

**RWE Renewables UK Dogger Bank
South (West) Limited**

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South (East) Limited**

Dogger Bank South Offshore Wind Farms

**Outline Marine Mammal Mitigation Protocol (Revision 2)
(Clean)**

Volume 8

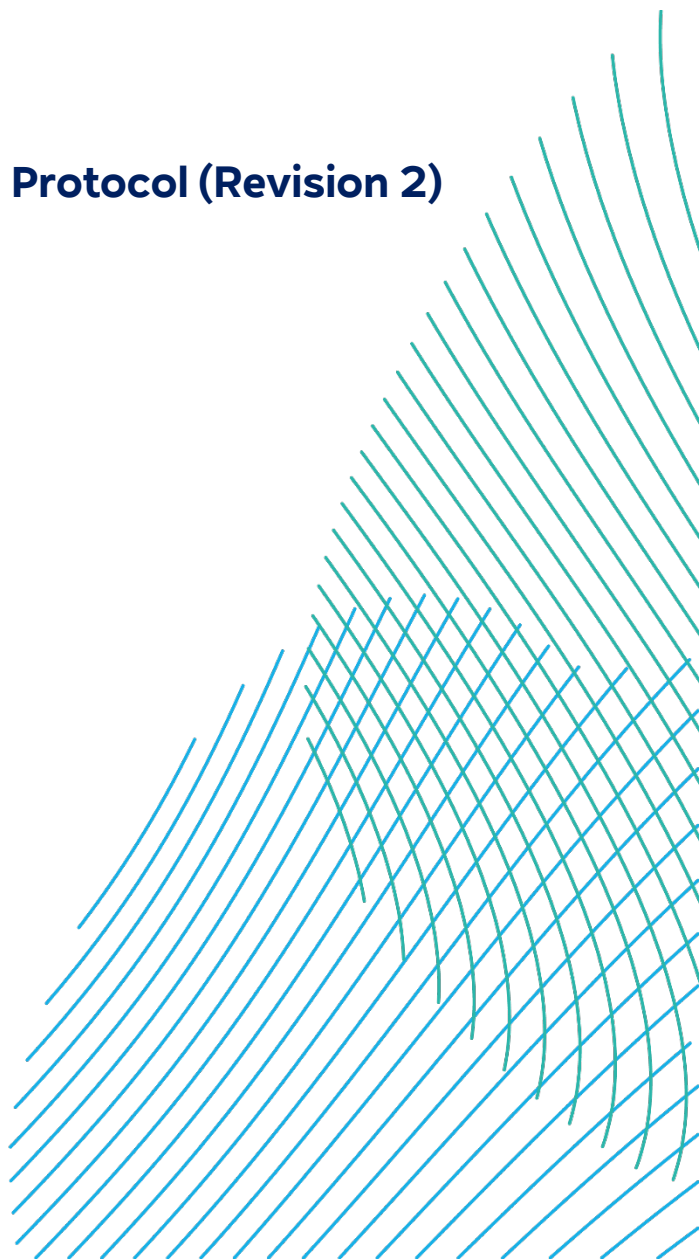
November 2024

Application Reference: 8.25

APFP Regulation: 5(2)(q)

Revision: 02

Unrestricted



Company:	RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited	Asset:	Development
Project:	Dogger Bank South Offshore Wind Farms	Sub Project/Package:	Consents
Document Title or Description:	Outline Marine Mammal Mitigation Protocol (Revision 2) (Clean)		
Document Number:	004300182-02	Contractor Reference Number:	PC2340-RHD-OF-ZZ-RP-Z-0132

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Rev No.	Date	Status/Reason for Issue	Author	Checked by	Approved by
01	June 2024	Final for DCO Application	RHDHV	RWE	RWE
02	November 2024	Update following receipt of relevant representations	RHDHV	RWE	RWE

Revision Change Log			
Rev No.	Page	Section	Description
01	N/A	N/A	Submitted for DCO Application
02	N/A	N/A	Updates have been made because of Marine Management Organisation (MMO) and Natural England Relevant Representations.
02	7-11	N/A	Minor amendments to glossary and acronym tables.
02	34	3.1.1	Minor text amendments.
02	35-36	3.1.2	Added in text to clarify a pre-piling search is required prior to ADD activation in response to NE RR-039: F 22.
02	36	3.1.3	Added in JNCC PAM reference in response to RR-039: F23.
02	39	3.1.5	Minor text amendments.
02	40	3.1.6	Minor text amendments.
02	41 - 42	3.1.9	Added in more details on types of NAS that could be used in response to MMO RR-030: 4.17.1; and Natural England RR-039: F3; RR-039: F11; RR-039: F18; RR-039: F22; RR-039: F24; RR-039: F25; RR-039: F33 and RR-039: Annex F1.4

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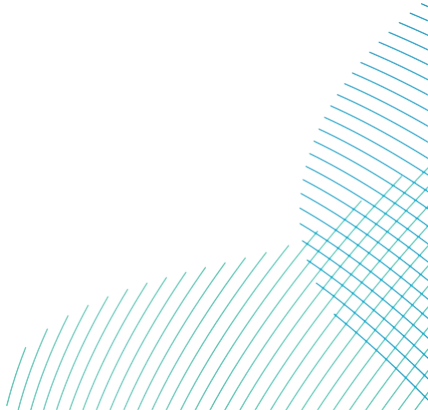
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Glossary

Term	Definition
ADD operator	A trained member of the team who will operate the Acoustic Deterrent Device (ADD)
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables would be located. The Array Areas do not include the Offshore Export Cable Corridor or that part of the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Array cables	Offshore cables which link the wind turbine generators to the Offshore Converter Platform(s).
Astronomical tide	The predicted tide levels and character that would result from the gravitational effects of the earth, sun, and moon without any atmospheric influences.
Collision	The act or process of colliding (crashing) between two moving objects.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the value, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Impact	Used to describe a change resulting from an activity via the Projects, i.e. increased suspended sediments / increased noise.
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Landfall	The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the Onshore Export Cables at the Transition Joint Bay (TJB) above mean high water.

Term	Definition
Marine Mammal Observers (MMObs)	Trained members of the team who will observe the Monitoring Area.
Mean Sea Level	The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events.
Mitigation Zone (MZ)	The area around each pile location in which it is predicted physical or permanent auditory injury is possible.
Monitoring Area (MA)	The area around each pile location to be monitored in the pre-piling watch, and where possible during any breaks in piling or soft-start by either Marine Mammal Observers (MMObs) or Passive Acoustic Monitoring Operator (PAM-Op).
Offshore Converter Platform (OCP)	The OCPs are fixed structures located within the Array Areas that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the Offshore Export Cables to the Project's Onshore Grid Connection Points.
PAM operators	A trained member of the team who will use the PAM station to undertake acoustic monitoring of the Monitoring Area.
Passive Acoustic Monitoring (PAM)	Use of acoustic sensors to monitor the presence of marine mammals in the Monitoring Area.
Pre-piling watch	The period prior to piling commencing during which observations are undertaken visually by the MMObs or acoustically by the PAM-Op of the Monitoring Area to determine if marine mammals are present in the Monitoring Area.
Ramp-up	Ramp-up forms the second part of the soft-start procedure and follows on from the low-energy blows.
Scour protection	Protective materials to avoid sediment erosion from the base of the wind turbine foundations and offshore platform foundations due to water flow.
Soft-start	The procedure used to commence piling at a lower hammer energy.

Term	Definition
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

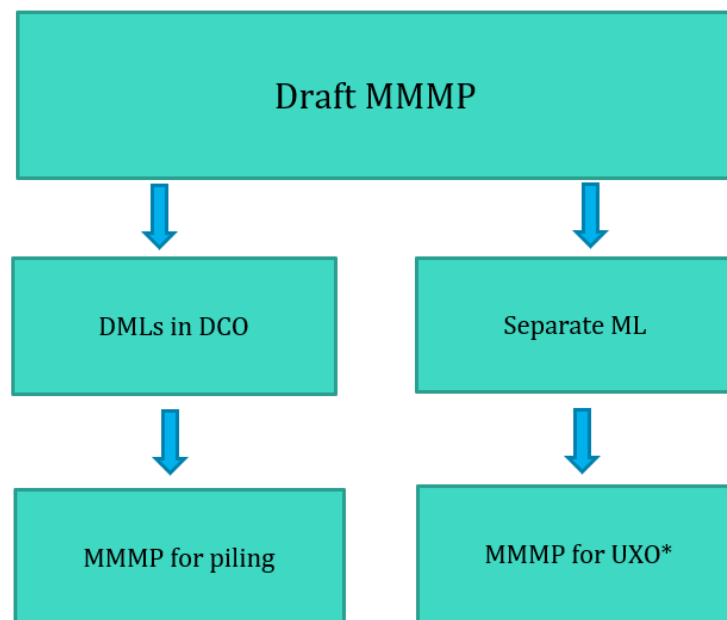
Term	Definition
ADD	Acoustic Deterrent Device
dB	Decibel
DBS	Dogger Bank South
DCO	Development Consent Order
DML	Deemed Marine Licence
ELO	Environmental Liaison Officer
EOD	Explosive Ordnance Disposal
ES	Environmental Statement
ESP	Electrical Switching Platform
ETG	Expert Topic Group
JNCC	Joint Nature and Conservation Committee
kg	Kilogram
kJ	Kilojoules
km	Kilometre
km ²	Kilometre squared
kV	Kilovolt
LAT	Lowest Astronomical Tide
m	Metre
m/s	Metres per second
MA	Monitoring Area
MMMP	Marine Mammal Mitigation Protocol

Term	Definition
MMO	Marine Management Organisation
MMObs	Marine Mammal Observers
MW	Megawatt
MZ	Mitigation Zone
NAS	Noise Abatement Systems
NPL	National Physical Laboratory
OCP	Offshore Converter Platform
PAM	Passive Acoustic Monitoring
PAM-Ops	Passive Acoustic Monitoring Operators
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PTS	Permanent Threshold Shift
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SEL _{cum}	Cumulative Sound Exposure Level
SIP	Site Integrity Plan
SNCB	Statutory Nature Conservation Body
SNS	Southern North Sea
SPL	Sound Pressure Level
SPL _{peak}	Peak Sound Pressure Level
TTS	Temporary Threshold Shift

Term	Definition
UK	United Kingdom
UXO	Unexploded Ordnance

1 Purpose of this Document

1. The purpose of this Outline 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 Dogger Bank South (DBS) East and the DBS West Offshore Wind Farms (hereafter referred to as ‘the Projects’).
2. Both unexploded ordnance (UXO) clearance and piling have the potential to produce underwater noise capable of causing auditory injury to marine mammals. This Outline MMMP details how the Applicants 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 Projects.
3. It should be noted that, pre-construction, a separate Marine Licence (ML) 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 Outline MMMP for information purposes only, consistent with Natural England’s advice that the DCO application includes an assessment of potential UXO clearance.
4. **Plate 1-1** sets out how the MMMPs for piling and UXO will be secured.



**To be obtained post consent*

Plate 1-1 Relationship between the draft and final MMMPs for piling and UXO and how that will be secured

5. As such, separate MMMPs for piling and UXO clearance would be developed for the Projects 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) and Statutory Nature Conservation Bodies (SNCBs).
6. This Outline MMMP also outlines how the Deemed Marine Licence (DML) conditions will be met, which are detailed below (**Volume 3, Draft DCO (application ref: 3.1)**):

“15. — (1) 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 consultation with Trinity House, the MCA and UKHO as appropriate — [...] (g) in the event that driven or part-driven pile foundations are proposed to be used, a marine mammal mitigation protocol (in accordance with the outline 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”.
7. This Outline MMMP for UXO clearance and piling sets out the protocol of how the Projects 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 conditions stated above.
8. 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.

9. The final MMMPs 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, 2010a¹), statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b) and JNCC guidance for the use of Passive Acoustic Monitoring in UK waters for minimising the risk of injury to marine mammals from offshore activities (JNCC, 2023a).
10. Following Natural England's request in response to the Preliminary Environmental Information Report (PEIR), Annex 1: Vessel Good Practice to Avoid Marine Mammal Collisions of this document provides further information on the proposed good practice and code of conduct that would be followed by vessel operators to reduce any risk of collisions with marine mammals which would be included in the final Project Environmental Management Plan (PEMP) and is included in the **Volume 8, Outline PEMP (application ref: 8.21)**.
11. In addition to the Outline MMMP, **Volume 8, In Principle Site Integrity Plan (SIP) (application ref: 8.26)** has been submitted with the DCO application. The SIP sets out the approach for delivery of the required mitigation measures for the Projects to ensure the avoidance of Adverse Effect on Integrity of the SNS SAC in-combination with other plans and projects.
12. A Marine Wildlife Licence application would be made to the Marine Management Organisation (MMO) for all activities that have the potential for injury or disturbance on European Protected Species (EPS; cetaceans). The activities that may require an EPS licence include piling and UXO clearance and separate applications would be submitted as required.

1.1 Description of DBS East and DBS West

13. The Applicants are seeking a DCO for the DBS East and DBS West Offshore Wind Farms. The Projects are located in the Dogger Bank region of the southern North Sea, with the closest point to the coast being 100 kilometres (km) from DBS West and 122km from DBS East.

¹ The draft JNCC guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment (October 2023) is currently out for consultation and measures will be updated accordingly once the requirements are finalised.

14. The Projects' Array Areas for the application cover approximately 349 kilometre squared (km²) DBS East and 335km² for DBS West. This equates to a combined array application area of 704km².
15. The minimum and maximum water depths within the Array Areas at the time of the site-specific geophysical survey ranged from approximately 11m to 40m below the lowest astronomical tide (LAT)) (**Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**).
16. Once built, the Projects would comprise the following offshore components:
 - The offshore wind turbines and their associated foundations;
 - Scour protection around foundations and sub-sea cables as required;
 - Up to eight offshore platforms supporting required electrical equipment, possibly also incorporating offshore facilities; and
 - Subsea cables comprising:
 - Array cables between the turbines and OCPs;
 - Inter-platform cables; and
 - Export cables between the OCPs and landfall.
17. The detailed design of the Projects (e.g. numbers of wind turbines, layout configuration, foundation type and requirement for scour protection) would be determined post-consent. Therefore, the key parameters presented in **Table 1-1** are indicative based on current information and assumptions. These parameters have formed the worst case scenario for the underwater noise assessment as presented in **Volume 7, Chapter 11 Marine Mammal Ecology (application ref: 7.11)**.
18. The earliest any offshore construction works would start is assumed to be 2026.
19. Offshore construction works would require up to seven years (excluding pre-construction activities such as surveys) if both Projects are constructed sequentially (worst case scenario). It should be noted that the construction programme is dependent on numerous factors including consent timeframes and funding mechanisms.

1.1.1 Key Relevant Parameters

20. **Table 1-1** shows the key design parameters for the Projects that are relevant to the Outline MMMP.

Table 1-1 Key Relevant Parameters

Parameter	Details		
	DBS East	DBS West	Combined
Approximate offshore construction duration (years)	5	5	5 (7 years if sequential build)
Application area for Array Area (excluding offshore temporary works area) (km ²)	349	335	704
Maximum length of export cable to landfall (per cable) (km)	188 per cable	153 per cable	N/A
Maximum export cable length (km) for all cables	376	306	682
Maximum number of export cables and trenches	2	2	4
Array Area water depth range (m)	10.68-35.16	12.88-38.16	10.68 - 38.16
Distance from Array Area to coast (closest point) (km)	127	105	N/A
Number of wind turbines ²	57-100	57-100	113-200
Number of Platforms	4 (ESP may be located in the export cable corridor or Array Area)	4 (ESP may be located in the export cable corridor or Array Area)	8 (ESP may be located in the export cable corridor or a single Array Area)

² In situations where a number does not divide equally between DBS East and DBS West (e.g. 113 turbines), rounded up to higher number (e.g. 57 31.5MW turbines as opposed to 56.5).

Parameter	Details		
	DBS East	DBS West	Combined
Wind turbine foundation type options	Steel monopile, piled jacket		
OCP foundation type options	Steel monopile, piled jacket, suction bucket jacket, gravity based foundation		
Number of piles per foundation for wind turbines	57-100 (maximum number of legs for pin piles is 4 per foundation, so total maximum number of legs is 228-400)	57-100 (maximum number of legs for pin piles is 4 per foundation, so total maximum number of legs is 228-400)	113-200 (maximum number of legs for pin piles is 4 per foundation, so total maximum number of legs is 452-800)
Maximum number of piles for platforms	4 for monopiles/ 32 for pin-pile jackets	4 for monopiles/ 32 for pin-pile jackets	8 for monopiles/ 64 for pin-pile jackets
Hammer energies (kilojoules) (kJ)	6,000kJ for monopiles/ 3,000kJ for pin pile jackets	6,000kJ for monopiles/ 3,000kJ for pin pile jackets	N/A
Maximum pile diameter (m)	11 for small turbine/ 15 for large turbine	11 for small turbine/ 15 for large turbine	N/A

1.2 Consultation

21. The draft of the Outline MMMP has been provided to the Marine Mammal Expert Topic Group (ETG) pre-consent in order to gain feedback through consultation. This was a request from Natural England made through the PEIR consultation comments.
22. During consultation on the PEIR and ETG meetings, comments relevant to the MMMP were received and the Applicants' responses are provided in **Table 1-2**.

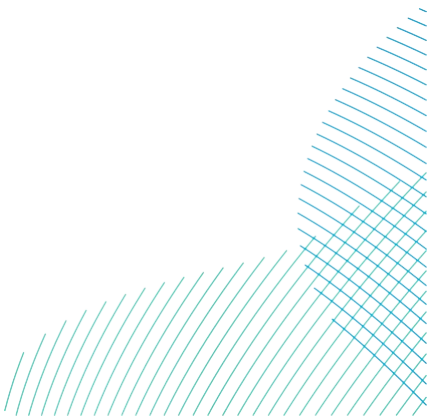
Table 1-2 Pre-Application Consultation Comments Received on the PEIR Regarding the MMMP

Consultee	Date / Document	Comment Received	Project Response
Orsted	15/07/2023 – PEIR Responses	Orsted will want to be consulted on the Marine Mammal Mitigation Protocol (MMMP) for piling and UXO and the respective SIPs.	Orsted would be provided with a copy of the final MMMP for piling and UXO and advised once the SIPs are available for their information.
Marine Management Organisation (MMO)	15/07/2023 – PEIR Responses	MMO comment that a MMMP for piling will be developed in the pre-construction period and based upon best available information, methodologies, industry best practice, latest scientific understanding, current guidance and detailed project design. The MMMP for piling will be developed in consultation with the relevant Statutory Nature Conservation Bodies (SNCBs) and the MMO, detailing the proposed mitigation to reduce the risk of any physical or Permanent Threshold Shift (PTS) to marine mammals during all piling operations. This will include details of the embedded mitigation, for the soft-start and ramp-up, as well as details of the proposed mitigation zone and any additional mitigation measures required in order to minimise potential impacts of any physical or PTS. A Draft MMMP will be submitted with the DCO application and the MMO welcomes early engagement of this document.	Acknowledged.
		The PTS and Temporary Threshold Shift (TTS) predictions for a 7,000 kJ hammer energy indicate that the standard mitigation measures which are typically employed for offshore wind farm developments (such as a monitoring zone, soft-start piling and Acoustic Deterrent devices (ADDs)) will not suffice. Given the availability of effective alternatives to unmitigated piling – i.e. measures to reduce noise at source, also known as noise abatement – it will be difficult for unmitigated pile driving to be justified on the basis that there are no realistic alternatives. It is therefore clear that noise abatement measures will be required for this development, in order to reduce the risk of potential impact on marine receptors.	Acknowledged. In developing the final MMMP all suitable mitigation options would be considered, including the use of noise abatement measures. The maximum hammer energy has now also been reduced to 6,000kJ for monopiles and 3,000kJ for pin pile jackets in the Environmental Statement (ES) (see Volume 7, Chapter 5 Project Description (application ref: 7.5)).
		The MMO would highlight that given the wider context of the current ramp up of offshore wind development at unprecedented scale in the North Sea it is vital that these discussions begin as soon as possible. To ensure adequate preparations are made and potential delays avoided, it is therefore in the applicant's interest to plan for noise abatement measures at the earliest opportunity and to incorporate such measures into any future MMMP.	Acknowledged. In developing the final MMMP all suitable mitigation options would be considered, including the use of noise abatement measures as outlined in section 3.1.9.
Natural England	15/07/2023 – PEIR Responses	When assessing the potential impacts during construction, the information presented by the Applicants indicates that the full injury ranges are not suitable to be mitigated by ADDs. As a result, there will be a residual impact i.e., an area where permanent loss of hearing sensitivity (PTS) can occur, beyond the area that is mitigated. Natural England has not yet had sight of the draft MMMP. Therefore, Natural England cannot agree at this stage that the measures in the MMMP will be sufficient to significantly reduce any potential for PTS injury. Should a residual injury risk remain, Natural England will recommend that a European Protected Species (EPS) licence to injure is sought. However, such a licence can only be granted if the	Acknowledged. The mitigation measures in the final MMMP and final SIP would be discussed and agreed with Natural England during development of these documents and prior to submission of the final versions. The proposed mitigation would reduce the risk of PTS in marine mammals for the full injury zone, this would include, if required, the options for using noise abatement measures. It is proposed that an EPS licence for disturbance would be

Consultee	Date / Document	Comment Received	Project Response
		authority is satisfied that there is no satisfactory alternative (the second test). This includes alternatives to minimise the risk of injury, such as mitigation like noise abatement systems. Provide the information needed to demonstrate that the full injury zone will be mitigated in the submitted ES. This information should demonstrate that the Applicants have considered all mitigation options to minimise the risk of injury. We advise that the Applicants engage with Natural England on the draft MMMP and SIP during the Evidence Plan Process.	submitted, but with adequate mitigation, this should not be required for injury.
		Natural England note in section 11.6.1.1.11; The maximum Peak Sound Pressure Level (SPL_{peak}) PTS range for VHF cetaceans is greater than 500m for both monopiles and pin piles in certain locations. Therefore, the monitoring zone within the MMMP will need to reflect this. To note for when the MMMP is produced. The monitoring zone in the MMMP should encompass the maximum PTS range for a single strike of hammer.	Acknowledged. The monitoring zone in the final MMMP would encompass the maximum PTS range for a single strike of hammer.
		In Table 11-4; Table 11-90; Natural England support the Applicant's commitment to submit Draft MMMPs for piling activities and UXO clearance at the DCO stage.	Acknowledged.
		In section 11.6.1.2.2.4; Natural England note that the use of ADDs and their duration will be discussed with regulators and their advisors post consent, during finalisation of the MMMP. Therefore, we agree that the assessment of ADD disturbance is illustrative and will not comment on the outcomes of the assessment at this time.	This would be reviewed and agreed for the final MMMP. The use of ADDs and their duration would be discussed with regulators and their advisors post consent, during finalisation of the MMMP. Therefore, the assessment of ADD disturbance in the ES would be illustrative.
		Natural England note in section 11.6.1.1.11; The maximum SPL_{peak} PTS range for VHF cetaceans is greater than 500m for both monopiles and pin piles in certain locations. Therefore, the monitoring zone within the MMMP will need to reflect this. To note for when the MMMP is produced. The monitoring zone in the MMMP should encompass the maximum PTS range for a single strike of hammer.	Acknowledged. The monitoring zone in the final MMMP would encompass the maximum PTS range for a single strike of hammer.
Natural England	02/02/2024 – Draft Outline MMMP consultation response (DAS/464359)	Natural England request further information be provided regarding minimising impacts. Our current key issues with the MMMP are as follows: 1) Pause in Piling between 10 minutes and 2 hours with intention to continue without marine mammal checks, soft start or ramp up. This is against current JNCC guidelines. If operations are deviating from the guidelines, formal justification, with supporting evidence is required. There also needs to be consideration to whether this action would require an EPS licence to injure. Natural England does not support this approach. 2) The use of Passive Acoustic Monitoring (PAM) as an alternative to Marine Mammal Observers (MMObs) during times of poor visibility or at night. Natural England does not recommend commencing piling or continuing after a break of more than 10 minutes in these conditions, as it is	Updates and amendments have been made in section 3.1 to ensure a delay in ADD use if marine mammals are present in the Mitigation Zone and that MMObs will be dedicated with at least one experienced MMOb (under the JNCC guidance definition) present. Due to the improvements in scientific understanding and the development of a better knowledge base of the efficacy of certain mitigation measures recommended in the JNCC (2010) protocol, further discussion regarding breaks in piling, the recovery rates of marine

Consultee	Date / Document	Comment Received	Project Response
		against JNCC guidelines. As above, if operations are deviating from the guidelines, formal justification, with supporting evidence, is required. 3) Further information on the use of Acoustic Deterrent Devices (ADD) if Marine Mammals are in the mitigation zone is needed. We will provide further comment following receipt of this information. 4) Natural England recommends that MMObs are dedicated and experienced. If trained vessel crew are used, it is important to consider all the requirements of the MMObs and how that would fit into other duties.	mammals and the use of PAM as an efficient mitigation tool (as now recognised for seismic and geophysical surveys (JNCC guidance 2017) and for UXO clearance (JNCC guidance 2023) and through the JNCC guidance for the use of PAM in UK waters for minimising the risk of injury to marine mammals from offshore activities (2023)) will be undertaken post consent before the finalisation of the MMMP.
MMO	22/02/2024 – Draft Outline MMMP consolidation response (Ref: DCO/2022/00007)	Section 1 and 2 of the draft Marine Mammal Mitigation Protocol (MMMP) note that a separate Marine Licence Application will be submitted for any required Unexploded Ordnance (UXO) clearance. It would be helpful to confirm within these sections if a corresponding European Protected Species (EPS) licence application will additionally be sought for both piling and UXO works, as is proposed within Table 1-2, page 16.	Noted. This has been updated accordingly.
		We welcome the proposal for the final MMMP to include full consideration of all available mitigation measures, including consideration of noise abatement systems (NAS). The applicants should be aware that in determining any EPS licence application, the MMO as the regulator must be satisfied that there is no other satisfactory alternative to the project as proposed, which would include consideration of all available mitigation measures.	In addition to NAS, the Draft Outline MMMP also includes provision for any new technologies or methods not currently on the market to be considered during the development of the final MMMP. Updates as needed will be made to the MMMP, SIP and EPS Licence application, where relevant, for agreement prior to construction. The Applicants acknowledge that in order to obtain an EPS licence, the MMO must be satisfied that there is no other satisfactory alternative to the project as proposed and has sought to retain flexibility in the DCO application in order to ensure the most effective option can be selected prior to construction.
		It is noted on page 34 of the draft MMMP (paragraph 144 of section 3.1.6) that: “for any breaks in piling of more than 10 minutes but less than two hours, then piling can recommence with an altered soft-start procedure (e.g. five to six blows of the hammer at starting hammer energy) before continuing as required, provided there are no marine mammals within the Monitoring Area”. The Joint Nature Conservation Committee (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 MMO 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.	Acknowledged; continuous monitoring for any potential breaks in piling (where possible) has been amended in section 3.1. Regarding breaks in piling and restarting of installation, this is a method that has been previously applied and approved at other offshore wind farm projects successfully. Due to the improvements in scientific understanding and the development of a better knowledge base of the efficacy of certain mitigation measures recommended in the JNCC (2010) protocol, further discussion regarding

Consultee	Date / Document	Comment Received	Project Response
		However, if there has been no watch, the complete pre-piling search and soft-start procedure should be undertaken. 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 needs to be agreed with the regulator and any statutory nature body. The MMO requires that the guidance is adhered to, and the full soft start of 20 minutes is implemented (not 5 to 6 blows at the starting hammer energy as is proposed in the MMMP) and this is updated in the MMMP.	breaks in piling, the recovery rates of marine mammals will be undertaken post consent before the finalisation of the MMMP.
		Bubble curtains would be required for all high-order detonations and not just for Unexploded Ordnance (UXOs) that are larger than 50kg charge weight. The MMO requests the MMMP is updated to confirm (with the specific UXO contractor) what parameters will be appropriate for the safe deployment of bubble curtains. The draft MMMP notes that array water depths vary between 10.68 metres (m) and 38.16 m.	Acknowledged and amended accordingly in section 2.2.2.
		Please note you will need two separate MMMPs and SIPs for the UXO clearance and piling activities as these are taking place at different times.	Acknowledged. The Outline MMMP and In Principle SIP present the approach of the Applicants and stipulate that these documents would be split post consent to support the DCO conditions and the application for the UXO clearance Marine License.



2 Draft Protocols for UXO Clearance and Piling

2.1 UXO Clearance

23. Based on previous experience in offshore wind projects in the North Sea, including in the wider Dogger Bank area, 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 Outline MMMP is to demonstrate the principles of the final MMMP for any UXO clearance at the Projects.
25. This Outline 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 the Projects (including the Array Areas and offshore cable corridors).
26. The final MMMP for UXO clearance would 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 would be developed pre-construction based on the latest survey information which would provide detailed information on the UXO clearance which could be required. The final MMMP for UXO clearance would provide details of the predicted impact (PTS) ranges and areas from UXO clearance.
28. The final MMMP for UXO clearance would 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 would incorporate the most appropriate mitigation measures based upon best available information and proven methodologies at that time.
29. The Applicants are committed to using the best practicable means at the time to mitigate the impacts of the Projects.
30. The mitigation in the final MMMP would be based on contemporary best practice, guidance and information, including updated underwater noise modelling, if required, and would be updated no later than four months prior to UXO clearance activities being undertaken.

2.2 Mitigation

31. The Applicants would ensure that the mitigation measures are adequate to reduce the risk of any physical or permanent auditory injury (PTS) within the Mitigation Zone (MZ) during all UXO clearance.
32. The final MMMP would involve the establishment of a suitable MZ around a UXO location before any UXO clearance. The MZ is the entire mitigation area for the maximum PTS ranges.
33. The methods for establishing the MZ and reducing the potential impacts of any UXO clearance would be agreed with the MMO in consultation with the relevant SNCBs and would be secured as commitments within the final MMMP.
34. The UXO clearance mitigation measures could include:
 - Low-order disposal techniques (see section 2.2.1), this would be the preferred method for all UXO clearance;
 - The use of bubble curtains if high-order UXO detonation is required (see section 2.2.2), taking into account the environmental conditions within which they could be effective;
 - The activation of acoustic deterrent devices (ADD) (see section 2.2.3) 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 2.2.4):
 - The observation of the MA would be conducted by trained, dedicated and experienced Marine Mammal Observers (MMOs) during daylight hours and when conditions allow suitable visibility, pre-and post-detonation (see section 2.2.5); and
 - Deployment of passive acoustic monitoring (PAM) in the MA (see section 2.2.6), if the equipment can be safely deployed and retrieved.
 - Other UXO clearance techniques, such as avoidance or relocation of UXO would also be considered, if required and suitable; or
 - The UXO clearance and disposal would 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 would 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 would be the preferred method. High-order detonation would 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 would be reviewed and updated based on the latest information and guidance in the final MMMP.

2.2.1 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 (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. In the 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.

2.2.2 Bubble Curtains

43. Where possible, bubble curtains would 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 would be used and fitted with large hose reels and a number of air compressors. Compressed air would 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 would be deployed in prior to deployment, to ensure that they are effective, safe to deploy and taking in to account the contractor's limitations safety restrictions. Key considerations are environmental constraints such as water depth, current speeds and wave height.
46. It is understood that, currently, it is possible to deploy bubble curtains for UXO detonation under the following scenarios:
 - Water depths are between approximately 5m and 40m;
 - Significant wave heights are less than approximately 1m;
 - Maximum wind speed is less than approximately 8m/s; and
 - Current speeds are less than approximately 1.5 knots.

47. The above figures are subject to change and would be dependent on available technology at the time of any potential detonations. The exact parameters for the safe deployment of bubble curtains will be confirmed in the final MMMP with the information from the assigned contractor. Once the bubble curtain is in place and prior to the bubble curtain being activated an explosive charge would be attached to, or placed next to, the UXO by a Remotely Operated Vehicle (ROV), and detonation would be undertaken remotely.
48. Once the charge has been detonated, a visual inspection survey using an ROV would be undertaken to confirm that the UXO has been successfully detonated.

2.2.3 Acoustic Deterrence Device (ADD)

49. An ADD would 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, Dudgeon Offshore Wind Farm, East Anglia ONE and Moray East.
51. The type and model of ADD would be determined in the final MMMP for UXO clearance, based on the latest information and advice, and would 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 would 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 would be present on board, in case there are issues with activation of the primary system.
53. The ADD would be deployed and ready to be activated prior to UXO clearance and activated within the last 30 minutes of the pre-clearance search (depending on the time needed to deter marine mammals). If a marine mammal is detected within the MZ the ADD activation will be delayed until the animal is at least 500m away from the ADD.

54. The ADD would be positioned within the water column to ensure that sound can be emitted in all directions. The ADD would 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, would 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 would 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 would 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 would not be activated during transit to another clearance event and would be activated prior to all clearance events.
58. After the ADD has been activated for the required duration, the ADD operator would 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 would be determined based on the maximum potential area for PTS.

2.2.4 Monitoring Area

60. The MA is the area over which a pre-detonation search would be undertaken by trained, dedicated and at least one experienced MMObs. The MA, based on current guidance (JNCC, 2010a¹) and the distance over which MMObs can undertake effective observations, would have a radius of 1km from the UXO location.
61. The 1km radius of the MA would be measured out from the UXO detonation site with a 360° coverage, representing an area of 3.14km².
62. The MA would be monitored for a minimum of 1 hour prior to UXO clearance.

2.2.5 Marine Mammal Observers

63. Marine mammal observations would be undertaken by JNCC accredited MMObs. They may be subcontractors or assigned installation vessel crew members that have undertaken the JNCC MMOb course and would 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 would conduct surveys to cover the entire MA. Marine mammal observations would be carried out from vantage points to allow unobstructed observations of the entire MA.
67. The MMObs would be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with reticles and reporting forms. The MMObs would 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 would be carried out to monitor the MA before, during and after UXO clearance.
69. The pre-clearance search would 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 would commence at least one hour prior to the clearance event. This would continue until one hour has passed and no marine mammals have been detected within the MA, the MMObs would then advise that the UXO clearance can commence. The ADD would 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 would be delayed. If a marine mammal has been sighted within the MA, it would 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 would be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the MA, then the clearance event would be delayed, and the full mitigation procedure, including the pre-clearance search, would 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 would always be used. Therefore, if the MMObs cannot be sure whether a marine mammal is within the MA or not, then the UXO clearance would 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 would continue observations during ADD activation, bubble curtain activation (if required) and all UXO clearances.
75. Marine mammal observations would 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 would 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) would also be recorded. The MMObs would complete the relevant marine mammal recording form(s) and reporting (see section 2.3).
77. There would be clear communication channels between the MMObs, the ADD operator and the EOD team (see section 2.4). The communication procedures would 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.

2.2.6 Passive Acoustic Monitoring

78. The use of PAM is unlikely to be required, as all clearances would take place in daylight and in favourable conditions with good visibility (sea state 3 or less).
79. If required, the use of PAM would be undertaken by trained, dedicated and experienced PAM Operators (PAM Ops). PAM Ops would be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment would be appropriate to detect vocalising cetaceans in the MA. PAM Ops would be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all UXO clearance.

2.3 Reporting

80. Reports detailing all UXO clearance activity and mitigation measures would be prepared. This would 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; and
 - Details of any problems encountered including any instances of non-compliance with the agreed mitigation protocol.

81. A final report would be submitted to the MMO. The final report would 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 would also discuss the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future projects.

2.4 Communication and Responsibilities

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

3 Piling

84. Depending on the installation method for the installation of the foundations for the wind turbines and platforms, impact piling could be required.
85. The purpose of this Outline MMMP is to demonstrate the principles of the final MMMP for piling that could be required for the Projects.
86. This Outline MMMP for piling outlines the proposed mitigation to reduce the likelihood of any injury, including any PTS, to marine mammals during all piling operations for the Projects.
87. The final MMMP for piling would be developed in the pre-construction period, when there would be more detailed information on the Projects design, and would incorporate the most appropriate mitigation measures based upon the latest and best available information and proven methodologies at that time. The final MMMP would be developed in consultation with the MMO and relevant SNCBs.
88. The final MMMP would 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 would be given to the requirements following any breaks in piling as well as prior to piling commencing.
89. The Applicants are committed to using the best practicable means at the time to mitigate the potential impacts of the Projects.
90. The mitigation in the final MMMP would be based on current best practice, guidance and information, including updated underwater noise modelling, if required, and would 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 OCP foundations from:
 - First strike of the starting hammer energy of the soft start;
 - Single strike of the maximum hammer energy; or
 - Cumulative exposure during installation would be based on worst-case for two monopiles installed sequentially or four OCP pin-piles installed sequentially in the same 24 hour period at either Project.
92. Underwater noise modelling would be used to derive the maximum potential PTS ranges.

3.1 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 would provide details of the maximum predicted impact (PTS) ranges and areas for piling.
94. The Applicants would 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 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 3.1.1);
 - The observation of the MA would 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); and
 - Deployment of PAM devices in the MA during poor visibility or at night.
 - The activation of ADD (see section 3.1.4);
 - Soft-start and ramp-up (see section 3.1.5); and
 - Procedure for breaks in piling (see section 3.1.6).

3.1.1 Monitoring Area

97. The MMMP would involve the establishment of a MA with a minimum radius of 500m around each wind turbine location and OCP location before piling for the Projects.
98. The radius of the MA would be greater than the maximum predicted impact range for single strike PTS for marine mammal species that could be present in or around the Projects.
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 would be monitored for a minimum of 30 minutes prior to soft-start commencing.

3.1.2 Marine Mammal Observers

101. Marine mammal observations would be undertaken by JNCC accredited MMObs. MMObs would have undertaken the JNCC MMOb course.
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 (including at least one experienced and dedicated observer) would conduct surveys to cover the entire MA around each pile location. Marine mammal observations would be carried out from vantage points to allow unobstructed observations of the entire MA.
105. The MMObs would be equipped with binoculars and a tool to estimate distance i.e. range finding stick or binoculars with reticles and reporting forms. The MMObs would 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 would be carried out to monitor the MA:
 - During ADD activation;
 - During the soft-start and ramp-up procedure; and
 - During any breaks in piling prior to piling recommencing.
107. Where possible, MMObs would continue monitoring during piling to allow for any breaks in piling.
108. The pre-piling monitoring would commence prior to all piling events, or after any break in piling. The visual observations by the MMObs would commence at least 30 minutes prior to the ADD activation followed by the soft-start. If a marine mammal has been detected inside the MA during the pre-piling search, the ADD can be activated once the MA is clear of marine mammals for at least 20 minutes; the MMObs would then advise that the ADD can be switched on. Once the ADD has been activated for the required duration, the ADD can be switched off once the soft-start has commenced.
109. During ADD activation, if animals are sighted within the MA, they would be tracked and monitored. If, at the end of the ADD activation period, the individual(s) remains within the MA, then the soft-start would be delayed, and the full mitigation procedure, including the pre-monitoring, would be undertaken again.

110. The MMObs would 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 would also be recorded. The MMObs would complete the relevant marine mammal recording form(s) and reporting (see section 3.2).
111. There would be clear communication channels between the MMObs, the ADD operator and the Piling Supervisor (see section 3.3). The communication procedures would 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.

3.1.3 Passive Acoustic Monitoring

112. The use of PAM would be undertaken by trained PAM Ops (including at least one experienced and dedicated PAM Ops) during periods of poor visibility and darkness prior to piling in line with the JNCC (2023a) guidance. If required, the two methods, visual or acoustic, would be used concurrently to ensure the best possible mitigation.
113. PAM Ops would be trained to JNCC standards, with an appropriate level of field experience. The PAM equipment would be appropriate to detect vocalising cetaceans in the MA. PAM-Ops would be responsible for deployment, maintenance and operation of the equipment, including spare equipment, in relation to all piling activities.
114. The PAM Ops would 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 would be conducted, prior to when deployment may be needed, to agree the best locations for deployment and monitoring. PAM Ops would assist in preparation and update of risk assessment for hydrophone deployment in collaboration with vessel personnel.
115. If required, PAM would be carried out to monitor the MA:
 - During pre-piling monitoring period;
 - During ADD activation;
 - During the soft-start and ramp-up procedure; and
 - During any breaks in piling prior to piling recommencing.

- 116. Where possible, PAM would continue monitoring during piling to allow for any breaks in piling.
- 117. The PAM Ops would 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 would provide the necessary data and information to be included in the reporting (see section 3.2).
- 118. There would be clear communication channels between the PAM Ops, MMObs, the ADD operator and the Piling Supervisor (see section 3.3).

3.1.4 Acoustic Deterrent Device (ADD)

- 119. An ADD would be activated after a pre-piling search and prior to the soft start as mitigation to reduce the risk of PTS during piling. If a marine mammal is detected in the MA prior to activation of the ADD, the ADD will not be activated until the animal has left.
- 120. The type and model of ADD would be determined in the final MMMP for piling, based on the latest information and advice, and would provide sufficient evidence to demonstrate that it is effective at deterring the marine mammal species that could be present in the MA.
- 121. The ADD would 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 would be present on board, in case there are issues with activation of the primary system.
- 122. The ADD would be deployed and ready to be activated prior to soft-start commencing.
- 123. The ADD would be positioned within the water column to ensure that sound can be emitted in all directions. The ADD would 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.
- 124. For deployment of the ADD, the transducer part of the device would 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 would be predetermined to ensure it is below the draft of the vessel, and well above the seabed (preferably in the middle of the water column) at the piling location.

125. The ADD would 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.
126. The duration of the ADD activation time would be determined based on the maximum range for PTS. The maximum duration of the ADD activation time would also be determined to reduce risk of increased disturbance. Note that the required duration would be confirmed within the final MMMP post-consent.
127. Further information on ADDs is provided in section 2.2.3.
128. The MA would be monitored by MMObs and / or PAM Ops during the ADD activation period. Once the soft-start proceeds, the ADD would be switched off.
129. The procedures for ADD activation for breaks in piling is outlined in section 3.1.6. ADD would not be operated intermittently during any breaks in piling.
130. The ADD would 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 would be conducted to agree the best location and method of providing power supply and communications. ADD equipment would have sufficient cable from the power point on the vessel to be deployed in the mid-water column.
131. The ADD operator would maintain a detailed record of all ADD deployments and activation. These reports would 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.

3.1.5 Soft-Start and Ramp-Up

132. Following the activation period of the ADD, the soft-start procedure would commence. The soft-start starting hammer energy would be the lowest possible starting hammer energy.
133. A ramp-up period would 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.
134. The Applicants would ensure that a soft-start and ramp-up procedure for piling is conducted for a minimum of 30 minutes.

135. It is proposed that each piling event would commence with a minimum of 10 minutes at reduced hammer energy, for example 10% of the maximum hammer energy, followed by a gradual ramp-up for at least 20 minutes for all pile driving activities.
136. 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.
137. 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)).
138. In the event that the full soft-start and ramp-up procedure is not completed, or that there is a break of more than 10 minutes during the soft-start and ramp-up procedure, the full pre-piling watch, ADD, and soft-start and ramp-up procedure would be restarted.
139. In the event that piling activity is stopped for more than two hours, the Applicants would ensure that a full restart of the procedures as stated above is conducted prior to piling re-commencing.
140. The soft-start and ramp-up procedure would be embedded mitigation for all piling operations.

3.1.6 Breaks in Piling

141. Monitoring of the Monitoring Area during any breaks in piling would be conducted by MMObs during daylight hours and suitable visibility or by PAM-Ops during poor visibility or at night.
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) as long as MMObs and/or PAM

Ops have been in continuous watch and no marine mammals are detected within the MA during the break period;

- For any breaks in piling of more than 10 minutes, but less than two hours, as long as MMObs and / or PAM Ops have been in continuous watch and no marine mammals are detected within the MA during the break period, then piling can recommence with an altered soft-start procedure (e.g. five to six blows of the hammer at starting hammer energy) before continuing as required³, provided there are no marine mammals within the MA:
 - If there are marine mammals within the MA, then the full mitigation procedure (as outlined above) would be undertaken, 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).
- For any breaks in piling of more than two hours then the full mitigation procedure (as outlined above) is required, including 30 minute monitoring of the Monitoring Area by MMObs and / or PAM, ADD deployment and activation for the required time, followed by the soft-start and ramp-up procedure.
 - If monitoring was conducted during piling prior to any breaks and the Monitoring Area 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.

3.1.7 Piling at Night / Poor Visibility

143. If piling is to commence in poor visibility or at night, the monitoring of the MA would be undertaken by PAM as outlined in section 3.1.3.
144. The deployment and activation of the ADD in poor visibility and at night would follow the same procedure as outlined in section 3.1.4, as would the soft-start and ramp-up procedure as outlined in section 3.1.5.
145. If there are any breaks in piling during poor visibility or at night, monitoring of the MA would be done by PAM.

³ Based on the evidence that marine mammals do not return to the piling area within two hours of piling ceasing (e.g. Nabe-Neilson et al., 2018, Brandt et al., 2009; 2011).

3.1.8 Mitigation for Multiple Pile Locations

146. For multiple pile locations, the mitigation as set out above for single pile locations would apply and be undertaken at each pile location. The potentially required ADD activation times may be increased to cover an increase in the potential impact ranges, however, this would be confirmed for the multiple pile scenario in the post-consent phase, when finalising the MMMP, and once, the final pile design, and the potential for multiple locations at once, is better understood.

3.1.9 Additional Mitigation Measures

147. Once the project design has been confirmed post consent additional mitigation and/or management options would also be considered as outlined in **Volume 8, In Principle SIP (application ref: 8.26)**. The final mitigation requirements would be confirmed in the MMMP and through consultation with the relevant SNCBs. These measures may include but are not limited to:
- Different foundation types and installation methods;
 - Noise mitigation systems;
 - Scheduling of pile driving; and
 - Seasonal or spatial restrictions on concurrent piling.
148. Consideration of different installation methods will look at alternative methods other than piling, including but not limited to drilling, vibro piling and blue piling, which have been documented to reduce sound levels significantly.
149. Another consideration is the use of noise abatement systems (NAS), including but not limited to, the following types of bubble curtains, such as big bubble curtains, small bubble curtains, and layered (ring) bubble curtains.
150. Big bubble curtains involve the layering of perforated flexible tubes onto the seabed around the piling activity prior to piling, via a compressor on board the vessel, a continuous flow of air is pumped in the tubes to then create a curtain of bubbles around the piling event. Small bubble curtains are very similar; however, the perforated pipes are hung vertically from a frame around the piling event, with a continuous flow of air being pumped into the pipes to create a curtain of bubbles around the piling event. Finally, layered or ring bubble curtains consist of multiple perforated rings of metal pipes which can be fixed to the foundation, and via the onboard compressor, provides a continuous flow of bubbles close to the piling event.

151. Alternative noise abatement systems to bubble curtains are hydro sound dampers, which use gas filled containers such as balloons or pieces of foam fixed to a net or frame around the piling event acting as a static bubble curtain, cushioning in the sound.
152. The need for additional mitigation will be determined pre-construction when the final project design is available. Once determined, the mitigation (or combination of mitigation) required will be included in the final MMMP and agreed with the MMO and other relevant SNCBs. The final MMMP will be based on the final project design and will consider new and emerging technologies, guidance and advice that may have emerged before construction, in addition to the measures described above.

3.2 Reporting

153. 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; and
 - Details of any problems encountered during the piling process including instances of non-compliance with the agreed piling and / or mitigation protocol.
154. 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.

3.3 Communication and Responsibilities

155. The final MMMP for piling would 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.
156. The final MMMP for piling would also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken for all piling activity. This would 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.

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Annex 1: Vessel Good Practice to Avoid Marine Mammal Collisions

1. This Annex includes the embedded good practice measures that would be put in place to reduce vessel collision risk with marine mammals.
2. These measures include that vessel movements, where possible, would 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 would be kept to the minimum number that is required to reduce any potential collision risk.
3. Operators of all vessels would 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 would be undertaken with all vessel operators to promote collision awareness and avoidance, including code of conduct.
4. Code of conduct for vessel operators would be produced and issued to reduce the risk of collision with marine mammals across all phases of the Projects.
5. The code of conduct for good practice would be developed prior to construction based on the latest information and guidance.
6. The code of conduct for good practice to avoid marine mammal collisions with vessels would include, but not be limited to:
7. Avoid deliberately approaching marine mammals when sighted;
8. Avoid abrupt changes to course or speed should marine mammals approach the vessel or bow-ride;
9. 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;
10. Where possible and safe to do so, transiting vessels will maintain distances of 1km distance from the coast, particularly in areas near known seal haul-out sites when outside official shipping channels; and
11. Include a Protocol to report any collisions.

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