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OFFSHORE WIND FARM
PRELIMINARY ENVIRONMENTAL
INFORMATION REPORT

VOLUME 7, REPORT 8: MARINE MAMMAL
MITIGATION PROTOCOL FOR PILING

Document Reference 004685587-01
Revision A
Date March 2023





Project	Five Estuaries Offshore Wind Farm
Sub-Project or Package	Preliminary Environmental Information Report
Document Title	Volume 7, Report 8: Outline Marine Mammal Mitigation Protocol
Document Reference	004685587-01
Revision	A

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Revision	Date	Status/Reason for Issue	Originator	Checked	Approved
A	Mar-23	Final for PEIR	GoBe	GoBe	VE OWFL



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DEFINITION OF ACRONYMS

Term	Definition
ADD	Acoustic Deterrent Device
BBC	Big Bubble Curtain
DBBC	Double Big Bubble Curtain
DCO	Development Consent Order
dML	Deemed Marine Licence
EIA	Environmental Impact Assessment
GS	Grey seal
HP	Harbour porpoise
HS	Harbour seal
HSD	Hydrosound-Damper
JNCC	Joint Nature Conservation Committee
MDS	Maximum Design Scenario
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MMOb	Marine Mammal Observer
NMS	Noise Mitigation System
ORJIP	Offshore Renewables Joint Industry Programme
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
OWFL	Offshore Wind Farm Limited
PAM	Passive Acoustic Monitoring
PCW	Phocine Carnivore in Water
PEIR	Preliminary Environmental Impact Report
PTS	Permanent Threshold Shift
SEL	Sound Exposure Level
SEL _{cum}	Cumulative Sound Exposure Level
SPL	Sound Pressure Level
SPL _{peak}	Peak Sound Pressure Level
SNCB	Statutory Nature Conservation Body
UXO	Unexploded Ordnance



Term	Definition
VE	Five Estuaries
VHF	Very High Frequencies
VMP	Vessel Management Plan
WTG	Wind Turbine Generator
μPa	Micropascal



GLOSSARY

Term	Definition
Applied Mitigation	Mitigation that has been applied throughout undertaking the assessments
Baseline	Refers to the existing conditions represented by the latest available survey and other data which are used to assess the benchmark for making comparisons to assess the impact of a development.
Development Consent Order	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact in question with the sensitivity of the receptor in question, in accordance with defined significance criteria.
Embedded Mitigation	Mitigation that is embedded in the project design
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial, resulting from the activities associated with the construction, operation and maintenance, or decommissioning of the project.
Magnitude	The extent of any interaction, the likelihood, duration, frequency and reversibility of any potential impact.
Maximum Design Scenario	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed.
Mitigation	Mitigation measures, or commitments, are commitments made by the project to reduce and/or eliminate the potential for significant effects to arise as a result of the project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects (applied mitigation).
Peak Sound Pressure Level	Characterised as a transient sound from impulsive noise sources, it is the maximum change in positive pressure as the wave propagates
PEIR	Preliminary Environmental Information Report. The PEIR is written in the style of a draft Environmental Statement (ES) and forms the basis of statutory consultation. Following consultation, the PEIR documentation will be updated into the final ES that will accompany the application for the Development Consent Order (DCO).
Receptor	These are as defined in Regulation 5(2) of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and include population and human health, biodiversity, land, soil, water, air, climate,



Term	Definition
	material assets, cultural heritage and landscape that may be at risk from exposure to pollutants which could potentially arise as a result of the Proposed Development.
Sensitivity	The potential vulnerabilities of receptors to an impact from VE, their recoverability and the value/importance of the receptor.
Significant Effects	It is a requirement of the EIA Regulations to determine the likely significant effects of the development on the environment which should relate to the level of an effect and the type of effect. Where possible significant effects should be mitigated.
Sound Exposure Level	Measure that considers both the received level and duration of exposure.
Sound Pressure Level	Measure of the average unweighted level of sound, usually a continuous noise source



8 MARINE MAMMAL MITIGATION PROTOCOL

8.1 INTRODUCTION

PROJECT BACKGROUND

- 8.1.1 Five Estuaries Offshore Wind Farm Ltd ('the Applicant') is proposing to develop Five Estuaries Offshore Wind Farm (VE) as an extension to Galloper Offshore Wind Farm that has been operational since 2018. The offshore elements for VE are adjacent to the east of the existing Galloper project, comprising seabed areas 37 km offshore from the Suffolk coast.
- 8.1.2 VE will include both onshore and offshore infrastructure including an offshore generating station (wind farm) of up to 79 wind turbine generators (WTG), two offshore substation platforms (OSP), export cables to landfall, and connection to the National Grid near Ardleigh, Essex.

PURPOSE OF THE OUTLINE MARINE MAMMAL MITIGATION PROTOCOL (MMMP)

- 8.1.3 The primary aim of this Outline MMMP is to detail the mitigation measures proposed to reduce the risk of permanent threshold shift (PTS) auditory injury to any marine mammal species in the close proximity to the pile driving for the installation of VE monopile and pin-pile foundations to negligible (as defined for magnitude and sensitivity in Tables 7.6 and 7.7 in Volume 2, Chapter 7: Marine Mammal Ecology). This Outline MMMP draws on the guidance provided by the Joint Nature Conservation Committee (JNCC, 2010) and Statutory Nature Conservation Bodies (SNCB) recommendations with regards to use of Acoustic Deterrent Devices (ADD) (JNCC, 2020).
- 8.1.4 This piling Outline MMMP has been developed for VE during the pre-consent phase and the final MMMP will be updated post-consent to take into account the most suitable mitigation measures. For unexploded ordnance (UXO) clearance, a Marine License will be applied for post-consent and included in that application will be a UXO MMMP. Therefore, this Outline MMMP is for pile driving activities for the foundation structures only.

IMPLEMENTATION OF THE OUTLINE MMMP

- 8.1.5 This document establishes the principles which will be implemented during construction. Following the granting of the Development Consent Order (DCO) and once the final project design has been confirmed, a final MMMP will be prepared following the principles established in this Outline MMMP. Specific details regarding proposed mitigation can be found in Volume 7, Report 2: Schedule of Mitigation.

8.2 DESCRIPTION OF THE PROJECT

SCENARIOS CONSIDERED

- 8.2.1 For the offshore aspects of VE, the Maximum Design Scenario (MDS) is the installation of up to 79 small or 41 large WTG foundations and two Offshore Substation Platforms (OSP).



- 8.2.2 Both monopiles and pin-piles may be installed at VE and so both foundation types have been assessed in the PEIR (see Volume 2, Chapter 7: Marine Mammal Ecology). The construction programme comprises the installation of up to 79 WTGs and up to two OSPs (81 structures in total) on either monopile or jacket (multileg) foundation structures over a period of 12 months. A summary of the parameters assessed are presented in the sections below, with the outcome of the marine mammal assessment summarised in Section 3.
- 8.2.3 For the purpose of the PEIR assessment, two different MDSs have been considered: a spatial MDS and a temporal MDS. The spatial MDS equates to the greatest area of effect from subsea noise at any one-time during piling. The temporal MDS represents the longest duration of effects from subsea noise. These two MDS' are presented in the sections below.
- 8.2.4 The assessment presented in Volume 2, Chapter 7: Marine Mammal Ecology of the PEIR, provides details on the predicted impacts arising from the MDS. The MDS is intended to cover the maximum piling parameters that would ever be required to install a foundation (in terms of maximum hammer energies and longest piling durations). The MDS, based on engineering predictions, is a maximum 7,000 kJ hammer energy for monopiles and 3,000 kJ for pin-piles.

MONOPILE MDS

- 8.2.5 Table 2.1 details the piling parameters that represent the spatial MDS (monopiles). For full details of the piling parameters see Volume 4, Annex 6.2: Underwater Noise Technical Report.

Table 2.1: Monopile MDS parameters

Parameter	Monopiles		
	Large WTG	Small WTG	OSP
Maximum hammer energy (kJ)	7,000	7,000	7,000
Number of monopiles	41	79	2
Maximum pile diameter (m)	15	13	15
Soft start duration (mins)	10	10	10
Ramp up duration (mins)	20	20	20
Maximum piling time per foundation (mins)	450	450	360
Maximum total piling time (hours)	307.5	592.5	12

PIN-PILE MDS

- 8.2.6 Table 2.2 details the piling parameters that represent the temporal MDS (pin-piles). For full details of the piling parameters see Volume 4, Annex 6.2: Underwater Noise Technical Report.



Table 2.2: Multi-leg pin-piled jackets MDS parameters

Parameter	Multi-leg pin-piled jackets		
	Large WTG	Small WTG	OSP
Maximum hammer energy (kJ)	3,000	3,000	3,000
Number of jacket foundations	41	79	2
Number of legs per foundation	4	4	6
Pin-piles per leg	1	1	2
Total pin-piles	164	316	24
Maximum pile diameter (m)	3.5	3.5	3.5
Soft start duration (mins)	10	10	10
Ramp up duration (mins)	20	20	20
Maximum piling time per foundation (mins)	240	240	240
Maximum total piling time (hours)	656	1,264	96

8.3 SUMMARY OF POTENTIAL IMPACTS

MAXIMUM DESIGN SCENARIO

8.3.1 For full details of the piling Parameters assessed see Volume 4, Annex 6.2: Underwater Noise Technical Report.

INSTANTANEOUS AND CUMULATIVE PTS-ONSET

8.3.2 As per the approach set out in Volume 2, Chapter 7: Marine Mammals, only harbour porpoise, grey seal and harbour seal have been assessed in this MMMP. These were the species scoped into the PEIR chapter as agreed in the Pre- and Post-scoping Evidence Plan meetings and based on site-specific surveys that have been undertaken.

8.3.3 The largest instantaneous PTS-onset impact range (unweighted SPL_{peak}) for piling is estimated at 740 m for harbour porpoise. For all other marine mammal receptors, the maximum range was 60 m (Table 3.1). The largest PTS-onset impact range (weighted SEL_{cum}) for piling is estimated to be 7,300 m for harbour porpoise. For all other marine mammal receptors, the maximum range was <100 m (Table 3.1).



Table 3.3: Estimated instantaneous and cumulative PTS-onset impact ranges (m) at full hammer energy (MDS)

Species	Threshold	Monopile (7,000 kJ)	Pin-pile (3,000 kJ)
		Maximum range (m)	Maximum range (m)
Harbour porpoise	Unweighted SPL _{peak} 202 dB re 1µPa	740	590
Very high frequency (VHF) cetacean	VHF weighted SEL _{cum} 155 dB re 1 µPa ² s	7,300	5,400
Grey Seal	Unweighted SPL _{peak} 218 dB re 1µPa	60	<50
Phocid carnivores in water (PCW)	PCW weighted SEL _{cum} 185 dB re 1 µPa ² s	<100	<100
Harbour seal PCW	Unweighted SPL _{peak} 218 dB re 1µPa	60	<50
	PCW weighted SEL _{cum} 185 dB re 1 µPa ² s	<100	<100

SUMMARY OF IMPACTS ASSESSED FOR MARINE MAMMALS IN RELATION TO PTS FOR PILING NOISE

8.3.4 Volume 2, Chapter 7: Marine Mammal Ecology presents the full assessment of the impacts of PTS onset for piling noise of marine mammals. In summary, the assessment concluded that, with the use of embedded mitigation methods (outlined within this Outline Marine Mammal Mitigation Protocol), it is expected that the risk of PTS will be negligible under the MDS for both monopiles and pin-piles and is not therefore considered to have a significant effect on any marine mammal species considered in the assessment.

8.4 EMBEDDED ENVIRONMENTAL MEASURES

8.4.1 As part of the VE design process, a number of embedded environmental measures have been adopted to reduce the potential for impacts on marine mammals. These embedded environmental measures have evolved over the development process as the EIA has progressed and in response to consultation.

8.4.2 These measures typically include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing these embedded environmental measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of VE and are set out in this MMMP.



8.4.3 All monitoring and mitigation are detailed within Volume 7, Report 1: Schedule of Monitoring and Volume 7, Report 2: Schedule of Mitigation. Of primary relevance to this Outline MMMP, the Schedule of Mitigation includes a Commitment to develop and implement a piling MMMP.

8.4.4 Table 4.1 sets out the relevant embedded environmental measures within the design and how these affect the marine mammal assessment.

Table 4.4: Relevant marine mammal mitigation measures

Mitigation measure proposed	Project phase measure introduced	How the mitigation measures will be secured	Relevance to marine mammal assessment
A Vessel Management Plan will be developed pre-construction	Scoping	DCO requirements or dML conditions	The VMP will reduce the risk of vessel disturbance and collision risk. The assessment of vessel disturbance and collision risk are assessed in Sections 7.11, 7.12 and 7.13 of Volume 2, Chapter 7: Marine Mammal Ecology
A piling MMMP will be implemented during construction and will be developed in accordance with JNCC (2010) guidance and up to date current best practise. The piling MMMP will include details of soft start to be used during piling operations.	Scoping	DCO requirements or dML conditions	The piling MMMP will reduce the impact of underwater noise from piling activities, lowering the risk of injury, including PTS
A decommissioning MMMP will be implemented during the decommissioning phase and will be in line with the latest relevant guidance	PEIR	DCO requirements or dML conditions	The decommissioning MMMP will reduce the impact of underwater noise generated from decommissioning activities, lowering the risk of injury including PTS



8.5 MITIGATION METHODOLOGY

INTRODUCTION

- 8.5.1 In order to minimise the risk of any auditory injury to marine mammals from underwater noise during pile driving, there is a suite of mitigation measures that could be implemented for VE piling. These mitigation measures may include (but are not limited to) the following:
- > Pre-piling deployment of ADDs;
 - > Marine Mammal Observation (MMOb);
 - > Passive acoustic monitoring (PAM) system; and
 - > Piling soft start procedure.
- 8.5.2 The specific mitigation measure (or suite of measures) that will be implemented during the construction of VE will be determined, in consultation with relevant SNCBs, following the appointment of the installation contractors (and therefore, confirmation of final hammer energies and foundation types), collection of additional survey data (noise or geophysical data) and/ or acquisition of noise monitoring data, and/ or information on maturation of emerging technologies. This additional data and information will allow the noise modelling to be updated to feed into the final MMMP and discussions on the appropriate mitigation measure(s).
- 8.5.3 The following sections provide a high-level methodology for each of these elements. A final MMMP will be produced for approval by the MMO prior to the relevant works commencing.

MITIGATION ZONE

- 8.5.4 The mitigation zone is defined as the maximum potential PTS-onset impact range. VE will update the noise modelling, if required, prior to construction once the final project details are known. The JNCC (2010) recommends a mitigation zone of 500 m during piling. The actual mitigation zone for VE piling will be confirmed in the final MMMP and will be determined based on the final confirmed foundation options and hammer energies etc. If the final noise modelling estimates a PTS-onset impact range larger than the 500 m suggested in the JNCC piling guidance, the mitigation zone will be increased to cover the PTS-onset impact.

MARINE MAMMAL OBSERVERS

- 8.5.5 JNCC recommends a pre-piling search of a minimum period of 30 minutes (JNCC 2010) for both monopiles and pin-piles. The marine mammal observer (MMOb) would undertake visual monitoring for marine mammals within the defined mitigation zone around the piling location from a suitable elevated platform. The MMOb would record all periods of marine mammal monitoring, including start and end times. Details of environmental conditions (sea state, weather, visibility, etc.) and any sightings of marine mammals around the piling vessel would also be recorded as per JNCC marine mammal recording forms and guidelines. In addition, any obvious responses of animals to the ADD activation (see section below) would be recorded (e.g. a change in behaviour from milling or bottling, to directed travel away from the ADD at the onset of ADD activation).



- 8.5.6 If, during the MMOB pre-piling search, a marine mammal is detected within the mitigation zone, the soft start will be delayed until it is assessed by the MMOB that the marine mammal has vacated the mitigation zone and a further 20 minutes have elapsed since the last detection within the mitigation zone. At the same time, the ADD will be checked to ensure correct operation. The MMOB would continue to note detections and observations on animal behaviour during the soft start period.
- 8.5.7 Full details on the role and responsibilities of the MMOB with respect to piling are described in JNCC guidelines for minimising the risk of injury to marine mammals from piling noise (JNCC 2010).
- 8.5.8 The specific details regarding MMOBs and methods employed will be updated in the final MMMP with respect to any updated and available guidance at the time.

PASSIVE ACOUSTIC MONITORING

- 8.5.9 A Passive Acoustic Monitoring (PAM) system may be used to allow a trained PAM operative to conduct acoustic monitoring. This would be utilised in conjunction with visual monitoring during daylight operations and/ or as an alternative method of monitoring the mitigation zone during periods of reduced visibility (e.g. at night, fog, high sea state i.e. above sea state 4 as per JNCC 2010). If a PAM is not available for monitoring, then piling would be unable to commence during such periods of restricted visibility that are not conducive to visual monitoring as there is a greater risk of failing to detect the presence of marine mammals.

PRE-PILING DEPLOYMENT OF ACOUSTIC DETERRENT DEVICES (ADD)

ADD CHOICE AND SPECIFICATION

- 8.5.10 If an ADD is chosen as part of the suite of mitigation measures set out in the final MMMP, the ADD that is likely to be used is the Lofitech AS seal scarer, although this will be confirmed within the final MMMP. This ADD has been shown to have the most consistent effective deterrent ranges for harbour seals, grey seals and harbour porpoise (Sparling *et al.*, 2015; McGarry *et al.*, 2017). The Lofitech AS seal scarer has been successfully used for marine mammal mitigation purposes at a number of OWF construction projects in Europe, including the C-Power Thornton Bank OWF in Belgium (Haelters *et al.*, 2012), the Horns Rev II, Nysted and Dan Tysk OWFs in Denmark (Carstensen *et al.*, 2006; Brandt *et al.*, 2009; Brandt *et al.*, 2011; Brandt *et al.*, 2013; Brandt *et al.*, 2016). Additionally, Lofitech AS seal scarer has been used as mitigation for UK projects such as Dudgeon Offshore Wind Farm, Beatrice Offshore Wind Farm and Race Bank Offshore Wind Farm.
- 8.5.11 It is important to note that there may be additional ADD models identified in the pre-construction phase for VE that are available and suitable for use. As such, if an ADD is identified as part of the suite of mitigation measures set out in the final MMMP, the final ADD choice and specification would be confirmed within the final MMMP.

DURATION OF DEPLOYMENT

- 8.5.12 Herschel *et al.* (2013) recommend that the ADD should be activated for at least as long as it takes for a marine mammal to swim twice the distance of the injury zone at the onset of soft-start piling. The duration of ADD deployment would be calculated using swimming speed assumptions to ensure that marine mammals are beyond the mitigation zone when piling commences.



- 8.5.13 A swim speed of 1.5 m/s (Lepper *et al.*, 2012; Otani *et al.*, 2000) will be assumed for all marine mammals. A recent study by Kastelein *et al.*, (2018) showed that a captive harbour porpoise responded to playbacks of pile driving sounds by swimming at speeds significantly higher than baseline mean swimming speeds, with greatest speeds of up to 1.97 m/s which were sustained for the 30-minute test period. In another study, van Beest *et al.*, (2018) showed that a harbour porpoise responded to an airgun noise exposure with a fleeing speed of 2 m/s.
- 8.5.14 Marine mammals are expected to continue moving away during the soft start and throughout the ramp up. In addition, the presence of novel vessel activity on-site is also predicted to result in animals moving away from the piling location and out of the mitigation zone prior to the commencement of piling (Brandt *et al.*, 2018; Graham *et al.*, 2019).
- 8.5.15 The duration of the ADD will be based on the maximum PTS-onset range for the hammer energy at the commencement of the soft-start (1,050 kJ for monopile and 450 kJ for pin-piles) and will be determined on the underwater noise modelling presented in the Environmental Statement. This ADD duration will be subject to review and finalised in the final MMMP which will be submitted under the dML condition during the pre-construction phase.

ADD DEPLOYMENT PROCEDURE

- 8.5.16 The JNCC (2010) guidance states that “ADDs should be switched on throughout the pre-piling search and turned off immediately after the piling activity has started”. Given that the pre-piling search is recommended to be a minimum of 30 minutes, this means that the ADD should be activated for a minimum of 30 minutes. Recent best-practice for offshore wind farms has involved the required ADD duration to be observed to ensure an animal is outside any PTS-onset range being run concurrently to the MMObs watch, but not for the full MMObs watch period. This ensures that the risk of PTS is negligible, whilst avoiding excessive disturbance to marine mammals through extended ADD durations. The final ADD activation period will be discussed and agreed with SNCBs and JNCC, prior to MMO approval, to ensure that the mitigation ensures clearance of the mitigation zone without resulting in unnecessary disturbance impacts.
- 8.5.17 It is expected that during monopile or pin-pile installation, one ADD will be deployed from the deck of the piling platform/vessel, with the control unit and power supply on board the platform/vessel in suitable, safe positions on deck. The ADD will be verified for operation prior to pre-piling activation. The exact deployment procedure will be agreed once the piling contractor is in place and will follow safe, standard working practices using experienced/trained staff to ensure the ADD equipment is used and deployed correctly within the confines of different vessel layouts.



ADD OPERATOR TRAINING AND RESPONSIBILITIES

8.5.18 A trained and dedicated ADD operator will be responsible for ADD maintenance, operation and reporting. The ADD duties involved would be to deploy the ADD from the installation platform or vessel, to verify the operation of the ADD before deployment, to operate the ADD throughout the pre-piling period (and be available in the case of piling breaks to reactivate), ensure batteries are fully charged and that spare equipment is available in case of any problems, and record and report on all ADD and piling activity. Prior to the start of the marine mammal observer pre-piling watch period, the ADD operator will test the equipment to ensure the ADD is working and ensure they are deployed appropriately from the vessel or jacket to an agreed depth. Following the deployment and testing of the ADD equipment, before the commencement of the soft start procedure (for monopiles/pin-piles respectively), the ADD operator will activate the ADD and the marine mammal observer will commence the pre-piling watch. When the soft start commences the ADD operator will deactivate the ADD.

SOFT START PROCEDURE

8.5.19 Following the pre-piling deployment of the ADDs and the marine mammal observer pre-piling watch, the installation of each foundation will commence with a soft start of reduced maximum hammer energy for set duration of time. The hammer energy will then ramp up in steps until the levels required to install the pile are reached or up to the maximum hammer energy. The “soft-start” comprises the piling procedure from the first blow until the maximum energy is reached. The parameters will be determined in the pre-construction MMMP as the safe and effective operation of the piling hammer will need to be considered.

8.5.20 The hammer energy will not be increased above the hammer energy required to complete each installation – i.e. if ground conditions are such that a lower than maximum hammer energy is sufficient to complete installation, then hammer energy will not be unnecessarily ramped up to full hammer energy.

BREAKS IN PILING

8.5.21 Breaks in the piling process could provide the potential for marine mammals to re-enter the mitigation zone. The guidance provided in JNCC (2010) states:

“If there is a pause in the 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”.

8.5.22 However, the ability to restart with a soft start may depend on the stage of piling and the pile/soil behaviour. If it is not possible to re-start with a soft start, the pre-piling ADD deployment and pre-piling search would be conducted before recommencing piling. The final procedure for breaks in piling will be agreed with input from the piling contractor (once contracted) and SNCBs and set out within the final MMMP.



DELAY IN COMMENCEMENT OF PILING

8.5.23 Should there be a delay in the commencement of piling, there is a risk of animals moving back into the mitigation zone when ADDs are switched off. However, there is also a risk of habituation as a result of no aversive piling noise commencing after ADD activation. ADDs will therefore be turned off as soon as the delay in the commencement is realised. The ADD will not be switched on again until there is confirmation that piling is ready to commence. The ADD will then be reactivated, as above, for the minimum duration required for animals to move out of the mitigation zone.

COMMUNICATIONS

8.5.24 The final MMMP will detail a communications 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 undertaken for all piling activities.

8.5.25 The final MMMP will also detail all key personnel and their responsibilities to ensure that all marine mammal mitigation measures are successfully undertaken for all piling activities. This will be developed based on the mitigation measures and personnel required with the titles and responsibilities being refined depending on the contractual agreement.

REPORTING

8.5.26 Reports detailing the piling activity and mitigation measures would be prepared. Where appropriate these include, but are not necessarily limited to:

- > Outline of the marine mammal monitoring methodology and procedures employed;
- > Record of piling operations detailing date, soft start duration, piling duration, hammer energy during soft start and piling and any operational issues for each pile;
- > Record of ADD deployment, including start and end times of all periods of ADD activation, any problems with ADD deployment;
- > Record of marine mammal observations and PAM detections including duration of marine mammal observer pre-piling search;
- > Environmental conditions during the pre-piling search, description of any marine mammal sightings/PAM directions and any actions taken, and a record of any incidental sightings made during outwith the pre-piling search;
- > Details of any problems encountered during the piling process including instances of noncompliance with the agreed piling protocol; and
- > Any recommendations for amendment of the protocol.



8.5.27 Reports would be collated and provided to MMO on a weekly basis during the period in which piling operations are being conducted. In addition, a final report is provided following the completion of the construction activity which would be submitted to MMO. The final report will include any data collected during piling operations, details of ADD deployment, details of pre-piling search periods and observations, a detailed description of any technical problems encountered and what, if any, actions were taken. The report will also discuss the protocols followed and put forward recommendations based on project experience and the use of ADDs as mitigation during the construction period that could benefit future construction projects.



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