Open Water Peer Review Panel
Monitoring Plan Recommendations Report
for SAExploration's Proposed 3D Seismic Survey in the Beaufort Sea, Alaska

April 2014

The Open Water Peer Review Panel (hereinafter referred to as the Panel) reviewed SAExploration's (SAE) Marine Mammal Monitoring Plan (4MP) for its proposed 3D seismic survey in 2015 in the Beaufort Sea, Alaska. Additional information regarding the proposed survey was provided by SAE and its contractors on the first day of the Panel meeting. To conduct its review, the National Marine Fisheries Service's Office of Protected Resources (PR) provided the Panel with specific questions to answer (identified below in bold), as well as additional guidance based on the general monitoring requirements outlined in the implementing regulations of the Marine Mammal Protection Act (MMPA) (see Appendix). The following report summarizes SAE's proposed activities, answers the specific questions provided by PR, and provides additional recommendations, as appropriate.

Summary of Activities:

SAE intends to conduct a 3D seismic survey in the Beaufort Sea of northern Alaska during the 2015 open water season, from about 1 July to 15 October. The specific location of the survey is not yet known but will most likely be near West Dock, adjacent to Prudhoe Bay, or Oliktok Point, just to the east of the Colville River Delta. The activities proposed in SAE's application for an Incidental Harassment Authorization (IHA) are to conduct a 3D seismic survey in an area no larger than 777 square kilometer (300 square miles) within a 4,562 square kilometer area (1,761 square mile) within the central Beaufort Sea (see Figure 1-1 on page 2 of SAE's IHA application). The purpose of the proposed survey is to evaluate and better understand the geological structures that may contain oil or gas reserves.

The primary seismic sources for the surveys are 620 cubic inch airgun arrays although a 1,240 cubic inch array may be used in deeper waters. Two vessels, each with a 620 cubic inch array will shoot simultaneously in an alternating shot mode. One vessel will shoot while the other is recharging. Airgun shots will occur every 16 seconds for an individual vessel, thus overall the shots will be 8 seconds apart. The survey will use a "recording patch" approach. Each patch will consist of 6 receiver lines and 32 source lines. Each receiver line is 8 kilometers (5 miles) in length and each line is spaced 402 meters (1,320 feet) apart. The receiver patch is oriented such that lines run parallel to the shoreline, thus source lines run perpendicular to the shoreline. Source lines are considerably longer than the receiver lines (see Figure 1-1, on page 4 of the IHA application). Each receiver patch is 19.4 square kilometers (7.5 square miles).

The 4MP proposed by SAE (Appendix B of the IHA application) consists of vessel-based protected species observers (PSOs). No sound source verification (SSV) studies are proposed for 2015, but safety and disturbance radii are based on SSV studies conducted in 2008, 2012, and 2014 (Aerts et al. 2008; Austin and Warner 2013; Heath et al. 2014). Those studies used the same vessels and airgun arrays; however the acoustic footprint of the 1,240 cubic inch array was measured in Cook Inlet. The distance to the 190 and 180 dB re 1 µPa thresholds were measured

at 195 meters and 635 meters, respectively, for the 620 cubic inch array and 250 and 910 meters for the 1,240 cubic inch array. The distance to the 160 dB re 1 µPa threshold for the 620 and 1,240 cubic inch arrays were 1.82 and 5.2 kilometers, respectively. SAE proposes to use those radii for monitoring in 2015. To monitor the proposed safety zone, SAE would deploy two to four PSOs on each of the source vessels, allowing for one to two observers to stand watch during daylight operations.

Even though acoustic monitoring was not included in their IHA application, during their presentation to the Panel, SAE stated they would also conduct acoustic monitoring. They intend to deploy two Micromars recorders at each of four monitoring sites. Micromars would be capable of recording marine mammal sounds as well as ambient and anthropogenic noise.

Questions

I. 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 below? If not, how should the objectives be modified to better accomplish the goals below?

The objectives for vessel-based monitoring are:
(1) Ensure that disturbance to marine mammals is minimized and all permit stipulations are followed.
(2) Document the effects of the proposed seismic activities on marine mammals.
(3) Collect data on the occurrence and distribution of marine mammals in the proposed project area.

Because no acoustic monitoring was included in the IHA application or the Marine Mammal Monitoring and Mitigation Plan (4MP), objectives were not explicitly stated. The Panel assumed the objectives to be generally similar to those for vessel-based monitoring with the exception of objective #1. PAM will not be used for real-time monitoring. Thus PAM will not be usable for implementing mitigation measures (i.e., ramp-downs, shutdowns). Another reasonable objective is to document ambient noise levels in the project area as well as potential differences in marine mammal detections when the seismic array is operating and when it is not.

The Panel believed that the objectives for both vessel-based and passive acoustic monitoring were appropriate.

II. Can the applicant achieve the stated objectives based on the methods described in the plan?

This issue was complicated for the Panel because the specific location of the seismic survey area was not known and the seismic sources that SAE would use depend on the location of the seismic survey. We attempted to address these issues in a general way but the question should be evaluated for the specific project area and seismic source once they are known. For example, if the project were to occur near the Colville River Delta, the Panel might suggest some robust

monitoring of impacts to spotted seals. If the survey area is offshore, the panel might be more concerned about monitoring of potential impacts to belugas and bowheads.

Vessel-based visual monitoring

The Panel agreed that the objectives of real-time mitigation of potential disturbance of marine mammals would be mostly met through visual monitoring. However, there are some limitations associated with PSOs' ability to monitor the entire safety radii at all times. Many of those limitations have been discussed in previous Panel reports.

For the SAE seismic survey, two observers will be on watch on the "primary" source vessel during daylight but only one observer will be on the "secondary" source vessel. Bunk space is limited on the secondary source vessel, which limits the number of observers. The observers' on the source vessels primary responsibility is to detect marine mammals that may be in or about to enter the safety zone so that mitigation measures (e.g., ramp down or shut down) can be implemented as necessary. The observer's ability to detect marine mammals within the safety zone at night or during times of poor visibility is limited. Having only a single observer stand watch on the secondary source vessel also limits the observer's ability to monitor the entire safety and disturbance radii and may not be able to cover all hours of airgun activity. Therefore, SAE will not be able to fully implement mitigation measures as may be needed during such times.

The single observer on the secondary source vessel will also have less time to observe the behavior and response of marine mammals to the seismic survey activities. And, as noted in previous panel reports, data collected by vessel-based PSOs on the occurrence and distribution of marine mammals in the project area during survey activities will be limited (1) during times of limited visibility, (2) to distances relatively close to the vessels, which does not include the entire disturbance zone, and (3) to only those animals detected at the surface, without benefit of a correction factor to account for animals not available for detection or missed by the observer and thereby not providing an accurate estimate of total takes. For those reasons, SAE's ability to address the objective of documenting "the effects of the proposed survey activities on marine mammals" will be limited.

To more effectively address Objectives 2 and 3, PSOs will need to observe during active seismic shooting and non-active times. That comparison should provide insights to possible effects of seismic activities on marine mammals. The times when airgun arrays are not operating will also provide more reliable, potentially unbiased data, about the occurrence and distribution of marine mammals. PSOs will not be able to detect long-range or over the horizon effects.

To more fully accomplish the objectives of vessel-based monitoring, the Panel recommends that at least two observers be on watch on both of the source vessels as much as possible.

Acoustic monitoring

Acoustic monitoring with Micromars should be helpful for meeting an objective of documenting ambient noise conditions in the project area only if they expand their proposed monitoring period to include baseline ambient noise conditions. PAM may also provide data on the effects of the

seismic survey on vocalizing marine mammals. However, the deployment of recorders in only four locations would not be sufficient to adequately examine the spatial and temporal distribution of marine mammals based on acoustic detections of their vocalizations. PAM may also provide some data on the distribution and occurrence of marine mammals in the project area but there are limitations. For example, not all marine mammals vocalize and shallow water is not conducive to sound propagation. Because of the potential for marine mammal displacement by noise, PAM should be extended to periods outside the planned seismic activities.

III. 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?

Sound Source Verification

If SAE decides to use the larger airgun array (i.e., the 1,240 cubic inch array), the Panel recommends that sound source verification be conducted on the array in the vicinity and at the same time of year in which the seismic survey is to be conducted in the Beaufort Sea. The Panel did not agree that using a safety radius for the 1,240 cubic inch array, which was measured in Cook Inlet, is a sufficient substitute for a SSV for that array in the Beaufort Sea because acoustic propagation conditions in Cook Inlet are much different than in the proposed area of operations in the Beaufort Sea.

Visual monitoring

The Panel recommended that SAE limit seismic operations at night or during periods of low visibility because PSOs' ability to detect marine mammals entering the safety zone is limited. Also, to the extent possible, SAE should consider deploying an additional observer on the secondary source vessel such that at least two observers are on watch during all daylight hours. This would increase the probability that animals are detected that are about to enter or are in the safety zone, that information on behavioral responses is recorded, and that the periods of airgun operations are fully monitored.

If seismic surveys occur during night or in poor visibility conditions, the Panel recommends that SAE use an adaptive approach for monitoring based on recent sightings of marine mammals. For example, if a bowhead whale mother/calf pair or an aggregation of three or more bowhead whales are sighted within the Level B harassment zone prior to the onset of night or during that day, SAE could be more cautious during darkness based on the potential risk to marine mammals. If the risk is relatively high, it might be decided that airguns should be shut down for that night. If this recommendation is accepted, SAE would need to work closely with NMFS PR for making the decision about whether to continue shooting during the night or in inclement weather.

If SAE uses the 1,240 cubic inch array and the measured safety radii in the Beaufort Sea are similar to Cook Inlet, then the Panel recommends that a dedicated scout vessel with at least 2 PSOs would be needed to adequately monitor the 180 dB safety radii (~910m) for mitigating Level A takes and the behavioral radii for estimating “takes”.

As proposed, SAE could ramp up, whether from quiet or with mitigation gun, to the full array within 15 minutes (turn on 1 gun, wait 5 minutes, turn on 2 more guns, wait 5 minutes, then turn on 4 more guns, wait 5 minutes then turn on the last airgun). We recommend that ramp up occur with one gun added every 5 minutes: thus there would be a minimum time of 35 minutes from zero to full array, assuming there are 8 airguns in the array. SAE proposed that ramp up would occur so there is an increase of 6 dB (doubling of acoustic energy) every 5 minutes. There are not enough data to support the effectiveness of this approach, thus the Panel recommends a more conservative approach of adding one airgun every 5 minutes.

Acoustic monitoring

Because the Panel did not know the specific location of the 3D seismic survey nor the final seismic source to be used, we did not know the specific plan for acoustic monitoring. Therefore, we were not able to provide many specific recommendations. Our recommendations would likely differ if the seismic survey were located inside barrier islands or offshore. If the seismic surveys are offshore, SAE would likely need more instruments and locations than what is currently planned. The Panel recommended that the Micromars be deployed well before the seismic surveys begin in order to collect baseline data before all the vessels are operative in the area and the airgun arrays begin operating.

With regard to the Micromars themselves, the Panel suggested that there are methods for deploying them in shallow water with a more compact mooring design, particularly because of the compact size of these recorders. EARs, C-PODs and Loggerhead DSGs have been used in Cook Inlet and Kotzebue Sound with a very compact deployment approach (M. Castellote, NMFS, NMML, pers. comm.). That approach might also be very suitable for use in the shallow waters of the nearshore Beaufort Sea.

Because Micromars have very recently been commercialized, the Panel recommends that additional testing be conducted to verify this recorder's performance due to the limited or non-existent field experience in long term deployments and cold Arctic waters. The Panel was not sure whether Micromars were fully calibrated. If not, they should be calibrated before they are deployed if the data are to be used for ambient noise characterization.

IV. 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?

Aerial Survey

Observing marine mammals from a source vessel has limitations. PSOs can only view marine mammals that are relatively close to the vessel. Moreover, animals may be influenced by the presence of the vessel or the airguns. Therefore, another method for visually detecting marine mammals is needed. Aerial surveys are helpful in mitigating potential impacts, understanding impacts, and for improved knowledge about the distribution and occurrence of marine mammals in the area. Aerial surveys provide data beyond the viewing range (i.e., over-the-horizon) of

PSOs on vessel. Also aerial surveys provide a more independent view of effects and distribution of marine mammals. If manned aerial surveys are not going to be used for monitoring, NMFS could ask SAE to improve the effectiveness of Unmanned Aerial Systems for monitoring of marine mammals in the Beaufort Sea.

Mitigation Airgun

The efficacy of a mitigation airgun to reduce impacts to marine mammals is unknown. There may be situations where it is appropriate to use; however, additional data need to be collected about this issue. The Panel recommended that SAE not use a mitigation gun for an extended period of time. It may be suitable for use during turns and short periods when airguns are shut down but not for longer periods of time. The Panel recommended that the mitigation gun should only be operated for up to one hour, which is the equivalent amount of time for surveying the safety radii plus ramp up. The Panel encourages SAE to attempt to gather data that would be useful for evaluating the efficacy of the use of a mitigation airgun.

The Panel also recommended the continuation of the past recommendation that the mitigation airgun be shot only once every minute instead of every few seconds. This will help reduce the amount of anthropogenic sound energy put into the water but will still alert marine mammals to the presence of the seismic survey.

V. 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 Panel recommended that the following be included in SAE's 90-day and/or comprehensive report:

- To ensure the accurate classification of vocalizations by species, SAE should provide information in the reports about how the detections obtained by the Micromars are ground-truthed. This should occur in consultation with biologists experienced in arctic species vocalizations. Error rates should be included in the reports if automatic detection algorithms are to be used.
- Even though the Micromars are intended to monitor marine mammals and characterize ambient noise, acoustic characteristics of the identified noise sources should be included in the reports to provide a better understanding of source levels and the robustness of SSV results, and other acoustic characteristics of the seismic survey equipment, such as spectral content, and received levels in different metrics such as RMS dB, cSEL 24h, dB peak to peak and 1/3 octave bands.
- Sightability curves should be included in the reports, as much as possible. If there are few data for each species of seal, it is probably suitable to combine ringed and spotted seals sightings. If enough data are not collected (i.e., too few marine mammals are seen), SAE should include a section in their reports about the range limitations of PSOs using sightability curves from previous reports resulting from IHAs.

Other comments regarding SAE's application

- The bowhead whale population size should be updated to reflect the most recent abundance estimate (16,892 in 2011, Givens et al. 2013).
- If SAE's seismic survey area is near the Colville River Delta, SAE should coordinate and collaborate with other companies (such as Caelus and Repsol) for monitoring the aggregated effects of all their activities on spotted seals, especially animals that may be hauled out. Aerial surveys many not be the most appropriate approach but other means, such as video and in-air acoustic monitoring might be useful.
- The Panel acknowledged SAE's willingness to share data. We encourage them to continue to make all environmental data (including PSO observations, acoustic monitoring, vessel track lines and timing of operations) available to the general public. That information will be needed for evaluation of cumulative effects among other reasons.

References

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Givens, G.H., S.L. Edmondson, J.C. George, R. Suydam, R.A. Charif, A. Rahaman, D. Hawthorne, B. Tudor, R.A. DeLong, and C.W. Clark. 2013. Estimate of 2011 abundance of the Bering-Chukchi-Beaufort seas bowhead whale population. Rep. Int. Whal. Comm., Paper SC/65a/BRG01. Cambridge, UK.

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Appendix

Monitoring Plan Requirements

The MMPA implementing regulations generally indicate that each Incidental Harassment Authorization (IHA) applicant's monitoring program should be designed to accomplish one or more of the following: document the effects of the activity (including acoustic) on marine mammals; document or estimate the actual level of take as a result of the activity (in this case, seismic surveys or exploratory drilling programs); increase the knowledge of the affected species; or increase knowledge of the anticipated impacts on marine mammal populations. As additional specific guidance beyond that provided in the MMPA regulations, NMFS further recommends that monitoring measures prescribed in MMPA authorizations should be designed to *accomplish or contribute to one or more of the following top-level goals*:

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

(b) An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammal species to any of the potential stressor(s) associated with the action (e.g., sound, explosive detonation, or expended materials), through better understanding of one or more of the following: 1) the action itself and its environment (e.g., sound source characterization, propagation, and ambient noise levels); 2) the affected species (e.g., life history or dive patterns); 3) the likely co-occurrence of marine mammal species with the action (in whole or part) associated with specific adverse effects, and/or; 4) the likely biological or behavioral context of exposure to the stressor for the marine mammal (e.g., age class of exposed animals or known pupping, calving or feeding areas).

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

(d) An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: 1) the long-term fitness and survival of an individual; or 2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival).

(e) An increase in our understanding of the effectiveness of mitigation and monitoring measures.

(f) A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization and incidental take statement.

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