



Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Draft Marine Mammal Mitigation Protocol (MMMP)

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Glossary of Acronyms

ADD	Acoustic Deterrent Device
dB	Decibel
DCO	Development Consent Order
DEP	Dudgeon Offshore Wind Farm Extension Project
DML	Deemed Marine Licence
DOW	Dudgeon Offshore Wind Farm
ELO	Environmental Liaison Officer
EOD	Explosive Ordnance Disposal
EPP	Evidence Plan Process
ETG	Expert Topic Group
GBS	Gravity Base Structure
JNCC	Joint Nature and Conservation Committee
kg	Kilogram
kJ	Kilojoules
km	Kilometre
km ²	Kilometre squared
kV	Kilovolt
LAT	Lowest Astronomical Tide
m	Metre
MA	Monitoring Area
m/s	Metres per second
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMObs	Marine Mammal Observers
MW	Megawatt
MZ	Mitigation Zone
NPL	National Physical Laboratory
OSP	Offshore Platform
PAM	Passive Acoustic Monitoring
PAM-Ops	Passive Acoustic Monitoring Operators
PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift



ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SEL _{cum}	Cumulative Sound Exposure Level
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SIP	Site Integrity Plan
SNCB	Statutory Nature Conservation Body
SNS	Southern North Sea
SOW	Sheringham Shoal Offshore Wind Farm
SPL	Sound Pressure Level
SPL _{peak}	Peak Sound Pressure Level
TWT	The Wildlife Trust
UK	United Kingdom
UXO	Unexploded Ordnance



Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DEP offshore site	The Dudgeon Offshore Wind Farm Extension consisting of the DEP wind farm site, interlink cable corridors and offshore export cable corridor (up to mean high water springs).
DEP onshore site	The Dudgeon Offshore Wind Farm Extension onshore area consisting of the DEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
DEP North array area	The wind farm site area of the DEP offshore site located to the north of the existing Dudgeon Offshore Wind Farm
DEP South array area	The wind farm site area of the DEP offshore site located to the south of the existing Dudgeon Offshore Wind Farm
DEP wind farm site	The offshore area of DEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area. This is also the collective term for the DEP North and South array areas.
Interlink cable corridor	This is the area which will contain the interlink cables between offshore substation platform/s and the adjacent Offshore Temporary Works Area.
Order Limits	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
Mitigation Zone	The area in which mitigation will be implemented.
Monitoring Area	An area within the Mitigation Zone in which marine mammal observers conduct a visual search for marine mammals.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.



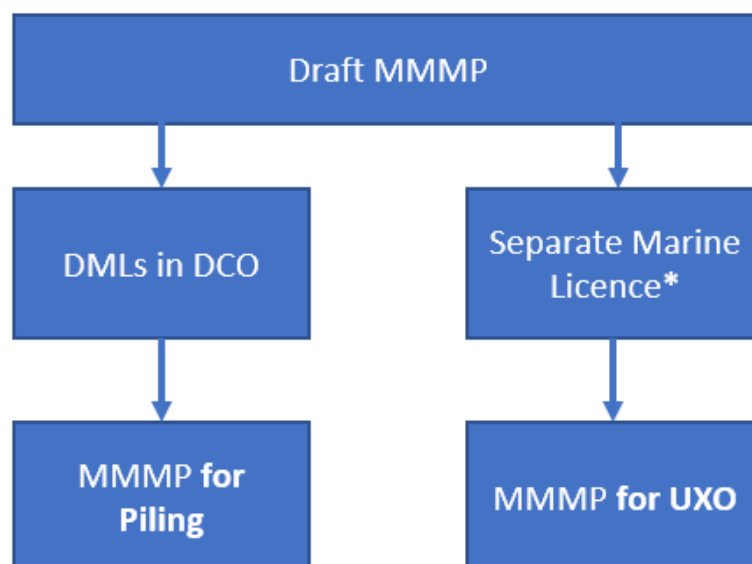
Offshore export cable corridor	This is the area which will contain the offshore export cables between offshore substation platform/s and landfall, including the adjacent Offshore Temporary Works Area.
Offshore substation platform (OSP)	A fixed structure located within the wind farm site/s, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Offshore Temporary Works Area	An Offshore Temporary Works Area within the offshore Order Limits in which vessels are permitted to carry out activities during construction, operation and decommissioning encompassing a 200m buffer around the wind farm sites and a 750m buffer around the offshore cable corridors. No permanent infrastructure would be installed within the Offshore Temporary Works Area.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
SEP offshore site	Sheringham Shoal Offshore Wind Farm Extension consisting of the SEP wind farm site and offshore export cable corridor (up to mean high water springs).
SEP onshore site	The Sheringham Shoal Wind Farm Extension onshore area consisting of the SEP onshore substation site, onshore cable corridor, construction compounds, temporary working areas and onshore landfall area.
SEP wind farm site	The offshore area of SEP within which wind turbines, infield cables and offshore substation platform/s will be located and the adjacent Offshore Temporary Works Area.
The Applicant	Equinor New Energy Limited. As the owners of SEP and DEP, Scira Extension Limited and Dudgeon Extension Limited are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.



DRAFT MARINE MAMMAL MITIGATION PROTOCOL

1.1 Purpose of this Document

1. The purpose of this draft marine mammal mitigation protocol (MMMP) is to demonstrate the principles of the final MMMP to be submitted for approval as required under the draft Development Consent Order (DCO) for the proposed Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and the proposed Dudgeon Offshore Wind Farm Extension Project (DEP).
2. As the owners of SEP and DEP, Scira Extension Limited (SEL) and Dudgeon Extension Limited (DEL) are the named undertakers that have the benefit of the DCO. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of SEL and DEL as the undertakers of SEP and DEP.
3. Both unexploded ordnance (UXO) clearance and piling have the potential to produce underwater noise capable of causing auditory injury to marine mammals. This Draft MMMP details how the Applicant would reduce the risk of underwater noise of UXO clearance and piling from causing auditory injury to marine mammals that could be present in and around the SEP and DEP offshore sites.
4. It should be noted that, pre-construction, a separate Marine Licence for UXO clearance will be sought, with the necessary information (including the final MMMP for UXO clearance), being provided through the marine licensing process. Proposed measures to mitigate potential impacts from UXO clearance have been provided within this draft MMMP for information purposes only, consistent with Natural England's advice that the DCO application includes an assessment of potential UXO clearance.
5. **Plate 1** sets out how the MMMPs for piling and UXO will be secured.



**To be obtained post consent*

Plate 1: Relationship between the draft and final MMMPs for Piling and UXO and how they will be secured



6. As such, separate MMMPs for piling and UXO clearance will be developed for SEP and DEP at the pre-construction stage. These final MMMPs will take account of the most suitable mitigation measures and up to date scientific understanding at the time of construction. These measures will be consulted upon with the Marine Management Organisation (MMO), Statutory Nature Conservation Bodies (SNCB) and The Wildlife Trusts (TWT).
7. This draft MMMP also outlines how the Deemed Marine Licence (DML) conditions will be met.
8. The relevant conditions of the DMLs state that:

The licensed activities or any phase of those activities must not commence until the following (insofar as relevant to that activity or phase of activity) have been submitted to and approved in writing by the MMO — in the event that driven or part-driven pile foundations are proposed to be used, a marine mammal mitigation protocol (in accordance with the draft marine mammal mitigation protocol), the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies.
9. This draft MMMP for UXO clearance and piling sets out the protocol of how SEP and DEP would:
 - Mitigate impacts to reduce the likelihood of injury to marine mammals as a result of underwater noise during UXO clearance;
 - Mitigate impacts to reduce the likelihood of injury to marine mammals as a result of underwater noise during piling operations; and
 - Meet the relevant DML condition stated above.
10. The final MMMP for piling will be submitted to the MMO at least six months prior to construction, for approval in consultation with the relevant SNCBs.
11. The final MMMP will be developed in the pre-construction period and will be based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. Current guidance includes Joint Nature and Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC, 2010a) and statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b).
12. Following Natural England request on Preliminary Environmental Information Report (PEIR), **Annex 1** provides further information on the proposed good practice and code of conduct that will be undertaken by vessel operators to reduce any risk of collisions with marine mammals.
13. In addition to the draft MMMP, an **In Principle Site Integrity Plan (SIP) for the Southern North Sea (SNS) Special Area of Conservation (SAC)** (document reference 9.7) has been submitted with the DCO application. The SIP sets out the approach for delivery of the required mitigation measures for SEP and DEP to ensure the avoidance of Adverse Effect on Integrity of the SNS SAC in-combination with other plans and projects.



1.1.1 Description of SEP and DEP

14. The Applicant is seeking a DCO for SEP and DEP which are extensions to the existing Sheringham Shoal Offshore Wind Farm (SOW) and Dudgeon Offshore Wind Farm (DOW), located in the SNS off the north Norfolk Coast.
15. The SEP wind farm site will cover an area of approximately 92.6km² and the DEP wind farm site will cover an area of approximately 103.5km² (excluding the offshore temporary works area). The closest point to the coast is 15.8km from SEP and 26.5km from DEP. Depths range from 14m below Lowest Astronomical Tide (LAT) in the northwest of the SEP wind farm site to 36m in the northwest of the DEP North array area.
16. Water depths within the offshore export cable corridor range from 25-27m in the offshore part closest to SEP, shallowing to about 16m near the eastern tip of Sheringham Shoal sand bank and then decreasing progressively to 0m at the coast.
17. Once built, SEP and DEP would comprise the following offshore components:
 - The offshore wind turbines and their associated foundations;
 - Scour protection around foundations as required;
 - Offshore substation platform/s (OSP/s) supporting required electrical equipment, possibly also incorporating offshore facilities; and
 - Subsea cables comprising infield, interlink and offshore export cables and associated external cable protection as required.
18. The detailed design of SEP and DEP (e.g. numbers of wind turbines, layout configuration, foundation type and requirement for scour protection) will be determined post-consent. Therefore, the key parameters presented in **Table 1** are indicative based on current information and assumptions. These parameters have formed the worst case scenario for the underwater noise assessment as presented in **Chapter 10 Marine Mammal Ecology**.
19. The earliest any offshore construction works would start is assumed to be 2027.
20. Offshore construction works would require up to two years per Project (excluding pre-construction activities such as surveys), assuming SEP and DEP were built at different times. If built at the same time, offshore construction could be completed in two years.
21. It should be noted that the construction programme is dependent on numerous factors including consent timeframes and funding mechanisms.

1.1.2 Key Relevant Parameters

Table 1: Key Relevant Parameters

Parameter	Details		
	SEP	DEP	Combined
Approximate offshore construction duration	2 years	2 years	2 to 4 years
Wind farm site area (excluding offshore)	92.60	103.50	196.10



Parameter	Details		
	SEP	DEP	Combined
temporary works area) (km ²)			
Offshore cable corridor area (excluding offshore temporary works area) (km ²)	18.65	82.29	Up to 92.33*
Wind farm site water depth range (m)	14-36	14-36	14-36
Distance from wind farm site to coast (closest point) (km)	15.8	26.5	15.8
Number of wind turbines	13-23	17-30	30-53
Number of OSP/s	One	One	Up to two
Wind turbine foundation type options	<ul style="list-style-type: none"> • Piled monopile; • Suction bucket monopile; • Piled jacket; • Suction bucket jacket; and • Gravity base structure (GBS). 		
OSP foundation type options	<ul style="list-style-type: none"> • Piled jacket; or • Suction bucket jacket. 		
Number of piles per foundation for wind turbines	Monopile = 1 Piled jacketed = 4		
Maximum number of piles for wind turbines	Monopiles = 23 Piled jacket = 92	Monopiles = 30 Piled jacket = 120	Monopiles = 53 Piled jacket = 212
Maximum number of piles for OSPs	2 x 4 leg-jacket = 8 pin piles	2 x 4 leg-jacket = 8 pin piles	4 x 4 leg-jacket = 16 pin piles
Hammer energies (kilojoules) (kJ)	Maximum hammer energy for monopiles: <ul style="list-style-type: none"> • Up to 5,000kJ for 15 MW wind turbines • Up to 5,500kJ for 18+MW wind turbines Maximum hammer energy for pin-piles: up to 3,000kJ		
Maximum pile diameter (m)	<ul style="list-style-type: none"> • 3.5-4m for piled jackets • 13-16m for monopiles 		

* Based on a two OSP scenario where both the DEP North and South array areas are developed.

1.2 Consultation

22. A draft version of the draft MMMP was shared for consultation with the marine mammals Expert Topic Group (ETG) on the 1st of February 2022 as part of the Evidence Plan Process (EPP). The comments received and the Applicant's responses are provided in **Table 2**.



Table 2: Pre-Application Consultation Comments Received on the Draft MMMP

Consultee	Date / Document	Comment Received	Project Response
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.1, Paragraph 27: We consider that it would be beneficial for the final MMMPs for UXO and piling to contain clearly-presented details of the predicted impact (permanent threshold shift (PTS)) ranges from the UXO clearance and piling activities.	Clearly presented details of the predicted impact (PTS) ranges and areas from the UXO clearance and piling activities will be included in the final MMMPs prepared prior to construction.
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2, Paragraph 34: Please note that we no longer advise the use of scare charges as a mitigation tool for marine mammals during UXO clearance. However, these may be required to mitigate injury to fish. The relevant Regulator/advisory body should be consulted for requirements for fish species.	The use of scare charges will not be included in the UXO MMMP.
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.1: We welcome the proposal to use low-order UXO disposal techniques as the preferred option for UXO clearance. We advise that the evidence base for different low order techniques should be reviewed prior to finalising the UXO MMMP. It is essential that any low order techniques proposed have sufficient evidence to demonstrate consistent reduction in underwater noise. At this stage, we consider that sufficient evidence has been provided for deflagration to demonstrates its effectiveness as a low order technique.	Noted.



Consultee	Date / Document	Comment Received	Project Response
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.2: We welcome the proposal to use bubble curtains during high order detonation of UXOs, where possible. Should bubble curtains be used, we advise that noise monitoring to demonstrate their effectiveness in mitigating noise impacts is undertaken.	Noted. Provision for monitoring the effectiveness of bubble curtains in the event that high order detonation of UXO is required will be agreed through the licensing process for UXO clearance post-consent.
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.3, Paragraph 50: It is important that the acoustic deterrence devices (ADD) model chosen has sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the impact zones.	Noted. This will be agreed during production of the final MMMPs (Sections 1.3.2.3 and 1.4.1.4).
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.3, Paragraph 53: We query why the ADD will only be activated once the one-hour pre-clearance search has been completed. We suggest that the ADD should be activated at such a time that the end of activation coincides with the end of the pre-clearance search. This will cut down on total time required pre-clearance, and will also minimise the time period between observations and UXO clearance. This is of particular importance in scenarios where ADDs will be activated for a long period of time.	This has been reviewed and updated. The ADD will be activated at a time so that the end of activation coincides with the end of the monitoring period (Section 1.3.2.3 and 1.4.1.4). As such the ADD activation will be during the monitoring period and not before.
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.3: We query why two ADDs are proposed, when it has been already stated that the ADD will be positioned in the water column to ensure that sound can be emitted in all directions. Whilst the focus of ADDs is to mitigate the injury zone, excessive disturbance from ADDs should be minimised. Therefore justification is needed to demonstrate the need for two ADDs rather than one. We concur that a backup ADD should be present on board, in case there are issues with activation of the primary system. This point is also applicable to the piling MMMP.	This has been reviewed and updated. Two ADDs were included in the previous draft MMMP as a precautionary approach. However, based on feedback from other projects, one ADD correctly positioned in the water column is sufficient to ensure that sound can be emitted in all directions (Section 1.3.2.3 and 1.4.1.4).



Consultee	Date / Document	Comment Received	Project Response
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.5, Paragraph 63: To note/clarify, a dedicated MMOB is someone who is employed on the vessel solely for the purpose of undertaking marine mammal mitigation. If the MMOB has other duties onboard, e.g., is part of the installation crew, then they are strictly a non-dedicated MMOB. As per the JNCC (2010) Guidelines, dedicated MMOBs are recommended for UXO clearance. The same applies to MMOBs during piling (in reference to Page 14). And they should be located so that full 360° observations are achievable.	This has been reviewed and updated to clarify the MMOB requirements and role (Sections 1.3.2.5 and 1.4.1.2).
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.5, Paragraph 67: We advise that consideration should be given to the possibility of marine mammal observations during ADD deployment and what appropriate actions should be taken if this was to occur.	Marine mammal monitoring will be conducted during all ADD activation times and further information provided for appropriate actions if marine mammals are detected during ADD activation (Sections 1.3.2.5 and 1.4.1.2).
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.3.2.6: Please note that, as per JNCC 2010 Guidance, we advise that UXO clearance should only be commenced during the hours of daylight and good visibility, so that MMOBs can monitor the full extent of the mitigation zone.	This has been clarified in Section 1.3.2 .
Natural England	11/03/22 / 13015 Consultation: 382532	Section 1.4, Paragraph 91 (also applicable to Section 1.4.1.4, Paragraph 121): Natural England does not consider mitigation of solely the SPL _{peak} distance is sufficient as it will not take into account any of the exposure to sound over time, which will certainly occur and which could lead to PTS onset. We strongly advise that the full SEL _{cum} PTS zone is mitigated and that the mitigation distance should reflect the largest distance predicted for PTS onset as a result of either SEL _{cum} or SPL _{peak} , whichever is largest.	Mitigation will cover the maximum predicted PTS distance (Section 1.4).



Consultee	Date / Document	Comment Received	Project Response
Natural England	11/03/22 / 13015 Consultation: 382532	<p>Section 1.4.1, Paragraph 96: We note that the proposals do not explicitly include a pre-piling search for marine mammals. Only a monitoring area has been detailed, but not a dedicated monitoring period prior to noisy activities (for example, pre-piling monitoring is not listed in Paragraph 98). A pre-piling search is part of the standard piling protocol in the JNCC 2010 Guidance. We strongly advise that a pre-piling search of a minimum of 30 minutes should be undertaken prior to piling activity. Also we advise that consideration should be given to potential delays and the approach that will be taken should a marine mammal be sighted in the mitigation zone prior to piling. Again, we strongly advise that this measure is included, as it is a standard measure from the JNCC 2010 Guidance to reduce the risk of injury to marine mammals.</p>	<p>Clarification has been provided on marine mammal monitoring prior to UXO clearance and piling (Sections 1.3.2.5 and 1.4.1.1).</p>
Natural England	11/03/22 / 13015 Consultation: 382532	<p>Section 1.4.1.4: Natural England does not agree that the ADD should only be activated for long enough for animals to flee the instantaneous PTS zone. This approach does not take into account the possibility of PTS from cumulative sound exposure, which can occur in animals outside the small instantaneous PTS zone. As mentioned above, we strongly advise that the full SEL_{cum} PTS zone is mitigated and that the mitigation distance should reflect the largest distance predicted for PTS onset as a result of either SEL_{cum} or SPL_{peak}, whichever is largest. The largest mitigation distance should be used when calculating the ADD activation duration. The activation duration, and rationale, should be clearly detailed in the final piling MMMP.</p>	<p>Mitigation will cover the maximum predicted PTS distance (Section 1.4). The ADD activation duration, and rationale, will be clearly detailed in the final piling MMMP</p>



Consultee	Date / Document	Comment Received	Project Response
Natural England	11/03/22 / 13015 Consultation: 382532	<p>Section 1.4.1.6: Natural England notes that it is proposed for breaks between 10 minutes and 2 hours, that piling will recommence with 5-6 blows at low energy, followed by piling at full energy. This is not the same as undertaking a “soft-start and ramp-up”, as stated on Page 17 (Paragraph 124). We do not agree that this approach can be used without further evidence to demonstrate that it will not result in injury to marine mammals. Furthermore, information should be provided on what would happen if a marine mammal was detected during a break in piling activity.</p>	The breaks in piling procedure has been reviewed and updated (Section 1.4.1.6).
Marine Management Organisation	01/03/22 / DCO/2019/00004	<p>Section 1.4.1.6, Para 140: States that “in the event that piling activity is stopped for more than 10 minutes, the Applicant would ensure that the soft-start and ramp-up procedure is conducted prior to piling re-commencing”, which is appropriate. However, under section 3.2.1.6, it is also proposed that for any breaks in piling of more than 10 minutes and less than 2 hours, piling can recommence, with 5 to 6 blows at low energy (300kJ or 320kJ lowest possible hammer energy), followed by piling at full energy.</p>	The breaks in piling procedure has been reviewed and updated (Section 1.4.1.6).



Consultee	Date / Document	Comment Received	Project Response
Marine Management Organisation	01/03/22 / DCO/2019/00004	<p>Section 1.4: The JNCC (2010) guidance recommends that if there is a pause in piling operations for a period of greater than 10 minutes, then the pre-piling search and soft-start procedure should be repeated before piling recommences. If a watch has been kept during the piling operation, the Marine Mammal Observers (“MMObs”) or Passive Acoustic Monitoring (“PAM”) operative should be able to confirm the presence or absence of marine mammals, and it may be possible to commence the soft-start immediately. The guidance recommends that the soft-start duration should be a period of not less than 20 minutes. Any requested variation from a 20-minute soft-start should be agreed with the relevant agency and regulator. The MMO recommend that the guidance is adhered to, and the full soft start of 20 minutes is implemented (not 5 to 6 blows at low energy as is proposed in the MMMP).</p>	<p>The breaks in piling procedure has been reviewed and updated (Section 1.4.1.6).</p>
Marine Management Organisation	01/03/22 / DCO/2019/00004	<p>Section 1.4.1: The MMO recognize that the final MMMPs will take into account the most suitable mitigation measures and proven methodologies at that time. The Applicant should consider suitable noise abatement measures for pile driving. Bubble curtains, for example, have been widely demonstrated to be effective in waters up to 45m for percussive pile driving, and they are already being routinely deployed in other parts of the North Sea in order to reduce the risk of impact on marine life, particularly marine mammals (Merchant and Robinson, 2020).</p>	<p>The requirement for noise abatement will be considered along with other mitigation options in the development of the final MMMPs.</p>



Consultee	Date / Document	Comment Received	Project Response
<p>Marine Management Organisation</p>	<p>01/03/22 / DCO/2019/00004</p>	<p>Section 1.3.2.3: It is noted that the MMMP discusses the use of Acoustic Deterrent Devices (“ADDs”), stating the following: “ADDs will be activated prior to any UXO low-order disposal or high-order detonation to ensure marine mammals are deterred from the area and reduce the risk of any physical or auditory injury”.</p> <p>The MMO would like to highlight that ADDs cannot ensure that marine mammals are deterred from the area. Scientific literature indicates that ADDs can be successful in deterring some marine mammals up to a certain distance from the noise source, but the range in deterrent distance varies considerably. As stated in Brandt <i>et al.</i> (2013), “the application of seal scarers prior to pile driving certainly reduces the risk of injury in (harbour) porpoises to a great extent” (although the same study further notes that “whether the observed absolute deterrence range applies to different behavioural contexts remains difficult to judge, as porpoises may be less likely to be deterred if they are feeding in prey-rich habitats than if they are just moving through an area”). Brandt <i>et al.</i> (2012), noted from their study that “the use of seal scarers as a mitigation tool during offshore construction, however, seems promising. Nevertheless, these results also highlight that its application will not guarantee the safety of all animals, as not all individuals will react with avoidance reactions”.</p>	<p>The final MMMPs will take account of the most suitable mitigation measures and up to date scientific understanding at the time of construction, including further consultation with the MMO, Natural England and TWT.</p>



Consultee	Date / Document	Comment Received	Project Response
Marine Management Organisation	01/03/22 / DCO/2019/00004	Section 1.3.2.3: In Brandt <i>et al.</i> (2013), total deterrence was observed only to a maximum of 1.9km, and on two occasions, a porpoise was observed at a distance of only ~ 800m away, pointing to variability in how porpoises react; this may depend on the sensitivity of the individual or the behavioural context of the reaction (Brandt <i>et al.</i> , 2013). Similarly, in Brandt <i>et al.</i> (2012), some porpoises were still present within 750m of the source.	As outlined above, the type of ADD will be determined prior to construction to ensure it provides effective mitigation for the marine mammal species that could be present in the area.
Marine Management Organisation	01/03/22 / DCO/2019/00004	Section 1.4.1.6: Regarding breaks in piling activity, it is recommended that if there is a pause in piling operations for a period of greater than 10 minutes, then the pre-piling search and soft-start procedure should be repeated before piling recommences (JNCC, 2010). If a watch has been kept during the piling operation, the MMObs or PAM operative should be able to confirm the presence or absence of marine mammals, and it may be possible to commence the soft-start immediately. The soft-start duration should be a period of not less than 20 minutes. The guidance recommends that any requested variation from a 20-minute soft-start should be agreed with the relevant agency and regulator. The MMO recommend that the guidance is adhered to, and the full soft start of 20 minutes is implemented.	The breaks in piling procedure has been reviewed and updated (Section 1.4.1.6).
Marine Management Organisation	01/03/22 / DCO/2019/00004	Section 1.3.1: Overall, the MMO consider the MMMP for Unexploded Ordnances (“UXO”) clearance and piling is appropriate and note that it includes the standard mitigation measures that are typically proposed for offshore wind developments.	Noted.



1.3 Draft Protocols for UXO Clearance and Piling

1.3.1 UXO Clearance

23. Based on previous experience, including at DOW, there is a likely requirement for UXO clearance prior to construction. Whilst the preference would be to avoid any underwater UXO that are identified, it is necessary to consider the potential for underwater UXO detonation where retrieval is deemed to be unsafe and avoidance is not possible.
24. The purpose of this draft MMMP is to demonstrate the principles of the final MMMP for any UXO clearance at SEP and DEP.
25. This draft MMMP outlines the mitigation to reduce the risk of injury, including permanent auditory injury / a permanent shift in hearing sensitivity (Permanent Threshold Shift (PTS)), to marine mammals during any UXO clearance work associated with SEP and DEP (including the wind farm sites and offshore cable corridors).
26. As set out in **Section 1.1**, the final MMMP for UXO clearance will be submitted for approval under a future Marine Licence application, separate from the DCO application.
27. The exact number, type or size of UXO and duration of UXO clearance operations is therefore not known at this stage. Therefore, the final detailed MMMP for UXO clearance will be developed pre-construction based on the latest survey information which will provide detailed information on the UXO clearance which could be required. The final MMMP for UXO clearance will provide details of the predicted impact (PTS) ranges and areas from UXO clearance.
28. The final MMMP for UXO clearance will ensure there are embedded mitigation measures, as well as any additional mitigation, if required, to reduce the risk of physical or permanent auditory injury (PTS) to marine mammals. This will incorporate the most appropriate mitigation measures based upon best available information and proven methodologies at that time.
29. The Applicant is committed to using the best practicable means at the time to mitigate the impacts of SEP and DEP.
30. The mitigation in the final MMMP will be based on current best practice, guidance and information, including updated underwater noise modelling, if required, and will be updated no later than six months prior to UXO clearance activities being undertaken.

1.3.2 Mitigation

31. The final MMMP would involve the establishment of a suitable Mitigation Zone (MZ) around the UXO location before any UXO clearance. The MZ is the entire mitigation area for the maximum PTS ranges.
32. The Applicant will ensure that the mitigation measures are adequate to reduce the risk of any physical or permanent auditory injury (PTS) within the MZ during all UXO clearance.

33. The methods for establishing the MZ and reducing the potential impacts of any UXO clearance will be agreed with the MMO in consultation with the relevant SNCBs and TWT and will be secured as commitments within the final MMMP.
34. The UXO clearance mitigation measures could include:
- Low-order disposal techniques (see [Section 1.3.2.1](#)), this would be the preferred method for all UXO clearance.
 - The use of bubble curtains if high-order UXO detonation is required (see [Section 1.3.2.2](#)), taking into account the environmental conditions within which they could be effective.
 - The activation of acoustic deterrent device (ADD) (see [Section 1.3.2.3](#)) prior to all UXO low-order clearance or high-order detonation (with or without bubble curtains).
 - All UXO clearance taking place in daylight and, when possible, in favourable conditions with good visibility (sea state 3 or less).
 - Establishment of a Monitoring Area (MA) with a minimum of 1km radius (see [Section 1.3.2.4](#)).
 - The observation of the MA will be conducted by trained, dedicated and experienced Marine Mammal Observers (MMObs) during daylight hours and when conditions allow suitable visibility, pre- and post-detonation (see [Section 1.3.2.5](#)).
 - Deployment of passive acoustic monitoring (PAM) in the MA (see [Section 1.3.2.6](#)), if the equipment can be safely deployed and retrieved.
 - Other UXO clearance techniques such as avoidance or relocation of UXO will also be considered, if required and suitable.
 - The UXO clearance and disposal will be undertaken by specialist contractors, using the minimum amount of explosives required in order to achieve safe disposal of the device.
35. Where possible and safe to do so, the preferred options would be as follows, in order of preference:
- UXO will be avoided and left *in situ*;
 - Micro-siting of infrastructure, if possible, to avoid any potential UXO, so clearance is not required; and
 - If the UXO appears structurally sound and there is no risk, the UXO could potentially be relocated to a location that is not in a sensitive area (e.g. a designated site or in close proximity to existing or planned infrastructure) for subsequent clearance, subject to a proportional assessment of the risk posed to the vessel and staff from a health and safety perspective.

- 36. If these options are not possible, and UXO clearance is the only option, then low-order clearance will be the preferred method. High-order detonation will only be used if low-order clearance was unsuccessful or the UXO device is unsafe for low-order clearance.
- 37. It is important to note these techniques and options are presented as current examples, but the mitigation options will be reviewed and updated based on the latest information and guidance in the final MMMP.

1.3.2.1 Low-order UXO Clearance Techniques

- 38. Low-order UXO clearance techniques, where the ordnance is disposed of or rendered safe without a high-order detonation is the preferred option for clearance for this work. Examples of low-order techniques include (NPL, 2020):
 - Freezing the munition to render it inactive;
 - Water abrasive suspension cutting in order to physically disrupt the munition;
 - Disposal in a Static Detonation Chamber;
 - Photolytic destruction of the munition; and
 - Low-order deflagration.
- 39. Deflagration is a technique whereby the explosive within the UXO is rapidly burned at subsonic speeds using plasma from a small shaped charge that generates insufficient shock to detonate the UXO (Merchant and Robinson, 2020; NPL, 2020). The explosive material inside the UXO reacts with a rapid burning rather than a chain reaction that would lead to a full explosion (NPL, 2020).
- 40. Substantial noise reduction for deflagration over high-order (peak sound pressure level (SPL_{peak}) and Sound Exposure Level (SEL) are more than 20 dB lower) and acoustic output for deflagration depends only on the size of the shaped charge (rather than the size of the UXO) (NPL, 2020; Robinson *et al.*, 2020).
- 41. The technique of low-order clearance appears to present a viable option to avoid high-order explosive detonation. Low-order techniques, such as deflagration, are relatively new to civilian applications but have been used by the UK military since 2005 (Merchant and Robinson, 2020).
- 42. Currently, in the unlikely event that low-order clearance was unsuccessful or deemed unsuitable for a specific UXO (e.g. due to its condition) high-order detonation may need to be undertaken.

1.3.2.2 Bubble Curtains

- 43. Where possible, bubble curtains will be used for any high-order detonations to reduce underwater noise impacts from the explosion.



44. Bubble curtains are a flexible system of tubes fitted with special nozzle openings which can be installed on the seabed at a sufficient radius around the UXO. A specialist vessel that is designed specifically for the launch and recovery of the bubble curtain will be used and fitted with large hose reels and a number of air compressors. Compressed air will be discharged via the hose nozzles prior to and during the detonation, causing a curtain of continually rising air bubbles that surround the water column around the UXO location. This process changes the physical condition of the water column with regard to underwater acoustics and upon detonation, acoustic waves are repeatedly broken, theoretically limiting their spatial extent.
45. It is important to consider the environment that the bubble curtains will be deployed in prior to deployment, to ensure that they are effective. Key considerations are water depth, current speeds and wave height.
46. Bubble curtains can be deployed for UXO detonation under the following scenarios:
 - UXO is larger than 50kg charge weight;
 - Water depths are between approximately 5m and 40m;
 - Significant wave heights are less than 1m;
 - Maximum wind speed is less than 8m/s; and
 - Current speeds are less than 1.5 knots.
47. Once the bubble curtain is in place and prior to the bubble curtain being activated an explosive charge will be attached to, or placed next to, the UXO by a Remotely Operated Vehicle (ROV), and detonation will be undertaken remotely.
48. Once the charge has been detonated, a visual inspection survey using an ROV will be undertaken to confirm that the UXO has been successfully detonated.

1.3.2.3 Acoustic Deterrence Device (ADD)

49. An ADD will be activated prior to any UXO low-order clearance or high-order detonation to ensure marine mammals are deterred from the area and reduce the risk of any physical or auditory injury.
50. ADDs have proven to be effective mitigation for harbour porpoise, dolphin species, grey and harbour seal (Sparling *et al.*, 2015; McGarry *et al.*, 2017, 2020). ADDs have been widely used as mitigation to deter marine mammals during offshore wind farm piling and UXO clearance at sites in Europe (for example, Brandt *et al.*, 2011, 2012, 2013a,b) and offshore wind farm sites in the UK, including but not limited to, Galloper, DOW, East Anglia ONE and Moray East.
51. The type and model of ADD will be determined in the final MMMP for UXO clearance, based on the latest information and advice, and will provide sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the MZ.
52. The ADD will be tested prior to the pre-clearance search to ensure it is working correctly. If there are any technical problems with the ADD then, if required, the UXO clearance would be delayed until these issues are resolved. A back-up ADD will be present on board, in case there are issues with activation of the primary system.

53. The ADD will be deployed and ready to be activated prior to UXO clearance.
54. The ADD will be positioned within the water column to ensure that sound can be emitted in all directions. The ADD will be deployed from a vessel in close proximity to the clearance site, where it is safe to be positioned prior to the commencement of the UXO clearance.
55. The best locations to deploy the ADD, and the method to provide power to the device, will be decided through a pre-deployment survey of the vessel or vessels by the ADD operator(s), MMObs, Explosive Ordnance Disposal (EOD) supervisor and vessel operational manager. Once the best locations for the ADD have been determined, the control unit and power supply would be temporarily installed. For deployment of the ADD, the transducer part of the device will be lowered over the side of the deck to a water depth that is below the draft of the vessel to ensure the sound can be emitted in all directions and not dampened by the presence of the vessel.
56. The ADD will be activated at a time so that the end of ADD activation coincides with the end of the monitoring period, immediately prior to either the bubble curtain activation (if being used) or clearance event to allow marine mammals to move beyond the area of potential PTS risk.
57. The ADD will not be activated during transit to another clearance event and will be activated prior to all clearance events.
58. After the ADD has been activated for the required duration, the ADD operator will deactivate and recover the ADD and undertake routine checks to ensure it is still working correctly, ready for the next deployment and activation.
59. The ADD activation times for low-order clearance, high-order detonation with bubble curtain and high-order detonation without bubble curtain will be determined based on the maximum potential area for PTS.

1.3.2.4 Monitoring Area

60. The MA is the area which a pre-detonation search will be undertaken by trained, dedicated and experienced MMObs. The MA, based on current guidance (JNCC, 2010a) and the distance over which MMObs can undertake effective observations, will have a radius of 1km from the UXO location.
61. The 1km radius of the MA will be measured out from the UXO detonation site with a 360° coverage, representing an area of 3.14km².
62. The MA will be monitored for a minimum of 1 hour prior to UXO clearance.

1.3.2.5 Marine Mammal Observers

63. Marine mammal observations will be undertaken by JNCC accredited MMObs. This may be subcontractors or assigned installation vessel crew members that have undertaken the JNCC MMOb course and will be available as dedicated and experienced MMObs, when required, taking into account their other duties.
64. 'Dedicated' is defined as a trained MMOb with the sole purpose of undertaking visual observations to detect marine mammals.

65. 'Experienced' is defined as minimum of 20 weeks experience of implementing JNCC guidelines in UK water within the previous five years.
66. At least two MMObs will conduct surveys to cover the entire MA. Marine mammal observations will be carried out from vantage points to allow unobstructed observations of the entire MA.
67. The MMObs will be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with reticles and reporting forms. The MMObs will scan the MA with the unaided eye and use binoculars when needed to look in detail at an area where a possible sighting has been made. Binoculars should not be used continually as they restrict peripheral vision and views close to the vessel.
68. Marine mammal observations will be carried out to monitor the MA before, during and after UXO clearance.
69. The pre-clearance search will commence prior to all clearance events, or after any break in the clearance event, and at the end of a clearance event. The visual observations by the MMObs will commence at least one hour prior to the clearance event. This will continue until one hour has passed and no marine mammals have been detected within the MA, the MMObs will then advise that the UXO clearance can commence. The ADD will be activated during the monitoring period at a time so that the end of ADD activation coincides with the end of the monitoring period prior to the UXO clearance.
70. If a marine mammal is detected within the MA during the pre-clearance search, then the commencement of the UXO clearance procedure will be delayed. If a marine mammal has been sighted within the MA, it will be monitored and tracked until it is clear of the MA and the EOD team notified. The marine mammal(s) must be clear of the MA for at least 30 minutes before the UXO clearance commences.
71. During ADD activation, if animals are sighted within the MA, they will be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the MA, then the clearance event will be delayed, and the full mitigation procedure, including the pre-clearance search, will be undertaken again.
72. If the marine mammal(s) remains clear of the MA for at least 30 minutes and the one hour pre-search has been completed, and the required ADD activation time has been completed, then the UXO clearance can commence. A precautionary approach will always be used. Therefore, if the MMObs cannot be sure whether a marine mammal is within the MA or not, then the UXO clearance will be delayed accordingly until the MMObs are sure that there are no marine mammals present within the MA.
73. All MMObs must be a safe distance from the clearance site prior to any UXO clearance.
74. The MMObs will continue observations during ADD activation, bubble curtain activation (if required) and all UXO clearances.
75. Marine mammal observations will be carried out to monitor the MA during:
 - The pre-detonation search;
 - ADD activation;
 - Bubble curtain activation (if it is required);

- UXO clearance; and
- The post-detonation search.

76. The MMObs will record all periods of marine mammal observations, including start and finish time of pre-detonation searches, ADD activation, bubble curtain activation (if required), and conditions during observations (e.g. sea state, visibility, weather, etc.). Any sightings of marine mammals around the vessel(s) will also be recorded. The MMObs will complete the relevant marine mammal recording form(s) and reporting (see **Section 1.3.3**).

77. There will be clear communication channels between the MMObs, the ADD operator and the EOD team (see **Section 1.3.4**). The communication procedures will be established and agreed prior to any UXO clearance with regards to the communication of any marine mammals observed within the MA, the deployment of ADD, and when the MA is clear for the UXO clearance to commence.

1.3.2.6 Passive Acoustic Monitoring

78. The use of PAM is unlikely to be required, as all clearances will take place in daylight and in favourable conditions with good visibility (sea state 3 or less).

79. If required, the use of PAM will be undertaken by trained, dedicated and experienced PAM Operators (PAM-Ops). PAM-Ops will be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment will be appropriate to detect vocalising cetaceans in the MA. PAM-Ops will be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all UXO clearance.

1.3.3 Reporting

80. Reports detailing all UXO clearance activity and mitigation measures will be prepared. This will include, but not necessarily be limited to:

- A record of UXO clearance operations detailing date, location and times including information on the clearance methods and size of charges used.
- A record of mitigation measures such as ADD deployment, including the date, location, times, any operational issues, start and end times of watches by MMObs, start and end times of any acoustic monitoring using PAM, and details of all explosive activity during the relevant watches.
- A record of all occasions when UXO detonation occurred, including details of the activities used to ensure the MZ is established and any occasions when activity was delayed or stopped due to presence of marine mammals.
- Any relevant details on the efficiency of the marine mammal exclusion methodology.
- A record of marine mammal observations, conditions, description of any marine mammal sightings and any actions taken.
- Details of any problems encountered including any instances of non-compliance with the agreed mitigation protocol.

81. A final report will be submitted to the MMO. The final report will include any data collected during UXO clearance operations, details of all mitigation measures, a detailed description of any technical problems encountered and what, if any, actions were taken. The report will also discuss the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future projects.

1.3.4 Communication and Responsibilities

82. The final MMMP will detail the communication protocol to ensure that all marine mammal mitigation measures are successfully undertaken for all UXO clearance operations.
83. The final MMMP will also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken. This will be developed based on the mitigation measures and personnel required (e.g. ADD operator, MMOb, PAM-Ops, EOD team / UXO Manager, Environmental Liaison Officer (ELO)) with the titles and responsibilities being refined depending on the contractual agreement.

1.4 Piling

84. Depending on the installation method for the installation of the foundations for the wind turbines and OSP(s), impact piling could be required.
85. The purpose of this draft MMMP is to demonstrate the principles of the final MMMP for piling that could be required at SEP and DEP.
86. This draft MMMP for piling outlines the proposed mitigation to reduce the likelihood of any injury, including any PTS, to marine mammals during all piling operations at SEP and DEP.
87. The final MMMP for piling will be developed in the pre-construction period, when there is more detailed information on the SEP and DEP design and will incorporate the most appropriate mitigation measures based upon the latest and best available information and proven methodologies at that time. The final MMMP will be developed in consultation with the MMO, relevant SNCBs and TWT.
88. The final MMMP will include details of the embedded mitigation, such as the soft-start and ramp-up, as well as details of the MZ and any additional mitigation measures required to minimise potential impacts of any physical injury or PTS. Consideration will be given to the requirements following any breaks in piling as well as prior to piling commencing.
89. The Applicant is committed to using the best practicable means at the time to mitigate the potential impacts of SEP and DEP.
90. The mitigation in the final MMMP will be based on current best practice, guidance and information, including updated underwater noise modelling, if required, and will be updated no later than six months prior to piling operations.
91. The aim of the MMMP for piling is to reduce the risk of PTS during piling for either wind turbine or OSP foundations from:
 - First strike of the starting hammer energy of the soft start.
 - Single strike of the maximum hammer energy.
 - Cumulative exposure during installation, based on worst-case for two monopiles installed sequentially in the same 24 hour period or four OSP pin-piles installed sequentially in the same 24 hour period.
92. Underwater noise modelling will be used to derive the maximum potential PTS ranges.

1.4.1 Mitigation

93. The final MMMP would involve the establishment of a MZ around the pile location before each pile driving activity, based on the maximum predicted distance for PTS. The final MMMP for piling will provide details of the maximum predicted impact (PTS) ranges and areas for piling.
94. The Applicant will ensure that the mitigation measures are adequate to minimise the risk of marine mammals being present within the MZ prior to piling activity commencing, to reduce the risk of any physical or auditory injury (PTS).

95. The methods for establishing the MZ and reducing the potential impacts of piling operations would be agreed with the MMO in consultation with the relevant SNCBs and TWT and would be secured as commitments within the final MMMP.
96. The piling mitigation measures could include:
 - Establishment of a MA with a minimum 500m radius (see [Section 1.4.1.1](#)).
 - The observation of the MA will be conducted by trained, dedicated and experienced MMObs during daylight hours and when conditions allow suitable visibility (visibility of entire MA; sea state 3 or less).
 - Deployment of PAM devices in the MA during poor visibility or at night.
 - The activation of ADD (see [Section 1.4.1.4](#)).
 - Soft-start and ramp-up (see [Section 1.4.1.5](#)).
 - Procedure for breaks in piling (see [Section 1.4.1.6](#)).

1.4.1.1 Monitoring Area

97. The MMMP will involve the establishment of a MA with a minimum radius of 500m around each wind turbine location and OSP location before piling at SEP and DEP.
98. The radius of the MA will be greater than the maximum predicted impact range for PTS for marine mammal species that could be present in or around the SEP and DEP wind farm sites.
99. The requirement for a minimum radius of 500m is in line with the current JNCC (2010b) guidelines, to reduce the risk of PTS.
100. The MA will be monitored for a minimum of 30 minutes prior to soft-start commencing.

1.4.1.2 Marine Mammal Observers

101. Marine mammal observations will be undertaken by JNCC accredited MMObs. This may be subcontractors or assigned installation vessel crew members that have undertaken the JNCC MMOb course and will be available as dedicated and experienced MMObs, when required, taking into account their other duties.
102. 'Dedicated' is defined as a trained MMOb with the sole purpose of undertaking visual observations to detect marine mammals.
103. 'Experienced' is defined as minimum of 20 weeks experience of implementing JNCC guidelines in UK water within the previous five years.
104. At least two MMObs will conduct surveys to cover the entire MA around each pile location. Marine mammal observations will be carried out from vantage points to allow unobstructed observations of the entire MA.
105. The MMObs will be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with reticles and reporting forms. The MMObs will scan the MA with the unaided eye and use binoculars when needed to look in detail at an area where a possible sighting has been made. Binoculars should not be used continually as they restrict peripheral vision and views close to the vessel.
106. Marine mammal observations will be carried out to monitor the MA:

- During ADD activation
 - During the soft-start and ramp-up procedure
 - During any breaks in piling prior to piling recommencing
107. Where possible, MMObs will continue monitoring during piling to allow for any breaks in piling.
108. The pre-piling monitoring will commence prior to all piling events, or after any break in piling. The visual observations by the MMObs will commence at least 30 minutes prior to the soft-start commencing. This will continue until 30 minutes have passed and no marine mammals have been detected within the MA, the MMObs will then advise that the soft-start can commence. The ADD will be activated during the monitoring period at a time so that the end of ADD activation coincides with the end of the monitoring period prior to the soft-start.
109. If a marine mammal is detected within the MA during the pre-piling monitoring, then the commencement of the soft-start will be delayed. If a marine mammal has been sighted within the MA, it will be monitored and tracked until it is clear of the MA and the Piling Supervisor notified. The marine mammal(s) must be clear of the MA for at least 30 minutes before the soft-start commences.
110. During ADD activation, if animals are sighted within the MA, they will be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the MA, then the soft-start will be delayed, and the full mitigation procedure, including the pre-monitoring, will be undertaken again.
111. If the marine mammal(s) remains clear of the MA for at least 30 minutes and the pre-piling monitoring has been completed, and the required ADD activation time has been completed, then the soft-start can commence. A precautionary approach will always be used. Therefore, if the MMObs cannot be sure whether a marine mammal is within the MA or not, then the soft-start will be delayed accordingly until the MMObs are sure that there are no marine mammals present within the MA.
112. The MMObs will record all periods of marine mammal observations, including start and finish time of observations, when soft-start and piling commenced and conditions during observations (e.g. sea state, visibility, weather, etc.). Any sightings of marine mammals around the piling vessel will also be recorded. The MMObs will complete the relevant marine mammal recording form(s) and reporting (see [Section 1.4.2](#)).
113. There will be clear communication channels between the MMObs, the ADD operator and the Piling Supervisor (see [Section 1.4.3](#)). The communication procedures will be established and agreed prior to any piling to ensure clear communication of any marine mammal observations within the MA, the deployment of ADD, and when the MA is clear for the piling soft-start to commence.

1.4.1.3 Passive Acoustic Monitoring

114. The use of PAM will be undertaken by trained, dedicated and experienced PAM-Ops during periods of poor visibility and darkness prior to piling.

115. PAM-Ops will be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment will be appropriate to detect vocalising cetaceans in the MA. PAM-Ops will be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all piling activities.
116. The PAM-Ops will ensure that the equipment and spares are functioning correctly prior to the start of the mitigation. Hydrophones and software should be configured to detect the species relevant to the area (including harbour porpoise and dolphin species). If the PAM equipment is to be deployed from the deck of the piling vessel, a survey of the piling vessel will be conducted, prior to when deployment may be needed, to agree the best locations for deployment and monitoring. PAM-Ops will assist in preparation and update of risk assessment for hydrophone deployment in collaboration with vessel personnel.
117. If required, PAM will be carried out to monitor the MA:
 - During pre-piling monitoring period
 - During ADD activation
 - During the soft-start and ramp-up procedure
 - During any breaks in piling prior to piling recommencing
118. Where possible, PAM will continue monitoring during piling to allow for any breaks in piling.
119. The PAM-Ops will record and report all periods of PAM, including start and finish time of monitoring, if and when marine mammals were detected, especially in relation to when ADDs were activated and, when soft-start, ramp-up and piling was underway. The PAM-Ops will provide the necessary data and information to be included in the reporting (see [Section 1.4.2](#)).
120. There will be clear communication channels between the PAM-Ops, MMObs, the ADD operator and the Piling Supervisor (see [Section 1.4.3](#)).

1.4.1.4 Acoustic Deterrent Device (ADD)

121. An ADD will be activated prior to the soft start as mitigation to reduce the risk of PTS during piling.
122. The type and model of ADD will be determined in the final MMMP for piling, based on the latest information and advice, and will provide sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the MZ.
123. The ADD will be tested prior to the pre-piling monitoring to ensure it is working correctly. If there are any technical problems with the ADD then, if required, the soft-start would be delayed until these issues are resolved. A back-up ADD will be present on board, in case there are issues with activation of the primary system.
124. The ADD will be deployed and ready to be activated prior to soft-start commencing.
125. The ADD will be positioned within the water column to ensure that sound can be emitted in all directions. The ADD will be deployed from the piling vessel in close proximity to the piling location, where it is safe to be positioned prior to the commencement of the soft-start.

126. For deployment of the ADD, the transducer part of the device will be lowered over the side of the deck to a water depth that is below the draft of the vessel to ensure the sound can be emitted in all directions and not dampened by the presence of the vessel. The depth for the ADD deployment will be predetermined to ensure it is below the draft of the vessel, and well above the sea bed (preferably in the middle of the water column) at the piling location.
127. The ADD will be activated at a time so that the end of ADD activation coincides with the end of the monitoring period, immediately prior to soft-start commencing to allow marine mammals to move beyond the area of potential PTS risk.
128. The duration of the ADD activation time will be determined based on the maximum range for PTS. The maximum duration of the ADD activation time will also be determined to reduce risk of increased disturbance.
129. Further information on ADDs is provided in [Section 1.3.2.3](#).
130. The MA will be monitored by MMObs and / or PAM-Ops during the ADD activation period. Once the soft-start proceeds, the ADD will be switched off.
131. The procedures for ADD activation for breaks in piling is outlined in [Section 1.4.1.6](#). ADD will not be operated intermittently during any breaks in piling.
132. The ADD will be deployed from the deck of the piling vessel, with the control unit and power supply on board the piling vessel in suitable positions on deck. Prior to deployment, a survey of the piling vessel will be conducted to agree the best location and method of providing power supply and communications. ADD equipment will have sufficient cable from the power point on the vessel to be deployed in the mid-water column.
133. The ADD operator will maintain a detailed record of all ADD deployments and activation. These reports will include a record of all ADD start and stop times, a record of each verification of ADD activation and a record of any issues with ADD deployment and activation.

1.4.1.5 Soft-Start and Ramp-Up

134. Following the activation period of the ADD, the soft-start procedure will commence. The soft-start starting hammer energy will be the lowest possible starting hammer energy.
135. A ramp-up period will follow the soft-start, with the energy used per hammer blow gradually increasing so that if any marine mammals are in the area, despite the pre-piling activation of the ADD, they are encouraged to leave by the initial low levels of underwater noise prior to the noise reaching levels which could cause PTS.
136. The Applicant would ensure that a soft-start and ramp-up procedure for piling is conducted for a minimum of 30 minutes.
137. It is proposed that each piling event would commence with a minimum of 10 minutes at 10% of the maximum hammer energy, followed by a gradual ramp-up for at least 20 minutes up to 80% of the maximum hammer energy for all pile driving activities.
138. This 30 minute soft start and ramp-up procedure is more precautionary than the current JNCC (2010b) guidance, which recommends that the soft-start and ramp-up duration should be a period of not less than 20 minutes.

139. During the 30 minutes for the soft-start and ramp-up it is estimated that marine mammals would move at least 2.7km from the piling location. This would be greater than the maximum predicted distance for PTS from a single strike at the maximum hammer energy:
- During the 10 minute soft-start it is estimated that marine mammals would move a minimum of 0.9km from the piling (based upon a precautionary marine mammal swimming speed of 1.5m/s (Otani *et al.* 2000)); and
 - During the 20 minute ramp-up it is estimated that marine mammals would move a minimum of 1.8km from the piling location (based upon a precautionary average marine mammal swimming speed of 1.5m/s (Otani *et al.* 2000)).
140. In the event that piling activity is stopped for more than 10 minutes, the Applicant would ensure that the soft-start and ramp-up procedure is conducted prior to piling re-commencing.
141. The soft-start and ramp-up procedure would be embedded mitigation for all piling operations.

1.4.1.6 Breaks in Piling

142. For any breaks in piling the following mitigation is proposed, depending on the duration of the break:
- For any breaks in piling of less than 10 minutes, piling may continue as required (i.e. as if there was no break).
 - For any breaks in piling of more than 10 minutes then the full mitigation procedure (as outlined above) is required, including 30 minute monitoring of the MA by MMObs and / or PAM, ADD deployment and activation for the required time, followed by the soft-start and ramp-up procedure (for a minimum of 20 minutes).
 - Monitoring of the MA during any breaks in piling will be conducted by MMObs during daylight hours and suitable visibility or by PAM-Ops during poor visibility or at night.
 - If monitoring was conducted during piling prior to any breaks and the MA has been confirmed as having no marine mammals, then it may be possible to commence the soft-start immediately. The soft-start and ramp-up procedure would be for a minimum of 20 minutes as outlined in the JNCC guidance.

1.4.1.7 Piling at Night / Poor Visibility

143. If piling is to commence in poor visibility or at night, the monitoring of the MA will be done by PAM as outlined in [Section 1.4.1.3](#).
144. The deployment and activation of the ADD in poor visibility and at night will follow the same procedure as outlined in [Section 1.4.1.4](#), as will the soft-start and ramp-up procedure as outlined in [Section 1.4.1.5](#).
145. If there are any breaks in piling during poor visibility or at night, monitoring of the MA will be done by PAM.

1.4.2 Reporting

146. Reports detailing the piling activity and mitigation measures would be prepared for all piling activity. This would include, but not necessarily be limited to:
- A record of piling operations detailing date, location, times (including soft-starts and ramp-up) and any technical or other issues for each pile.
 - A record of mitigation measures such as ADD deployment and activation, detailing date, location, times and any operational issues.
 - A record of all occasions when piling occurred, including details of the activities used to ensure the MZ is established and any occasions when piling activity was delayed or stopped due to presence of marine mammals.
 - Any relevant details on the efficiency of the marine mammal exclusion methodology.
 - A record of marine mammal observations, conditions, description of any marine mammal sightings and any actions taken.
 - Details of any problems encountered during the piling process including instances of non-compliance with the agreed piling and / or mitigation protocol.
147. The reporting schedule is to be agreed with the MMO post-consent and may include weekly reports and a final report. Any final report would include information, such as data collected during piling operations, details of ADD deployment and / or other mitigation measures, a detailed description of any technical problems encountered and what, if any, actions were taken. The report would also discuss the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future construction projects.

1.4.3 Communication and Responsibilities

148. The final MMMP for piling will detail the communication protocol to ensure that all marine mammal mitigation measures, including any delays in commencing piling due to marine mammals being present in the area, are successfully undertaken for all piling activity.
149. The final MMMP for piling will also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken for all piling activity. This will be developed based on the mitigation measures and personnel required (e.g. ADD operators, MMOs, PAM operators, ELO, Piling Supervisor / Offshore Installation Manager) with the titles and responsibilities being refined depending on the contractual agreement.



1.5 References

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Annex 1: Vessel Good Practice and Code of Conduct to Avoid Marine Mammal Collisions

1. Embedded mitigation to reduce vessel collision risk with marine mammals includes that vessel movements, where possible, will follow set vessel routes and hence areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. All vessel movements will be kept to the minimum number that is required to reduce any potential collision risk
2. Operators of all vessels will be made aware of the risk and measures to avoid marine mammal collisions during mobilisation briefings. In order to reduce the risk of collisions, meetings will be undertaken with all vessel operators to promote collision awareness and avoidance, including code of conduct.
3. Code of conduct for vessel operators will be produced and issued to reduce the risk of collision with marine mammals across all phases of the Projects.
4. The code of conduct for good practice will be developed prior to construction based on the latest information and guidance.
5. The code of conduct for good practice to avoid marine mammal collisions with vessels will include, but not be limited to:
 - Avoid deliberately approaching marine mammals when sighted.
 - Avoid abrupt changes to course or speed should marine mammals approach the vessel or bow-ride.
 - Where possible, vessels will maintain a steady speed, and direction, to allow any marine mammal to predict where the vessel may be headed, and to move out of the way or avoid surfacing in the path of the vessel.
 - An agreed minimum distance from seal haul-out sites, particularly during sensitive periods such as pupping and moulting.
 - Protocol to report any collisions.