAM) program with Project-specific mitigation measures designed to minimize Project impacts on marine mammals. If marine mammals are observed within or about to enter Project-specific safety zones set around the proposed seismic survey activities and hydrographic program, mitigation will be initiated by vessel-based MMSOs or PAM operators. In addition, speed limits for all project vessels will be applied to minimize the potential for collisions with marine mammals.

A 600 meter (m) ‘safety zone’ and 200 m ‘protection zone’ will be used by the MMSOs and PAM operators during the course of the Project on the seismic vessel. A 50 m safety zone will be used by the MMSOs during the course of the Project on the hydrographic vessel. Safety zones were established using Project-specific acoustic modeling performed by JASCO Research. The methods and results of this modeling are discussed in detail in Appendix D of the Environmental Impact Assessment (EIA) completed for the Project (Golder 2012).

Data collected by the MMSOs and PAM operators during marine mammal and seabird observing program will also provide information to the Government of Greenland on the location, behaviour, abundance, and species observed during seismic and hydrographic investigations in the Tooq Block. Data will be collected opportunistically and during systematic marine mammal and seabird surveys conducted on-board. Dedicated systematic surveys will follow methodology described in BMP’s manual for seabird and marine mammal surveys on seismic vessels in Greenland (BMP 2011b).

2.0 MARINE MAMMAL MITIGATION

The objectives of the MMSO and PAM systems are to:

- Minimize and/or avoid potential impacts to marine mammals in the Tooq Block as a result of Project activities; and
- Collect data on marine mammals and seabirds in the Tooq Block during the proposed seismic and hydrographic surveys. Where feasible, MMSOs will also record observations during daytime non-survey periods such that comparisons can be made with data collected during active seismic / hydrographic operations.



MOKN's seismic and hydrographic program incorporates both design features and operational procedures for minimizing potential impacts on marine mammals.

2.1 Survey Design

Mitigation has been incorporated into the planning and design stage of the seismic and hydrographic programs. Survey design features include:

- The airgun array will not be larger than needed for the specific survey;
- Airguns will be operated at the lowest practicable power levels to achieve the geophysical objectives of the Project;
- When possible, the smallest airgun in terms of energy output (decibel [dB]) and volume (in^3) (the mitigation gun) will remain shooting when otherwise the entire array is shut-down; and
- The source/receiver ratio (i.e., number of hydrophone streamers per airgun array) has been increased to reduce the number of source shots and seismic lines required to complete the survey.

2.1.1 Marine Mammal and Seabird Observer (MMSO) Program

The MMSO program will be required to support the survey activities in the Tooq Block. Survey activities are expected to occur from early July to late September; however, the survey schedule may be altered depending on regulatory requirements, and weather, ice, and sea conditions.

The MMSO program will be carried out on the seismic vessel and the hydrographic vessel during the full duration of Project. The MMSO and PAM will be implemented by a team of experienced and certified MMSO and PAM operators trained in observation methodology and seismic mitigation and approved by BMP. During all seismic and hydrographic operations, a minimum of two qualified MMSOs will be onboard each survey vessel, and a minimum of one qualified MMSO will continuously monitor for marine mammals during all periods of daylight, good visibility, and sea states below Beaufort 3. One of the on-board MMSOs will be an experienced Field Crew Lead responsible for overseeing the MMSO program and managing the MMSO and PAM team onboard the survey vessel. At least one qualified PAM / MMSO operator with training in PAM techniques, PAM software, and seismic mitigation will be present onboard the seismic vessel to acoustically monitor for marine mammals during all periods of darkness, poor visibility, and sea states above Beaufort 3.

MMSO observation platforms will be located at the highest elevation point available on each vessel with the maximum viewable range from the bow to 90 degrees port/starboard of the vessel. Daytime observations will be made using reticule binoculars, the naked eye, and big-eye binoculars. Data collection techniques are described in section 3.0 below.

The MMSO and PAM operator responsibilities include:

- Conducting marine mammal and seabird watches prior to start-up (pre-shooting searches) and during active seismic and hydrographic operations in order to mitigate around project-specific safety zones. The MMSO will be responsible for advising the airgun and hydrographic equipment operator to shut-down operations if a marine mammal is observed within the designated safety or protection zones, as applicable (see section 3.1.1); and



- Systematically collecting data on marine mammals and seabirds using industry-standard survey protocols.

These actions shall be carried out during the active seismic and hydrographic surveys, during turning of the seismic vessel from one line to another (applicable to the seismic vessel), as well as during mobilization to and from the survey area. The data collected will improve the knowledge on the temporal and spatial distribution of marine mammals and seabirds in the Baffin Bay area. Data collected will be submitted to DCE to be included in their regional database.

2.1.1.1 Number of Observers and Watch Schedule

Standard procedures call for MMSO and PAM operators to work no longer than one continuous 4-hour shift with a minimum of 2-hours between shifts to avoid observer fatigue. For summer surveys at high latitudes, this typically requires the deployment of at least three MMSO and one PAM operator on the seismic vessel.

A sufficient number of MMSOs and PAM operators will be required onboard the survey vessels to meet the following criteria:

- 100% visual monitoring coverage during all daylight periods when visibility conditions permit;
- A maximum of 4 consecutive hours on watch per MMSO and PAM operator; and
- A maximum of ~12 hours of watch time per day per MMSO and PAM operator.

Table 1 and Table 2 outline examples of on-board schedules for the MMSO and PAM Program in the Tooq Block during summer of 2012. Option 1 (Table 1) includes a team of 3 MMSO (including 1 Crew Lead MMSO and 2 MMSO with alternative PAM duties) and one dedicated PAM operator. Option 2 (Table 2) includes a team of 4 MMSO (including 1 Crew Lead MMSO) and two dedicated PAM operators. Option 2 would be needed to meet the statistical design requirements of a systematic marine mammal survey to acquire density estimates using distance sampling techniques.



MOKN MMSO AND PAM - TOOQ BLOCK

Table 1: Example 1 of MMSO Schedule for Seismic Operations in the Tooq Block

24 Hour Clock (MDT)	Marine Mammal and Seabird Observer				Notes
	MMSO1	MMSO2 w PAM	MMSO3 w PAM	PAM1 / on call	
0:00	Watch	Break	Break	On-call	One MMSO assigned as crew lead During darkness and low visibility periods, MMSO1's watch duties will be replaced with PAM1 duties, MMSO2 & MMSO3 are also certified PAM operators. During low visibility conditions apply, their duties will switch to PAM operations.
0:30					
1:00					
1:30					
2:00					
2:30					
3:00					
3:30					
4:00	Break	Watch (on-call for PAM)	Break	Break	As above
4:30					
5:00					
5:30					
6:00					
6:30					
7:00					
7:30					
8:00	Break	Break	Watch (on-call for PAM)	Break	As above
8:30					
9:00					
9:30					
10:00					
10:30					
11:00					
11:30					
12:00	Watch	Break	Break	On-call	As above
12:30					
13:00					
13:30					
14:00					
14:30					
15:00					
15:30					
16:00	Break	Watch (on-call for PAM)	Break	Break	As above
16:30					
17:00					
17:30					
18:00					
18:30					
19:00					
19:30					
20:00	Break	Break	Watch (on-call for PAM)	Break	As above
20:30					
21:00					
21:30					
22:00					
22:30					
23:00					
23:30					



MOKN MMSO AND PAM - TOOQ BLOCK

Table 2: Example 2 of MMSO Schedule for a Systematic Marine Mammal Survey in Support of Seismic Operations in the Tooq Block

24 Hour Clock (MDT)	Marine Mammal and Seabird Observer				PAM Operators	
	Team 1		Team 2		Team 1	Team 2
	MMO1	MMO2	MMO3	MMO4	PAM1	PAM2
0:00						
0:30						
1:00						
1:30						
2:00						
2:30						
3:00						
3:30						
4:00						
4:30						
5:00						
5:30						
6:00						
6:30						
7:00						
7:30						
8:00						
8:30						
9:00						
9:30						
10:00						
10:30						
11:00						
11:30						
12:00						
12:30						
13:00						
13:30						
14:00						
14:30						
15:00						
15:30						
16:00						
16:30						
17:00						
17:30						
18:00						
18:30						
19:00						
19:30						
20:00						
20:30						
21:00						
21:30						
22:00						
22:30						
23:00						
23:30						

Notes: grey shading = MMSO 'on watch'; brown shading = PAM operator 'on watch'.



2.1.1.2 Observer Qualifications and Training

MMSOs will have previous marine mammal observation experience, and the MMSO Crew Lead will have direct experience conducting vessel-based seismic monitoring programs. Resumes for those individuals will be provided to BMP for their review and acceptance of MMSO qualifications. A MMSO manual adapted for the specifics of the planned survey program will be prepared and distributed to all MMSOs prior to commencement of the program.

Where possible, observers will complete a two-day refresher 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 crew lead experience during previous vessel-based seismic monitoring programs.

Primary objectives of the training include:

- Review of the Project-specific MMSO manual;
- Review of marine mammal observation, identification, and distance estimation methods;
- Review of operation of specialized equipment (reticle binoculars, GPS system and iPAQ system described below); and
- 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, data entry error control, and reporting requirements. These procedures will be implemented through use of a customized electronic database called Pendragon installed on laptop computers. Section 3.3 provides details on these systems.

2.1.1.3 MMSO Manual

Survey methodology described in BMP's manual for seabird and marine mammal surveys on seismic vessels in Greenland (BMP 2011b) will be implemented where practical into the MMSO manual. The manual will also include maps, illustrations, photographs, as well as Project-specific procedures for watch scheduling and reporting. The manual is intended to provide Project-specific guidance to trained MMSO and PAM operators. The following topics are examples of what may be covered in the MMSO manual for the MOKN 3D seismic and hydrographic program:

- Marine mammals of Baffin Bay (e.g., species identification, seasonal occurrence, behaviour);
- Role and responsibilities of MMSOs;
- Overview of the seismic and hydrographic program;
- Overview of mitigation measures;
- Health, Safety, and Environment;
- Equipment specifications, operation, and maintenance;
- Distances estimation techniques for various scenarios (reticle binoculars, no horizon);
- Observation techniques (scanning techniques, detection cues);
- Environmental variables; and
- Reporting templates and requirements.



2.1.1.4 Communication Plan

Proper and effective communication between the MMSOs, PAM operators, and seismic or hydrographic crew is essential for implementing a successful MMSO and PAM program. Prior to deployment, all MMSOs, PAM operators, seismic survey crew, and hydrographic survey crew will be made aware of the communication procedures in place for the Project.

A designated Crew Lead MMSO will be present and available on the seismic and hydrographic vessel at all times. The MMSO, PAM operator, airgun operator (instrument room), and hydrographic operator will have a direct line of contact to the Crew Lead MMSO at all times, likely by way of portable VHF radios or phones present on the bridge and in the instrument room. In instances of uncertainty for an operational shut-down or delay, the Crew Lead MMSO will make the final decision. Where problems in communication are encountered, these will be communicated with company representatives on the survey vessel.

There will be many different circumstances when communication will be necessary between the MMSO, PAM operator, and seismic or hydrographic crew. The following section provided details on communication procedures in place for the MMSO program.

The airgun / hydrographic equipment operator will contact the MMSO or PAM operator (as applicable) at least 20 minutes prior to the start of any airgun or hydrographic equipment activity to allow for the pre-shooting search. When testing of airguns is required, the airgun operator will clarify what type of testing is to be conducted. The MMSO or PAM operator will contact the airgun operator to communicate the following events:

- After each 20 minute pre-shooting search has been completed to allow for the start of ramp-up;
- Following a 'marine mammal event' within the designated safety zone / protection zone to communicate the need for a shut-down or delay in ramp-up (as applicable);
- After a marine mammal has been observed leaving the prescribed safety zone (i.e. the start of a 20 minute delay); and
- After a 20 minute delay has ended and a ramp-up procedure can begin.

3.0 ON-BOARD MITIGATION

The MMSO program will provide real-time mitigation on the survey vessels, and data collection on the occurrence, distribution, and activities of seabirds and marine mammals in the Tooq Block and surrounding area. All observations shall be undertaken from the seismic source vessel; the MV Asima; and the hydrographic survey vessel; either the RV Strait Explorer or the RV Strait Hunter. The MMSO shall be positioned on a high platform with a clear unobstructed view of the horizon and surrounding water. A detailed communication plan with the seismic crew (e.g. airgun operator) shall be established in a Project-specific MMSO manual to facilitate implementation of the proposed operational activities (shooting, testing, and line-changing) in conjunction with vessel-based mitigation actions.

On-board mitigation and best practices for the seismic and hydrographic program will include the following:

- Implementation of marine mammal safety zones;
- Implementation of ramp-up procedures;
- Implementation of pre-shooting searches;
- Implementation of shut-down procedures;



- Mitigation during breaks in shooting;
- Mitigation during line changes; and
- Implementation of a PAM program.

3.1 Seismic Survey (*Polarcus Asima*)

In order to minimize potential impacts to marine mammals as a result of seismic survey noise, the following vessel-based mitigation measures and best practices have been developed for the survey programs.

3.1.1 Safety Zones

Safety zones are used to mitigate the potential effect of injury (permanent or temporary trauma) to marine mammals as a result of airgun noise. It is not feasible for safety zones to be based on behavioural responses as these can occur at distances of many kilometres from the source (beyond the detection limits of vessel-based MMSO) and are not necessarily predictable based on the received airgun sound level (e.g., depends on behaviour, background noise, auditory experience, etc.).

A Project-specific marine mammal safety zone has been developed based on acoustic impact criteria established by the National Marine Fisheries Service (NMFS) for protecting marine mammals from anthropogenic noise. For impulsive noise sources, NMFS has adopted 190 dB re 1 uPa (rms) and 180 dB re 1 uPa (rms) as conservative thresholds for the onset of auditory injury for pinnipeds and cetaceans, respectively. Based on the proposed seismic program, JASCO Research conducted acoustic modeling (Appendix D) in the Tooq Block to predict Project-specific marine mammal safety radii, or the distance from the seismic array at which point seismic noise was predicted to exceed the applicable NMFS injury threshold for cetaceans (180 dB re 1 μ Pa rms). The range to this threshold was determined to be approximately 590 m ($R_{95\%}$) which exceeds the safety range recommended by the Joint Nature Conservation committee (JNCC) 2010 guidelines (JNCC 2010). Based on a pre-cautionary approach, a 600 m safety zone (as measured from the center of the source) was established for the Project. The occurrence of marine mammals within this designated safety zone will trigger specific on-board mitigation actions such to avoid potential for physical injury from the seismic source.

3.1.2 Ramp-ups / Soft-starts

A ramp-up (soft-start) procedure will occur prior to active shooting. Power will be built up slowly from a low energy start-up (starting with the smallest airgun in the array). Individual airguns will be started up sequentially in uniform stages to provide a constant increase in output that slowly increases over a minimum ramp-up period of 20 minutes (and no more than 40 minutes), thus providing adequate time for marine mammals to leave the area prior to the airguns operating at full power. The ramp-up period is defined as the time that airguns commence shooting until the time that full operational power is obtained. Where possible, ramp-ups will be planned so that they commence during daylight hours.

Ramp-ups will be applied every time the airguns are used; the only exceptions being for certain types of airgun testing or during short breaks in airgun activity (see sections below). Ramp-up procedures may occur while the survey vessel is in transit to the starting point of the transect line (i.e., during line-changes see section below).

3.1.3 Pre-shooting Search

A pre-shooting search will occur prior to the commencement of any airgun activity including ramp-up (some exceptions apply, see 'Breaks in Seismic Activity' section below) and will consist of a visual scan of the water by the MMSO or an acoustic scan of the areas by the PAM operator to determine that no marine mammals



are present within the 600 m safety zone as measured from the center of the array. The duration of the pre-shooting search will be 30 minutes in waters <200 m depth and 60 minutes in waters >200 m depth. If marine mammals are spotted within the 600 m safety zone during the pre-shooting search, the ramp-up procedure will be delayed 20 minutes from the time the marine mammal was observed leaving the safety zone, or 20 minutes from the time the marine mammal was last detected inside the safety zone.

To avoid unnecessary down time of seismic operations when surveying in deeper waters (when 60 minute pre-searches apply), pre-shooting searches for marine mammals will commence before the end of the survey line (whilst the airguns are still shooting). If marine mammals are spotted within the 600 m safety zone during a pre-shooting search conducted between survey lines (when no airguns are firing), the ramp-up procedure will be delayed 20 minutes from the time the marine mammal was observed leaving the safety zone, or 20 minutes from the time the marine mammal was last detected inside the safety zone.

3.1.4 Shut-downs

If marine mammals are observed within the 600 m safety zone during the ramp-up procedure, the airguns will be reduced to a single mitigation gun (smallest gun in the array in terms of energy output and volume), and a new ramp-up procedure will be initiated no sooner than 20 minutes after the marine mammals have left the safety zone. The theory behind maintaining the mitigation gun active during this procedure is to prevent further approach of the marine mammal to the array while reducing the potential injury to the animal.

Once airguns attain full operational power (post ramp-up), shut-down procedures will only occur if marine mammals are observed within 200 m of the seismic array (protection zone), in which case the airguns will be reduced to a single mitigation gun until the marine mammals are outside the 200 m protection zone. A new ramp-up procedure will be initiated no sooner than 20 minutes after the marine mammal has departed the 600 m safety zone. A shut-down procedure is not required if marine mammals are observed between the 200 m protection zone and the 600 m safety zone during full output power.

3.1.5 Breaks in Seismic Activity

If possible, the mitigation gun will remain shooting when otherwise the entire array is shut-down. In the event that a full break in shooting occurs (entire array and mitigation gun), then the following mitigation will be applied:

- For breaks less than 10 minutes:
 - The MMSO or PAM operator shall make a short visual or acoustic scan for marine mammals (not a pre-shooting search) within the 600 m safety zone.
 - If a marine mammal is detected in the safety zone at this time, a delay in commencement will occur (as per the pre-shooting search) followed by standard ramp-up procedures.
 - If a marine mammal is not detected in the safety zone at this time, the MMSO or PAM operator will advise commencement of airgun shooting at full output power.

For breaks greater than 10 minutes:

- A pre-shooting search and 20 minute ramp-up procedure shall be carried out.

3.1.6 Airgun Testing

Airgun testing may be required before the proposed seismic survey commences, or during the survey to test damaged or miss-firing guns. This may require the testing of individual airguns, or the whole array, or testing at various output energies. The following mitigation will be applied during any airgun testing:



- If full output power of the entire array is to be tested, then standard ramp-up procedures shall be applied.
- If a number of guns are to be tested (not the full array), the lowest powered airgun shall be fired first at its lowest power, with airgun power increasing gradually to the power of the required test. This modified ramp-up procedure will be carried out over a time period proportional to the number of guns being tested and ideally will not exceed 20 minutes in duration.
- MMSOs will maintain a watch as outlined in the pre-shooting search procedure before any instances of gun testing. If a single airgun on low power is to be tested then a ramp-up is not required.

3.1.7 Line Changes

Line changes are the activity of turning the seismic vessel at the end of one line prior to commencement of the next line. The duration of proposed line changes will be determined once the detailed seismic survey line plan has been finalized. The total airgun volume for the proposed seismic survey is 4,240 cubic inches. DCE recommends the following mitigation measures for line changes involving airgun volumes ≥ 500 cubic inches.

Firing of airguns will be terminated at the end of each survey line and a full 20 minute ramp-up will be undertaken before starting the next survey line, provided that the line change time is >20 minutes. A pre-shooting search will also be undertaken during the scheduled line change and the soft-start delayed if marine mammals are seen within the 600 m safety zone. When the line change time is ≤ 20 minutes, the smallest airgun in terms of energy output (dB) and volume (in³) (the mitigation gun) will remain shooting when otherwise the entire array is shut-down.

3.1.8 Passive Acoustic Monitoring (PAM)

A vessel-based PAM program will be carried out on the seismic vessel in conjunction with the MMSO program. A certified PAM operator will acoustically monitor for marine mammals (in lieu of visual monitoring) during all periods of darkness, limited visibility, and sea states greater than Beaufort 3. The designated PAM operator will follow the same mitigation approaches as described above (for MMSO), with respect to pre-shooting searches, ramp-ups, and shut-down procedures. Communication procedures will be established between the MMSO, PAM operator, and airgun operator for determining when and how the transfer of monitoring responsibilities will be implemented. This communication plan will be detailed in the Project-specific MMSO manual.

The PAM system chosen for detecting marine mammal vocalizations is provided by MSies[®]. The system has been used extensively on offshore seismic programs and consists of four custom-built SQ 174 omnidirectional towed hydrophone elements with onboard acoustic visualizing software (Pamguard) and audio output for real time monitoring. The sensors will be towed near the surface (<30 m depth) at a range of 240 m behind the vessel, thus minimizing ship noise contribution in the data. The sensors have a large bandwidth of 10 hertz (Hz) to 125 kilohertz (kHz), which allows for the detection of a variety of marine mammal species. Data will be sampled at a sampling frequency of 500 kHz. Identification will occur through recognition and comparison of the structure and spectral content of the detected calls with the signature call types of the predominant species found in the study area. The Pamguard software includes automated click detection and can be configured to identify and localize sounds from particular species of interest using filters and detection algorithms from the Ishmael[®] software package. Of particular interest are narwhals, beluga whales, and seal species which primarily vocalize in the mid- to higher-frequency range, and are therefore less likely to be masked by short pulses of predominant lower-frequency airgun noise (<1 kHz; Richardson *et al.* 1994) and narrow-band ship noise. PAM will be given particular importance during start up at night or during periods of low visibility or when the sea state is above 3, but the equipment will be



recording continuously. A detection range of 5,000 m is expected for vocalizations below 20 kHz. For frequencies greater than 20 kHz, this detection range is reduced to approximately 300 m. If the PAM operator considers that a marine mammal is present within 600 m of the source during a pre-shooting search, the soft-start will be delayed until 20 minutes has passed from the time of the last in-range detection. If the PAM operator considers that a marine mammal is located within the 200 m protection zone as measured from the center of the array while it is shooting at full power, the array will be reduced to the mitigation gun until the marine mammal exits the 200 m protection zone.

3.2 Hydrographic Program (RV Strait Hunter or RV Strait Explorer)

In order to minimize the potential impacts to marine mammals as a result of hydrographic survey noise, the following vessel-based mitigation measures and best practices have been developed for the hydrographic survey program.

3.2.1 Safety Zones

Based on specifications of the proposed hydrographic program, JASCO Research conducted acoustic modeling (Appendix D) in the Tooq Block to predict Project-specific marine mammal safety radii, or the distance from the vessel at which point noise from the hydrographic survey was predicted to exceed the applicable NMFS injury threshold for cetaceans (180 dB re 1 μ Pa rms). The range to this threshold was determined to be approximately 40 m for the single 60 in³ airgun and 50 m for other hydrographic sources. Based on a pre-cautionary approach, a 50 m safety zone (as measured from the center of the source) was established for the Project. The occurrence of marine mammals within the designated safety zone will trigger specific on-board mitigation actions such to avoid potential for physical injury from the hydrographic noise sources.

3.2.2 Ramp-ups / Soft-starts

As the hydrographic survey only involves a single airgun, no ramp-up (soft-start) procedure is proposed.

3.2.3 Pre-shooting Search

MMSOs will maintain a watch as outlined in the pre-shooting search protocol described in section 3.1.3.

3.2.4 Shut-downs

Shut-down procedures will only occur if a marine mammal is observed within the 50 m safety zone, in which case the source will be shut-down and activities will resume no sooner than 20 minutes after the marine mammal has departed the safety zone.

3.2.5 Breaks in Activity

If the source has stopped and not restarted for at least 10 minutes, then a pre-shooting search and ramp-up must be carried out. If the break is less than 10 minutes, the MMSO will visually scan for marine mammals within the 50 m safety zone (not a pre-shooting search). If a marine mammal is detected, a 20 minute delay will be applied prior to resuming operations.

3.2.6 Airgun Testing

Airgun testing on the hydrographic vessel will follow procedures described in section 3.1.6.

3.2.7 Line Changes

When line changes are applicable during operation of the airgun, the source will be terminated at the end of each survey line and a pre-shooting search will be undertaken before starting the next survey line, provided that the line change time is >20 minutes. Shooting will be delayed if marine mammals are seen within the



50 m safety zone during the search. When the line change time is ≤ 20 minutes, the airgun will continue shooting during the line change.

3.3 Data Collection and Survey Equipment

MMSOs will record data on all marine mammal sightings, airgun activities, and hydrographic survey activities. MMSOs will also record all responsive actions where and when they are required (e.g., shut-downs, ramp-ups). Data will be recorded using handheld computers called iPAQs integrated with a Bluetooth GPS system.

An iPAQ is a type of small, handheld computer with an integrated software program for data collection called Pendragon. iPAQs are used in lieu of hard-copy data sheets to record marine mammal sightings to maintain consistency of data input and efficiency in data reporting. iPAQs maximize the amount of data that can be collected during a MMSO program. Each iPAQ communicates with its own dedicated Bluetooth GPS unit which tracks the vessel location at all times and automatically transmits vessel waypoints to the iPAQ data system when prompted (e.g., in the event of a marine mammals encounter). To facilitate data entry, iPAQs are programmed with Project-specific data forms (drop-down windows) that prompt the user to record data in a consistent manner. The iPAQ forms will be programmed to the specifications of the survey protocol outlined in BMP's manual for seabird and marine mammal surveys (BMP 2011b). Data will be transferable to Shipsurvey 1.0[®] software.

Five data forms will be completed as part of the MMSO program:

- Marine Mammal and Seabird Survey Information Form;
- Marine Mammal and Seabird Sightings Form;
- Record of Seismic / Hydrographic Survey Activities;
- Record of Vessel Traffic; and
- Record of Environmental Variables.

MMSO forms will include:

- Information on watch/survey effort and vessel position and activity;
- Environmental variables (weather, sea state, etc.);
- Marine mammal and seabird observations; and
- Shut-downs / ramp-ups / line changes, and other important operational activities.

The electronic forms contain “drop-down” lists with pre-defined information (e.g., narwhal whale, belugas) which allows MMSOs to record data more rapidly, efficiently, and consistently than manual forms.

3.3.1 Data Entry and Back-up

At the end of each watch, data entered into the iPAQs will be transferred to a laptop computer and saved into excel spreadsheets, as well as backed-up in a Microsoft Access[®] database. A daily Quality Assurance / Quality Check (QA/QC) will be performed on the data by the MMSO or PAM operator responsible for collecting the data. The Crew Lead MMSO will also provide a QA/QC on all survey data prior to reporting. All raw survey data will be backed-up on an external hard drive or USB drive, and when possible, backed up off-vessel via the internet.



Easy step-by-step instructions on how to save data, make back-ups both on-board and off-vessel, as well as troubleshooting procedures, will be provided in the MMSO manual.

3.4 Vessel Traffic

All Project vessels will maintain a speed of <14 knots during all Project activities. This reduces the likelihood of collisions with marine mammals and allows sufficient time for vessel crews to detect and avoid marine mammals in the Project area. Vessel speed restrictions will apply to all vessel activities during seismic and hydrographic survey operations, support operations, and refuelling / resupply voyages between the License Block and the regional port facilities. Marine mammal monitoring will be conducted on the seismic and hydrographic vessel by trained MMSOs. The MMSO will notify the Survey Party Chief if there is a concern of the ship striking a marine mammal and if actions are required to avoid the risk of collision. This may include slowing the vessel down as practical until the animal has traveled clear of the ship's course.

In the event of a marine mammal encounter, the following mitigation will be applied:

- Vessels will not approach or be positioned closer than 100 m to any marine mammal;
- If marine mammals approach within 100 m of a Project vessel, the Project vessel will reduce its speed and will cautiously move away from marine mammals;
- If it is not possible for support vessels to detour around a stationary marine mammal or group of marine mammals, the support vessel will reduce its speed and wait until the animals depart the area and are at least 100 m from the vessel prior to resuming operational speed; and
- As possible, Project vessels will avoid marine protected areas and areas identified as important to marine mammals, as defined in Section 4.2.2 (Protected Areas) and presented on Figure 4.2-7 (Protected Area Figure from EIA). Vessels will avoid Melville Bay Reserve and Narwhal Protection Zone (NPZ) IV (summer habitat near Qaanaaq). Project vessels will limit time spent in NPZ-I: (summer habitat area in Melville Bay) and NPZ-II (autumn migratory corridor in Eastern Baffin Bay).

4.0 REPORTING

- Any significant environmental events will be immediately reported to BMP during the active seismic program;
- A 3-day activity report will be submitted to BMP three times a week throughout the active seismic program in accordance with the template provided (Attachment A – BMP 2011);
- A weekly report will be submitted each Monday throughout the active seismic program in accordance with the template provided (Attachment B – BMP 2011); and
- A completion report (cruise report) will be submitted immediately following completion of the seismic program in accordance with the template provided (Attachment C – BMP 2011).

5.0 LITERATURE CITED

- Bureau of Minerals and Petroleum (BMP). 2011a. BMP Guidelines for Application, Execution and Reporting of Offshore Hydrocarbon Exploration Activities (excluding drilling) in Greenland. December 2011. Greenland Government.
- BMP. 2011b. Manual for Seabird and Marine Mammal Surveys on Seismic Vessels in Greenland. May 2011. Government of Greenland and the National Environmental Research Institute (NERI), Aarhus University.



Danish Center for Environment and Energy (DCE). 2011. L. A. Kyhn, Boertmann, D., Tougaard, J., Johansen, K., Mosbech, A. Guidelines to Environmental Impact Assessment of Seismic Activities in Greenland Waters. 3rd Revised Edition, Dec. 2011.

Golder Associates Ltd. (Golder). 2012. Environmental Impact Assessment for a 3D Seismic Survey and Hydrographic Survey in Block 9 (Tooq). March 08, 2012.

JNCC (Joint Nature Conservation Committee). 2010. JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys. United Kingdom.



Report Signature Page

GOLDER ASSOCIATES A/S

Katelyn Zottenberg
Marine Mammal Biologist

Philippe Rouget
Senior Marine Biologist

pr/drm/

Registered in Denmark at Jagtvej 113 H, DK-2200 Copenhagen N, Denmark. CVR 29 62 42 24

https://uspws.golder.com/sites/p113340071eia3dseismic/reports/5001_eia_report/appendices/appendix_j_maersk_mmso_and_pam_12mar2012vf.docx



ATTACHMENT A

3-Day Activity Report Template

Appendix A; Template for 3 Day Activity Report

Activity report shall be submitted to: bmp@nanog.gl 3 times a week for the entire duration of the activity/survey using the below outlined template. If possible the font and size of the below template shall be used, and the reports shall be submitted in an edible word or pdf format, to facilitate an easy compilation of the reports.

Deadlines:

Sundays by 12 midnight

Tuesdays by 12 midnight

Thursdays by 12 midnight

Survey	
Activity/survey name	
Operator	
Short description of Activity/Survey methodology	
Total activity/survey area	e.g. the licence block(s)
Total activity/survey period	
Contact info at sea	
Vessel	Name of vessel: contact info:
Supply vessel(s)	Name of vessel(s): contact info:
Fishery Liaison Officer (FLO)	Vessel where FLO is stationed on: Name and telephone number of FLO:
Activity Report	
Current position, speed and direction	
Current (updated) activity/survey plan for the next 3 days	Corner positions or end points of survey lines: (if possible refer to lines in the enclosed map)
<i>Maps to be enclosed showing the completed acquisition, the last 3 days acquisition, and planned acquisition for the coming 3 days</i>	Map must show: <ul style="list-style-type: none"> • clear markings of longitudes and latitudes • key map showing where the activity/survey area is situated in Greenland • an arrow showing the current position of the vessel • activity/survey lines planned to be acquired over the coming 3 days marked with fat red font • activity/survey lines acquired (shot) the last 3 days marked with fat green font • Box stating the name and year of the survey • Box stating the date and time of the daily update
Report made by:	
Date and time of this update:	



ATTACHMENT B

Weekly Activity Report Template

Appendix B: Template for Weekly Reports

Licensee:	
Operator of the licensee:	
Contractor (e.g. seismic contractor):	
Vessels:	
Survey name:	
Survey area (licence area and positions):	
Time span for this reporting:	
Date of survey commencement:	
Expected date of survey termination:	
Type of data collected (survey methodology):	
<i>Results:</i>	
This weeks total production:	
Production per day, and daily average production:	
Total production in Greenlandic waters:	
Planned/expected total production in Greenlandic waters:	
Short description of this weeks activities:	

Description of deviations from the planned operations programme:	
<i>Maps to be enclosed showing the completed acquisition and the planned acquisition.</i>	
Incidents, accidents or near-incidents:	
Particular observations regarding ice, oceanographic, meteorological features, wildlife, fishery-activities etc.	
Others:	
Planned production in the coming week; scope and location:	
When and why is the next port call expected?:	
Reporting made by:	
Date:	



ATTACHMENT C

Completion Report Template

Appendix C; Template for Final Acquisition Report, offshore exploration activities

Licensee:	
Operator of the licensee:	
Contractor (e.g. seismic contractor):	
Vessels:	
Survey name:	
Survey area (licence area and positions):	
Time span for the operation; date of mobilisation, survey commencement, survey completion, demobilisation:	
Type of data collected (survey methodology):	
<i>Results:</i>	
Total production:	
Daily average production:	
Weekly average production	
Description of deviations from the planned operation programme:	
<i>Maps to be enclosed showing the completed</i>	

<i>acquisition and the planned acquisition.</i>	
Summary of Incidents, accidents or near-incidents:	
Particular observations regarding ice, oceanographic, meteorological features, wildlife, fishery-activities etc	<i>Completed log books from fishery liaison officer, marine mammal and seabird observer and logs of meteorological-, oceanographic- and ice observations (if applicable) shall in addition to this also be submitted in accordance with the Guidelines.</i>
Others	
Reporting made by:	
Date	

Please note that submission of this final acquisition report does not replace the requirements for submittal of data and geological reports etc. in accordance with chapter 8 of the Guidelines, Appendix I and the permission letter.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates A/S
Maglebjergvej 6, 1.
DK – 2800 Kgs. Lyngby
Denmark
T: +45 70 27 47 57

