Joint Industry Programme on E&P Sound and Marine Life - Phase III

Request for Proposals Number: JIP III-17-02

Field Work/Model Tool – Low Visibility Detection Techniques

Release Date: 19th May 2017

Introduction

This Request for Proposals (RFP) seeks proposals for a study to advance our understanding of the potential and the performance of commercial, currently available low-visibility monitoring systems under realistic operational conditions, i.e., as encountered during seismic surveys. Given that sensors have widely different characteristics with specific advantages and disadvantages depending on the operational constraints of the activity, environmental conditions, and focal species, a general model capable of adequately capturing this variability shall be developed. The performance of currently available low visibility detection systems shall be evaluated and necessary parameters for the models obtained through field studies of the relevant techniques.

This RFP seeks proposals that combine a detection assessment simulation tool or model (called "the model" hereinafter) with focused field studies to better constrain parameters entering the model and to validate the model. **Initially, applicants are requested to submit pre-proposals (<u>maximum 4 pages</u>).** These should describe the rationale & nature of the work proposed, the approach to addressing the questions posed in this RFP, and an estimate of time-scales & budget breakdown. After review and feedback from the JIP, short-listed applicants will be requested to submit a full proposal.

This RFP follows completion in 2016 of an initial desk-top review of Low Visibility Real-time Monitoring Techniques commissioned by the JIP. The research called for in this RFP is required to meet the information needs of the above JIP, specifically Research Category 4 *Mitigation and Monitoring* - see www.soundandmarinelife.orge.

The proposals being requested must address the Proposal Description, Proposal Features and Project Deliverables detailed below.

Organisations submitting proposals should also adhere to the Application Procedure and Critical Dates set out below. In addition, the Terms & Conditions referred to in the RFP shall apply.

Application Procedure

To respond to this RFP, please follow the relevant instructions given on the **Funding** page of the JIP website. Proposals should refer to the above RFP number and be submitted electronically to info@soundandmarinelife.org.

Those organisations submitting Proposals should refer to the **outline contract** on the JIP website. This sets out the terms & conditions under which any contract will be carried out under the management of the International Association of Oil & Gas Producers (IOGP). In particular, attention is drawn to the specific term relating to management of health, safety, security and environment aspects of a contract. All IOGP contracts have such a section, but the specific wording that will appear in this section depends on the type of activity (desk-top study, field work, etc.) to be conducted.

Critical Dates

19 May 2017   **Release of RFP**

16 June 2017   **Deadline for submission of Pre-Proposals**

Indicative subsequent time-table (subject to quality & volume of Pre-Proposals received):

July 2017 **   Notification of Request to short-listed Applicants for full Proposal

August 2017 **   Deadline for submission of Full Proposals

September 2017   Clarification of preferred Proposal(s)

October 2017   Contract award

*** Exact dates will be notified by IOGP to short-listed Applicants upon completion of Pre-Proposals evaluation process. IOGP reserves the right to amend or extend the time-table for full Proposals.*

We will confirm receipt of proposals. If you have not received confirmation of receipt of your proposal within 1 week of the above deadline, please contact John Campbell at IOGP (Tel +44 (0) 20 3763 9707; e-mail info@soundandmarinelife.org.

Background & Aim

In many regulatory frameworks, the presence of marine mammals has to be monitored during seismic surveys and other E&P related activities. If marine mammals are present within a pre-prescribed distance or area around the sound source (commonly called the mitigation or exclusion zone), mitigation actions are set into effect. This concept is based on monitoring the mitigation zone and where possible an extended area around it for the presence of marine mammals. If an animal is detected in the monitoring zone, it may be possible to track its movement to assess the likelihood of it entering mitigation zone in order to maximize the time available for making decisions to implement mitigation actions.

Historically, Marine Mammal Monitoring during seismic surveys has been conducted by human observers scanning the sea surface for the presence of marine mammals (or other endangered species). Visual observations are hence limited by a marine mammal's availability at the sea surface, by visibility and sea state.

In recent years, there has been an increased interest in using alternative technologies to address the limitations of visual monitoring. In particular, the use of Passive Acoustic Monitoring (PAM) has increased with some national guidelines encouraging its use and industry efforts focusing on improving existing PAM capabilities. Other monitoring technologies have also been developed and tested to overcome such limitations and provide additional (assistance) tools to generally increase the likelihood of detection. The JIP-commissioned report by SMRU Consulting (Ref SMRUM-OGP2015-002, June 2016) on Low Visibility Real-Time Monitoring Techniques Review identifies Passive Acoustic Monitoring PAM, thermal infrared (IR), Active Acoustic Monitoring (AAM), and radar as the most widespread supplementary technology technologies. This report is available from the JIP's Library Database accessible via its public website Library page http://www.soundandmarinelife.org/library.aspx. It will help inform the preparation of proposals in response to this RFP, specifically regarding recommendations related to modelling exercises and field experiments to quantify important parameters influencing the detection and false alert rates of the respective technologies. Organizations responding to this RFP are highly encouraged to review this report.

The JIP now seeks to advance its understanding of the potential and the performance of commercial, currently available low-visibility monitoring systems under realistic operational conditions, i.e., as encountered during seismic surveys. Given the fact that sensors have widely different characteristics with specific advantages and disadvantages depending on the operational constraints of the activity, environmental conditions and focal species, a general model capable of adequately capturing this variability shall be developed. The performance of currently available low visibility detection systems shall be evaluated and necessary parameters for the models shall be obtained through field studies of the relevant techniques.

Results shall:

a)   inform decisions on which are the best-suited low-visibility detection system(s) for a given environmental and operational setting.

b)   provide an open source simulation tool to assess the efficacy of using different low visibility monitoring methods for a wide range of survey scenarios.

Description of the Proposals Being Requested

Technologies identified as useful monitoring tools for the detection of marine mammals under low visibly conditions are PAM, AAM, radar and thermal IR. While other technologies exist, such as LiDAR, these four technologies are considered to have the highest level of commercial availability. All these technologies have a set of factors influencing their ability to detect (or miss) a marine mammal, but also to provide false detections or misreport the animal's position relative to the mitigation zone, potentially leading to false alerts. The JIP seeks to deepen its understanding of sensor and system performance with regard to which low-visibility monitoring technology (or combinations of technologies) provides the best results for realistic operational conditions under various environmental conditions. Results in this context should be considered in terms of number of correct mitigation decisions versus number of false mitigation decisions, i.e. missed events resulting in non-compliance and possibly imposing a risk to marine mammals, and false alerts, resulting in unnecessary and costly interruptions of a seismic survey.

This RFP seeks proposals which combine a detection assessment simulation tool or model (called "the model" hereinafter) with focused field studies to better constrain parameters entering the model and to validate the model. It requires a phased approach to proposal submission, as outlined above.

a)   General Points

Applicants are asked to consider the following general points in their applications:

•   Proposals should demonstrate the applicant's in-depth knowledge of marine mammal monitoring methods and the findings of the above-referenced desk-top study report on Low Visibility Real-Time Monitoring Techniques Review. This report gives clear guidance on specific needs to answer to this current RFP: the JIP expects proposals in response to this call to build on this work rather than to repeat it.

•   Applicants shall seek a suitable balance between model development and field work at their discretion and clearly explain interaction between these two parts of the work in answering to the general objectives. The JIP is open to support proposals with focus on model or field work, or taking a balanced approach, depending how objectives are met.

•   Applicants shall describe clearly how model work and proposed field work are linked together.

•   JIP expects the model to use open code or commercially available (e.g., Matlab) libraries and to be distributable as Open Source after completion of the project.

- Assessment of low-visibility monitoring technologies shall be conducted primarily on the basis of the model, which simulates the entire signal chain from signal/cue-production to detection and subsequent mitigation decision.

- Results shall be presented in terms of the number of correct mitigation decisions and number of false mitigation decisions, including cross-correlations (ROC curves) to evaluate which technologies provide complementary information.

- Modelling and field studies shall employ detection technologies in an operational setting. For PAM or AAM, this implies assuming/simulating/creating an acoustic environment as to be expected from a real seismic survey, including shadow zones and masking from air gun sound sources and vessel noise. For visual/optical techniques this implies including confounding factors such as changing observer alertness, typical sea states, glare, visibility etc.

- Modelling and field studies shall be carried out assuming the currently best commercially available systems/implementations for each technology in its optimal configuration; We explicitly discourage proposing any activities that may require significant levels of investment by including or aim at advancing emerging technologies as part of this RFP.

- Evaluation of technologies shall be performed in conjunction and comparison with traditional MMO visual monitoring as standard method that is used today. This implies that the performance (alertness, accuracy of distance estimates) of traditional MMO work should also be included (called the "VIS module" in the example in Appendix A) in the modelling and tested to create a realistic benchmark other low visibility technologies can be evaluated against.

- The JIP intends to support studies contributing to this RFP with up to 1 million $ US. Applicants are encouraged to deliver a financial breakdown of how available money is balanced between model and field study.

b)   Modelling Sensor Performance

Applicants are asked to consider the following points in their presentation of the modelling component:

- While the model should be generic, i.e., applicable to any marine mammal species (cetaceans and pinnipeds) and the full range of environmental and operational settings, the JIP requests the use of two survey scenarios to be explicitly evaluated by the model:

  o   An exploration survey in warm and deep water with sperm whales and dolphins as main target species.

  o   An exploration survey in cold and shallow waters with baleen whales (fin, blue or bowhead whale) as main target species.

- The model shall build on available information on animal behaviour and technology specific detection functions while including confounding factors such as environmental variables, observer/operator fatigue and survey design.

- Analysis of model results shall be based on a statistical approach to allow for parameter variances to calculate average values, error estimates and sensitivities to parameter settings.

- Model results should also be used to identify/guide field studies as needed to describe technology efficacy adequately, e.g., direction specific detection functions.

- The model should include a VIS-module (modelling the abilities of a marine mammal observer) which serves as general reference for performance metrics.

Proponents may develop their own model approach but see **Appendix A** for an illustration of what the JIP considers may be important elements of a conceptual model framework.

c) Field Studies

Field studies are thought of as a necessary validation addendum to the modelling work, deriving their right of existence from information needs identified *a-priori* in the above-referenced desk-top study report or from the output of the model on parameter sensitivities as available later in the study (to be included as placeholders in the proposal).

Proposed field work under this RFP will aim at gaining knowledge on sensor performance under realistic operational conditions such as would occur during seismic surveys. Particularly, spatially resolved detection rates and rates of type I (false positives) and type II (false negatives) errors shall be determined in the field under realistic conditions.

Applicants are asked to consider the following field-study specific points in their applications:

- The JIP acknowledges that a comprehensive field work, including simulations testing all detection methodologies in an operational setting on a seismic vessel is demanding and costly, especially when taking into account that commercial seismic surveys are not necessarily in areas where many encounters with focal specimen are to be expected. Hiring a seismic vessel with an active air gun array for an extended period of time to do a dedicated field test is outside the funding scope of the JIP. Rather, proposals suggesting a cost-effective field trial or a series of field trials, or usage of already available information or information from ongoing other activities, will more likely meet both the study's goals and the RFP's financial constraints.

- Field trials may employ artificial targets or cues to more systematically quantify detection functions, particularly regarding the performance of strictly computational algorithms.

- Applicants are encouraged to explore options to 'piggy-back' on other commercial seismic surveys or research cruises with vessels already equipped with the relevant technology for needed field studies.

- Field studies shall fully describe the environmental and operational conditions under which they were performed and provisions shall be taken to be able to transfer findings to other scenarios (e.g. detection functions will vary with observer/detector height).

- Field studies should be conducted as to ensure statistical robustness and mutual independence of the detections by the various low-vis techniques employed.

Desirable Features of Proposals

Responses to this RFP should address each of the following (see also **RFP Response Format** page of JIP website):

a) A detailed scope of work to prepare and provide the deliverables detailed below.
b) A detailed work plan to show how the terms of the contract will be met.
c) Timeframe for completion of project and significant milestone events during the project.
d) A detailed cost estimate in US dollars, which includes:
   - Support for travel in order to meet with related company representatives or others with expertise in this subject area;
   - Page charges associated with peer-reviewed publication and potential cost of open access to the full published articles;
   - Assumptions to support the cost estimate; and
   - Any contingencies to address unknowns.
e) A list of personnel to be involved in the project and their qualifications, and their proposed role in this project.
f) Researcher experience in this area and previous work.

g) Where appropriate to the project, a discussion on how you manage animal care and use in your proposed work (*see also Application Procedure above*)

h) An overall proposal summary (one paragraph).

Project Deliverables

Project deliverables shall include:

a) **Quarterly Progress Reports** that summarise the work conducted, tasks planned for the coming period, amount spent (vs budget), and forecasts a spend plan for the duration of the project. The specific reporting formats will be determined following contract award.

b) **Draft and Final Project Report** to include:
   1. A report detailing overall study, results and recommendations (as outlined in description of proposal)
   2. **Model tool** to be run in open source or commercial available libraries (e.g. MatLab), full source code free of proprietary rights and ready to be distributed as open source.

c) **One or more manuscripts** submitted for publication in a peer-reviewed journal.

d) A **two-page Fact Sheet** explaining results and findings for a non-specialist audience (to be published on the JIP website).

Terms & Conditions

By submitting a proposal to the JIP, the potential contractor accepts the terms and conditions set out in this RFP. This RFP does not commit the JIP, through IOGP, to contract for any supply or service and the JIP shall not be deemed to have accepted any proposal submitted by any potential contractor unless and until a duly executed written agreement is in place and then only for such scope as specifically identified in the written agreement.

The potential contractor acknowledges that IOGP and the JIP participants may accept or reject any proposal for any reason whatsoever. The JIP may decide to fund a study in part or as a whole. The JIP will not enter into discussion on its decision on any award made as a result of this RFP.

Those responding to this RFP are advised that the JIP will not pay for any costs incurred in preparation of a response to this invitation, including without limitation costs and expenses of attending meetings and worksite visits related to this RFP.

All correspondence and documentation associated with this invitation will be in English. Submissions and information will not be shared with other potential contractors.

Appendix A – Conceptual Model Framework (Illustrative)

Proponents may develop their own model approach. However, the following module descriptions are provided as an illustration of what the JIP considers may be important elements of a conceptual model framework:

1.) Operational module
Input: location, time and type of operation
Output: time series of vessel positions and associated activity incl. acoustic emissions.

Represents the activity of a seismic vessel for a variety of typical operational settings, e.g. line change, soft-start/ramp up or data acquisition phase, survey scale and duration, mitigation requirements (e.g. shut-down radius, periods, soft-start/ramp-up times).

2.) Animal movement module (ideally individual 'animat' type model):
Input: species, location and time of operation
Output: Time series of positions and timing of cues (i.e. vocalizations, blows, surface display and target strength).

Provides the trajectory and time series of cues as emitted by an individual of the focal species in a suitable space/time volume. The module should be capable of representing different species and behavioural states as expressed by model parameters like swim speed, dive and surface times, vocal behaviour, surface behaviour, along with their variability, as a basis to a statistical analysis approach of the model results. Module parameters should allow for, but not necessarily enforce, simulating behavioural responses to sound from seismic surveying.

These two modules provide a time series of vessel and (possibly multiple concurrent) "animat" and cue positions. The next two modules aim at evaluating how likely the "animat" is to be detected.

3.) The environmental module

Input: Location and time of survey
Output: Environmental conditions

Provides different atmospheric and acoustic environmental conditions, such as night/day, visibility (in km, as affected by fog, rain and snow), sea state, glare, as well as the acoustic environment at the location of the acoustic sensors, including natural (rain, wave) and anthropogenic (seismic vessel and source) sound.

4.) The sensor modules
Input: Time series of distance and direction of cue, environmental conditions
Output: Mitigation decision per cue, correct/false mitigation decision per encounter

Sensor specific detection likelihood models shall be developed on basis of known performance data. All models should factor in the typical environmental conditions as provided by module 3.
  a) The visual observer model, factoring in: Animal group specific detection functions (radial sighting probability), instant field of view (e.g. slowly rotating 120° sector), number of observers, fatigue, errors in distance and bearing estimates.

b) *The IR model, factoring in: Animal group specific detection functions, instant field of view (e.g. a 360° with some constraint from superstructures), errors in distance and bearing estimates.*

c) *The radar model, factoring in: Animal group specific detection functions, clutter from waves.*

d) *The PAM model, factoring in: Audio-class (click, whistle, LF-calls) specific, directionally resolved detection function*

e) *The AAM model, factoring in: Group specific target strengths, directionally resolved detection function (including "animat" depth), uncertainty in target identification, acoustic shadow zones*

5.) ***The model framework***

<u>*Input*</u>*: Survey location and timing*

<u>*Output*</u>*: Assessment of sensor performance on basis of metrics, such as:*

How many correct detections have been made?

How many false detections have been taken

The model framework shall repeatedly feed the above modules with specific realizations randomly selected from the parameter ranges and evaluate the results to arrive at statistically representative specific assessments for each survey scenario.

Note: It is assumed that the model features true alerts and missed events only, but no false positives. Some systems that are thought to be used as assistant system, allowing MMOs to eliminate false alerts as reported by the computer through real-time verification. Hence models might consider adjusting false alert errors according to assumed verifier performance, provided the false alert rate does not choke the system.