Cenos Offshore Windfarm Limited

# Cenos EIA

# Appendix 33 - Outline Marine Mammal Mitigation Protocol

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# CONTENTS

# ACRONYMS

| ACRONYM | DEFINITION |
|---|---|
| AC | Alternating Current |
| ADD | Acoustic Deterrent Device |
| BOWL | Beatrice Offshore Windfarm Ltd |
| CaP | Cable Plan |
| CBRA | Cable Burial Risk Assessment |
| CES | Crown Estate Scotland |
| CNS | Central North Sea |
| CPT | Cone Penetration Tests |
| cUXO | Confirmed Unexploded Ordnance |
| DC | Direct Current |
| DoL | Depth of Lowering |
| DSLP | Development Specification and Layout Plan |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EICC | Export/Import Cable Corridor |
| EMF | Electromagnetic Field |
| FTU | Floating Turbine Unit |
| HF | High Frequency |
| HOD | High-Order Detonation |
| IAC | Inter-Array Cable |
| INNS | Invasive Non Native Species |
| INNSMP | Invasive Non Native Species Management Plan |
| INTOG | Innovation and Targeted Oil & Gas |
| IPF | Initial Plan Framework |
| JNCC | Joint Nature Conservation Committee |
| Km | Kilometre |
| LF | Low Frequency |
| LOD | Low-Order Deflagration |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MBES | Multibeam Echo Sounder |

| ACRONYM | DEFINITION |
|---|---|
| MLA | Marine Licence Application |
| MD-LOT | Marine Directorate - Licensing and Operations Team |
| MMMP | Marine Mammal Mitigation Plan |
| MMO | Marine Mammal Observer |
| MPCP | Marine Pollution Contingency Plan |
| MZ | Mitigation Zone |
| NEQ | Net Equivalent Quantity |
| OSCP | Offshore Substation Convertor Platform |
| OSPAR | Oslo-Paris Convention |
| OWF | Offshore Wind Farm |
| PCW | Phocid Carnivores in Water |
| PS | Piling Strategy |
| PTS | Permanent Threshold Shift |
| pUXO | Potential Unexploded Ordnance |
| ROV | Remotely Operated Vehicle |
| SBP | Sub-Bottom Profiler |
| SOPEP | Ship Oil Pollution Emergency Plan |
| SOV | Service Operations Vessel |
| SSS | Side Scan Sonar |
| TLP | Tension Leg Platform |
| TTS | Temporary Threshold Shift |
| UHRS | Ultra High-Resolution Seismic |
| UXO | Unexploded Ordnance |
| VHF | Very High Frequency |
| VMP | Vessel Management Plan |
| WTG | Wind Turbine Generators |

# GLOSSARY

| TERM | DEFINITION |
|---|---|
| Array Area | The area within which the Wind Turbine Generators (WTGs), floating substructures, moorings and anchors, Offshore Substation Converter Platforms (OSCPs) and Inter-Array Cables (IAC) will be present. |
| Cenos Offshore Windfarm ('the Project') | 'The Project' is the term used to describe Cenos Offshore Windfarm. The Project is a floating offshore windfarm located in the North Sea, with a generating capacity of up to 1,350 Megawatts (MW). The Project which defines the Red Line Boundary (RLB) for the Section 36 Consent and Marine Licence Applications (MLA), includes all offshore components seaward of Mean High Water Springs (MHWS) (WTGs, OSCPs, cables, floating substructures moorings and anchors and all other associated infrastructure). The Project is the focus of this Environmental Impact Assessment Report (EIAR). |
| Cenos Offshore Windfarm Ltd. (The Applicant) | The Applicant for the Section 36 Consent and associated Marine Licences. |
| Developer | Cenos Offshore Windfarm Ltd., a Joint Venture between Flotation Energy and Vårgrønn As (Vårgrønn). |
| Environmental Impact Assessment (EIA) | The statutory process of evaluating the likely significant environmental effects of a proposed project or development. Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and maintenance and decommissioning. |
| Environmental Impact Assessment Report | A report documenting the findings of the EIA for the Project in accordance with relevant EIA Regulations. |
| Export/Import Cable | High voltage cable used to export/import power between the OSCPs and Landfall. |
| Export/Import Cable Corridor (EICC) | The area within which the Export/Import Cable Route will be planned and the Export/Import Cable will be laid, from the perimeter of the Array Area to MHWS. |

| TERM | DEFINITION |
|---|---|
| **Export/Import Cable Route** | The area within the Export/Import Export Corridor (EICC) within which the Export/Import Cable Bundle (EICB) is laid, from the perimeter of the Array Area to MHWS. |
| **Floating Turbine Unit (FTU)** | The equipment associated with electricity generation comprising the WTG, the floating substructure which supports the WTG, mooring system and the dynamic section of the IAC. |
| **Flotation Energy** | Joint venture partner in Cenos Offshore Windfarm Ltd. |
| **High Voltage Alternating Current (HVAC)** | Refers to high voltage electricity in Alternating Current (AC) form which is produced by the WTGs and flows through the IAC system to the OSCPs. HVAC may also be used for onward power transmission from the OSCPs to assets or to shore over shorter distances. |
| **High Voltage Direct Current (HVDC)** | Refers to high voltage electricity in Direct Current (DC) form which is converted from HVAC to HVDC at the OSCPs and transmitted to shore over longer distances. |
| **Horizontal Directional Drilling (HDD)** | An engineering technique for laying cables that avoids open trenches by drilling between two locations beneath the ground's surface. |
| **Inter-Array Cable (IAC)** | The cables which connect the WTGs to the OSCPs. WTGs may be connected with IACs into a hub or in series as a 'string' or a 'loop' such that power from the connected WTGs is gathered to the OSCPs via a single cable. |
| **Joint Venture** | The commercial partnership between Flotation Energy and Vårgrønn, the shareholders which hold the Exclusivity Agreement with CES to develop the Cenos site as an INTOG project. |
| **Landfall** | The area where the Export/Import Cable from the Array Area will be brought ashore. The interface between the offshore and onshore environments. |

| TERM | DEFINITION |
|---|---|
| **Marine Licence** | Licence required for certain activities in the marine environment and granted under the Marine and Coastal AccesMarine s Act 2009 and/or the Marine (Scotland) Act 2010. |
| **Mean High Water Springs (MHWS)** | The height of Mean High Water Springs is the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest. |
| **Mean Low Water Springs (MLWS)** | The height of Mean Low Water Springs is the average throughout a year of the heights of two successive low waters during periods of 24 hours (approximately once a fortnight). |
| **Mitigation Measures** | Measures considered within the topic-specific chapters in order to avoid impacts or reduce them to acceptable levels.<br>• Primary mitigation - measures that are an inherent part of the design of the Project which reduce or avoid the likelihood or magnitude of an adverse environmental effect, including location or design;<br>• Secondary mitigation – additional measures implemented to further reduce environmental effects to 'not significant' levels (where appropriate) and do not form part of the fundamental design of the Project; and<br>• Tertiary mitigation – measures that are implemented in accordance with industry standard practice or to meet legislative requirements and are independent of the EIA (i.e. they would be implemented regardless of the findings of the EIA).<br>Primary and tertiary mitigation are referred to as embedded mitigation. Secondary mitigation is referred to as additional mitigation. |
| **Mooring System** | Comprising the mooring lines and anchors, the mooring system connects the floating substructure to the seabed, provides station-keeping capability for the floating substructure and contributes to the stability of the floating substructure and WTG. |
| **Offshore Substation Converter Platforms (OSCPs)** | An offshore platform on a fixed jacket substructure, containing electrical equipment to aggregate the power from the WTGs and convert power between HVAC and HVDC for export/import via the Export/Import Cable to/from the shore. The OSCPs will also act as power distribution stations for the Oil & Gas platforms. |

| TERM | DEFINITION |
|---|---|
| **Onward Development** | Transmission projects which are anticipated to be brought forward for development by 3rd party oil and gas operators to enable electrification of assets via electricity generated by the Project. All Onward Development will subject to separate marine licensing and permitting requirements. |
| **Onward Development Area** | The area within which oil and gas assets would have the potential to be electrified by the Project. |
| **Onward Development Connections** | Oil and gas assets located in the waters surrounding the Array Area will be electrified via transmission infrastructure which will connect to the Project's OSCPs. These transmission cables are referred to as Onward Development Connections. |
| **Project Area** | The area that encompasses both the Array Area and EICC. |
| **Study Area** | Receptor specific area where potential impacts from the Project could occur. |
| **Transmission Infrastructure** | The infrastructure responsible for moving electricity from generating stations to substations, load areas, assets and the electrical grid, comprising the OSCPs, and associated substructure, and the Export/Import Cable. |
| **Vårgrønn As (Vårgrønn)** | Joint venture partner in Cenos Offshore Windfarm Ltd. |
| **Wind Turbine Generator (WTG)** | The equipment associated with electricity generation from available wind resource, comprising the surface components located above the supporting substructure (e.g., tower, nacelle, hub, blades, and any necessary power transformation equipment, generators, and switchgears). |

# APPENDIX 33 OUTLINE MARINE MAMMAL MITIGATION PROTOCOL

## 33.1 Introduction

### 33.1.1 Purpose of this Marine Mammal Mitigation Protocol

This Outline Marine Mammal Mitigation Protocol (MMMP) document has been prepared for Cenos Offshore Windfarm Ltd. (hereafter referred to as 'the Developer), a Joint Venture between Flotation Energy and Vårgrønn As (Vårgrønn), which is developing the Cenos Offshore Windfarm (hereafter referred to as 'the Project').

This Outline MMMP will form the basis of the MMMP, which will be finalised and adopted post-consent prior to the commencement of any construction works. The MMMP will be developed in accordance with relevant guidance and the conditions of the Section 36 Consent and Marine Licences granted for the Project and will be submitted to Marine Directorate - Licensing and Operations Team (MD-LOT) for approval on behalf of Scottish Ministers.

The information detailed in this document is based on the current understanding of the baseline environment (EIAR Vol. 3, Chapter 11: Marine Mammal Ecology) and how the Project will be constructed and operated using the best available technologies, in compliance with current legislation and best practice, specifically guidelines for minimising the risk of injury to marine mammals from explosives, piling noise, and geophysical surveys (JNCC 2010a, 2010b, 2017, 2023a, 2023b) at the time of writing. At the time of submission, the information provided in this document is accurate. This is a live document and will be subject to review and revision and will be updated as necessary.

This Outline MMMP briefly describes the noise generating activities to be undertaken during the construction phase of the Project (which includes pre-construction/site preparation), potential impacts arising from these activities and mitigation approaches to minimise any risk of injury to marine mammals. Where required, activities will be subject to a separate Marine Licence Application (MLA).

### 33.1.2 Objectives

This Outline MMMP details mitigation options based on the findings presented in the following supporting studies within the Environmental Impact Assessment (EIA):

- EIAR Vol. 4, Appendix 15: Underwater Noise Modelling Report;
- EIAR Vol. 4, Appendix 16: Marine Mammal Baseline Report; and
- EIAR Vol. 3, Chapter 11: Marine Mammal Ecology.

### 33.1.3 Consent compliance

The MMMP fulfils the consent conditions for the preparation of a MMMP as outlined in Table 33-1.

*Table 33-1 Consent conditions relating to the MMMP*

| CONSENT REFERENCE | CONDITION | RELEVANT SECTION |
|---|---|---|
| [To be added post consent] | | |
| | | |
| | | |

## 33.1.4 Relevant other documents and plans

This MMMP will form part of a set of approved documents that provide the framework for the construction of the Project.

The links of this MMMP with other consent plans specifically listed in the offshore consent conditions are detailed in Table 33-2.

*Table 33-2 Link with other consent plans*

| OTHER CONSENT PLANS/DOCUMENTATION | DETAILS |
|---|---|
| Environmental Management Plan (EMP) | The EMP will set out procedures to ensure all activities with the potential to affect the environment are appropriately managed and will include a description of planned activities and procedures, roles and responsibilities, pollution control and spillage response plans, incident reporting, chemical usage requirements, waste management plans, plant service procedures, communication and reporting structures, and programme of work. It will detail the final design selected and take into account Marine Licence conditions and commitments. The EMP will additionally include an Invasive Non Native Species (INNS) Management Plan (INNSMP) and a Marine Pollution Contingency Plan (MPCP). |
| MPCP | The MPCP will detail procedures in the event of an accidental release, characterise all sources for potential contaminant releases and provide key emergency contact details for use in the event of an accidental release. |
| Piling Strategy (PS) (if impact piling is required) | The PS will include details of expected noise levels piling activities, full details of the proposed method and anticipated duration of piling at all locations, details of soft-start piling procedures and anticipated maximum piling energy required at each pile location and details of any mitigation such as PAM and visual observations undertaken by MMO(s) prior to the commencement of impact piling, to ensure that no marine mammals will be exposed to the highest levels of underwater noise, in line with Joint Nature Conservation Committee (JNCC) (2010) guidelines and use of ADDs) to deter marine mammals from the zones within which they could experience acoustic injury and monitoring to be employed. |
| Vessel Management Plan (VMP) | The VMP will detail types, specifications and numbers of vessels, how vessel management will be coordinated and the location of ports, routes of passage and number of transits for the Project. The VMP will refer to the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife for guidance on how vessels should behave around Marine Wildlife. |
| Decommissioning Programme | The development of, and adherence to, a Decommissioning Programme, approved by Scottish Ministers prior to construction and updated throughout the Project's operational life. |
| Development Specification and Layout Plan (DSLP) | The DSLP will confirm the final specification and layout of the Project Area. The Plan will include location and coordinates of all Offshore Wind Farm (OWF) infrastructure including cables and the final design parameters of the OWF. |

## 33.1.5 Structure of the plan

The structure of the document is as follows:

- Section 1 – Introduction;
- Section 2 - Project background;
- Section 3 – Overview of mitigation measures;
- Section 4 – Geophysical surveys;

- Section 5 – Unexploded Ordnance (UXO) clearance;
- Section 6 – Pile driving;
- Section 7 – Reporting; and
- Section 8 – References.

## 33.2 Project Background

In November 2022, Flotation Energy and Vårgrønn submitted a joint leasing application under the Innovation and Targeted Oil & Gas (INTOG) Leasing Round and were subsequently awarded an Exclusivity Agreement to develop the Project through their joint venture company, Cenos Offshore Windfarm Ltd. The Project is entirely located within the area INTOG 'E-a' as defined in the Initial Plan Framework (IPF), which was published to appoint the planning framework and the areas of seabed that will form the spatial footprint for the Crown Estate Scotland (CES) leasing process.

The Project is located in the Central North Sea (CNS) approximately 200 kilometres (km) offshore east of Aberdeen and comprises both the Array Area and the Export / Import Cable Corridor (EICC). The key components of the Project include:

- Up to 95 Floating Turbine Units (FTUs) each with a Wind Turbine Generator (WTG) and floating substructure, which will be anchored to the seabed to maintain station keeping an allowable radius for each FTU within the Array Area;
- Up to two Offshore Substation Convertor Platforms (OSCPs) within the Array Area, connected to the WTGs using dynamic subsea Alternating Current (AC) power cables (the Inter-Array Cables (IACs)). OSCPs topsides will be located on bottom-fixed jacket foundations with 50 metre (m) spacing between jackets. OSCPs topsides will be linked via bridge-link;
- Up to 350 km of IACs (including 280 km of buried, static cabling, and 70 km of dynamic cabling); and
- An Export/Import Cable bundle comprising two High Voltage Direct Current (HVDC) cables and a fibre optic cable bundled in a single trench. Each has a maximum length of 230 km from the OSCPs to Landfall at Longhaven.

Project related noise generating activities include:

- Site investigation works including geophysical survey;
- UXO clearance; and
- Impact piling.

Other activities related to site investigation surveys (geotechnical investigations) using Cone Penetration Tests (CPT), vibrocoring and borehole drilling are generating underwater noise. However, the likelihood of auditory injury due to these activities is very small, as it is expected that marine mammals will move away from the activity due to the presence of the survey vessel itself. Therefore, no mitigation measures are proposed for the above.

[Section to be updated post consent with final details of the Project]

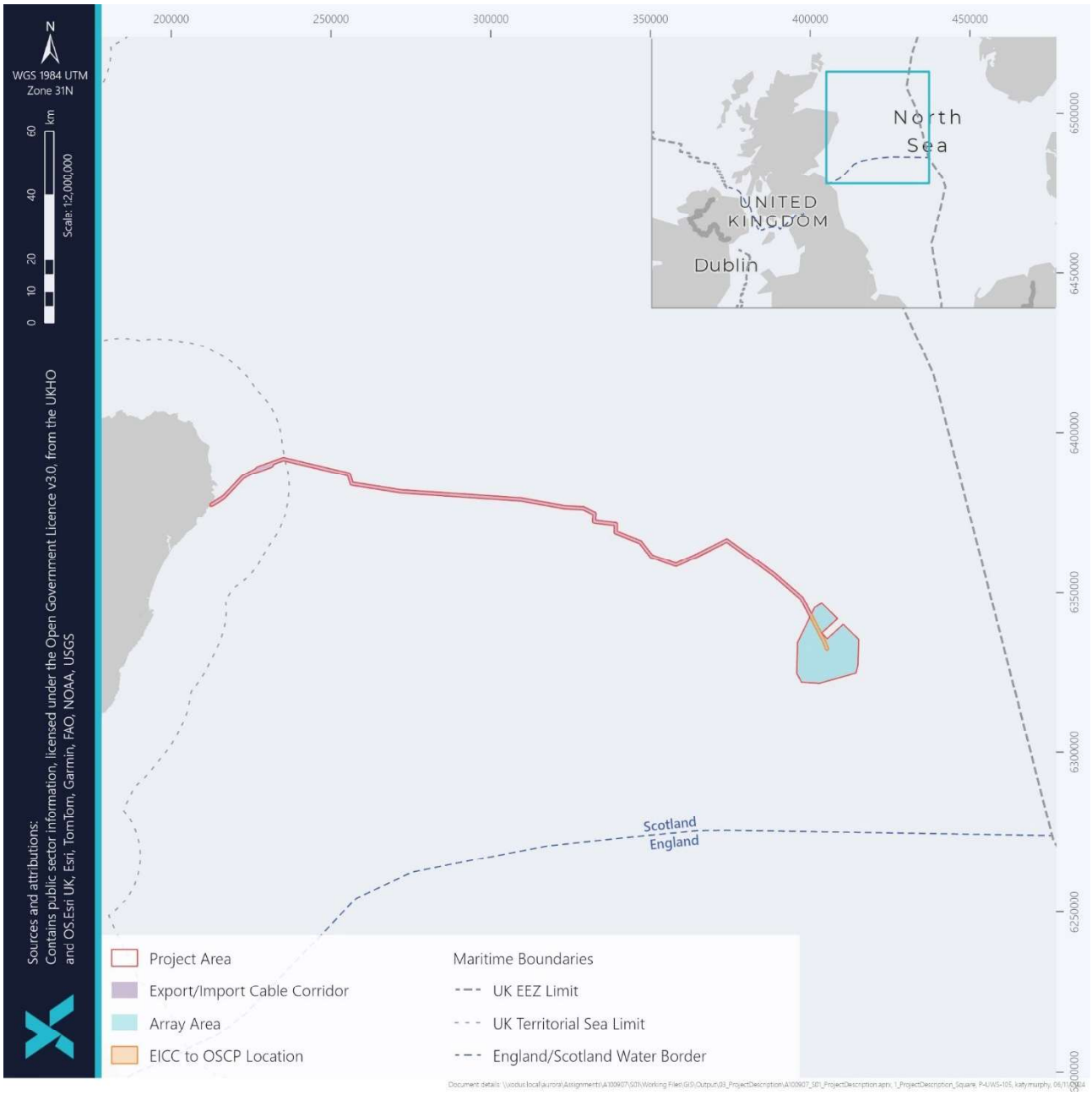


*Figure 33-1 Location of the Project; Array Area, Export/Import Cable Route and EICC*

## 33.3 Overview of Mitigation Measures

This Section of the Outline MMMP includes a general description of each mitigation measure to be applied to reduce the potential injury to marine mammals from geophysical surveys, pile driving and UXO clearance activities, together with scientific evidence of their efficacy.

### 33.3.1 Acoustic Deterrent Devices

Acoustic Deterrent Devices (ADDs) emit a loud, mid-frequency (ca. 12 kHz) sound signal with the intention of deterring marine mammals from the area close to where they are deployed. The Joint Nature Conservation Committee (JNCC) guidelines (JNCC, 2023a; JNCC, 2024) note that ADDs have the potential to reduce the risk of injury to marine mammals by causing them to flee from locations where even louder sounds might be expected (e.g. close to pile-driving or UXO clearance operations). An example ADD commonly used in UK waters is a Lofitech device[1]. Graham *et al.* (2019) used wind farm construction operations at Beatrice Offshore Windfarm Ltd (BOWL) in the Moray Firth as an in-situ experiment to evaluate the effectiveness of ADDs. This study assessed the response behaviours of harbour porpoise to ADDs and pile driving, and the response to pile driving only. It was determined that the short-term response to the cumulative impact on harbour porpoise was greater with the addition of ADDs than pile driving alone. However, the study also referenced an increase in probability of response due to increased baseline vessel activity. Also in the Moray Firth, Thompson *et al.* (2020) noted a strong behavioural response from harbour porpoise following a 15-minute experimental exposure to an ADD. Furthermore, Boisseau *et al.* (2021) reported that the Lofitech ADD is effective at evoking a deterrence response in minke whales, suggesting that this device could be effective at limiting the potential for low frequency cetaceans to experience auditory injury from exposure to sound generated during pile piling and UXO intervention. However, it should be noted that unnecessary prolonged use of ADDs might not be recommended, Thompson *et al.* (2020) reported that far-field responses to ADD playback were evident in a controlled, scientific study in the Moray Firth from only a 15 minute ADD activation, where there was a 50% probability of a harbour porpoise response within 21.7 km of the ADD. For this reason, the maximum proposed ADD activation in this MMMP is no longer than 60 minutes.

### 33.3.2 Soft start and ramp-up procedures

Soft start and ramp-up procedures are used for piling activities to protect marine mammals from a sudden, loud noise that may cause injury or strong behavioural response.

These procedures involve gradually increasing the intensity of pile driving and hammer energy over a set period, rather than starting at full power immediately. The gradual increase in noise emission allows marine mammals to detect the sound and move away from the area, thereby reducing the risk of auditory injury or disturbance. This approach is designed to minimise the impact on marine mammals by giving them time to vacate the vicinity before the noise reaches its peak intensity. These procedures are also used to minimise the risk of auditory injury from specific geophysical survey equipment (JNCC, 2017).

[1] *https://www.lofitech.co.uk/*

### 33.3.3 Marine Mammal Observers

Marine Mammal Observers (MMO) are individuals that are responsible for conducting visual watches for marine mammals on vessels prior to works being conducted. MMOs should be appropriately trained (i.e. have completed a certified JNCC course) and understand the mitigation procedures during surveys, or construction activities. The role of the MMO is to monitor the Mitigation Zone (MZ) prior to the activity commencing. The MZ is defined as the area over which an MMO keeps watch for marine mammals (JNCC, 2010a).

The MMO will consider the environmental (e.g. meteorological) conditions before proceeding with an activity. The MMO shall be positioned in an elevated platform with an unobstructed view of the entire MZ before they begin. Ideally the watch will be conducted in the following environmental conditions:

- Daylight hours – between sunrise and sunset;
- Good visibility (> 5 km); and
- Sea state no greater than Beaufort 3.

All MMOs will have undertaken formal training approved by JNCC, have knowledge and experience in identifying UK marine mammal species and at least one of the MMOs will be experienced, i.e. will have a minimum of 20 weeks experience of implementing JNCC noise mitigation guidelines in UK waters, ideally within last five years, but no later than within the last 10 years.

The specific procedures that MMO are required to follow depend on the project-specific activities being carried out.

### 33.3.4 Passive Acoustic Monitoring

Passive Acoustic Monitoring (PAM) can be used to monitor the presence of marine mammals during night time and periods of poor visibility to ensure that no marine mammals are present within the area before the activities commence. Specialist trained PAM operatives are required to set up, deploy the equipment, and interpret the detected sounds (JNCC, 2023b).

PAM should be used when the environmental conditions prevent visual observations, or to supplement them. Visual searches are considered the most effective methods to monitor marine mammals. PAM should be utilised under the following circumstances:

- Beaufort sea state 4 or above;
- Visibility drops to a level where the MZ cannot be seen clearly in its entirety; or
- Light levels drop to a level where the MZ is not clearly visible without the aid of artificial light.

All PAM operatives are required to have undertaken formal training approved by JNCC to implement the JNCC mitigation guidelines, as well as undertake specialist training in the use of PAM. As a minimum, the PAM operator needs to be capable of assembling and configuring the PAM system, detecting marine mammal vocalisations, and interpreting bearing and range information. JNCC recommends that newly qualified PAM operatives work with experienced personnel (with a minimum of 20 weeks of experience of using PAM for mitigation and implementing the JNCC noise mitigation guidelines over the previous five to ten years) for the first five PAM jobs (JNCC, 2023b).

Consideration should also be given to the number of PAM operators in a mitigation team to reduce fatigue during night-time operations and long shifts. MMOs trained as PAM operators can be beneficial, although one individual must not carry out both roles at the same time.

The specific procedures that PAM operatives are required to follow depends on the project-specific activities being carried out.

## 33.4 Geophysical Surveys

### 33.4.1 Scenarios considered

Site investigation geophysical surveys during the pre-construction phase can result in injury to marine mammal species depending on the acoustic characteristics of the equipment used.

The pre-construction geophysical surveys will be conducted under the assumption that one or two campaigns will be required, each lasting no longer than 60 days. The important noise generating survey methods/equipment will include:

- Multibeam Echo Sounder (MBES);
- Two-dimensional (2D) and three-dimensional (3D) seismic surveys / UHRS;
- Side-Scan Sonar (SSS); and
- Sub-Bottom Profiler (SBP).

Ultra-short Baseline (USBL) will also be used although the technology generates sounds of a relatively low amplitude (ca. 200 dB) and will always be operated in proximity to a survey vessel (itself generating notable sound emissions). The risk of injury is highly implausible and any disturbance effect due to the use of this equipment is considered to be incidental and not likely to generate any effect greater than the disturbance effect of the survey vessel itself.

There is likely to be overlap between the functional hearing of marine mammals (Table 33-3) and the sound frequency emitted from the intended geophysical survey equipment. The expected sound source pressure level and frequencies for the different equipment types are presented in Table 33-4.

*Table 33-3 Summary of generalised and best range hearing in marine mammal species (NMFS, 2018; Southall et al., 2019)*

| MARINE MAMMAL HEARING GROUP | EXAMPLE SPECIES | GENERALISED HEARING | RANGE OF BEST HEARING |
|---|---|---|---|
| LF (Low-Frequency cetacean) | Minke whale | 7 Hz – 35 kHz | 0.2 kHz – 19 kHz |
| HF (High-Frequency cetacean) | Delphinids | 150 Hz – 160 kHz | 8.8 kHz – 110 kHz |
| VHF (Very High-Frequency cetacean) | Porpoise | 275 Hz – 160 kHz | 12 kHz – 140 kHz |
| PCW (Phocid Carnivores in Water) | Seals | 50 Hz – 86 kHz | 1.9 kHz – 30 kHz |

*Table 33-4 Characteristics of underwater noise sources generated by geophysical activities (**EIAR Vol. 4, Appendix 15: Underwater Noise Modelling Report**)*

| UNDERWATER NOISE GENERATING ACTIVITY | FREQUENCY RANGE (kHz) | INDICATIVE SPL ($SPL_{PEAK}$ DB RE 1µPA) |
|---|---|---|
| MBES | 400-700 | 180-240 |
| SSS | 300-900 | 213-225 |
| SBP | 8-100 | 247 |
| UHRS | 0.5-4 | 226 |

## 33.4.2 Summary of impacts

MBES when operating in 'shallow waters' (< 200 m) typically operate at high frequencies (>200 kHz) that fall outwith the known hearing range of marine mammal species likely to be present within the Project Area. This is also the case for SSS (operating at frequencies >300 kHz). Therefore, there is no potential for acoustic effect to marine mammal receptors as a result of these activities and mitigation for these sound sources is not needed (JNCC, 2017).

The sources of sound that have the potential to cause injury to marine mammals is related to the use of SBP and UHRS. Underwater noise modelling was conducted to assess expected injury ranges for marine mammals. The results calculated based on non-impulsive SEL thresholds set out in Southall *et al.*, (2019) are presented in Table 33-5.

*Table 33-5 Potential PTS impact ranges (m) for marine mammals during the geophysical investigation with the use of SBP and UHRS*

| UNDERWATER NOISE GENERATING ACTIVITY | POTENTIAL PTS RANGES (m) | | | |
|---|---|---|---|---|
| | LF | HF | VHF | PCW |
| SBP* | 100 | 110 | 400 | 105 |
| UHRS* | 5 | N/A | 10 | N/A |

*Non-impulsive SEL threshold from Southall et al., 2019 used

SBP sound sources are highly directional (Pace *et al.*, 2021), therefore, it is likely that the potential for injury is greatest when a marine mammal is positioned directly underneath or in close vicinity of the acoustic beam. Once outwith the main beam, the potential for injury significantly reduces.

The UHRS source is a sparker, which produces a broadband impulsive sound. Sparkers emit an omnidirectional broadband acoustic pulse into the water column by first creating an electrical pulse between electrodes located on the tip of the device, and a grounding point located on the body. The resulting acoustic pulse penetrates into the seabed and is dispersed by the sediment. Dispersion varies with the thickness of sediment layers, grain size and position, and the energy reflected back to the sparker system hydrophones creates a profile of the seabed (Ruppel *et al.*, 2022). This method is useful for visualising the boundaries within marine sediment layers and the internal structures which can help inform design and placement of infrastructure. The potential for impacts is only within very close proximity to the source, therefore the possibility for injury to marine mammals is limited to very close distance to the sound source.

## 33.4.3 Mitigation measures

Mitigation for geophysical activities with the use of SBP and UHRS will follow JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017, JNCC, 2023a). Sections 33.4.3.1 to 33.4.3.3 provide detail on the mitigation measures typically employed when applying the JNCC standard mitigation protocols and will be reviewed and updated as required within the final MMMP submitted post-consent.

### 33.4.3.1 MMO and PAM

To reduce possibility of injury to marine mammals, a non-dedicated MMO (a trained MMO who may undertake other roles on the vessel when not conducting their mitigation role) and/or a PAM operative will conduct 30-minute pre-search per each activation of the SBP and UHRS , that should cover MZ of 500 m. MMOs will only proceed with the pre-search under favourable weather conditions described in Section 33.3.3. A minimum of one PAM operative is required when PAM equipment is to be deployed, with consideration of the survey specifics to determine the total number of operatives. PAM may be required to supplement visual surveys (in additional to night-time use and periods of poor visibility), such as a minimum of two PAM operatives should be employed to allow for 4-hour PAM coverage.

All monitoring should be undertaken from the source vessel, with the MMO positioned on a high platform with a clear view of the horizon, MZ and ahead of the vessel. The PAM operator should be positioned in the most appropriate location to allow them to monitor the PAM equipment for acoustic detections and maintain contact with both the MMO and relevant crew, for both mitigation purposes and ensuring the PAM equipment is deployed correctly. If marine mammals are detected within the MZ during the pre-search, the SBP and UHRS activation must be delayed until their passage, or transit of the vessel, and there are no animals within the MZ. There must be a minimum of a 20-minute delay from the time of the last detection within the MZ and the SBP and UHRS activation. If marine mammals are detected within the MZ whilst the SBP and UHRS is active, there is no requirement to stop the survey activities.

A flowchart illustrating mitigation decision-making pathway during the geophysical surveys is presented in Figure 33-2.

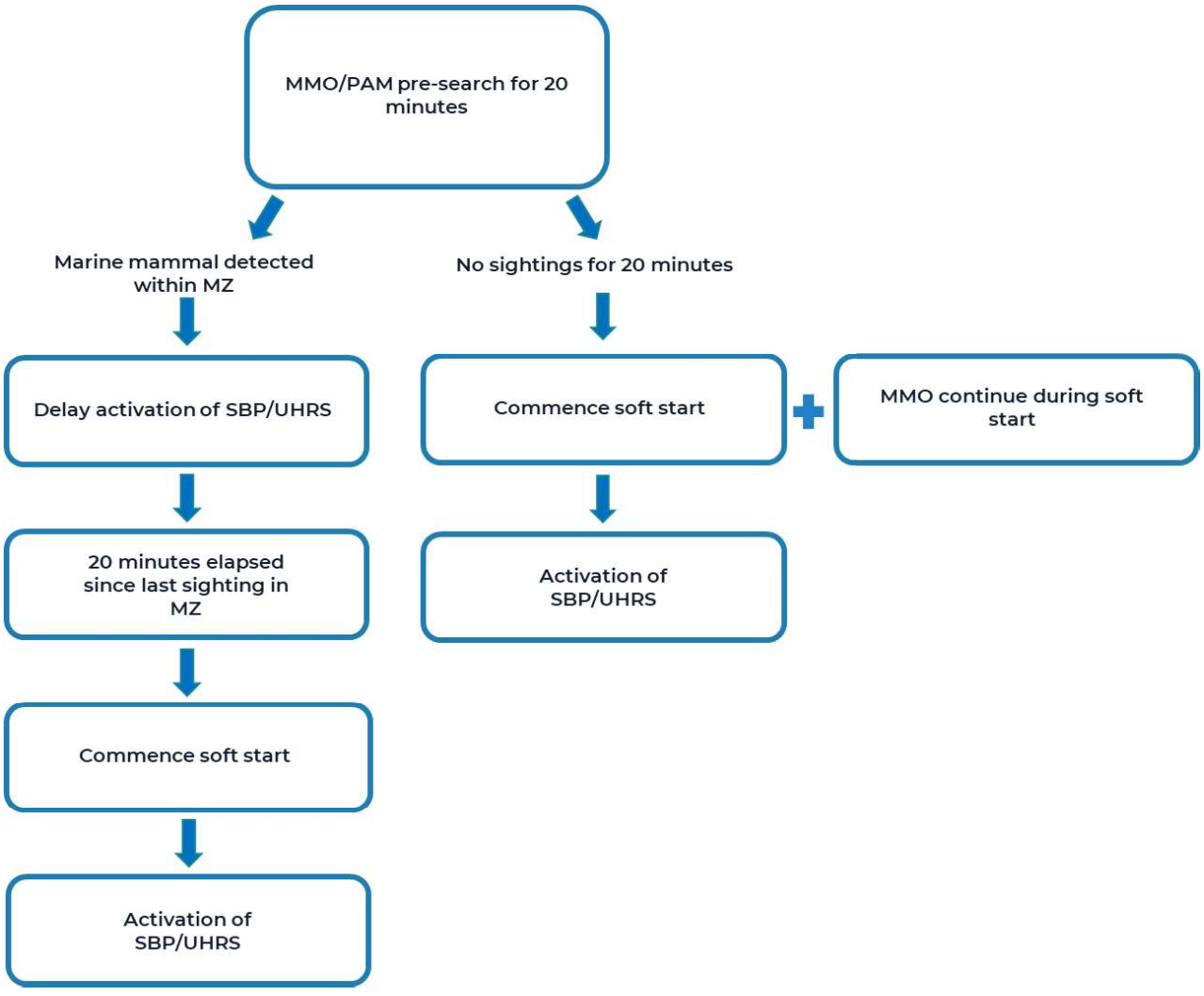


*Figure 33-2 Flowchart illustrating mitigation decision-making pathway during geophysical surveys with the use of SBP and UHRS*

#### 33.4.3.2 Soft start procedures

Soft start procedures can be implemented to minimise noise exposure from geophysical surveys, as it produces a lower sound level which allows animals to move away from the noise source which in turn reduces the risk of injury. Soft start procedures are not possible for some equipment, but where it is possible and following the pre-search by the MMO/PAM operative, a soft start procedure will commence. The MMO must monitor the MZ for the full duration of the pre-search and the soft-start procedure. Where PAM is being used in conjunction with or in place of visual surveys, acoustic monitoring must also occur for the full duration of the pre-search and soft-start procedure. The soft start procedure will be implemented in line with JNCC guidelines (JNCC, 2017).

#### 33.4.3.3 Unforeseen survey breaks

JNCC (2017) guidance will be followed in case of any unforeseen survey breaks. The MMO and/or PAM operatives should begin to monitor the MZ as quickly as possible following an unplanned break. If the breakdown occurs at night or during daylight conditions not conducive for a visual search, the MZ should be monitored as described above using PAM. If PAM is not available, the survey must be delayed until conditions are suitable for visual observations.

## 33.5 Unexploded Ordnance Clearance

### 33.5.1 Scenarios considered

Unexploded Ordnance (UXO) detonation produces a high amplitude shock wave and associated sound pressure wave. The extent of disturbance or injury depends primarily on the size and method of intervention, as well as water depth, bathymetry and type of seabed sediments at the UXO location, as well as distance of the receiving animal from the source. Injury can include death, physical trauma or hearing damage (permanent threshold shift; PTS). Currently two types of intervention are considered for the Project: Low noise methods of UXO intervention (e.g. Low-Order Deflagration (LOD)), where a small charge is placed using a Remotely Operated Vehicle (ROV) close to the UXO explosive material which, when ignited, causes a rapid burn of the UXO explosives without detonation; and High-Order Detonation (HOD), where a ROV is deployed to place an explosive charge against the UXO, which is then detonated from the investigation vessel. LOD is a preferred method of intervention, as it generates much lower sound pressure levels, and thus is less harmful to marine life.

An Unexploded Ordnance Threat and Risk Assessment for CENOS Project has been conducted by 6 Alpha Associated Ltd (EIAR Vol. 4, Appendix 5: UXO Threat and Risk Assessment). An archive search associated with the Project Area revealed the likely presence of World War II British naval mines. The semi-quantitative UXO risk assessment concluded that the risk to geotechnical investigation operations, WTG installation and any enabling works is 'low' within the Array Area, and 'medium' for the Export/Import Cable installation toward the western end of the EICC due to increased probability of encountering UXOs. The worst-case scenario for the Project involves clearance of up to 51 UXOs, with 50 LOD (preferred method for low noise UXO intervention) and one HOD of a 227 kg UXO.

When potential UXO (pUXO) are identified through survey activity they will, where required, be subject to further investigation including target investigation with ROV or similar. If confirmed UXO (cUXO) are identified through this process, actions will be taken to reduce the potentially harmful high sound emissions of UXO clearance into the marine environment. Where possible, cUXO will be avoided through micro-siting or micro-routeing, or through relocation of the cUXO.

## 33.5.2 Summary of Impacts

The severity of an impact is linked with the intensity of a sound generated and the distance of an animal to the sound source. The worst-case scenario for the Project includes:

- Up to 50 LOD, with a donor charge of 0.08 kg Net Equivalent Quantity (NEQ); and
- One HOD of a 227 kg UXO with a donor charge of 5 kg NEQ.

Both scenarios have been modelled using $SPL_{peak}$ and SEL thresholds established in Southall *et al.* (2019), Table 33-6 summarises modelling results and expected injury ranges for HOD, Table 33-7 shows results for LOD.

*Table 33-6 Injury Ranges for marine mammals due to HOD of 277 kg UXO with 5 kg donor charge*

| MARINE MAMMAL HEARING GROUP | POTENTIAL PTS RANGES | | | |
|---|---|---|---|---|
| | $SPL_{Peak}$ | | SEL (Weighted) | |
| | Threshold | Range (m) | Threshold | Range (m) |
| LF | 219 | 1,715 | 183 | 2,220 |
| HF | 230 | 560 | 185 | 79 |
| VHF | 202 | 9,685 | 155 | 2,865 |
| PCW | 218 | 1.900 | 185 | 0.420 |

*Table 33-7 Injury Ranges for marine mammals due to LOD using 0.08kg donor charge*

| MARINE MAMMAL HEARING GROUP | POTENTIAL PTS RANGES | | | |
|---|---|---|---|---|
| | $SPL_{Peak}$ | | SEL (Weighted) | |
| | Threshold | Range (m) | Threshold | Range (m) |
| LF | 219 | 120 | 183 | 50 |
| HF | 230 | 40 | 185 | N/E |
| VHF | 202 | 685 | 155 | 190 |
| PCW | 218 | 135 | 185 | 10 |

For the worst-case HOD UXO clearance (227 kg UXO plus a 5 kg donor charge), the underwater noise modelling PTS ranges reported above indicated that the greatest impact range would occur for harbour porpoise and minke whale (9.685 and 2.220 km respectively). LOD might cause PTS at distances no greater than 685 m (harbour porpoise).

## 33.5.3 Mitigation measures

Mitigation measures were drafted in line with industry and best practice guidance, specifically the *JNCC guidelines for minimising the risk of injury to marine mammals from using explosives* (JNCC, 2010a), the joint position statement from the Department of Environment, Food and Rural Affairs (Defra) and other government bodies regarding clearance of UXOs in the marine environment (Defra *et al.*, 2022) and with alignment to the *Draft guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment* (JNCC, 2023).

There are four stages of reducing the risk posed by UXO that may be employed during clearance activities. These methods will be implemented in the following hierarchy, in order to reduce potentially harmful sound emissions in the marine environment:

1. Avoidance: in the first instance, infrastructure will be micro-sited or micro-routed around UXO to avoid the need for use of explosives or relocation, and the location of UXO will be reported to the regulator;
2. Relocation ('lift and shift'): where infrastructure cannot be micro-sited/routed around a UXO, and where the UXO is deemed structurally sound and not significantly buried, consideration will be made to relocate the UXO to a safe place, leaving it *in situ*, to avoid the need for use of explosives. The regulator will be informed of any attempt to relocate UXO.
3. Minimising sound emissions through the use of LOD: where disposal of the UXO is required, LOD is the preferred approach. Should the first attempt not be successful, up to two additional attempts would be made per UXO. To minimise noise emissions associated with LOD clearance activities, the Developer will endeavour to conduct any additional attempts on the same day, where it is safe and feasible to do so. All attempts will be documented and, if unsuccessful, the Developer will provide evidence to MD-LOT to demonstrate that LOD have not been successful, and if possible, why this was the case.
4. High-order detonation (HOD): HOD will be deployed only as the final option, in instances where LOD has not been successful or is not considered to be possible based on independent expert judgement. Marine mammal mitigation measures will be applied in line with the draft JNCC guidelines (2023).

Details on the operational steps during the UXO clearance activities are given below and considering mitigation measures to be utilised in order to reduce the potential for injury to marine mammals.

The mitigation for UXO will involve MMO, PAM and ADD as per JNCC guidance (2023a, b). Sections 33.5.3.1 and 33.5.3.2 provide an outline of the propose mitigation measures that will be reviewed and updated as required at the point of submission of the final MMMP post-consent.

### 33.5.3.1 MMO and PAM

According to the draft JNCC guidance (2023) there must be at least two MMOs to cover the size of the search area for UXO clearance (minimum MZ of 1 km is required). The number of personnel will depend on the types of vessels used for clearance activity. The elevation platform from the vessel carrying out the UXO clearance platform may not provide 1 km visibility, therefore a second MMO may need to be positioned on another vessel, such as a guard vessel, positioned approximately 1 km away. Observing from one point on the MZ boundary effectively means monitoring a 2 km range.

PAM may be required to supplement visual observations. If used, the PAM operative should be in a position on the vessel that allows them to monitor the PAM equipment for acoustic detections and maintain contact with both the MMO and relevant crew. Where practical, the PAM equipment should be deployed such that it can cover as much of the mitigation zone as is possible (noting the detection range for some species is limited), with minimal disturbance from vessel noise.

Prior to the monitoring and intervention, there will be consideration of the environmental (e.g. meteorological) conditions, that may limit the successful application of mitigation in form of an MMO, which will contribute to the decision on whether to proceed with UXO intervention. The Developer will commit to only commencing with the UXO clearance during hours of daylight with good visibility using MMOs. Monitoring will be undertaken only when environmental conditions allow effective observation of the MZ by MMOs, which are:

- Daylight hours – between sunrise and sunset;
- Good visibility (> 5 km); and
- Sea state no greater than Beaufort 3.

#### 33.5.3.1.1 Pre-search

As detailed in the draft JNCC guidance (2023) during UXO clearance activities, there must be at least two MMOs conducting the pre-watch due to the large area of the MZ (1 km radius). Once positioned on an elevated platform on the vessel, the MMO will commence a pre-intervention search and observe a minimum MZ of 1 km over a minimum watch period of 60 minutes (and PAM operative, if required). The pre-watch will continue throughout the UXO clearance activities. Depending on the ADD activation time, the pre-intervention search may start 30 minutes before ADD activation (e.g. if the ADD is activated for 60 minutes this would occur concurrently with the MMO' 90-minute watch period).

Should any marine mammal be observed within the MZ during the watch period, then the MMO should cease the UXO intervention and delay the activity for either the remainder of the 60 minute pre-watch or 20 minutes, whichever is greater, to allow the marine mammal to move out of the MZ. The MMO (and PAM operative, if required) will monitor marine mammal(s) movement until they have vacated the MZ. The UXO clearance activities shall only restart once the MMO confirms that no marine mammals have been observed for at least 20 minutes.

#### 33.5.3.1.2 Post-search

Once the UXO clearance has been successfully completed, the MMO will conduct a post-intervention search, where they are required to record any notable information. The post-search will be conducted for a minimum of 15 minutes and will record any instances of injury or mortality of marine life, including fish. Any observations made will also be recorded and provided with the results in a post-intervention report.

### 33.5.3.2 Acoustic Deterrent Devices

An ADD will be used to mitigate the risk of injury to marine mammals during planned UXO intervention. An ADD will be utilised for both LOD and HOD of UXO. ADDs are not required for relocation (lift and shift) of UXO. A trained ADD operator will be utilised during the LOD and HOD of UXOs.

Prior to any ADD being used, the device will be calibrated by the manufacturer and an additional calibration check carried out by the ADD operator prior to being brought on the vessel for departure. An additional sound test will be undertaken on the vessel prior to deploying the ADD. The guidelines provided by JNCC (JNCC, 2023a) will be adhered

to ensuring the maximum effectiveness of the device and minimum additional adverse impacts. This includes deploying the ADD as near as is reasonably practicable to the UXO that is undergoing intervention. The ADD will be deployed in midwater, minimum 2 m below the keel of the vessel from which it is deployed and will be switched off immediately after the UXO intervention has commenced.

ADD activation should start after 30 minutes of MMO pre-search and confirmation that no marine mammal is within 100 m radius from ADD deployment location. This will allow for adherence to the most recent guidance allowing for animals to evacuate the injury zone whilst also reducing the cumulative noise impacts on the species present.

For HOD, the ADDs will be deployed for a specified period depending on NEQ of the UXO being cleared (

Table 33-8). This will allow for adherence to the most recent guidance allowing for animals to evacuate the injury zone whilst also reducing the cumulative noise impacts on the species present. The duration of ADD operation has been proposed based on the predicted range of PTS onset for a VHF cetacean (harbour porpoise), assuming an animal flees at 1.5 m $s^{-1}$, with a minimum ADD activation duration of 10 minutes. The maximum duration of ADD operation is proposed to be 60 minutes, concurrent with visual MMO. ADDs will be deactivated as soon as the detonation is complete.

*Table 33-8 Duration of an ADD operation for UXO intervention for a range of charge sizes (modelling results taken from Subacoustech (2018) and Project specific modelling (**EIAR Vol. 4, Appendix 15: Underwater Noise Modelling Report**).*

| CHARGE SIZE (NEQ kg) | 0.08* | 0.1 | 0.15 | 0.5 | 2 | 8 | 10 | 50 | 70 | 155 | 227* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Source sound pressure level ($SPL_{peak}$) | 266.1 | 266.8 | 268.1 | 276.6 | 281.1 | 281.9 | 281.9 | 287.1 | 288.2 | 290.8 | 292.1 |
| Range of PTS onset in m (VHF cetaceans) | 685 | 725 | 830 | 1200 | 1,920 | 2,990 | 3,210 | 5,200 | 6,500 | 8,400 | 9,685 |
| ADD playback duration (minutes) | 10 | 10 | 10 | 15 | 25 | 35 | 40 | 60 | 60 | 60 | 60 |
| * Project specific modelling result (EIAR Vol. 4, Appendix 15: Underwater Noise Modelling Report) | | | | | | | | | | | |

For LOD, the ADD would be activated for a period of time corresponding to charge size as per Table 33-8, to account for possibility of unexpected UXO explosion.

If MMOs detect marine mammals within the MZ before the ADD is active, the activation should be delayed by at least 20 minutes, the device can only be deployed once MMOs confirm no presence of marine mammal within the MZ.

In the unlikely event of marine mammal detection within the MZ while the ADD is active, the device should continue to be active and generate sound, as it is assumed that the animal entered the ensonified zone voluntarily. If an animal remains for an extended period in the vicinity of the UXO clearance location, clearance should be delayed for at least 20 minutes, and cannot commence until the animal vacates the area.

#### 33.5.3.2.1 Misfires

In the circumstance that there is a misfire, visual monitoring should continue by the MMO and the ADD activation should be resumed as soon as practicable. If ADD was active during the detonation attempt and misfire, it should stay active for up to 20 minutes with the MMO keeping their watch while manual fire attempt is made. If the manual fire was to be unsuccessful during this additional 20-minute period ADDs should be switched off and the full mitigation protocol should be repeated once the issue is resolved. If, during the misfire, the ADD is inactive for ≤15 minutes, there is no minimum ADD duration prior to intervention, as animals are not likely to have returned to the vicinity of the UXO clearance activities within this time period. If the ADD is inactive for >15 minutes, MMO pre-watch and ADD procedure has to be repeated as per Figure 33-3 prior to the subsequent clearance attempt.

#### 33.5.3.2.2 Unexpected delay during intervention

If there is an operational delay to UXO intervention following the commencement of the marine mammal mitigation measures, the UXO manager will confirm the expected delay to the intervention. This will dictate the subsequent sequence of events:

- If the delay is likely to be < 20 minutes, then the ADD playback and the MMO and PAM (if required) will continue until the intervention takes place; and
- If the delay is likely to be > 20 minutes, then the ADD should be deactivated and mitigation measures (including full 60-minute pre-watch) shall re-commence once operations can be restarted.

Flowchart illustrating mitigation decision-making pathway during UXO intervention surveys with the use is presented in Figure 33-3.

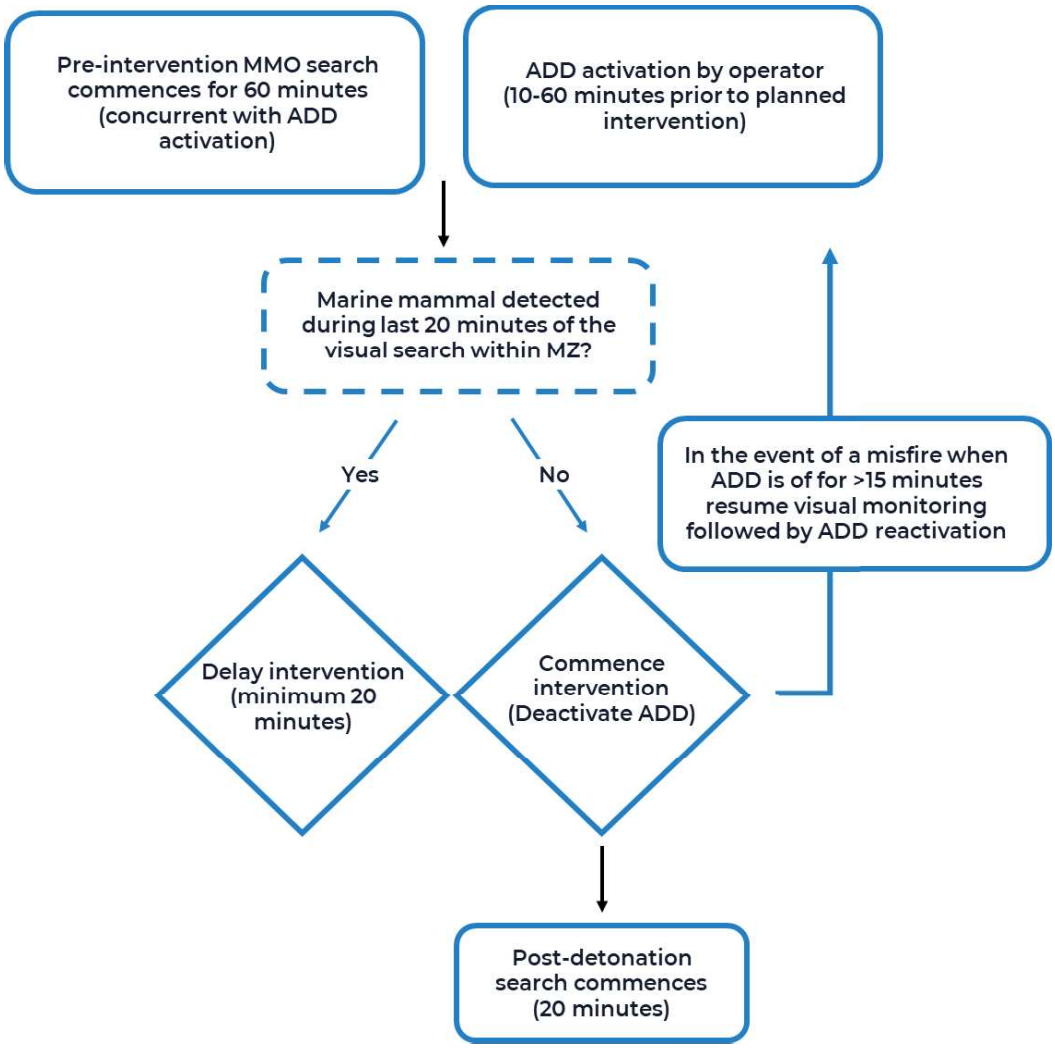


*Figure 33-3 Flowchart illustrating mitigation decision-making pathway during UXO intervention*

## 33.6 Pile Driving

### 33.6.1 Scenarios considered

Impact pile driving activities are required for the installation of FTUs and OSCPs. During piling, high intensity and amplitude noise is generated, which can potentially be harmful to marine life, especially to the noise-sensitive species such as marine mammals (Lucke *et al.*, 2009; Southall *et al.*, 2019).

There are two types of foundations under consideration for the FTUs:

- Tension Leg Platform (TLP); and
- Semi-submersible Platform.

The worst-case scenario for FTU piling in relation to marine mammal receptors considers:

- Up to nine piles per FTU (up to 855 piles in total);
- Maximum 4.5 m diameter pile (semi-submersible FTU, maximum 57 m pile penetration depth (TLP FTU);
- Maximum strike rate of 30 strikes per minute;
- Maximum hammer energy: 2000 kJ for up to 300 minutes (semi-submersible) and 2500 kJ (TLP FTU) for up to 106 minutes;
- Maximum of three piles installed over 24 hours (semi-submersible FTU) or nine piles over 24 hours (TLP FTU); and
- Maximum of 285 days (average of 95 days of piling per year), over three years.

The worst-case scenario for OSCPs piling in relation to marine mammal receptors considers:

- Up to 12 piles per OSCPs (up to 24 piles in total);
- Maximum 3.05 m diameter pile, maximum 57 m pile penetration depth;
- Maximum strike rate of 30 strikes per minute;
- Maximum hammer energy: 4400 kJ for up to 106 minutes;
- Maximum of 12 piles installed over 24 hours (average of 4); and
- Maximum of 14 days duration.

Soft start and ramp up are included for both the FTU and OSCPs piling scenarios (Table 33-9).

*Table 33-9 Summary of soft start and ramp up scenarios for the FTU and OSCPs piling*

| ACTIVITY/STAGE | DURATION (MINUTES) | HAMMER ENERGY | STRIKE RATE |
|---|---|---|---|
| FTU (TLP) | | | |
| Initiation | 1 | 350 | 3 |
| Soft start | 20 | 350 | 30 |
| Ramp up | 5 | 350 - 2,500 | 30 |
| Full power piling | 80 | 2,500 | 30 |
| FTU (Semi-submersible) | | | |
| Initiation | 1 | 200 | 3 |
| Soft start | 20 | 200 | 30 |
| Ramp up | 10 | 200 – 2,000 | 30 |
| Full power piling | 269 | 2,000 | 30 |
| OSCPs | | | |
| Initiation | 1 | 350 | 3 |
| Soft start | 20 | 350 | 30 |
| Ramp up | 5 | 350 - 2,500 | 30 |
| Full power piling | 70 | 3,500 | 30 |
| Driving to refusal | 10 | 4,400 | 30 |

## 33.6.2 Summary of impacts

Pile driving is required to secure the mooring and anchoring systems for the FTUs and the OSCPs onto the seabed. The noise generated by piling activities emits loud, impulsive sound into the marine environment causing potential physiological effects on marine mammals.

*Table 33-10 Summary of worst-case FTU pile driving underwater noise modelling results*

| SPECIES | IMPACT RANGE (m) | AREA ($km^2$) |
|---|---|---|
| INSTANTENOUS PTS ($SPL_{peak}$) | | |
| Harbour porpoise (VHF) | 355 | 0.395 |
| Dolphins (HF) | 21 | 0.014 |
| Minke whale (LF) | 57 | 0.01 |
| Grey seal/harbour seal (PCW) | 71 | 0.0158 |
| CUMULATIVE PTS ($SEL_{CUM}$) | | |
| Harbour porpoise (VHF) | 15 | 0.0007 |
| Dolphins (HF) | N/E | N/E |
| Minke whale (LF) | 137 | 0.058 |
| Grey seal/harbour seal (PCW) | N/E | N/E |

*Table 33-11 Summary of worst-case OSCPs pile driving underwater noise modelling results*

| SPECIES | IMPACT RANGE (m) | AREA ($km^2$) |
|---|---|---|
| INSTANTENOUS PTS ($SPL_{peak}$) | | |
| Harbour porpoise (VHF) | 508 | 0.785 |
| Dolphins (HF) | 31 | 0.003 |
| Minke whale (LF) | 168 | 0.0886 |
| Grey seal/harbour seal (PCW) | 102 | 0.0326 |
| CUMULATIVE PTS ($SEL_{cum}$) | | |
| Harbour porpoise (VHF) | 20 | 0.0012 |
| Dolphins (HF) | N/E | N/E |
| Minke whale (LF) | 815 | 2.09 |
| Grey seal/harbour seal (PCW) | N/E | N/E |

The maximum instantaneous PTS-onset range from all pile driving operations (at full hammer energy) was predicted at 508 m for harbour porpoise and a maximum cumulative PTS-onset range of 815 m for piling at a single location for minke whales moving away from the sound source, both during pile driving of the OSCPs.

## 33.6.3 Mitigation measures

In order to minimise the potential impacts of PTS to marine mammals from underwater noise during pile driving, mitigation measures are proposed in accordance with Statutory Nature Conservation Body (SNCB) protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b). Sections 33.6.3.1 to 33.6.3.4 provide detail on the mitigation measures typically employed when applying the JNCC standard mitigation protocols and will be reviewed and updated as required within the final MMMP submitted post-consent.

### 33.6.3.1 Marine Mammal Observer and Passive Acoustic Monitoring

The Developer will ensure that at least two trained MMOs will be present before commencing pile driving and will undertake a pre-piling search. Prior to the monitoring and pile driving, there will be consideration of the environmental (e.g. meteorological) conditions, limiting the successful application of mitigation in the form of MMOs, which will contribute to the decision on whether to proceed with pile driving. CENOS will commit to only commencing to start pile driving during hours of daylight with good visibility using a MMO. Monitoring will be undertaken only when environmental conditions allow effective observation of the MZ, which are:

- Daylight hours – between sunrise and sunset;
- Good visibility (> 5 km); and
- Sea state no greater than Beaufort 3.

PAM may be required to supplement visual observations. If used, the PAM operative should be in a position on the vessel that allows them to monitor the PAM equipment for acoustic detections and maintain contact with both the MMO and relevant crew. Where practical, the PAM equipment should be deployed such that it can cover as much of the MZ as is possible (noting the detection range for some species is limited), with minimal disturbance from vessel noise.

The MMO will commence a visual marine mammal observation within a minimum MZ of 500 m for 30 minutes concurrently to ADD activation and commencement of the soft start procedure. The MMO will be positioned in an elevated area on the installation vessel with unobstructed vision of the entire mitigation zone and good all-round view of the sea.

The MMO will record all periods of marine mammal observations, including the start and end times. They will also record details of the environmental conditions (sea state, weather, visibility, etc.) and any sightings of marine mammals around the piling vessel, as per JNCC marine mammal recording forms and guidelines. In addition, if a marine mammal is detected during the MMO pre-piling search, the soft-start procedure (see Section 33.6.3.3) will be delayed until the MMO has observed, assessed and confirmed that the marine mammal has vacated the MZ and there have been no sightings for 20 minutes. The MMO will continue observations the during the soft start procedure. If an animal is detected, if possible, the piling will stop, or the power of piling will not be increased until the animal exits the MZ, and there is no further detections for 20 minutes.

If an unforeseen break in pile driving occurs, and the pause is greater than 10 minutes, the pre-piling search and soft start procedure has to be repeated before piling recommences (see JNCC, 2010b). As per JNCC (2010b) if the MMO have kept watch during piling operations, they may be able to confirm the presence or absence of marine mammals, and it may be possible to recommence the soft start immediately if no marine mammal detections were made. If no watch has been undertaken, then the full pre-start watch would need to be undertaken prior to soft start.

#### 33.6.3.2 Acoustic Deterrent Devices

An ADD (Lofitech AS Seal Scarer), or alternative device (to be agreed with MD-LOT prior to deployment) will be used to mitigate the risk of injury to marine mammals during planned pile driving activities. A trained ADD operator will be responsible for following ADD deployment procedures.

Prior to any ADD being used, the device will be calibrated by the manufacturer and an additional calibration check carried out by the ADD operator prior to being brought on the vessel for departure. An additional sound test will be undertaken on the vessel prior to deploying the ADD. The principles outlined in the draft guidance for UXO clearance (JNCC, 2023a) will be adhered to ensuring the maximum effectiveness of the device and minimum additional adverse impacts, as ADDs are not described in detail within the guidance for piling. This includes deploying the ADD as near as is reasonably practicable to the pile driving location. It is expected that during the foundation installations, one ADD will be deployed from the deck of the piling vessel, with the control unit and power supply on board the vessel in a suitable, safe position on deck. The ADD will be deployed in midwater, minimum 2 m below the keel of the vessel from which it is deployed, to ensure 360° coverage and avoid interference by surface water noise.

ADDs will be utilised in combination with MMO/PAM operatives. The ADDs will be deployed for a specified period of 15 minutes prior to piling, followed by the soft start procedure (see 33.6.3.3). This will allow for adherence to the most recent guidance allowing for animals to evacuate the injury zone whilst also reducing the cumulative noise impacts on the species present. The soft start piling sequence will then continue to ramp up while it is expected that marine mammals will continue moving away from the piling source as the hammer energy ramps up. In case of a piling break (or a break between when ADDs are active and piling commences) longer than 10 minutes the ADD deployment procedure described in Table 33-12 should be followed.

In the unlikely event of a marine mammal detection while ADD is active, the device should continue to be active and generate sound, as it is assumed that animal entered ensonified zone voluntarily. If an animal remains for an extended period in the vicinity of the pile despite ADD being active pile driving cannot commence until 20 minutes after the last visual or acoustic detection of a marine mammal.

#### 33.6.3.3 Soft start and ramp up procedure

Soft start is often required by engineers when the pile first enters the sediment but also minimises noise exposure at the beginning of each piling sequence. Following the pre-piling procedures (as identified above, ADD activation and MMO pre-piling search), a soft start procedure will commence. The soft start noise levels will be agreed and confirmed within the Piling Strategy (PS) submitted post-consent.

If a marine mammal enters the MZ during the soft-start, then piling operations should cease whenever possible, or power should not be increased, until the marine mammal is no longer in the MZ and there is no further detection for 20 minutes. There is no requirement to cease piling activities, or reduce the power, if a marine mammal is detected in the MZ during full power operations.

Following the soft-start, the ramp up procedure will commence for up to 10 minutes where piling energy will be increased to a maximum of 4,400 kJ. After ramp up, pile driving will continue using minimum hammer energy levels required for pile driving operations.

#### 33.6.3.4 Unforeseen piling breaks

JNCC (2010b) guidance will be followed in case of any unforeseen piling breaks. In case of unforeseen piling break, the Offshore Construction Manager is responsible for informing the MMO about the break as soon as it occurs and MMO should start observation of the MZ.

If the piling break is less than 10 minutes and no marine mammals are detected pre-piling search, soft start and ADD reactivation is not required. It is very unlikely that marine mammals will return to the MZ within the 10-minute period, however, in this case, it is assumed that animal entered the zone voluntarily and no action is needed.

If a pause in the piling operations is greater than 10 minutes, then the pre-piling search and soft-start procedure will be repeated before piling recommences. If a watch has been kept by the MMO/PAM operative during the piling operation, the MMO/PAM operative will be able to confirm the presence or absence of marine mammals, and it may be possible to commence the soft-start immediately. However, if there has been no watch, the complete pre-piling search and soft-start procedure will be undertaken by the MMO/PAM operative. In case of piling break greater than one hour, the pre-piling search needs to be undertaken by the MMO/PAM operative and soft start completed, if due to technical limitations this is not possible, piling should resume at the same or lower hammer energy. The full procedure to be followed during unforeseen piling breaks is presented in Table 33-12.

*Table 33-12 Mitigation procedures for piling breaks based on harbour porpoise return times to pile driving locations (Nabe-Nielsen et al., 2018; Brandt et al., 2011).*

| BREAK DURATION | MITIGATION PROCEDURE |
|---|---|
| < 10 minutes | No requirement for pre-piling search, soft start or ADD reactivation |
| > 10 minutes < 1 hour | Pre-piling search required. If MMO/PAM operatives have maintained watch throughout piling and break, then operations can resume immediately providing no marine mammal is within the MZ. Delay if marine mammal within the MZ.<br><br>Soft start to be completed if possible. If not, then piling should resume at same or lower hammer energy than before the break.<br><br>No requirement to reactivate the ADD. |
| > 1 hour | Pre-piling search required. Soft start to be completed if possible. If not piling should resume at same or lower hammer energy.<br><br>ADD have to be reactivated for 15 minutes. |

Flowchart illustrating mitigation decision-making pathway during pile driving is presented in Figure 33-4.

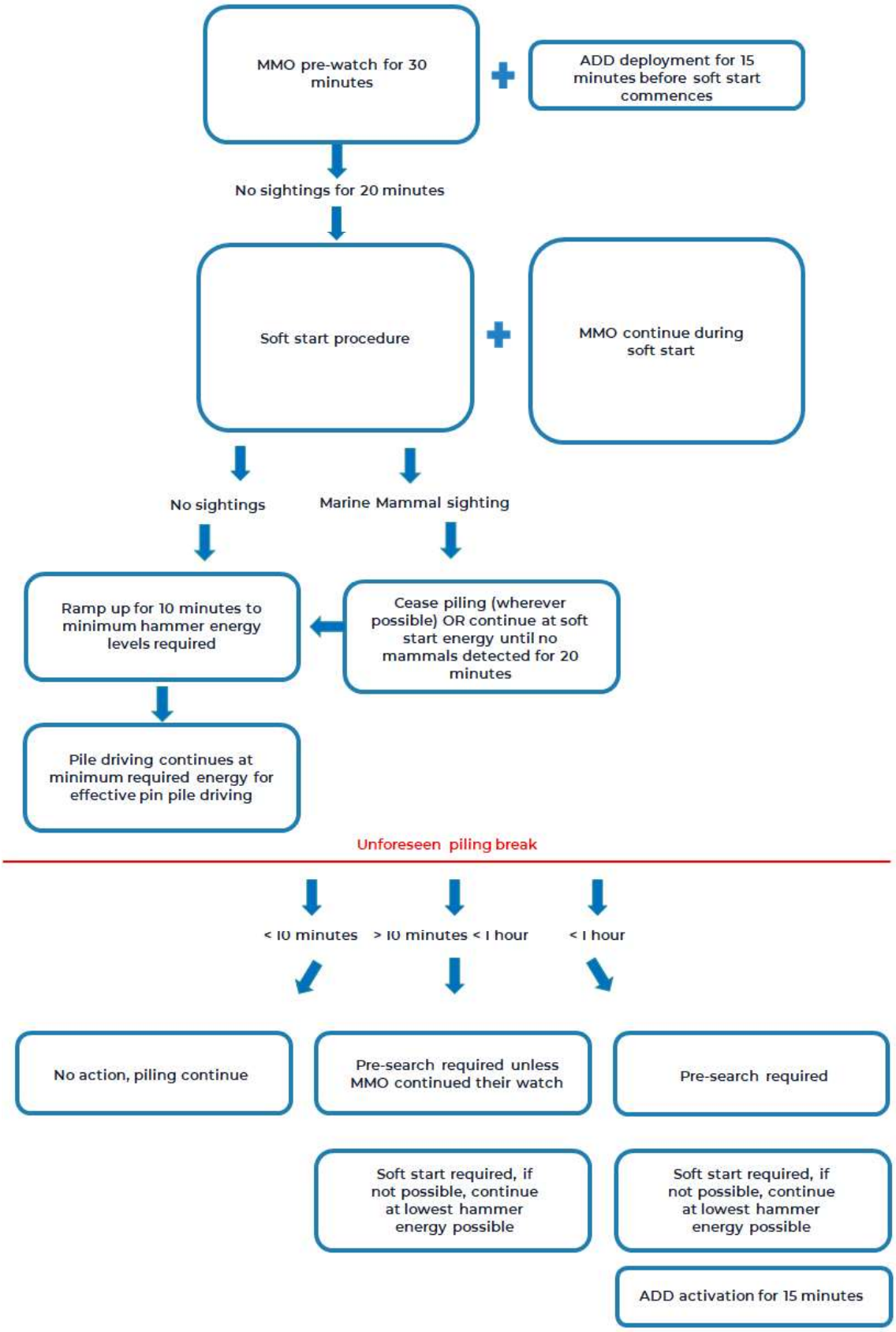


*Figure 33-4 Flowchart illustrating mitigation decision-making pathway during pile driving*

## 33.7 Reporting

### 33.7.1 Geophysical surveys

An MMO report must be submitted upon completion of a survey. The report should be accompanied by a completed JNCC marine mammal recording form (i.e. the raw data in the excel spreadsheets) and a copy of the relevant survey consent or licence. A copy of the MMO Report should be sent to JNCC. The report should include:

- Survey details:
  - Date and location of survey;
  - Type of the SBP used and details of its operation;
  - Average duration of all pre-watches;
  - Summary of MMO activities (i.e. full excel recording forms of operations and brief written summary);
  - Number and types of vessels involved in the survey; and
  - The geographical coordinates of the survey area and a map illustrating the location of the survey.
- MMO/PAM effort and detections:
  - Details of the number of staff employed, their working location(s) on the vessel;
  - Details on MMO experience i.e. level of training, number of previous mitigation assignments or previous experience of observing if new to the role;
  - Details of the lead operative responsible for the report who can be contacted if JNCC has any follow up questions;
  - Details of all monitoring effort (in the recording forms and summarised within the report);
  - The make and model of the PAM hydrophones, and how they were configured (including frequency and range), as well as the software used to identify detections and all modules applied. Confirmation that the system was able to detect all species likely to be present in the area and capable of vocalizing, with evidence to support this;
  - Details of any marine mammals encountered distinguishing between those recorded inside and outside the mitigation zone;
- Application of mitigation measures:
  - Details of any survey specific arrangements agreed with the Regulator as part of the survey consent or licence conditions prior to the start of the survey e.g. changes to the size of the mitigation zone etc;
  - Summary of mitigation procedures applied and whether delays in equipment activation were required;
  - Evidence to demonstrate the PAM system was able to detect vocalisations above background sound levels, and that the PAM system was working effectively throughout the mitigation period;
  - Details of all PAM watches and detections recorded in the JNCC spreadsheet, as well as screenshots of detections;
  - Details of any issues that have arisen relating to understanding or interpreting the JNCC guidelines describing the issue and how it was resolved, or including suggestions as to how it could have been resolved, to aid JNCC with future revisions of the guidelines; and
  - Any issues encountered in complying with the consent or licence conditions that relate to marine mammal mitigation should also be summarised in the report.

## 33.7.2 UXO clearance

The lead MMO will be responsible for completing data reporting in line with the draft JNCC guidelines (2023a) requirements, including recording form in a spreadsheet and a mitigation report. The copy of the report should be sent to JNCC. As a minimum, this report will include the following:

- Operator details:
  - Type of clearance (avoidance, relocation, LOD or HOD) and the type of explosives used; Date, time and location of any intervention events;
  - Sizes of explosive detonations, if used;
  - Outline of detonation procedure;
- Mitigation requirements:
  - Mitigation methods used in agreement with licence requirements;
  - MZ applied and the area visually searched with search durations;
  - Summary of planned MMO activities (number of personnel and their experience, personnel location including vessel and MMO(s) location during searches on the vessel, vessel location relative to detonation point and whether vessel position changed prior to detonation);
  - The make and model of the PAM hydrophones, and how they were configured (including frequency and range), as well as the software used to identify detections and all modules applied. Confirmation that the system was able to detect all species likely to be present in the area and capable of vocalizing, with evidence to support this;
  - Details of the timing of activation and cessation (therefore duration) of ADD deployment at each UXO site including deployment location and personnel involved;
  - An overview of communication channels established between vessel crew and the mitigation team and the procedure identified if a delay was needed;
- Application of mitigation procedures:
  - Evidence to demonstrate the PAM system was able to detect vocalisations above background sound levels, and that the PAM system was working effectively throughout the mitigation period;
  - Details of all PAM watches and detections recorded in the JNCC spreadsheet, as well as screenshots of detections;
  - A summary of all mitigation searches and the number of occasions when specified durations were not met (specific times for each search will be provided in the excel recording forms);
  - Sightings and marine mammal behavioural observations together with information on detonation delays due to sightings and how long they took; and
  - Details of technical problems or instances of non-compliance with explanation for any deviation from the proposed mitigation plan and lessons learned.

Where relevant, the final report will include recommendations (where possible) of how the JNCC protocol could be improved in the future.

Details of UXO activity schedules for the worst-case scenario will be uploaded to the Marine Noise Registry, hosted by JNCC, once a marine licence has been determined. Data on UXO clearance operations will be updated with the finalised programme prior to the activities beginning and updated regularly, with a final update once the activities are completed.

### 33.7.3 Pile driving

A Piling Report for MD-LOT will be collated once the piling campaign is finished. The report will include all records of piling operations, together with all mitigation applied (ADD deployment, marine mammal observations/PAM), including:

- An outline of the marine mammal monitoring methodology and procedures employed;
- A record of all piling operations detailing dates, soft-start and pre-search start time and duration, information on any occasions when piling activity was delayed or stopped due to presence of marine mammals, piling duration, hammer energy during soft-start and piling and any operational issues for each pile;
- A record of marine mammal observations from the MMO pre-piling searches and thereafter, environmental conditions during the pre-piling search, a description of any marine mammal sightings and any actions taken;
- A record of ADD deployment, including the start and finish times for all periods of ADD activation and any problems with the deployment and any relevant observations on their efficacy;
  - Evidence to demonstrate the PAM system was able to detect vocalisations above background sound levels, and that the PAM system was working effectively throughout the mitigation period;
  - Details of all PAM watches and detections recorded in the JNCC spreadsheet, as well as screenshots of detections;
- Details of any problems encountered during the piling process including instances of non-compliance with the agreed piling protocol; and
- Any recommendations for amendment of the protocol.

## 33.8 Summary

This outline MMMP presents the indicative mitigation measures to be implemented to minimise the risk of injury to marine mammals from explosives, piling noise, and geophysical surveys. The mitigation measures will be reviewed and updated within the final MMMP to be submitted post-consent to reflect any new research outputs, guidance updates, and the refinement of Project parameters. The MMMP will be developed in accordance with relevant Guidance and the conditions of the Section 36 Consent and Marine Licences granted for the Project.

A summary of mitigation options based on the worst-case scenario for PTS is presented in Table 33-13.

*Table 33-13 Summary of worst-case impacts for geophysical surveys, UXO clearance, and pile driving*

| ACTIVITY | IMPACT RANGE (WORST-CASE) | MITIGATION OPTIONS |
|---|---|---|
| **Geophysical surveys (PTS-onset)** | 400 m (SBP) | MMO/PAM<br>Soft start procedure |
| **UXO clearance (HOD) (PTS-onset)** | 9.685 km | Low noise methods<br>MMO/PAM<br>ADDs |
| **UXO clearance (LOD) (PTS-onset)** | 685 m | MMO/PAM<br>ADDs |
| **Pile driving (instantaneous PTS, $SPL_{peak}$)** | 508 m | MMO/PAM<br>ADDs |
| **Pile driving (cumulative PTS, $SEL_{cum}$)** | 815 m | MMO/PAM<br>Soft start and ramp up procedure<br>ADDs |

## 33.9 References

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