Morecambe Offshore Windfarm: Generation Assets

Development Consent Order Documents

Volume 6

Draft Marine Mammal Mitigation Protocol (Tracked)

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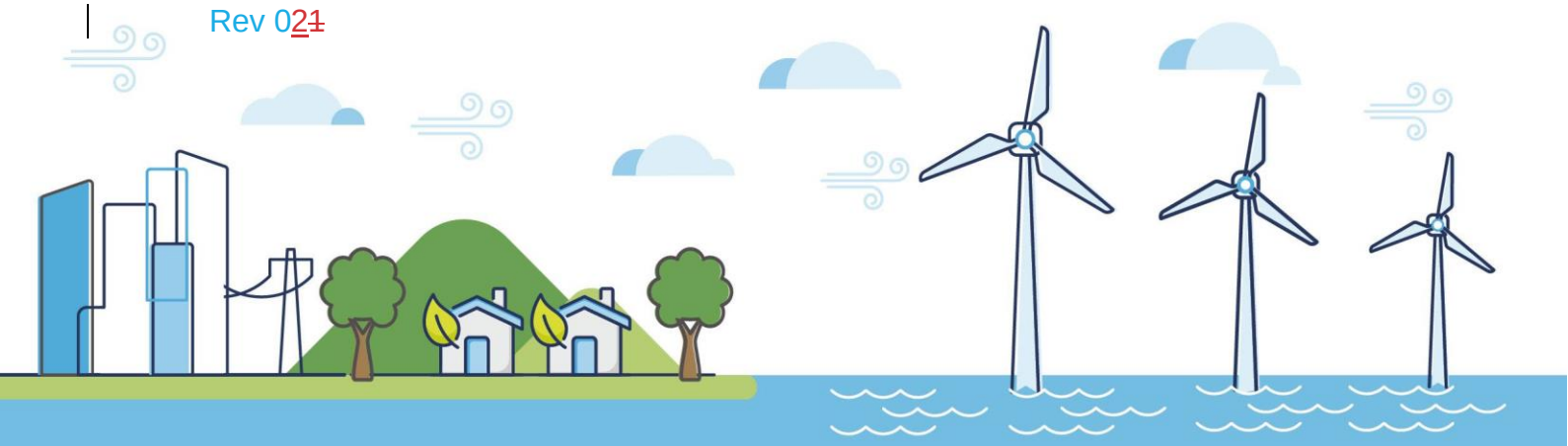

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Glossary of Acronyms

ADD	Acoustic Deterrent Device
BEIS	Department for Business, Energy and Industrial Strategy[1]
CIS	Celtic and Irish Sea
DAERA	Department of Agriculture, Environment and Rural Affairs
DCO	Development Consent Order
DESNZ	Department for Energy Security and Net Zero
DML	Deemed Marine Licence
EIA	Environmental Impact Assessment
ELO	Environmental Liaison Officer
EOD	Explosive Ordnance Disposal
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
GBS	Gravity Base Structure
HRA	Habitats Regulation Assessment
HF	High Frequency
JNCC	Joint Nature and Conservation Committee
LAT	Lowest Astronomical Tide
LF	Low Frequency
MA	Monitoring Area
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMObs	Marine Mammal Observers
MU	Management Unit
NPL	National Physical Laboratory
NRW	Natural Resources Wales
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSP	Offshore substation platform
PAM	Passive Acoustic Monitoring
PAM-Ops	Passive Acoustic Monitoring Operators
PCW	Phocids in Water

[1] As of February 2023, the Department of Business, Energy and Industrial Strategy (BEIS) is known as the Department for Energy Security and Net Zero (DESNZ).

PEIR	Preliminary Environmental Information Report
PTS	Permanent Threshold Shift
RIAA	Report to Inform Appropriate Assessment
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SEL_{cum}	Cumulative Sound Exposure Level
SIP	Site Integrity Plan
SoS	Secretary of State
SNCB	Statutory Nature Conservation Body
SPL	Sound Pressure Level
SPL_{peak}	Peak Sound Pressure Level
TTS	Temporary Threshold Shift
TWT	The Wildlife Trusts
UK	United Kingdom
UV	Ultraviolet
UXO	Unexploded Ordnance
VHF	Very High Frequency
WTG	Wind turbine generator

Glossary of Unit Terms

dB	Decibel
kg	Kilogram
kJ	Kilojoules
km	~~K~~kilometre
km^2	~~Kilometre~~ square kilometre ~~squared~~
kV	~~K~~kilovolt
m	~~M~~metre
m/s	~~M~~metres per second

Glossary of Terminology

Applicant	Morecambe Offshore Windfarm Ltd
Cetaceans	Commonly known as whales, dolphins or porpoises.
European sites	Designated nature conservation sites, which include the National Site Network (designated within the United Kingdom (UK)) and Natura 2000 sites (designated in any European Union country). This includes candidate Special Areas of Conservation (cSAC), Sites of Community Importance, Special Areas of Conservation (SAC) and Special Protection Areas (SPA).
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics. The EPP provides a mechanism to agree the information required to be submitted to the Planning Inspectorate as part of the Development Consent Order (DCO) application. This function of the EPP helps Applicants to provide sufficient information in their application, so that the Examining Authority can recommend to the Secretary of State whether or not to accept the application for examination and whether an appropriate assessment is required
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Generation Assets (the Project)	Generation assets associated with the Morecambe Offshore Windfarm. This is infrastructure in connection with electricity production, namely the fixed foundation wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s).
High-order detonation	An explosive donor charge will be attached to or placed next to the unexploded ordnance (UXO) and will be detonated.
Inter-array cables	Cables which link the WTGs to each other and the OSP(s).
Low-order detonation	This is a method that usually uses a small charge to deflagrate or burn out the explosive material within an UXO, without detonating it.
Management Unit	Management units provide an indication of the spatial scales at which impacts of plans and projects alone, cumulatively and in-combination, need to be assessed for the key cetacean species in UK waters, with consistency across the UK.
Monitoring Area	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). This area is 700m from the pile location in all directions based on the current Project design.

Morgan and Morecambe Offshore Windfarms: Transmission Assets	The transmission assets for the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm. This includes the OSP(s)[2], interconnector cables, Morgan offshore booster station, offshore export cables, landfall site, onshore export cables, onshore substations, 400kV cables and associated grid connection infrastructure such as circuit breaker infrastructure. Also referred to in this chapter as the Transmission Assets, for ease of reading.
Offshore substation platform(s)	A fixed structure located within the windfarm site, containing electrical equipment to aggregate the power from the WTGs and convert it into a more suitable form for export to shore.
Permanent Threshold Shift (PTS)	A permanent total or partial loss of hearing sensitivity caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear, and thus a permanent reduction of hearing acuity.
Pinnipeds	Commonly known as seals.
Platform link cable	An electrical cable which links one or more OSP(s).
Ramp-up	In the piling process, ramp-up forms the second part of the soft-start procedure and follows on from the initial low-energy blows. It comprises a 10-minute period of piling, starting at the low-energy blow level, and gradually increasing in hammer energy. The maximum hammer energy required (operational power for that specific pile) must not be reached within this 10-minute ramp-up period.
Safety Zones	An area around a structure or vessel which should be avoided, as set out in Section 95 of the Energy Act 2004 and the Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations due to the flow of water.
Sequential piling	A scenario where one pile is installed after another pile in the same 24-hour period (e.g. two monopiles in the same 24 hour period or four pin-piles in the same 24 hour period).
Soft-start	The procedure used to commence piling at a lower hammer energy. The soft-start procedure consists of low-energy blows for 10 minutes which are immediately followed by ramp-up for 10 minutes.
Sound Exposure Level (SEL)	The constant sound level acting for one second, which has the same amount of acoustic energy, as indicated by the square of the sound pressure, as the original sound. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels, and temporal characteristics.

[2] At the time of writing the Environmental Statement (ES), a decision had been taken that the offshore substation platforms (OSP(s)) would remain solely within the Generation Assets application and would not be included within the Development Consent Order (DCO) application for the Transmission Assets. This decision post-dated the Preliminary Environmental Information Report (PEIR) that was prepared for the Transmission Assets. The OSP(s) are still included in the description of the Transmission Assets for the purposes of this ES as the Cumulative Effects Assessment (CEA) carried out in respect of the Generation/Transmission Assets is based on the information available from the Transmission Assets PEIR.

Cumulative Sound Exposure Level (SELcum)	The SEL summed up over multiple exposures / multiple impulsive events such as for a pile driving sequence.
Sound Pressure Level (SPL)	The sound pressure level or SPL is an expression of the sound pressure using the decibel (dB) scale, and the standard reference pressures of 1 µPa for water and 20 µPa for air.
Study area	This is an area which is defined for each Environmental Impact Assessment (EIA) topic, which includes the windfarm site, as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each EIA topic is intended to cover the area within which an effect can be reasonably expected.
Technical stakeholders	Technical consultees are considered to be organisations with detailed knowledge or experience of the area within which the Project is located and/or receptors which are considered in the EIA and HRA. Examples of technical stakeholders include the Marine Management Organisation (MMO), local authorities, Natural England and the Royal Society for the Protection of Birds (RSPB).
Windfarm site	The area within which the WTGs, inter-array cables, OSP(s) and platform link cables will be present.
Wind turbine generator (WTG)	A fixed structure located within the windfarm site that converts the kinetic energy of wind into electrical energy.

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1 Introduction

1.1 Purpose of this document

1. This Outline Marine Mammal Mitigation Protocol (MMMP) forms part of a set of documents that supports the Development Consent Order (DCO) Application submitted by Morecambe Offshore Windfarm Ltd (the Applicant) for the Morecambe Offshore Windfarm Generation Assets (the Project).

2. The purpose of this draft MMMP is to demonstrate the principles of the final MMMP to be submitted for approval, as required under the relevant condition in the draft Deemed Marine Licence (DML) as part of the draft DCO (Document Reference 3.1), for the Project.

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 from UXO clearance and piling from causing auditory injury to marine mammals that could be present in and around the Project area.

4. It should be noted that, pre-construction, a separate marine licence for UXO clearance would 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 should include a high level assessment of potential UXO clearance.

5. As such, separate MMMPs for piling and UXO clearance would be developed for the Project at the pre-construction stage. These final MMMPs would take account of the most suitable mitigation measures and up to date scientific understanding at the time of construction. These measures would be consulted upon with the Marine Management Organisation (MMO) and Statutory Nature Conservation Bodies (SNCBs).

6. **Plate 1.1** highlights the relationship between the draft and final MMMPs for piling and UXO clearance and how they would be secured via the DML within the DCO and separate marine licence(s).

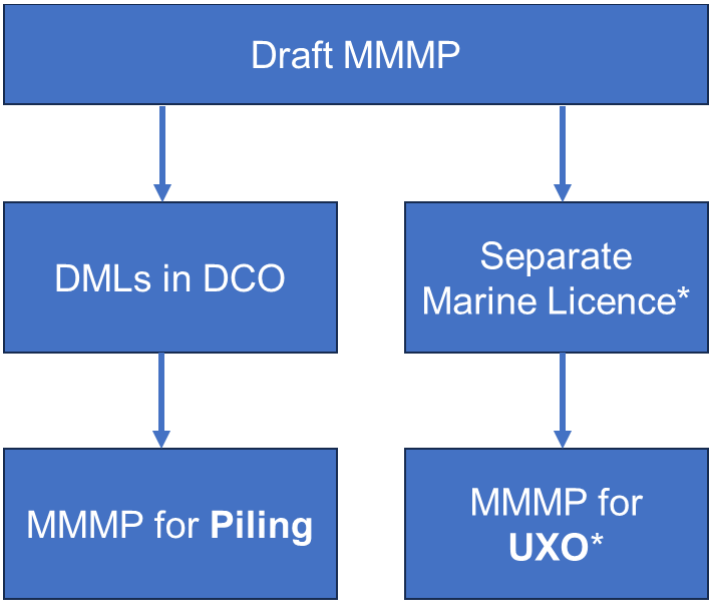

Plate 1.1 Relationship between the draft and final MMMPs for piling and UXO and how they would be secured

7. This draft MMMP also outlines how the DML conditions would be met.

8. This draft MMMP for UXO clearance and piling sets out the protocol of how the Applicant 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
   - Meet the relevant DML condition stated above

9. The final MMMP for piling and UXO clearance would be submitted to the MMO for approval prior to the start of relevant works, in consultation with the relevant SNCBs.

10. The final MMMP for piling and UXO clearance would be developed in the pre-construction period and would be based upon best available information, methodologies, industry best practice, latest scientific understanding and detailed project design information. Current guidance at the time of application and any relevant updates would be taken into account.

11. Recent guidance specific to marine mammals includes Joint Nature Conservation Committee JNCC guidelines for minimising the risk of injury to

marine mammals from UXO clearance (JNCC, 2023[3]), statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise (JNCC, 2010b), 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) and the joint interim statement which sets the position on the use of lower noise alternatives to high order detonation of UXOs within the marine environment (BEIS *et al*., 2022).

12. ~~Following Natural England's comments on the Preliminary Environmental Information Report (PEIR), **Annex 1 Vessel good practice to avoid marine mammal collisions** provides further~~It is noted that information on the proposed good practice measures that would be undertaken by vessel operators to reduce any risk of collisions with and disturbance to marine mammals, ~~which would also~~are ~~be~~ included in the Project Environmental Management Plan (PEMP) (Document Reference 6.2) which is secured in the DCO.

1.2 Description of the Project

13. The Applicant is seeking a DCO for Morecambe (the Project), which is an offshore windfarm in the Eastern Irish Sea.

14. The windfarm site would cover an area of approximately 87km^2. The windfarm site is located approximately 30km from the nearest point on the coast of Lancashire. Water depths within the windfarm site range from 18m to 40m (relative to Lowest Astronomical Tide (LAT)).

15. Once built, the Project would comprise the following offshore components:

- The wind turbine generators (WTGs) 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
- Subsea cables, comprising inter-array and platform link cables, and associated external cable protection, as required

16. The detailed design of the Project (e.g. numbers of WTGs, layout configuration, foundation type and requirement for scour protection) would be determined post-consent. Therefore, the key parameters presented in **Table 16.1** 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 11 Marine Mammals** (Document Reference 5.1.11) the Environmental Statement (ES).

[3] DRAFT guidelines for minimising the risk of injury to marine mammals from unexploded ordnance clearance in the marine environment (JNCC, 2023a) were issued for consultation in 2023. It is anticipated that the publication of the guidelines will occur after submission of this DCO application.

17. The earliest any offshore construction works would start is assumed to be 2027, with construction undertaken across two and a half years (excluding pre-construction activities, such as surveys).

18. It should be noted that the construction programme is dependent on numerous factors, including consent timeframes and funding mechanisms.

Table 1.1 Key relevant parameters

Parameter	Detail
Approximate offshore construction duration	2.5 years
Windfarm site area (km^2)	87
Offshore cable corridor area (km^2)	Not part of this document, but as part of the Morgan and Morecambe Offshore Windfarms: Transmission Assets (undergoing a separate DCO application)
Windfarm site water depth range (m below LAT)	18 to 40
Distance from windfarm site to coast (~~closest point~~approximate) (km)	30
Number of WTGs	35 (maximum)
Number of OSP(s)	Up to 2
WTG foundation type options	▪ Gravity base structure (GBS) ▪ Multi-legged pin-piled jacket (three-legged or four-legged jackets) ▪ Monopile, and/or ▪ Multi-legged suction bucket jacket (three-legged jackets)
OSP(s) foundation type options	As per WTG foundation types
Number of piles per foundation for WTGs	Monopile = 1 Pin-pile = 4
Maximum number of piles for maximum number of WTGs	Monopile = 35 Pin-pile = 140
Maximum number of piles for OSP(s)	Monopile = 2 Pin-pile = 8
Maximum hammer energies (kilojoules) (kJ)	Monopile = 6,600 Pin-pile = 2,500
Maximum pile diameter (m)[4]	▪ 12 for monopile ▪ 3 for pin-piles

[4] It is noted that the impact ranges reported in Table 3.1 represent more precautionary diameters of 14m for monopiles and 5m for pin piles with modelling undertaken before further design refinement. Updated modelling for the final design would be undertaken post consent.

1.3 Consultation

19. During consultation on the PEIR, comments relevant to the draft MMMP were received and the Applicant's responses are provided in **Table 1.2**.

Table 1.2 Pre-application consultation comments received on the draft MMMP

Consultee	In reference to	Comment	Recommendation	Response
Natural England	Draft Report to Inform Appropriate Assessment (RIAA) Paragraph 1.766, 1.796	The Applicant has Identified that up to 13% of the Celtic and Irish Sea (CIS) management unit (MU) population of harbour porpoise may be disturbed at any one time from all projects in-combination. Whilst we acknowledge no spatial overlap between the Project and the Bristol Channel Approaches SAC, our concern is whether this level of in-combination disturbance could impact the ability of harbour porpoise to remain a viable component of the site (Conservation Objective 1). We welcome further engagement on potential further assessment/mitigation to demonstrate/ensure that no adverse effect on site integrity could occur.	Continue engagement on potential further assessment/mitigation of in-combination disturbance effects to demonstrate no AEoI [NB: adverse effect on site integrity] to harbour porpoise SACs.	Assessments have been updated in the final RIAA, including population modelling, which has been discussed as part of the Evidence Plan Process (EPP).
Natural England	PEIR Chapter 11 Marine Mammals Table 11.23	Natural England notes that the worst-case Permanent Threshold Shift (PTS) distance from single strike is 660m. This is greater than the standard 500m mitigation zone in the JNCC guidelines for minimising the risk of injury from piling. Therefore, a larger mitigation zone should be included in the MMMP when it is produced.	To note, use 660m as the minimum size of the mitigation zone in the MMMP.	As a precautionary approach, based on the current Project design, a 700m mitigation zone (or Monitoring Area) would be taken forward, noting this radius is considered to be easier to manage in the field.
Natural England	PEIR Chapter 11 Marine Mammals	Natural England has not yet had sight of the draft MMMP. Therefore, we cannot agree at this stage that the measures in the MMMP will be sufficient to avoid residual significant effect in EIA terms.	Provide the draft MMMP at the DCO Application stage, as already stated by the Applicant. Include	Noted. Options for noise abatement systems are included in the draft MMMP (see **Section 2.2.4** and **3.1.7**)

Consultee	In reference to	Comment	Recommendation	Response
	Paragraph 11.263	We advise that noise abatement systems should be included as an option in the draft MMMP.	noise abatement systems in the draft MMMP.	
Natural England	PEIR Appendix 11.3 UXO Assessment	Natural England welcomes the UXO Assessment undertaken. We acknowledge that the assessment is illustrative at this stage as the UXO clearance Marine Licence will be applied for post-consent. We do not expect that additional information will be available to refine the UXO assessment envelope prior to the Application. The illustrative assessment concludes that UXO clearance activities should not have a significant impact on marine mammal populations so long as appropriate marine mammal mitigation is secured. Subject to the Applicant's commitment to a UXO MMMP and continued engagement with Natural England on the measures in the MMMP, we are content that this document does not require any further amendments until the time of application for the UXO marine licence. Hence, we will not be providing further comment on this assessment at the DCO/dML Application. We welcome continued engagement on the finer details of the UXO assessment and mitigation measures post-consent	Continue engagement.	Noted. The Applicant would continue engagement on UXO post-consent. Preliminary impact calculations for high and low order detonations can be found in **Appendix 11.3 Marine Mammal UXO Assessment** of the ES (Document Reference 5.2.11.3).
Natural England	Draft RIAA, Paragraph 1.658	The conclusion of no significant effect references the mitigation to be detailed in the piling MMMP. A draft piling	Provide the draft piling MMMP with the DCO Application	Noted.

Consultee	In reference to	Comment	Recommendation	Response
		MMMP will be submitted with the DCO Application. Natural England cannot provide a view on the assessment conclusion for the pathway of "physical and permanent auditory injury" until the draft MMMP has been provided.	(already proposed by the Applicant).	
Natural England	Draft RIAA, Paragraph 1.708	The conclusion of no significant effect references the mitigation to be detailed in the PEMP. A draft piling MMMP will be submitted with the DCO Application. Natural England cannot provide a view on the assessment conclusion for the pathway of "vessel interactions" until the PEMP has been provided.	Provide the PEMP with the DCO Application (see good practice measures in **Annex 1** Vessel good practice to avoid marine mammal collisions.	Noted.
Natural England	PEIR Chapter 11 Marine Mammals, Section 11.6.3.2	Natural England welcomes that a range of approaches have been taken to determining disturbance, including EDRs and dose- response curves, as there is no single agreed threshold for disturbance. We acknowledge that there is insufficient data to apply all these methods to all species. Note that as the Acoustic Derrent Device (ADD) duration has not been discussed or agreed, nor the noise impact modelled, we cannot agree with the magnitude of the effect at this stage.	To note.	Noted.
North West Wildlife Trusts	PEIR Chapter 11 Marine Mammals,	We welcome the statement that an MMMP will be developed and implemented for piling to reduce the risk of PTS from the first strike of the soft	Continue engagement.	The Applicant would continue to engage with consultees through development of the MMMP post-consent, including on any monitoring requirements. The Applicant notes,

Consultee	In reference to	Comment	Recommendation	Response
	Paragraph 11.263	start, single strike of the maximum hammer energy. We also welcome that a monitoring zone has been set up and ADD activation will be used. However, a great deal more work is required to understand the effectiveness of current mitigation for underwater noise impacts and to develop better options if the current mitigation is found to be inadequate. We suggest that monitoring is undertaken to confirm the effectiveness of ADD if this is utilised. We welcome the approach in engaging with NWWT & the wildlife trust (TWT) on Morecambe during the evidence plan process and we hope that this can continue into the post-consent stage to reflect the best practice we have been developing with other wind farm developer's post-consent. We request to be named on all marine mammal monitoring and mitigation documents as a consultee. We look forward to discussing this in more detail with you over the coming months."		however, that it is for the MMO to determine who are relevant consultees on post-consent document submissions to discharge DML conditions.
Natural Resources Wales (NRW)	PEIR Chapter 11 Marine Mammals, Table 11.4	The use of noise mitigation strategies/ attenuation technology such as bubble curtains, timing of piling, or piling methods, have not been proposed as potential mitigation methods in Table 11.4 – Additional measures. Natural Resource Wales (NRW) (A) strongly	-	A number of different options for the management and mitigation of underwater noise would be considered as options for the reduction of impact to marine mammals.

Consultee	In reference to	Comment	Recommendation	Response
		recommend that these are considered and included in any future mitigation plan. Whilst mitigation might not be formally required for the purposes of removing Adverse Effect on Site Integrity (AEOSI) in the Habitats Regulations Assessment (HRA) or reducing significant effects in the Environmental Impact Assessment (EIA), it should be incorporated in accordance with industry best practice to reduce effects in relation to European Protected Species (EPS) protection.		It is not possible at this stage to determine which options would be needed, or which would be the most appropriate to implement, as it depends on the final foundation design, the piling programme, if piled foundations are carried forward, any other relevant noisy activities that may be happening at the same time, and whether options for either mitigation or management, or alternative installation techniques, become available at the time of finalisation that are not available now. Therefore, the Applicant considers that whilst it is currently possible to state the options that would be considered, it would not be appropriate to finalise and commit to mitigation and management options at this time, as it would not allow for future methods and knowledge to be incorporated. When the Applicant is considering the detailed design for piling, potential mitigation and management measures would be a key consideration during that process. It is not in the Applicant's interest to choose a piling design that has only limited mitigation options. Having only limited options available could adversely impact on the wider Project programme. For the reasons set out above, the Applicant considers that retaining the flexibility in final mitigation

Consultee	In reference to	Comment	Recommendation	Response
				and management options is beneficial from both an ecological perspective and from a Project delivery perspective.
NRW	Draft RIAA Section 9.4.2 Paragraph 1.658	In Section 9.4.2 Project Alone Assessment, Paragraph 1.658, please refer to our comments in Paragraph 11 of the current document regarding the use of noise mitigation strategies/attenuation technology such as bubble curtains, timing of piling (given North Anglesey Marine is a summer site) and piling methods as potential mitigation methods.	N/A	As above.
Natural England / MMO	Expert Topic Group (ETG) 6 31st January 2024	Natural England can understand why a Site Integrity Plan (SIP) isn't needed and this would be the approach for English waters. An alternative assessment for cumulative impacts of underwater noise will be of interest for Natural England and Welsh colleagues. At the wildlife licence stage it's too late to change piling schedules. It would be useful to show an outline of timeline of where extra measures will be considered and that options are still feasible.	Further consultation on mitigation measures to manage potential for cumulate effects.	The location of the Project is outside any SAC designated for harbour porpoise so there is no official requirement for a SIP. It is therefore proposed the MMMP take into account potential cumulative effects and would be consulted on as outlined in **Section 1.3.1**.

1.3.1 Schedule for agreement for piling MMMP

20. It is not possible at this stage to determine exact dates for agreement and refinement of the final MMMP for piling. However, the key milestones have been outlined in **Table 1.3** to indicate the likely development of the MMMP from its current 'draft' status to the final version between consent award and the start of construction.

Table 1.3 Indicative milestones for refinement of the draft MMMP towards agreement of the final MMMP pre-construction

Indicative Stage	When	Action for the Applicants	Relevant Authority/ Consultee	Status
Draft MMMP	DCO submission	Draft MMMP to be submitted with DCO Application	Secretary of State (SoS)	This document
Update to MMMP	During DCO examination process	If required, the MMMP would be reviewed and updated during the DCO examination process	MMO and Natural England	To be completed
Engineering Design	Pre-construction	Any updates or changes during the pre-construction period, within the consented envelope. Any updated project design would also require consideration in the MMMP.	Internal only	To be completed
Preparation and consultation on draft Final MMMP	Approximately 12 months prior to commencement of pile driving/following appointment of a piling contractor	The MMMP would be updated to capture all relevant cumulative assessments and mitigation measures.	MMO, Natural England	To be completed
Final design	At least four months prior to construction	Provide project details relevant to the MMMP. In addition, accompanying environmental information, including an assessment of the efficacy of mitigation or management measures would be provided.	MMO, Natural England	To be completed

Indicative Stage	When	Action for the Applicants	Relevant Authority/ Consultee	Status
Final MMMP approval	At least four month prior to commencement of pile driving	The MMMP would be updated and finalised. The final MMMP would be submitted for approval alongside the Marine Wildlife Licence application at least four months prior to the commencement of pile driving for written approval from the MMO prior to any piling works commencing.	MMO	To be completed
Construction monitoring and reporting	Construction	Monitoring/management reports would be submitted to the MMO.	MMO	To be completed

2 Draft protocols for UXO clearance

21. Items of UXO are regularly encountered in the Irish Sea area, as has been confirmed by a variety of Royal Navy clearance tasks (Alpha Associates, 2012). The Applicant has also undertaken a desk based study to identify the potential presence of UXO across the windfarm site.

22. Based on previous experience in offshore wind projects in the North Sea (Moray East and West OWF and Dudgeon OWF), there is a likely requirement for UXO clearance prior to construction. Whilst the preference would be to avoid or relocate 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 or relocation is not possible.

23. The purpose of this draft MMMP is to demonstrate the principles of the final MMMP for any UXO clearance for the Project.

24. This draft MMMP outlines the mitigation to reduce the risk of injury, including permanent auditory injury/a permanent shift in hearing sensitivity (PTS), to marine mammals during any UXO clearance work associated with the Project.

25. As set out in **Section 1**, the final MMMP for UXO clearance would be submitted for approval under a future marine licence application, separate from the DCO Application.

26. The exact number, type or size of UXO, and duration of UXO clearance operations, is not known at this stage. Therefore, the final detailed MMMP for

UXO clearance would be developed pre-construction if required, based on the latest survey information, which would provide detailed information on the confirmed UXO and provide details of the predicted impact (PTS) ranges and areas for UXO clearance.

27. 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.

28. The Applicant is committed to using the best practicable means at the time of UXO clearance to mitigate the impacts of the Project. In order to limit negative impacts, the sequential steps of a mitigation hierarchy would be followed: Avoid – Relocate – Low order clearance – High order clearance with bubble curtains (worst-case) (more details in **Section 2.2**).

29. The mitigation in the final MMMP would be based on current best practice, guidance and information, including updated underwater noise modelling, if required, would be submitted as part of the ML application prior to UXO clearance activities being undertaken.

2.1 Potential impact ranges

30. **Table 2.1** summarises the maximum potential impact ranges (PTS and Temporary Threshold Shift (TTS)) for low and high order UXO detonation, using a charge weight of 0.5kg and 353.5kg, respectively. For more details refer to **Appendix 11.1 Underwater Noise Assessment** of the ES (Document Reference 5.2.11.1) which describes the underwater modelling undertaken.

Table 2.1 Summary of impact ranges modelled for low (0.5kg charge weight) and high order (353.6kg + donor charge weight) detonations for all species groups

High order (NEQ 353.6kg + donor charge weight)		
	PTS	**TTS**
Harbour porpoise	11km (380.13km^2)	20km (1,256.64km^2)
Bottlenose dolphin, Risso's dolphin, common dolphin, and white-beaked dolphin	0.64km (1.29km^2)	1.1km (3.80km^2)
Minke whale	7.9km (196.07km^2)	89km (24,884.56km^2)
Grey seal and harbour seal	2.1km (13.86km^2)	16km (804.25km^2)
Low order (0.5kg)		
	PTS	**TTS**
Harbour porpoise	1.2km (4.52km^2)	2.3km (16.62 km^2)
Bottlenose dolphin, Risso's dolphin, common dolphin, and white-beaked dolphin	0.07km (0.015km^2)	0.13km (0.053km^2)
Minke whale	0.32km (0.32km^2)	4.5km (63.62km^2)
Grey seal and harbour seal	0.24km (0.18km^2)	0.8km (2.01km^2)

2.2 Mitigation

31. The Applicant would ensure that the mitigation measures are adequate to reduce the risk of any physical or permanent auditory injury (PTS) during all UXO clearance activities. The process through which the mitigation takes place is demonstrated in a flow-chart in **Plate 2.1**.

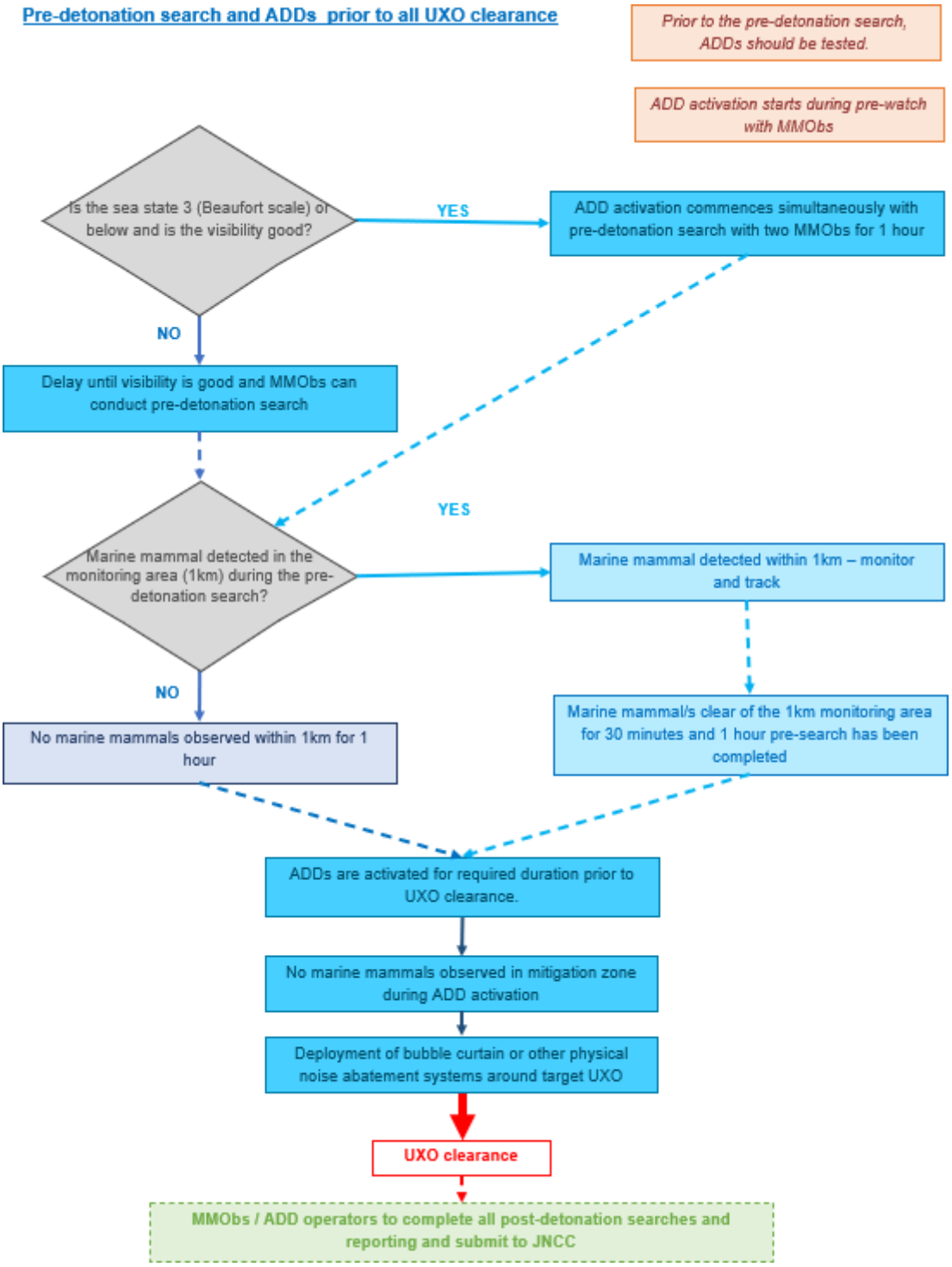

Plate 2.1 Flowchart diagram showing the mitigation process prior to any UXO clearance

32. The methods for reducing the potential impacts of any UXO clearance would be agreed with the MMO in consultation with relevant stakeholders including SNCBs and would be secured as commitments within the final MMMP.

33. 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 where possible
- 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 2.2.2**)
- The activation of ADD (see **Section 2.2.3**) prior to all UXO low-order clearance or high-order detonation (with or without bubble curtains)
- The ~~potential~~ use of bubble curtains or other approved noise abatement systems if high-order UXO detonation is required (see **Section 2.2.4**), taking into account the environmental conditions within which they could be effective.

34. The observation of the MA would 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 2.2.2.1**). Deployment of passive acoustic monitoring (PAM) in the MA (see **Section 2.2.2.2**) would also be undertaken, if the equipment can be safely deployed and retrieved.

35. Other UXO mitigation measures, such as avoidance or relocation of UXO, would also be considered, if required and deemed suitable.

36. The UXO clearance and disposal activities would be undertaken by specialist contractors, using the minimum amount of explosives required in order to achieve safe disposal of the device.

37. 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
- If the UXO appears structurally sound and there is an acceptably low health and safety risk of detonation in transit, the UXO could potentially be relocated to a location within the DCO boundary that is not in a sensitive area (e.g. away from a designated site or existing or planned infrastructure) for subsequent long term storage or clearance if required, subject to consultation with relevant sea users

38. If these options are not possible, and UXO clearance is the only option, then low-order clearance (as further described in **Section 2.2.1**) would be the preferred method. High-order detonation would only be used if low-order clearance was unsuccessful or the UXO device is considered to be unsafe for low-order clearance.

39. It is important to note that 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

40. 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 (National Physical Laboratory (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
- Low-order deflagration

41. Photolytic destruction of munition refers to the process of breaking down or decomposing explosive materials using light energy (photolysis), typically ultraviolet (UV) light, which can trigger chemical reactions within the explosive compounds (Haas & Pfeiffer, 2007 in Koschinski and Kock, 2015)

42. 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).

43. Substantial noise reduction for deflagration over high-order detonation (peak sound pressure level (SPL_{peak}) and Sound Exposure Level (SEL) are more than 20dB 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).

44. 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).

45. 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.

2.2.2 Monitoring area

46. The MA is the area within which a pre-detonation search would be undertaken by trained, dedicated MMObs. The MA, based on current guidance (JNCC, 2023) and the distance over which MMObs can undertake effective observations, would have a radius of 1km from the UXO location.

47. The 1km radius of the MA would be measured out from the UXO detonation site with a 360° coverage, representing an area of 3.14km^2.

48. The MA would be monitored for a minimum of 1 hour prior to UXO clearance.

2.2.2.1 Marine Mammal Observers

49. Marine mammal observations would be undertaken by JNCC accredited MMObs. 'Dedicated' is defined as a trained MMOb with the sole purpose of undertaking visual observations to detect marine mammals. 'Experienced' is defined as minimum of 20 weeks experience of implementing JNCC guidelines in UK waters within the previous five years.

50. At least two MMObs (with at least one experianced team member) would conduct surveys to cover the entire MA. Marine mammal observations would be carried out from a suitable elevated platform to allow unobstructed observations of the entire MA.

51. 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.

52. Marine mammal observations would be carried out to monitor the MA before, during and after UXO clearance.

53. 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 that would ensure that the end of the ADD activation period coincides with the end of the monitoring

period, so that there would be no gaps between ADD activation and active monitoring prior to the UXO clearance.

54. 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 Explosive Ordnance Disposal (EOD) team notified. The marine mammal(s) must be clear of the MA for at least 30 minutes before the UXO clearance commences.

55. 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.

56. 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 certain that there are no marine mammals present within the MA.

57. All MMObs must be a safe distance from the clearance site prior to any UXO clearance.

58. The MMObs would continue observations during ADD activation, bubble curtain activation (if required) and all UXO clearances.

59. Marine mammal observations would be carried out to monitor the MA during:

- The pre-detonation search
- ADD activation
- Bubble curtain activation (if required)
- UXO clearance
- The post-detonation search

60. 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**).

61. There would be clear communication channels between the MMObs, the ADD operator and the EOD team (see **Section 2.3**). 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.

2.2.2.2 Passive Acoustic Monitoring (PAM)

62. 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). For species that are difficult to detect visually, PAM may be required to supplement visual observations (JNCC, 2023a).

63. If it is required, however, the use of PAM would be undertaken by trained, dedicated and ~~and~~ at least one 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.

2.2.3 Acoustic Deterrence Device (ADD)

64. 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 to reduce the risk of any physical or auditory injury.

65. 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 windfarm piling and UXO clearance at sites in Europe (for example, Brandt *et al*., 2011, 2012, 2013a,b) and offshore windfarm sites in the UK, including but not limited to, Gwynt y Môr, Galloper, Dudgeon, East Anglia ONE and Moray East.

66. 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 MA.

67. 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.

68. The ADD would be deployed and ready to be activated prior to UXO clearance.

69. 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.

70. 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(s) 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.

71. 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.

72. The ADD would not be activated during transit to another clearance event and would be activated prior to all clearance events.

73. 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.

74. The ADD activation times for low-order clearance and/or high-order detonation with bubble curtain (if required) would be determined based on the maximum potential area for PTS impact ranges, and would be confirmed once the final UXO clearance requirements are known.

75. If marine mammals are still within the MA following the ADD activation, the ADD can remain active for an additional 10 minutes. If marine mammals are still within the MA following the additional 10 minutes (or have been within the previous 20 minutes), the ADD should be switched off. Once the ADD has been off for 10 minutes, then the ADD should be reactivated for a further 10 minutes. If marine mammals remain in the area, the above extended ADD protocol, of cycling the ADD on and off for 10 minutes, should continue until the marine mammal has been clear of the MA for at least 20 minutes.

2.2.4 Bubble curtains

76. Where required, bubble curtains or other approved noise abatement systems would be used for any high-order detonations, to reduce underwater noise impacts from the explosion. Studies suggest that bubble curtains can achieve noise reductions of up to approximately 10 to 20 dB, though variations may

occur based on factors such as bubble size, distribution, water depth, and the specific UXO clearance methodology (Song, 2023).

77. 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. The different emitted sizes of bubbles cause interference in noise propagation and causes less sound to transit past the curtain. Sound levels beyond the bubble curtain are therefore measurably lower than without the bubbles forming a propagation barrier.

78. It is important to consider the environment that the bubble curtains would be deployed in prior to deployment, to ensure that they are effective. Key considerations are water depth, current speeds and wave height.

79. Bubble curtains ~~could~~ would be deployed for UXO detonation in line with mandatory requirements, however it should be noted that there are likely to be limits to the environmental conditions within which they are able to provide effective mitigation.

80. 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.

81. Once the charge has been detonated, a visual inspection survey using an ROV would be undertaken to confirm that the UXO has been successfully cleared.

2.3 Reporting

82. 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 MA 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.

83. 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

84. The final MMMP would detail the communication protocol to ensure that all marine mammal mitigation measures are successfully undertaken for all UXO clearance operations.

85. 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 Draft mitigation protocols for piling

86. Depending on the final approved design of the foundations for the WTGs and OSP(s), impact piling may be required for foundation installation.

87. The purpose of this draft MMMP is to demonstrate the principles of the final MMMP for piling that could be required at the Project.

88. 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 the Project.

89. The final MMMP for piling would be developed in the pre-construction period, when there is more detailed information on the Project 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 stakeholders.

90. The final MMMP would include details of the embedded mitigation, such as the soft-start and ramp-up, as well as details of the MA 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.

91. The Applicant is committed to using the best practicable means at the time to mitigate the potential impacts of the Project.

92. 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 prior to piling operations starts.

93. The aim of the MMMP for piling is to reduce the risk of PTS during piling for either WTG or OSP foundations from:

- The peak ranges of a single strike during the Soft Start
- The cumulative ranges of a single pile

94. Potential impact ranges presented in **Table 3.1** summarises the maximum predicted impact ranges (PTS and TTS) taken forward for assessment for piling. For more details, refer to **Appendix 11.1** of the ES (Document Reference 5.2.11.1) which describes the underwater modelling undertaken for the maximum strike rate scenario.

Table 3.1 Summary of impact ranges cumulative sound exposure Level (SEL_{cum}) modelled for piling of monopile and pin-pile at the worst-case (south west) location based on the current Project design

Monopile (6,600 kJ maximum blow energy)		
PTS (maximum range/area)		
Impulsive Weighted SEL_{cum}	Low Frequency (LF) Minke whale (183dB)	13km (330km^2)
	High Frequency (HF) Delphinids (185dB)	<0.1km (< 0.1km^2)
	Very High Frequency (VHF) (155dB) Harbour porpoise	8.1km (150km^2)
	Phocids in water (PCW) (185dB) Grey and harbour seal	0.95km (1.9km^2)
TTS (maximum range/area)		
Impulsive Weighted SEL_{cum}	LF (168dB) Minke whale	34km (2,100km^2)
	HF (170dB) Delphinids	<0.1km (< 0.1km^2)
	VHF (140dB) Harbour porpoise	26km (1,400km^2)
	PCW (170dB) Grey and harbour seal	15km (500km^2)
Pin-pile (2,500 kJ maximum blow energy)		
PTS (maximum range/area)		
Impulsive Weighted SEL_{cum}	LF (183dB) Minke whale	8.9km (150km^2)
	HF (185dB) Delphinids	<0.1km (<0.1km^2)
	VHF (155dB) Harbour porpoise	5.1km (60km^2)
	PCW (185dB) Grey and harbour seal	<0.1km (<0.1km^2)
TTS (maximum range/area)		
Impulsive Weighted SEL_{cum}	LF (168dB) Minke whale	29km (1,500km^2)
	HF (170dB) Delphinids	<0.1km (<0.1km^2)
	VHF (140dB) Harbour porpoise	22km (1,000km^2)
	PCW (170dB) Grey and harbour seal	12km (330km^2)

3.1 Mitigation

95. The final MMMP would involve the establishment of a MA around the pile location before each pile driving activity, based on the maximum predicted distance for instantaneous PTS (SPL_{peak}). The final MMMP for piling would provide details of the maximum predicted impact (PTS) ranges and areas for piling.

96. The Applicant would ensure that the mitigation measures are adequate to minimise the risk of marine mammals being present within the MA prior to piling activity commencing, to reduce the risk of any physical or auditory injury (PTS).

97. The methods for establishing the MA and reducing the potential impacts of piling operations would be agreed with the MMO, in consultation with relevant stakeholders, and would be secured as commitments within the final MMMP.

~~98.~~ The piling mitigation measures ~~could~~ would include the following standard measures:

~~99.~~98. ~~Deployment of piling noise abatement systems~~

- Establishment of a MA with a minimum ~~700m~~ 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)
    - Deployment of PAM devices in the MA during poor visibility or at night
- The activation of ADD (see **Section 3.1.2**)
- Soft-start and ramp-up (see **Section 3.1.3**)
- Procedure for breaks in piling (see **Section 3.1.4**)

~~100.~~99. The process through which the mitigation takes place is demonstrated in a flow-chart in **Plate 3.1**.

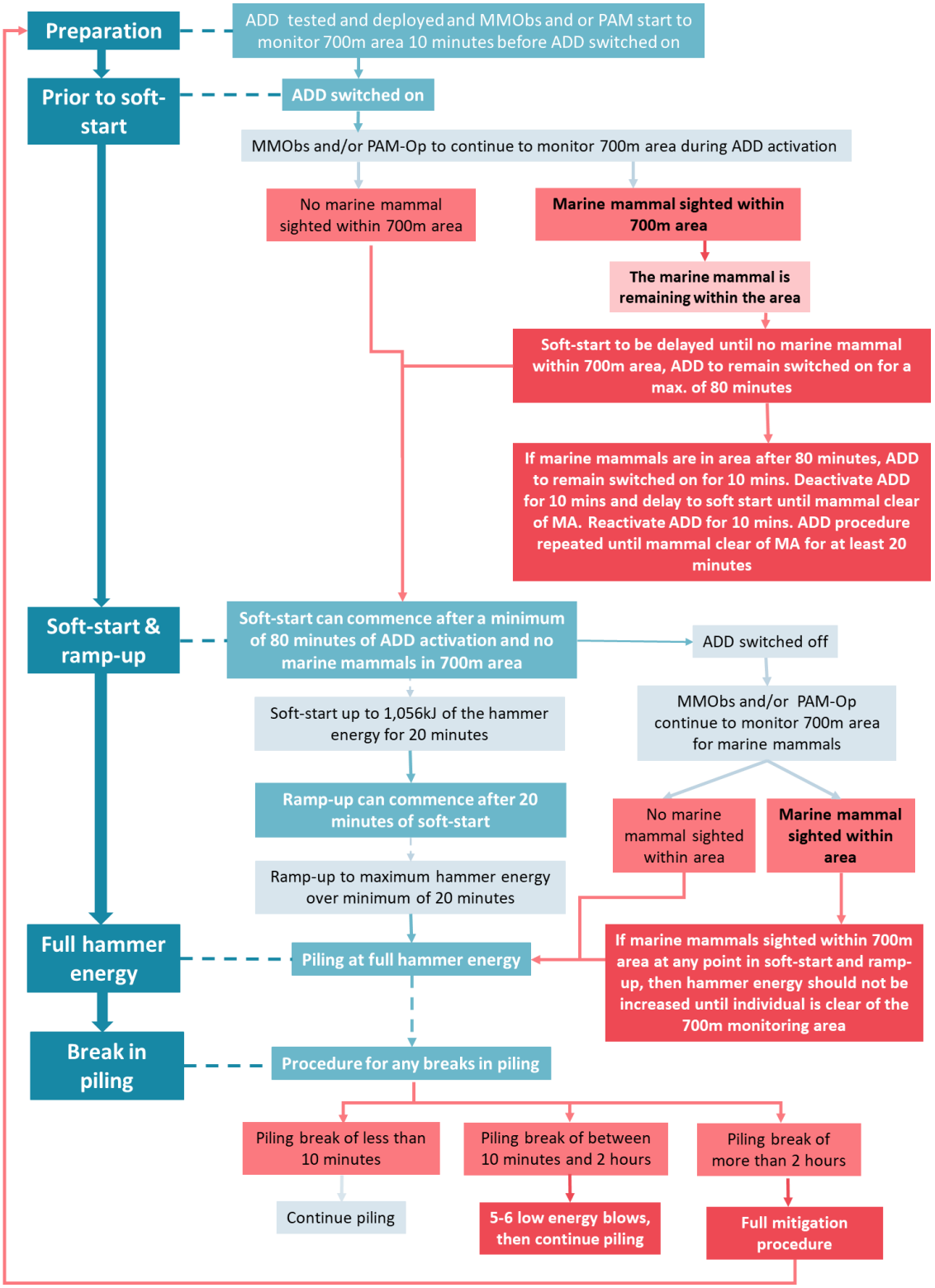

Plate 3.1 Flowchart diagram showing the mitigation process prior to piling (based on current Project design)

3.1.1 Monitoring area

~~101.~~100. The MMMP would involve the establishment of a MA, with a minimum radius of ~~700m~~ 500m around each WTG location and OSP location, before piling at the Project.

~~102.~~101. The radius of the MA is greater than the maximum predicted impact range for instantaneous PTS (SPL_{peak}) for marine mammal species that could be present in or around the Project.

~~103.~~102. The current predicted impact range for instantaneous PTS (SPL_{peak}) is a radius of 700m which ~~meets~~ is above the current JNCC (2010b) guidelines, to reduce the risk of PTS.

~~104.~~103. The MA would be monitored for a minimum of 30 minutes prior to ADD activation and then continued until the commencement of soft-start ~~commencing~~.

3.1.1.1 Marine Mammal Observers

~~105.~~104. Refer back to **Section 2.2.2.1** for detailed information about MMObs.

~~106.~~105. Marine mammal observations would be carried out to monitor the MA:

- At least 30 minutes prior to ADD activation
- During ADD activation
- During the soft-start and ramp-up procedure
- During piling at full power
- During any breaks in piling prior to piling recommencing

~~107.~~106. Where possible, MMObs would continue monitoring during piling to allow for any breaks in piling.

~~108.~~107. The pre-piling monitoring would commence prior to all piling events, or during any break in piling. The visual observations by the MMObs would commence at least 30 minutes prior to the ADD activation ahead of soft-start commencing. If no marine mammals have been detected within the MA, the MMObs would then advise that the ADD can be activated and once the ADD has been on for the minimum required time, the soft-start can commence. It is important that t~~T~~he ~~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 soft-start.

~~109.~~108. If a marine mammal is detected within the MA during the pre-piling monitoring, then the commencement of the ADD or the soft-start 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 Piling Supervisor notified. The marine mammal(s) must be clear of the MA for at least 20

minutes before ~~the~~ ADD is activated or the soft- start commences.

~~110.~~109. During ADD activation, if marine mammals 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. If the marine mammal(s) remains clear of the MA for at least 20 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 would always be used. Therefore, if the MMObs cannot be sure whether a marine mammal is within the MA or not, then the soft-start would be delayed accordingly until there are no marine mammals present within the MA.

~~111.~~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 3.1.6**).

~~112.~~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.

3.1.1.2 Passive Acoustic Monitoring

~~113.~~112. PAM should be used when environmental conditions prevent visual observations by the ~~marine mammal observer (~~MMObs~~)~~; in some circumstances, it may also be needed to supplement visual observations When undertaking searches during bad weather or civil twilight conditions[5], it is beneficial to undertake both visual (if possible) and PAM searches if sufficient staff are available (JNCC, 2023a).

~~114.~~113. The use of PAM would be undertaken by trained, dedicated and at least one experienced PAM-Ops during periods of poor visibility and darkness prior to piling. 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.

The PAM-Ops would ensure that the equipment and spares are functioning correctly prior to the start of the mitigation. Hydrophones and software should

[5] The period of twilight when the geometric centre of the sun is less than 6 degrees below the horizon

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, retrieval and monitoring. PAM-Ops would assist in preparation and update of risk assessment for hydrophone deployment in collaboration with vessel personnel.

~~115.~~114. 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
- During any breaks in piling prior to piling recommencing

~~116.~~115. Where possible, PAM would continue monitoring during piling to allow for any breaks in piling.

~~117.~~116. 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.~~117. There would be clear communication channels between the PAM-Ops, MMObs, the ADD operator and the Piling Supervisor (see **Section 3.3**).

3.1.2 Acoustic Deterrent Device (ADD)

~~119.~~118. An ADD would be activated prior to the soft-start as mitigation to reduce the risk of PTS during piling.

~~120.~~119. 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. It is expected that only one ADD would be required.

~~121.~~120. 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.~~121. The ADD would be deployed and ready to be activated prior to soft-start commencing.

~~123.~~122. 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.~~123. 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 pre-determined 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.~~124. 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.~~125. The duration of the ADD activation time has been determined based on the maximum range for PTS. It has been identified that a minimum of 90 minute ADD activation would be necessary to deter harbour porpoise from the impact area; this activation time would be sufficient to cover the impact ranges for minke whale, dolphins and seals.

- ADD needs to be activated for 90 minutes for harbour porpoise to swim to the maximum range of 8.1km (based on a swimming speed of 1.5m/s Otani *et al.* 2000)
- ADD needs to be activated for 67 minutes for minke whale to swim to the maximum range of 13km (based on a swimming speed of 3.25m/s (Blix and Folklow, 1995))

~~127.~~126. As outlined in **Chapter 11 Marine Mammals** of the ES, the recommended upper limit of ADD use is 80 minutes, in which harbour porpoise, dolphins and seals would swim at least 7.2km away and minke whale would move 15.6km away (more detail in Section 11.6.3.2 of **Chapter 11 Marine Mammals** of the ES). Apart from harbour porpoise, all other species would be sufficiently deterred. It can be assumed that it would be the same for harbour porpoise, as the precautionary swimming speed is based on a slow swimming mother and calf pair (Otani *et al*., 2000) and the impact ~~ranages~~ranges are based on ~~absolut~~absolute maximum hammer energy (= 120%). As such, the 80 minute ADD activation time is appropriate for all species.

~~128.~~127. Further information on ADDs is provided in **Section 2.2.3**.

~~129.~~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. If marine mammals are still within the MA following the ADD activation, the ADD can remain active for an additional 15 minutes. If marine mammals are still within the MA following the additional 15 minutes (or have been within the previous 20 minutes), soft-start should be delayed, and the

ADD switched off. Once the ADD has been off for 15 minutes, then the ADD should be reactivated for a further 10 minutes. If marine mammals remain in the area, the above extended ADD protocol, of cycling the ADD on and off for 15 minutes, should continue until the marine mammal has been clear of the MA for at least 20 minutes. Only then can soft-start commence.

~~130.~~129. 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 deactivated, but should remain in place in case of breaks in piling.

~~131.~~130. The procedures for ADD activation for breaks in piling is outlined in **Section 3.1.4**. ADD would not be operated intermittently during any breaks in piling.

~~132.~~131. 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.

~~133.~~132. 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.

3.1.3 Soft-start and ramp-up

~~134.~~133. 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.

~~135.~~134. 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.

~~136.~~135. It is proposed that each piling event would commence with a minimum soft- start of 20 minutes at 20% (or less) of the maximum hammer energy, followed by a gradual ramp-up to the maximum hammer energy for all pile driving activities. The total duration of soft-start and ramp up would be dependent on the final piling procedure and size of hammer to be used. However, the total time taken to reach full hammer energy would be greater than the current JNCC (2010b) guidance, which recommends that the soft-start duration (JNCC soft-start is defined as the gradual ramping up of piling power, incrementally over a set time period, until full operational power is achieved)

should be a period of not less than 20 minutes. In the situation that the maximum hammer is used, the combined soft-start and ramp-up period is expected to be a minimum of an hour.

~~137.~~136. During the initial 20 minutes, 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)). This would be greater than the maximum predicted distance for PTS from a single strike at the maximum hammer energy (0.69km for VHF, see **Appendix 11.1** of the ES (Document Reference 5.2.11.1) for underwater noise modelling).

~~138.~~137. 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.~~138. In the event that piling activity is stopped for more than two hours, the Applicant would ensure that the soft-start and ramp-up procedure is conducted prior to piling re-commencing.

~~140.~~139. The soft-start and ramp-up procedure would be embedded mitigation for all piling operations.

3.1.4 Breaks in piling

~~141.~~140. Monitoring of the MA 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.~~141. 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, but less than two hours, then the piling can recommence with a reduced soft-start procedure (e.g. five to six blows of the hammer at the starting hammer energy) before continuing as required[5], 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

[5] 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).

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 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).
    - 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.

3.1.5 Piling at night/poor visibility

~~143.~~142. If piling is to commence in poor visibility or at night, the monitoring of the MA would be done by PAM as outlined in **Section 3.1.1.2**.

~~144.~~143. The deployment and activation of the ADD in poor visibility and at night would follow the same procedure as outlined in **Section 3.1.2**, as would the soft-start and ramp-up procedure as outlined in **Section 3.1.3**.

~~145.~~144. If there are any breaks in piling during poor visibility or at night, monitoring of the MA would be done by PAM.

3.1.6 Embedded mitigation for multiple pile locations

~~146.~~145. No Project concurrent piling (piling at two or more locations at once) is planned and, as such, no further mitigation for multiple pile locations is required.

~~3.1.7~~3.2 Additional noise management options

~~147.~~146. Once the Project final design is confirmed, if the mitigation procedures described in ~~s~~**Sections 3.1.1** to **3.1.5** do not suitably mitigate for all marine mammals species that are likely to occur in the area, addition mitigation measures may be required. There are a number of additional noise management and abatement options, including bubble curtains (as described in **Section 2.2.4**) and piling noise reduction systems, as well as other mitigation options, such as timings and scheduling. The requirement for use of these options would be considered and agreed as part of the final MMMP, and through consultation with the relevant SNCBs alongside the development of the Project design and potential piling procedures. Further consideration would be given post- consent to any potential for cumulative noise effects and any management measures required to address this. Additional noise mitigation measures would be agreed via the Underwater

Sound Management Strategy which is secured in the DCO (Schedule 6 Condition 20).

~~3.2~~3.3 Reporting

~~148.~~147. 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 MA 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

~~149.~~148. 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~~3.4 Communication and responsibilities

~~150.~~149. 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.

~~151.~~150. 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, MMObs, 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~~

~~152. This Annex includes the embedded good practice measures that would be put in place to reduce vessel collision risk with marine mammals~~

~~153. 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.~~

~~154. 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 adherence to an agreed Code of Conduct.~~

~~155. A Code of Conduct for vessel operators would be produced and issued to all contractors to reduce the risk of collision with marine mammals across all phases of the Project.~~

~~156. The Code of Conduct for good practice would be developed prior to construction based on the latest information and guidance.~~

~~157. The Code of Conduct for good practice to avoid marine mammal collisions with vessels would 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 would 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 (outside of shipping routes) from seal haul-out sites, particularly during sensitive periods such as pupping and moulting~~
- ~~Draft a Project specific protocol to report any collisions~~