Environmental Impact Assessment Report
Volume 4: Outline Marine Mammal Mitigation Protocol

MarramWind Offshore Wind Farm

December 2025

MarramWind

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1. Introduction

1.1 Overview

1.1.1.1 This Outline Marine Mammal Mitigation Protocol (MMMP) has been produced along with the Environmental Impact Assessment (EIA) Report and aims to control the effects of underwater noise resulting from MarramWind Offshore Wind Farm (hereafter, referred to as 'the Project') activities on marine mammals. The EIA Report identified potential risks to marine mammals, including cetaceans and seals, and the Outline MMMP will detail measures to reduce the risk of auditory injury (permanent threshold shift (PTS)) to marine mammals to a negligible level. Activities identified that require mitigation measures include:

- the clearance of unexploded ordnance (UXO); and
- pile driving.

1.1.1.2 While site investigation surveys (geophysical surveys) were outwith the envelope of the EIA, this Outline MMMP may also be referenced during any future applications for surveys.

1.1.1.3 This Outline MMMP relates to M-032 of **Volume 3, Appendix 5.2: Commitments Register**.

1.2 Project background

1.2.1.1 The Project is wholly owned by Scottish Power Renewables UK Limited (SPR). MarramWind Limited, a subsidiary of SPR, is the Applicant for the Project.

1.2.1.2 MarramWind Offshore Wind Farm (hereafter, referred to as 'the Project') is a proposed floating wind farm located in the North Sea, with a grid connection capacity of up to 3 gigawatts. The location of the Project is determined by the Option Agreement Area (OAA), which is the spatial boundary of the Northeast 7 (NE7) Plan Option within which the electricity generating infrastructure will be located. The NE7 Plan Option is located north-east of Rattray Head on the Aberdeenshire coast in north-east Scotland, approximately 75 kilometres (km) at its nearest point to shore and 110km at its furthest point. An Option to Lease Agreement for the Project within the NE7 Plan Option was signed in April 2022.

1.2.1.3 A summary of the Project is provided in **Volume 1, Chapter 1: Introduction** and a comprehensive description of the Project is provided in **Volume 1, Chapter 4: Project Description** of the EIA Report.

1.2.1.4 The Outline MMMP relates to activities in the marine environment only, therefore the onshore components of the Project are not considered. The Project's offshore infrastructure, located seaward of Mean High Water Springs (MHWS), includes the following:

- wind turbine generators (WTGs), including WTG floating units (platforms and station keeping system);
- array cables;
- subsea distribution centres (SDC);
- subsea substations;
- offshore substations;
- reactive compensation platform(s) (if required); and
- offshore export cables to connect the offshore infrastructure to the landfall(s).

1.2.1.5 The EIA Report accompanies applications for offshore consents, licences and permissions for the Project to Marine Directorate - Licensing Operations Team (MD-LOT) under Section 36 (s.36) of the Electricity Act 1989, the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009, for the offshore infrastructure seaward of MHWS.

1.2.1.6 The EIA Report also accompanies an application to Aberdeenshire Council for planning permission in principle consent under The Town and Country Planning (Scotland) Act 1997, for the onshore infrastructure landward Mean Low Water Springs (MLWS).

1.2.1.7 There are four sets of EIA regulations applicable to the Project: the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 for offshore generating stations requiring s.36 consent; the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 and the Marine Works (Environmental Impact Assessment) Regulations 2007 for marine licence applications within Scottish territorial waters (0 to 12 nautical miles) and offshore waters (12 to 200 nautical miles) respectively; and the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 for planning applications submitted to Aberdeenshire Council for onshore infrastructure located landward of MLWS.

1.3 Purpose of the MMMP

1.3.1.1 The Outline MMMP will form the basis of the final MMMP. The Final MMMP will be finalised and approved post-consent as part of condition discharge prior to construction by Scottish Ministers in accordance with s.36 and marine licences associated with the planning permission. The MMMP sets out mitigation measures used to minimise the effects of underwater noise on marine mammals.

1.3.1.2 The broad objectives of the MMMP are as follows:

- set out statutory advice and requirements provided by Joint Nature Conservation Committee (JNCC) relating to minimising the risk of injury to marine mammals from underwater noise during the construction stage of the Project;
- detail mitigation measures and strategies which will be used to ensure that marine mammals occurring in the vicinity of the Project are not exposed to damaging levels of underwater noise, with the primary aim to mitigate against auditory injury during piling activities and UXO clearance; and
- provide a mechanism to ensure that measures to mitigate potentially adverse impacts on marine mammals are implemented.

1.3.1.3 The Final MMMP shall state the legislative requirements, current standards of practice and best practice measures that define the standard of construction practice adhered to by the Contractors. However, adhering to the Final MMMP does not absolve the Applicant, Contractors or Subcontractors from complying with legislation and bylaws relevant to their construction activities.

1.4 Legislation and guidance

1.4.1.1 The MMMP has been developed with reference to the following key legislation and guidance:

- Habitats Regulations (collective term for The Conservation (Natural Habitats, & c.) Regulations 1994, The Conservation of Habitats and Species Regulations 2017, and The Conservation of Offshore Marine Habitats and Species Regulations 2017), making it an offence to deliberately capture, kill, injure or disturb any porpoise, dolphin or whale (i.e. any cetacean);

- Marine (Scotland) Act 2010, making it an offence to intentionally or recklessly kill, injure or take a live seal or harass a seal at a designated haul-out site;
- JNCC guidelines for minimising the risk of injury to marine mammals from UXO clearance in the marine environment (JNCC, 2025a)
- JNCC guidelines for minimising the risk of injury to marine mammals from explosive use and UXO clearance in the marine environment – Annex (JNCC, 2025b);
- United Kingdom (UK) Government Joint Position Statement on UXO in the marine environment (UK Government, 2025);
- the evidence base for the application of acoustic deterrent devices (ADDs) as marine mammal mitigation (Version 5; Philips *et al.,* 2025); and
- JNCC guidelines for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010).

1.5 Implementation of the MMMP

1.5.1.1 The Final MMMP approved by Scottish Ministers will be incorporated into the contracts and marine licences for Principal Contractors responsible for the works. All parties involved, including Principal Contractors, Subcontractors and their suppliers, must comply with the relevant provisions of the detailed MMMP. They are obligated to provide documentation outlining how they will guarantee both the implementation and monitoring of the MMMP requirements.

1.5.1.2 Where relevant, the Applicant will apply for European protected species (EPS) disturbance licences during the post-consent phase. These will be informed and supported by the Outline and Final MMMP.

1.6 Scope of the MMMP

1.6.1.1 The Outline MMMP will cover the following:

- description of the mitigation zone;
- outline of the marine mammal observer (MMO) and passive acoustic monitoring (PAM) operator roles and responsibilities;
- protocols for reducing the risk of auditory injury to marine mammal receptors from UXO clearance and piling; and
- procedure for reporting environmental compliance matters associated with the MMMP to the JNCC and relevant bodies.

1.6.1.2 The Outline MMMP should be read in conjunction with the project description provided in **Volume 1, Chapter 4: Project Description** and the following relevant chapters:

- **Volume 1, Chapter 8: Underwater Noise:** Changes to underwater noise have the potential to affect marine mammal receptors and their prey species. The information from the underwater noise chapter and **Volume 3, Appendix 8.1: Underwater Noise Modelling Assessment** have been used to inform this Outline MMMP.
- **Volume 1, Chapter 11: Marine Mammals:** This chapter provides detailed baseline information about the marine mammal species likely to be present in the vicinity of the Project and assesses the impacts of the Project on marine mammals. It is supported by **Volume 3, Appendix 11.1: Marine Mammal Baseline Technical Report**. Both have been used to inform this Outline MMMP.

1.7 Other related implementation plans

1.7.1.1 The Outline MMMP will be developed with consideration of the content and requirements of other relevant outline implementation plans. These are set out in **Table 1.2** below with details of the linkages.

Table 1.2 Other related implementation plans to the MMMP

Implementation Plan	Linkage with MMMP
Piling Strategy	Details how piling methods relate to mitigation measures for marine mammals and best practice techniques, such as soft-start and ramp-up procedures.
Cable Plan	Details how cable installation relates to mitigation measures, such as timing, location and construction methods.
Construction Method Statement	Details how construction methods relate to marine mammal mitigation measures.
Environmental Management Plan	Details the process for implementation of noise mitigation and best practice techniques.
Offshore Operational Maintenance Plan	Details how Project activities carried out in the operational stage relate to mitigation measures.
Project Environmental Monitoring Plan	Details guidance on the monitoring of potential environmental impacts, including marine mammal monitoring.
Vessel Management and Navigational Safety Plan	Details protocols to mitigate effects on marine mammals relating to vessels.

2. Description of the Project

2.1 Key relevant Project characteristics and worst-case scenarios

2.1.1.1 The final design of the Project, including number of WTGs, turbine configuration and foundation type, will be confirmed post-consent. The worst-case scenario Project characteristics with key relevance to the mitigation of underwater noise effects on marine mammals are given in **Table 2.1**.

Table 2.1 Key relevant Project characteristics and worse-case scenarios

Parameter	Characteristic
Project construction programme	From 2030, with a maximum of six years of piling activity.
OAA surface area	684km^2
Offshore export cable corridor length	130km to 140km
Windfarm water depth range	87.8 to 133.7 metres (m).
Number of WTGs	126 to 225.
WTG foundation type and moorings	Floating – mooring concepts considered include catenary mooring, taut-line mooring, semi-taut mooring and vertical tendon mooring.
Number of WTG floating units	126 to 225.
Type of WTG floating unit / platform considered	Semi-submersible, barge, tension leg platform, or any other hybrid design to take into account emerging or future technologies.
Maximum number of mooring lines per WTG floating unit	Eight
Anchor type	Drag embedment anchors, driven pile anchors and suction anchors.
Number of SDC	45 (between five to eight array cables can be connected into one SDC).
Foundation type for SDC	Suction caisson / skirt and gravity base foundations.

Parameter	Characteristic
Number of offshore substations	Four
Foundation type for offshore substations	Jacket foundations secured by suction caisson or driven piles.
Maximum number of driven piles for each offshore substation	12
Maximum hammer energy for offshore substation	3,500 kilojoule (kJ).
Maximum driven pile diameter for offshore substation	3m
Number of driven piles per day	Minimum of one and maximum of two.
Maximum number of concurrent piling activities	Two (piling of a substation and piling of an anchor).
Number of concurrent UXO clearance events	Zero
Estimated number of UXO clearances	Subject to pre-construction survey – to be confirmed.
Estimated size of UXO clearances	Maximum charge size for high-order detonations = 907 kilograms (kg) plus donor charge of 0.5kg

3. Background of the EIA

3.1.1.1 An EIA has been carried out, which has made an assessment of potential impacts on marine mammal receptors as a result of the Project (**Volume 1, Chapter 11: Marine Mammals**).

3.1.1.2 Based on the Project's worse-case scenarios, piling and UXO clearance have the potential for auditory injury (PTS) and disturbance of marine mammals. As outlined in **Section 1.4**, all marine mammals in UK waters are protected from intentional killing or injury. Cetaceans are given strict legal protection at a European level, under Annex IV of the Habitats Directive (making them EPS). This Outline MMMP, therefore, may be reviewed for any future EPS licence applications. It sets out the approach required for reducing instantaneous injury to a negligible level.

3.2 Unexploded ordnance clearance

3.2.1.1 For auditory injury (PTS) as a result of high-order UXO clearance, it has been assessed that harbour porpoise (very high frequency (VHF) cetaceans); bottlenose dolphin, Risso's dolphin, white-beaked dolphin, Atlantic white-sided dolphin, short-beaked common dolphin (high frequency (HF) cetaceans), and grey seal and harbour seal (Phocid Carnivores in Water (PCW)) have a residual significance of effect of **Negligible**, and minke and humpback whale (low frequency (LF) cetaceans) have a residual significance of **Minor**.

3.2.1.2 For disturbance as a result of high-order UXO clearance, it has been assessed that harbour porpoise (VHF cetaceans); Atlantic white-sided dolphin, bottlenose dolphins, white-beaked dolphins, Risso's dolphins, and short-beaked common dolphin (HF cetaceans), humpback whale (LF cetacean) and grey seal and harbour seal (PCW) have a residual significance of **Negligible**, and minke whale (LF cetacean) has a residual significance of **Minor**.

3.2.1.3 For disturbance from low-order UXO clearance, it has been assessed that all marine mammal receptors have a residual significance of **Negligible**. Low-order clearance / deflagration techniques will be used wherever possible, however in some exceptional circumstances high-order techniques may be required, which represent the worst-case scenario modelled for UXO clearance.

3.2.1.4 Detail on equipment and methodology for clearance of UXO will be provided in the Final MMMP.

3.3 Piling

3.3.1.1 For auditory injury (PTS) from piling, it has been assessed that all marine mammal receptors have a residual significance of **Negligible**.

3.3.1.2 For disturbance from piling, it has been assessed that Atlantic white-sided dolphin, short-beaked common dolphin and harbour porpoise (HF cetaceans) have a residual significance of **Negligible** and bottlenose dolphin, Risso's dolphin, and white-beaked dolphin (also HF cetaceans) have a residual significance of **Minor**.

4. Project Embedded Environmental Measures

4.1.1.1 The following measures have been included as embedded environmental measures described in **Volume 3, Appendix 5.2**:

- M-114: Use of 'low-order' techniques for UXO disposal, where possible and required;
- M-115: UXO Management Plan, to mitigate any potential for UXO within the offshore construction area and also disposal, once encountered; and
- M-120: Outline Construction Method Statement, giving details relating to commencement dates, duration and phasing of construction elements, procedures and working practices, roles and responsibilities, and delivery of mitigation.

4.1.1.2 In addition to embedded environmental measures, the Applicant is also committed to the following:

- no concurrent UXO detonations; however, more than one UXO may be detonated within one 24-hour period;
- no UXO clearance will occur at the same time as any piling activity; however, activities may both occur within a 24-hour period; and
- all UXO clearance (if needed) will be detonated during daylight hours.

5. Draft Protocols for Unexploded Ordnance Clearance and Piling

5.1 Unexploded ordnance clearance

5.1.1.1 Mitigation will be required for any UXO clearance associated with the Project, in line with JNCC guidelines (JNCC, 2025a). The Final MMMP will set out all embedded environmental measures and additional mitigation measures identified within the EIA Report and will be better informed during the pre-construction stage with regard to the number of devices requiring to be cleared. Mitigation measures for UXO clearance aim to reduce the risk of physical and / or auditory injury to marine mammals. The protocol for UXO clearance is based on the best available information at time of writing.

5.1.2 Mitigation zone

5.1.2.1 The initial step is to define a mitigation zone, equal to the full extent within which auditory injury (PTS-onset) could occur, or a 1km radius, whichever is larger (JNCC, 2025a). The mitigation zone is the area monitored pre-detonation and post-detonation and is required to be clear of marine mammals before any explosive is detonated. If the mitigation zone extends to distances which cannot be effectively mitigated, for example if the area is too large to be visible to an MMO, an EPS licence may be required before works are undertaken.

5.1.2.2 Further to Project-specific underwater noise modelling, the maximum instantaneous auditory injury range is 15km for VHF cetaceans; however, this would be for the largest charge size in a high-order detonation scenario. Given the Project's commitment to the use of low-order techniques, wherever possible, the 1km mitigation zone should be sufficient.

5.1.2.3 In preparing the Final MMMP, the mitigation zone should be agreed with the relevant stakeholders, once the final charge sizes and detonation methods are confirmed. The use of acoustic deterrent devices (ADDs) and noise abatement systems may be required to mitigate larger impact ranges.

5.1.3 Marine mammal observers and passive acoustic monitoring

5.1.3.1 MMOs and PAM operators advise the Operational Manager to support the Applicant in its compliance with the marine licence, guidance and regulations regarding UXO clearance activities. The MMO's primary task is to carry out visual monitoring to determine whether marine mammals are present within the mitigation zone. An MMO requires good weather conditions for observation, including a sea state of four or less on the Beaufort scale or JNCC sea state category 'c' or above, clear visibility and daylight hours.

5.1.3.2 To ensure compliance with the marine licence and to increase the chance of detecting the presence of marine mammals, PAM may be used. The PAM operator's primary task is to acoustically detect marine mammals within the mitigation zone. To enable distance estimation, the PAM system requires a hydrophone array cable (comprising multiple hydrophones) capable of detecting high and low frequency detections. MMOs and PAM operators concentrate their watches during mitigation periods, which include pre- and post-detonation. MMOs and PAM operators are also responsible for providing advice to crew to keep within the limitations of the marine licence or JNCC guidance, and for producing reports on mitigation and Project activities.

5.1.4 Clearance methodologies

5.1.4.1 During UXO clearance, UXO detonations are not anticipated to occur concurrently, that is to say there will be no detonation occurring for the Project at the same time. In line with the UK Government's joint position statement (UK Government, 2025), low-order, or deflagration, techniques are the default method to be used to clear all UXO; only under exceptional circumstances might high-order clearances be considered necessary and acceptable. For example, high-order techniques may be required where the location exceeds the expected or demonstrated capabilities for use of low-order techniques (JNCC, 2025).

5.1.5 Pre-clearance search

5.1.5.1 A pre-clearance search should be carried out visually by an MMO, during daylight hours and in good weather conditions to allow visual observations to take place. The pre-clearance search of the mitigation zone should be for a minimum of 60 minutes before the planned clearance and should cover the greater of the defined mitigation zone or minimum radius (1km). Given the large size of the mitigation zone, a minimum of two MMOs should carry out the search simultaneously. For mitigation zones greater than 1km, the MMOs should observe as much as possible and additional mitigation (for example, ADDs) should be used. Any use of ADDs requires that a visual search is also carried out prior to activation.

5.1.5.2 For species difficult to detect visually or in areas of high abundance, the pre-clearance search should be supplemented with PAM, but should not be used in place of the visual search or either of the MMOs. PAM should also commence a minimum of 60 minutes before the clearance activity.

5.1.5.3 If marine mammals are detected within the mitigation zone during the pre-clearance search, there must be a delay of at least 20 minutes after the last visual or acoustic detection, to allow the animal to move out of the mitigation zone. It should, therefore, be adjusted according to the size of the mitigation zone.

5.1.5.4 Should there be any delay to the clearance works, a decision must be made as to whether to stop and resume the pre-clearance search for a new 60-minute period, or continue the search.

5.1.6 During and post-clearance search

5.1.6.1 Visual monitoring should continue throughout the procedure and for a minimum of 15 minutes after UXO clearance has been completed. Evidence of any injury to marine life (including fish kills) should be noted.

5.1.7 Noise abatement system

5.1.7.1 Noise abatement systems may be used for the Project but this will be determined post-consent. Noise abatement systems are used to reduce the risk of injury to marine mammals from underwater noise, during piling. Common systems can include bubble curtains, resonators and isolating casings, which work either by absorbing sound or enclosing the noise source.

5.1.7.2 Noise abatement systems would only be considered when low-order fails and high-order clearance is required.

5.1.8 Acoustic deterrent devices

5.1.8.1 ADDs can be applied as noise mitigation measures during offshore construction activities including piling and UXO clearance. The purpose of an ADD is to deter marine mammals from potential injury zones by emitting medium-to-high frequency sounds so that animals travel away from the noise source prior to the commencement of the soft-start or UXO clearance. There is sufficient evidence to suggest that animals move away from ADDs, with fewer animal detections during ADD activation and an increase in behavioural observations including fleeing, moving away, increased swim speed and extended diving (Boisseau *et al.,* 2021; Elmegaard *et al*., 2023; Philips *et al.,* 2025).

5.1.8.2 During construction activities, multiple ADDs may be required depending on the size of the mitigation zone, with devices spaced appropriately to avoid an increased risk of cumulative effects. Multiple ADDs may also be required where a single ADD cannot target multiple species / hearing groups (Philips *et al.,* 2025). Given that ADDs generate noise designed to deter marine mammals from the noise source, ADDs may introduce additional disturbance, however the disturbance occurring as a result of the ADD is unlikely to exceed the ecological effect of construction activities if marine mammals were to remain in the area. The design of mitigation protocols for ADD deployment and operation should consider potential operational benefits against potential ecological risks (Philips *et al.,* 2025).

5.1.9 Requirement for mitigation measures

5.1.9.1 As per the recommendation from NatureScot, to avoid an over-precautionary approach, only instantaneous PTS onset, calculated using unweighted peak sound pressure levels, should be mitigated. Based on underwater noise modelling carried out for UXO detonation for the Project, the ranges for instantaneous PTS onset for low-order deflagration and for increasingly larger charge sizes for high-order detonation are given in **Table 5.1**.

5.1.9.2 Worst-case scenario ranges for instantaneous PTS, based on a high-order detonation with a maximum weight charge of 907kg (+donor) are:

- 15km for harbour porpoise;
- 880m for high-frequency cetaceans, for example, dolphins;
- 2.7km for minke whale and humpback whale; and
- 3km for grey and harbour seals.

Table 5.1 Instantaneous auditory injury ranges for the four marine mammal groups, including low-order deflagration and increasingly larger charge sizes for high-order detonation

Charge weight (kg)	PTS-onset (unweighted peak sound pressure level)			
	LF	HF	VHF	PCW
Low order (0.25kg)	170m	60m	990m	190m
25kg (+donor)	820m	260m	4.6km	910m

Charge weight (kg)	PTS-onset (unweighted peak sound pressure level)			
	LF	HF	VHF	PCW
55kg (+donor)	1.0km	340m	6.0km	1.1km
120kg (+donor)	1.3km	450m	7.8km	1.5km
240kg (+donor)	1.7km	560m	9.8km	1.9km
525kg (+donor)	2.2km	730m	12.0km	2.5km
698kg (+donor)	2.4km	810m	13.0km	2.7km
750kg (+donor)	2.5km	830m	14.0km	2.8km
907kg (+donor)	2.7km	880m	15.0km	3.0km

5.1.9.3 Based on the above PTS ranges, mitigation measures are required to reduce the effects of UXO detonation for all marine mammal receptors.

5.1.10 Reporting

5.1.10.1 Reports including all UXO clearance for the Project will be prepared. Reporting will include information on:

- a summary of the project-specific information, MMO and PAM recording forms (for example, operations, effort and sightings), and MMO report, alongside a copy of the consent and / or licence;
- a detailed account of UXO clearance operations undertaken including date, time, location and size of charge;
- a record of any embedded or further mitigation used including data, time, location and the MMO and PAM operators' account of works, to include timings of the pre-activity search, soft starts, mitigation actions including any delays and the number of occasions where guidelines were not met and non-compliances were reported;
- a summary of marine mammal observations, environmental conditions or any actions taken relating to marine mammal presence; and
- any further details of relevance to the UXO clearance or marine mammal observations.

5.1.11 Communication and responsibilities

5.1.11.1 The final MMMP will list the key roles and responsibilities, alongside a communication strategy, to ensure that mitigation measures are successfully undertaken for UXO clearance operations.

5.2 Piling

5.2.1.1 Mitigation will be required for any piling associated with the Project, in line with JNCC guidelines (JNCC, 2010). The Final MMMP will set out all embedded environmental measures and additional mitigation measures identified within the EIA Report in additional detail than the outline MMMP, given that further information may be available on Project activities by the pre-construction stage. Mitigation measures for piling activities aim to reduce the risk of physical and / or auditory injury to marine mammals. The protocol for piling is based on the best available information at time of writing.

5.2.2 Mitigation zone

5.2.2.1 The initial step is to define a mitigation zone, equal to the full extent within which instantaneous auditory injury (PTS-onset, based on peak sound pressure level) could occur and no less than 500m radius. There are a number of factors that may determine the extent of this zone, such as pile diameter, water depth and substrate type.

5.2.2.2 As discussed in **Section 5.2.8**, further to Project-specific underwater noise modelling, the maximum instantaneous auditory injury range is 660m for VHF cetaceans. This is therefore the radius of the mitigation zone to be used for piling activities, though this may be refined post-consent, in discussion with the relevant stakeholders.

5.2.3 Marine mammal observers and passive acoustic monitoring

5.2.3.1 MMOs and PAM operators advise the Operational Manager to support the Applicant in its compliance with the marine licence, guidance and regulations relating to piling activities. The MMO's primary task is to carry out visual monitoring to determine whether marine mammals are present within the mitigation zone. An MMO requires good weather conditions for observation, including a sea state of four or less on the Beaufort scale or JNCC sea state category 'c' or above, clear visibility, and daylight hours.

5.2.3.2 To ensure compliance with the marine licence and to increase chance of detecting the presence of marine mammals, PAM may be used. The PAM operator's primary task is to acoustically detect marine mammals within the mitigation zone. To enable distance estimation, the PAM system requires a hydrophone array cable (comprising multiple hydrophones) capable of detecting high and low frequency detections. MMOs and PAM operators concentrate their watches during mitigation periods, which cover the pre-activity search and soft-start (see **Section 5.2.5**). MMOs and PAM operators are also responsible for providing advice to crew to keep within the limitations of the marine licence or JNCC guidance, and for producing reports on mitigation and Project activities.

5.2.4 Acoustic deterrent devices

5.2.4.1 ADDs can be applied as noise mitigation measures during offshore construction activities including piling and UXO clearance. The purpose of an ADD is to deter marine mammals from potential injury zones by emitting medium-to-high frequency sounds so that animals travel away from the noise source prior to the commencement of the soft-start or UXO clearance. There is sufficient evidence to suggest that animals move away from ADDs, with fewer animal detections during ADD activation and an increase in behavioural observations including fleeing, moving away, increased swim speed and extended diving (Boisseau *et al.,* 2021; Elmegaard *et al*., 2023; Philips *et al.,* 2025).

5.2.4.2 During construction activities, multiple ADDs may be required depending on the size of the mitigation zone, with devices spaced appropriately to avoid an increased risk of cumulative effects. Multiple ADDs may also be required where a single ADD cannot target multiple

species / hearing groups (Philips *et al.,* 2025). Given that ADDs generate noise designed to deter marine mammals from the noise source, ADDs may introduce additional disturbance, however the disturbance occurring as a result of the ADD is unlikely to exceed the ecological effect of construction activities if marine mammals were to remain in the area. The design of mitigation protocols for ADD deployment and operation should consider potential operational benefits against potential ecological risks (Philips *et al.,* 2025).

5.2.5 Soft-start and ramp-up

5.2.5.1 A soft-start is the initial, intermittent and low-energy form of piling and the ramp-up is a gradual increase in piling energy, to reach the full operational power, over a pre-designed period of time. JNCC guidance (JNCC, 2025a) states that the soft-start / ramp-up duration should be no less than 20 minutes, to allow any marine mammals to leave the mitigation zone before piling power reaches levels at which auditory injury / PTS could occur. Underwater noise modelling for the Project was based upon the strike rates, piling energies and timings shown in **Table 5.2**.

Table 5.2 Summary of the soft start and ramp up periods used for the underwater noise modelling of impact piling

Impact piling	9% (320kJ)	14% (490kJ)	18% (630kJ)	38% (1330kJ)	62% (2170kJ)	76% (2660kJ)	81% (2835kJ)	100% (3500kJ)
No. of strikes	180	180	180	150	180	150	2331	150
Duration	30 minutes	6 minutes	6 minutes	5 minutes	6 minutes	5 minutes	~78 minutes	5 minutes
Strike rate (strikes/min)	6	30	30	30	30	30	30	30
3,501 strikes over 2 hours 20 minutes 42 seconds per pile. 7,002 strikes over 4 hours 41 minutes 24 seconds for two sequentially installed piles.								

5.2.5.2 A pre-piling search should be carried out visually by an MMO, and / or acoustically using PAM equipment before the soft-start and ramp-up. The pre-piling search of the mitigation zone should be for a minimum of 30 minutes. The soft-start procedure can only begin once the pre-piling search has been completed. While the pre-piling search may be carried out acoustically, the guidance stipulates that piling should not commence during periods of darkness or poor visibility.

5.2.5.3 If marine mammals are detected within the mitigation zone, piling cannot commence until 20 minutes after the last visual or acoustic detection. If a marine mammal is detected during the soft-start, piling should cease, or at least the power should not be increased (in certain cases, cessation of piling may risk pile integrity, due to pile design or substrate), until the animal has left the mitigation zone and there are no further detections for 20 minutes.

5.2.6 Breaks in piling

5.2.6.1 Once piling has reached full power, there is no requirement to cease piling or lower hammer energy if a marine mammal enters the mitigation zone. However, should there be a break

in piling of greater than ten minutes, the pre-piling search should recommence before another soft-start and ramp-up period, to full power.

5.2.6.2 If MMOs and / or PAM operators have continued to monitor the mitigation zone before and during the break and found no animals to be present, there need not be a delay in beginning the soft-start. There should again be a period of 20 minutes without marine mammal detections before re-starting the soft-start.

5.2.7 Concurrent and sequential piling

5.2.7.1 Piling may be undertaken at up to two piling locations concurrently (simultaneously). Piling of up to two piles sequentially may also occur at each location. There is therefore a maximum of four piles that may be driven in any 24-hour period.

5.2.8 Requirement for mitigation measures

5.2.8.1 As per the recommendation from NatureScot, to avoid an over-precautionary approach, only instantaneous PTS onset, calculated using unweighted peak sound pressure levels, should be mitigated. Based on the underwater noise modelling carried out for piling for the Project, the maximum potential range for instantaneous PTS onset at any location is:

- 660m for harbour porpoise;
- <50m for high-frequency cetaceans, for example, dolphins;
- <50m for minke whale and humpback whale; and
- 60m for grey and harbour seals.

5.2.8.2 Based on the above PTS ranges, mitigation measures are required to reduce the effects of piling noise for all marine mammal receptors.

5.2.9 Reporting

5.2.9.1 Reports including piling activity and mitigation for the Project will be prepared. Reporting will include:

- a summary of the Project-specific information, MMO and PAM recording forms, and MMO report, alongside a copy of the consent and / or licence;
- a detailed account of piling operations undertaken including date, time, location and times of soft-start and ramp-up;
- a record of any embedded or further mitigation used such as ADDs, including date, time, location and the MMO and PAM operators' account of works, to include timings of the pre-activity search, soft starts, mitigation actions including any delays and the number of occasions where guidelines were not met and non-compliances were reported;
- information on whether piling was stopped or delayed due to marine mammal presence;
- a summary of marine mammal observations, environmental conditions and any actions taken relating to marine mammal presence; and
- any further details of relevance to the piling operations or marine mammal observations.

5.2.10 Communication and responsibilities

5.2.10.1 The Final MMMP will list the key roles and responsibilities, alongside a communication strategy, to ensure that mitigation measures are successfully undertaken for piling operations.

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7. Glossary of Terms and Abbreviations

7.1 Abbreviations

Acronym	Definition
ADD	Acoustic Deterrent Device
EIA	Environmental Impact Assessment
EPS	European Protected Species
HF	High-Frequency Cetacean
JNCC	Joint Nature Conservation Committee
kJ	kilojoule
km	kilometre
LF	Low-Frequency Cetacean
MHWS	Mean High Water Springs
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Mammal Observer
NE7	Northeast 7
OAA	Option Agreement Area
PAM	Passive Acoustic Monitoring
PCW	Phocid Carnivore In Water
PTS	Permanent Threshold Shift
s.36	Section 36
SDC	Subsea distribution centre
SPR	ScottishPower Renewables
UK	United Kingdom
UXO	Unexploded Ordnance
VHF	Very-High-Frequency Cetacean
WTG	Wind Turbine Generator

7.2 Glossary of terms

Term	Definition
Passive Acoustic Monitoring	A technique involving the deployment of hydrophone (underwater microphones) to listen for a record marine mammal (or other) vocalisations.
Permanent threshold shift	A permanent change in the hearing ability at a particular sound frequency, in this case caused by exposure to loud sound.

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