



**SCOTTISHPOWER  
RENEWABLES**

# **East Anglia TWO Offshore Windfarm**

## **Marine Mammals**

### **Marine Mammal Mitigation Protocol**

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## Glossary of Acronyms

|                     |   |
|---------------------|---|
| ADD                 | Acoustic Deterrent Device                       |
| DCO                 | Development Consent Order                       |
| EIA                 | Environmental Impact Assessment                 |
| ELO                 | Environmental Liaison Officer                   |
| EOD                 | Explosive Ordnance Disposal                     |
| ES                  | Environmental Statement                         |
| JNCC                | Joint Nature and Conservation Committee         |
| kg                  | Kilogram  |
| kJ                  | Kilojoules                                      |
| km                  | Kilometre                                       |
| km <sup>2</sup>     | Kilometre squared                               |
| LAT                 | Lowest Astronomical Tide                        |
| LiDAR               | Light Detection and Ranging                     |
| m                   | Metre   |
| m/s                 | Metres per second                               |
| MMMP                | Marine Mammal Mitigation Protocol               |
| MMO                 | Marine Management Organisation                  |
| MMOs                | Marine Mammal Observers                         |
| MW                  | Megawatt  |
| NEQ                 | Net Explosive Quantities                        |
| NMFS                | National Marine Fisheries Services              |
| NOAA                | National Oceanic and Atmospheric Administration |
| PAM                 | Passive Acoustic Monitoring                     |
| PTS                 | Permanent Threshold Shift                       |
| SAC                 | Special Area of Conservation                    |
| SEL                 | Sound Exposure Level                            |
| SEL <sub>cum</sub>  | Cumulative Sound Exposure Level                 |
| SIP                 | Site Integrity Plan                             |
| SNCB                | Statutory Nature Conservation Body              |
| SPL                 | Sound Pressure Level                            |
| SPL <sub>peak</sub> | Peak Sound Pressure Level                       |
| UK                  | United Kingdom                                  |
| UXO                 | Unexploded Ordnance                             |

## Glossary of Terminology

|  |  |
|--|--|
| Applicant  | East Anglia TWO Limited.   |
| Construction, operation and maintenance platform | A fixed structure required for construction, operation and maintenance personnel and activities.   |
| East Anglia TWO project                          | The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure. |
| East Anglia TWO windfarm site                    | The offshore area within which wind turbines and offshore platforms will be located.   |
| Inter-array cables                               | Offshore cables which link the wind turbines to each other and the offshore electrical platforms. These cables will include fibre-optic cables.  |
| Landfall   | The area (from Mean Low Water Springs) where the offshore export cables would make contact with land, and connect to the onshore cables.   |
| Meteorological mast                              | An offshore structure which contains meteorological instruments used for wind farm data acquisition.   |
| Monitoring buoys                                 | Buoys to monitor <i>in situ</i> conditions within the windfarm, for example, wave and met ocean conditions.  |
| Offshore cable corridor                          | This is the area which will contain the offshore export cable between offshore electrical platforms and landfall jointing bay.   |
| Offshore development area                        | The East Anglia TWO windfarm site and offshore cable corridor (up to Mean High Water Springs).   |
| Offshore electrical infrastructure               | The transmission assets required to export generated electricity to shore. This includes the inter-array cables from the wind turbines to the offshore electrical platforms, offshore electrical platforms, platform link cables and export cables from the offshore electrical platform to the landfall.  |
| Offshore electrical platform                     | A fixed structure located within the windfarm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.  |
| Offshore export cables                           | The cables which would bring electricity from the offshore electrical platforms to the landfall. These cables will include fibre optic cables.   |
| Offshore infrastructure                          | All of the offshore infrastructure including wind turbines, platforms, and cables.   |
| Offshore platform                                | A collective term for the offshore construction operation and maintenance platform and the offshore electrical platforms.  |
| Platform link cable                              | An electrical cable which links one or more offshore platforms. These cables will include fibre optic cables.  |
| Scour protection                                 | Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.  |

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# 1 Introduction

## 1.1 Purpose of this Document

1. The purpose of this draft Marine Mammal Mitigation Protocol (MMMP) is to demonstrate the principles of the final MMMP to be submitted for approval as required under the draft Development Consent Order (DCO) for the proposed East Anglia TWO project, and to detail contingency arrangements to respond to and minimise the impacts of unexploded ordnance (UXO) clearance and piling associated with the construction of the proposed East Anglia TWO project.
2. The draft DCO states that:

*No removal or detonation of UXO can take place until the following have been submitted to and approved in writing by the MMO -*

*a marine mammal mitigation protocol in accordance with the draft marine mammal mitigation protocol, the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies;*
3. The draft DCO states that:

*The licensed activities or any part of those activities must not commence until the following (as relevant to that part) have been submitted to and approved in writing by the MMO: In the event that driven or part-driven pile foundations are proposed to be used, a marine mammal mitigation protocol in accordance with the draft marine mammal mitigation protocol, the intention of which is to prevent injury to marine mammals, following current best practice as advised by the relevant statutory nature conservation bodies.*
4. This draft MMMP is in relation to potential impacts of piling and for UXO clearance. During the pre-construction period separate MMMPs for both piling and UXO clearance will be developed for the proposed East Anglia TWO project. The final MMMPs to be developed will take account of the most suitable mitigation measures.
5. This draft MMMP for piling and UXO clearance sets out the protocol of how the proposed East Anglia TWO project would:
  - Mitigate impacts assessed in the Environmental Impact Assessment (EIA) to reduce the likelihood of injury to marine mammals as a result of underwater noise during underwater piling operations and UXO clearance; and
  - Meet the relevant licence condition as stated above.

6. The final MMMP for piling and UXO clearance will be submitted to the MMO at least six months prior to construction, in consultation with the relevant SNCBs. East Anglia TWO Limited will follow the relevant guidelines at the time in relation to a strategic approach to construction and monitoring, and the development of the final MMMP for both piling and UXO clearance as detailed in the In-Principle Monitoring Plan (DCO Document 8.12).

## 2 Description of the Project

7. East Anglia TWO Ltd ('the Applicant') is seeking a DCO for the proposed East Anglia TWO project, an offshore windfarm located in the southern North Sea.
8. The East Anglia TWO windfarm site will cover an area of approximately 218km<sup>2</sup> in the southern North Sea; approximately 33km from its nearest point to Southwold and 37km from the port of Lowestoft. Water depths within the site range from 33 to 67m (relative to the Lowest Astronomical Tide (LAT)), with water depths generally increasing in the south-east of the East Anglia TWO windfarm site.
9. Once built, the proposed East Anglia TWO project would comprise the following offshore components:
  - The offshore wind turbines and their associated foundations;
  - Scour protection around foundations as required;
  - Offshore electrical platforms supporting required electrical equipment, possibly also incorporating offshore facilities;
  - Up to one meteorological mast (met mast) and associated foundations for monitoring wind speeds during the operational phase;
  - Up to one construction, operation and maintenance platform may be required to house construction, operation and maintenance personnel and equipment; and
  - Subsea cables comprising inter-array, platform link and offshore export cables and associated cable protection as required.
10. The detailed design of the proposed East Anglia TWO project (e.g. numbers of wind turbines, layout configuration, foundation type and requirement for scour protection) would not be determined until post-consent. Therefore, realistic worst-case scenarios in terms of potential impacts/effects are adopted to undertake a precautionary and robust impact assessment.
11. The proposed East Anglia TWO project would consist of a maximum of 60 x 300m or 75 x 250m blade tip height wind turbines (above Lowest Astronomical Tide

- (LAT). Therefore, the assessments in the Environmental Statement (ES) are based on a worst case of either 60 x 300m or 75 x 250m turbines.
12. The full offshore construction window is expected to be approximately 27 months and offshore construction is anticipated to commence around 2025.
  13. There is the likely requirement for UXO clearance prior to construction. Whilst any underwater UXO that are identified would preferentially be avoided, it is necessary to consider the potential for underwater UXO detonation where retrieval is deemed to be unsafe and avoidance is not possible.
  14. A detailed UXO survey would be completed prior to construction. The exact number of possible detonations and duration of UXO clearance operations is therefore not known at this stage. It has been estimated, based on the UXO survey for the currently under-construction East Anglia ONE (East Anglia ONE Limited 2018), that there could be up to approximately 80 UXO within the offshore development area.
  15. It is not currently known the size or type of the UXO that could be present, therefore a range of charge sizes, based on the UXO survey for East Anglia ONE (East Anglia ONE Limited 2018), has been assessed, with the maximum charge weight of up to 700kg.
  16. The maximum charge weight assumed is considered to provide a good baseline for predicting and measuring the effects of any UXO that could be encountered within the offshore development area.

## 2.1 Key Relevant Project Characteristics and Worst-Case Scenarios

| Parameter   | Characteristic  |
|---|---|
| Approximate construction duration   | 27 months   |
| East Anglia TWO windfarm site area  | 218km <sup>2</sup>  |
| Maximum offshore cable corridor area  | 138km <sup>2</sup>  |
| East Anglia TWO windfarm site water depth range   | 33m to 67m (relative to the LAT)  |
| Distance from East Anglia TWO windfarm site to shore (closest point of site to Southwold) | 33km  |
| Number of wind turbines   | Up to 75  |
| Number of other offshore platforms  | Up to four electrical platforms.<br><br>One construction, operation and maintenance platform. |

| Parameter                                       | Characteristic  |
|---|---|
|   | One met mast.   |
| Wind turbine foundation type options            | 1 (monopile) or<br>4 legged jacket (pin-piles) or<br>4 legged jacket (suction caisson) or<br>Suction caisson or<br>Gravity base foundation.   |
| Meteorological mast foundation type options     | 1 monopile or<br>4 legged jacket (pin-piles) or<br>4 legged jacket (suction caisson) or<br>Suction caisson or<br>Gravity base foundation.   |
| Offshore platform foundation type options       | 8 legged jacket (pin-piles) or<br>8 legged jacket (suction caisson) –or<br>Gravity base foundation.   |
| Number of piles per foundation                  | <u>Wind turbines:</u><br>1 (monopile) or<br>4 legged jacket (pin-piles).<br><u>Offshore platforms:</u><br>8 legged jacket (pin-piles).<br><u>Met mast:</u><br>1 monopile or<br>4 legged jacket (pin-piles). |
| Maximum number of piles<br>- Wind turbines      | 75 x 4 pin-piles (250m wind turbine with 4 legged jacket)<br>= 300  |
| Maximum number of piles<br>- Offshore platforms | 4 x offshore electrical platform with 8 piles =<br>32<br><br>1 x Met masts = 4  |

| Parameter                          | Characteristic  |
|------------------------------------|---|
|                                    | 1 x construction, operation and maintenance platform = 8<br><br>Total = 44  |
| Hammer energies                    | Maximum hammer energy:<br><br>2,400kJ pin-pile<br><br>4,000kJ monopile<br><br>Starting hammer energies of 10% will be used followed by ramp-up. |
| Pile diameter                      | 15m monopile (300m wind turbine)<br><br>4.6m pin pile (300m wind turbine)   |
| Number of concurrent piling events | None  |
| Estimated number of UXO            | Up to 80*   |
| Estimated size of UXO              | Up to 700kg (net explosive quantity) *  |

*\*Indicative only – based on best available information from East Anglia ONE (East Anglia ONE Limited 2018).*

### 3 Background

17. The Applicant has made an assessment of potential impacts to marine mammals as part of the EIA which is reported in **Chapter 11 Marine Mammals** of the Environmental Statement (ES) (document reference 6.1.11).
18. At a project level, the potential impacts from the proposed East Anglia TWO project, based on the worst-case scenarios of piling and UXO clearance, have been assessed for any permanent auditory injury (Permanent Threshold Shift (PTS)) in harbour porpoise, grey seal and harbour seal as a result of underwater noise from UXO clearance or piling.
19. Both UXO clearance and piling have the potential to produce underwater noise capable of causing auditory injury and disturbance to marine mammals. This draft MMMP details how the Applicant would reduce the risk of underwater noise of UXO clearance and piling from causing auditory injury to marine mammals that could be present in and around the East Anglia TWO site.

20. Whilst any underwater UXO that are identified would preferentially be avoided, it is necessary to consider the requirement for underwater UXO detonation where it is deemed unsafe to retrieve the UXO from the seafloor.
21. For UXO clearance, it has been assessed that for harbour porpoise, the largest possible UXO clearance event in the site could have a major to moderate adverse impact without mitigation, for grey seal it could have a moderate adverse impact and for harbour seal it could have a minor adverse impact, without mitigation. The final MMMP developed in the pre-construction period, where more information is available on the sizes and locations of any UXO devices present, would reduce the impact to **minor adverse** for all species.
22. For the impact of PTS from piling, it has been assessed that a single strike of the starting hammer energy, or a single strike of the maximum hammer energy (for either monopiles or pin piles), could have a minor adverse impact on harbour porpoise, grey seal and harbour seal, with or without any mitigation. Permanent auditory injury (PTS) as a result of underwater noise during piling due to cumulative exposure in harbour porpoise, grey seal and harbour seal have also been assessed as minor adverse with or without mitigation. These impacts remain as **minor adverse** with mitigation measures implemented, as outlined below.
23. In addition to the draft MMMP, an In Principle East Anglia TWO Southern North Sea Special Area of Conservation (SAC) Site Integrity Plan (SIP) (document reference 8.17) has been submitted with the DCO application. This document sets out the approach for the Applicant to deliver the required mitigation measures for the proposed East Anglia TWO project to ensure the avoidance of Adverse Effect on Integrity to the designated features of the Southern North Sea SAC in-combination with other projects.

## 4 East Anglia TWO Commitments

24. In addition to the embedded mitigation secured through this MMMP (such as establishing a mitigation zone based on the maximum potential range for PTS, soft-start and ramp-up, and activation of ADDs prior to soft-start, see **section 5**), the Applicant has also committed to the following:
  - Only one UXO would be detonated at a time during UXO clearance operations in the East Anglia TWO offshore development area. There would be no simultaneous UXO detonations, but potentially more than one UXO detonation could occur in a 24 hour period.
  - There would be no concurrent piling at East Anglia TWO, with only one pile being installed at a time, with no overlap in the piling duration of any two piles.

Piles will be installed sequentially, and more than one pile could be installed in a single 24 hour period.

- There would be no UXO detonation in the East Anglia TWO offshore development area at the same time as piling in the East Anglia TWO offshore development area during the winter period, in that although they may occur in the same day or 24 hour period, they would not occur at exactly the same time.
- There would be no concurrent piling or UXO detonation between the proposed East Anglia TWO and East Anglia ONE North projects if both projects are constructed at the same time.

25. The commitments apply irrespective of any additional measures agreed through the development of the SIP.

## 5 Draft Protocols for UXO Clearance and Piling

### 5.1 UXO Clearance

26. The final MMMP for UXO clearance will ensure there are embedded mitigation measures, as well as any additional mitigation, if required, to prevent the risk of any physical or permanent auditory injury to marine mammals. This will be developed in the pre-construction period, when there is more detailed information on the level of UXO clearance required and hence, it will incorporate the most appropriate mitigation measures based upon best available information and proven methodologies at that time.
27. The Applicant is committed to using the best practicable means at the time to mitigate the impacts of the proposed East Anglia TWO project.
28. The protocol outlined below is in line with current best practice and will be updated no later than six months prior to construction.

#### 5.1.1 Mitigation Zone

29. The final MMMP would involve the establishment of a suitable mitigation zone around the UXO location before any detonation. The Applicant will ensure that the mitigation measures are adequate to ensure no marine mammals are present within the mitigation zone prior to any UXO detonation, to reduce the risk of any physical or permanent auditory injury (PTS).

30. The methods for achieving the mitigation zone would be agreed in consultation with the MMO and Natural England and secured as commitments within the final MMMP. The required mitigation measures could include:
- All detonations taking place in daylight.
  - The controlled explosions of the UXO, undertaken by specialist contractors, using the minimum amount of explosives required in order to achieve safe disposal of the device.
  - Consideration of any commercially available alternative (e.g. Low Order deflagration).
  - Monitoring of the mitigation zone by marine mammal observers (MMOs) during daylight hours and when conditions allow suitable visibility, pre- and post-detonation.
  - Deployment of passive acoustic monitoring (PAM) devices, if required, and if the equipment can be safely deployed and retrieved.
  - The activation of acoustic deterrent devices (ADDs).
  - If required and where possible and safe to do so, a soft-start procedure using scare charges.
  - The sequencing of detonations, if there are multiple UXO in close proximity to be disposed of near simultaneously, where practicable, will start with the smallest detonation and end with the larger detonations.
  - Protocol in event marine mammals are observed in the mitigation zone.

### 5.1.2 Concurrent UXO Detonations

31. The Applicant would ensure that no concurrent UXO detonations take place, i.e. there would be no simultaneous UXO detonations within the East Anglia TWO offshore development area, although they could occur within the same 24 hour period.

### 5.1.3 The Effectiveness of Possible Mitigation Measures

32. Based on the current predictive underwater noise modelling in the ES (**Chapter 11 Marine Mammals**), the maximum potential range for PTS for marine mammals from a UXO with a possible maximum charge weight of 700kg is:
- 3.6km for harbour porpoise using the NOAA (NMFS, 2018) weighted PTS SEL criteria of 155 dB re 1  $\mu\text{Pa}^2\text{s}$ .
  - 1.8km for grey and harbour seal using the NOAA (NMFS, 2018) weighted PTS SEL criteria of 185 dB re 1  $\mu\text{Pa}^2\text{s}$ .
33. Based on the 3.6km potential PTS SEL impact range for harbour porpoise, possible mitigation could include the use of MMOs and ADDs.

- For example, activation of the ADDs for 35 minutes prior to UXO detonation would allow marine mammals to move over 3.78km from the UXO location<sup>1</sup>.
34. Therefore, after the ADD activation there should be no harbour porpoise, grey seal or harbour seal in the potential impact range for PTS SEL from the largest UXO detonation.

#### 5.1.4 Reporting

35. Reports detailing all UXO clearance activity and mitigation measures will be prepared. This will include, but not necessarily be limited to:
- A record of UXO clearance operations detailing date, location and times including information on the 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 MMOs, 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 mitigation zone 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.
36. A final report will be submitted to the MMO. The final report will include any data collected during UXO clearance operations, details of all mitigation measures, a detailed description of any technical problems encountered and what, if any, actions were taken. The report will also discuss the protocols followed and put forward any recommendations and lessons learned based on the mitigation measures used that could benefit future projects.

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<sup>1</sup> Based on a precautionary marine mammal swimming speed of 1.8m/s; e.g. Kastelein et al. (2018) recorded swimming speeds of 1.97m/s in harbour porpoise during playbacks of pile driving sounds

### 5.1.5 Communication and Responsibilities

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

## 5.2 Piling

39. The final MMMP for piling will ensure there are embedded mitigation measures, as well as any additional mitigation, if required, to prevent the risk of any physical or permanent auditory injury to marine mammals. This will be developed in the pre-construction period, when there is more detailed information on the proposed East Anglia TWO project design (and environmental conditions) and hence, it will incorporate the most appropriate mitigation measures based upon best available information and proven methodologies at that time.
40. The protocol will be developed in consultation with the MMO and relevant SNCBs, detailing the proposed mitigation measures to reduce the risk of physical or permanent auditory injury (PTS) to marine mammals during all piling operations. This will include details of the embedded mitigation, for the soft-start and ramp-up, as well as details of the mitigation zone and any additional mitigation measures required to minimise potential impacts of any physical or permanent auditory injury (PTS). Consideration will be given to the requirements following any breaks in piling as well as prior to piling commencing. The Applicant is committed to using the best practicable means at the time to mitigate the impacts of the proposed East Anglia TWO project.
41. The protocol outlined below is in line with current best practice and will be updated no later than six months prior to construction.

### 5.2.1 Mitigation Zone

42. The final MMMP would involve the establishment of a mitigation zone around the pile location before each pile driving activity, based on the maximum predicted distance for permanent auditory injury (PTS).
43. The Applicant would ensure that the mitigation measures are adequate to minimise the risk of marine mammals being present within the mitigation zone prior to piling activity commencing, to reduce the risk of any physical or auditory injury.

### 5.2.2 Soft-Start and Ramp-Up

44. The Applicant would ensure that a soft-start and ramp-up procedure for piling is conducted for a minimum of 30 minutes. In the event that piling activity is stopped for more than 10 minutes, the Applicant would ensure that the soft-start and ramp-up procedure is conducted prior to piling re-commencing.
45. Each piling event would commence with a minimum of 10 minutes at 10% of the maximum hammer energy, followed by a gradual ramp-up for at least 20 minutes up to 80% of the maximum hammer energy for all pile driving activities. This 30 minute soft start and ramp-up procedure is more precautionary than the current JNCC (2010b) guidance, which recommends that the soft-start and ramp-up duration should be a period of not less than 20 minutes.
46. During the 30 minutes for the soft-start and ramp-up it is estimated that marine mammals would move at least 2.7km from the piling location<sup>2</sup>. This would therefore be greater than the maximum predicted distance of 1.2km for PTS from a single strike at the maximum hammer energy for monopiles of 4,000kJ, based on the unweighted SPL<sub>peak</sub> NOAA (NMFS 2018) criteria:
- During the 10 minute soft-start it is estimated that marine mammals would move a minimum of 0.9km from the piling (based upon a precautionary average marine mammal swimming speed of 1.5m/s); and
  - During the 20 minute ramp-up it is estimated that marine mammals would move a minimum of 1.8km from the piling location (based upon a precautionary average marine mammal swimming speed of 1.5m/s).

### 5.2.3 Concurrent Piling

47. The Applicant would ensure that no concurrent piling events take place, i.e. there would be no simultaneous piling operations from piling vessels within the East Anglia TWO windfarm site during construction, although more than one pile could be installed within the same 24 hour piling period.

### 5.2.4 Other Mitigation Measures

48. The final MMMP for piling could also include additional mitigation such as:
- The activation of ADDs prior to the soft-start; and / or
  - Monitoring of the mitigation zone by MMOs during daylight hours and when conditions allow suitable visibility; and / or

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<sup>2</sup> Based on a precautionary marine mammal swimming speed of 1.5m/s (Otani et al. 2000); however, Kastelein et al. 2018 recorded swimming speeds of 1.97m/s in harbour porpoise during playbacks of pile driving sounds

- Deployment of a PAM device, if required, during hours of darkness and poor visibility.
49. The final MMMP for piling will detail all agreed mitigation measures, including provision for any breaks in piling and piling at night or in poor visibility, to ensure that the mitigation measures are successfully undertaken for all piling activity.

### 5.2.5 Effectiveness of Mitigation Measures

50. Based on the current predictive underwater noise modelling as presented in **Chapter 11 Marine Mammals** of the ES (document reference 6.1.11):
- The maximum potential range for instantaneous PTS ( $SPL_{peak}$ ) from a single strike of the starting hammer energy of 400kJ would be 0.58km for harbour porpoise and less than 0.05km for grey and harbour seal.
    - Mitigation, such as the activation of ADDs prior to the first strike of the soft-start, would allow marine mammals to move away prior to the soft-start and ramp-up. For example, the activation of ADDs for 10 minutes prior to the soft-start would allow harbour porpoise and other marine mammals to move at least 0.9km from the piling location (based on a precautionary average marine mammal swimming speed of 1.5m/s), which is beyond the maximum PTS predicted impact range of 0.58km for the starting hammer energy of up to 400kJ. Therefore, after the ADD activation there should be no harbour porpoise, grey seal or harbour seal in the potential impact range for PTS from the first strike of the soft-start.
  - The estimated maximum ranges (without mitigation) within which cumulative sound exposure level ( $SEL_{cum}$ ) for PTS could occur in harbour porpoise is estimated to be 6.4km and 21km for the maximum hammer energy of the monopile (4,000kJ) and pin-pile (2,400kJ), respectively. The estimated maximum ranges (without mitigation) within which PTS  $SEL_{cum}$  could occur in grey and harbour seal 4.9km for the maximum hammer energy of the monopile (4,000kJ) and 6.8km for the maximum hammer energy of the pin-pile (2,400kJ).
51. Mitigation for East Anglia ONE windfarm consisted of a mitigation zone of 500m around each individual piling location, each piling event commenced with a soft-start of at least 20 minutes and an ADD was activated for 15-30 minutes immediately prior to the soft-start to actively deter marine mammals from the mitigation zone. During daylight hours MMOs conducted a dedicated pre-piling watch of the mitigation zone for a minimum of 30 minutes prior to the commencement of soft-start piling. At night and during periods of poor visibility pre-piling monitoring was undertaken by a PAM Operator using a PAM system. The three dedicated dual role MMOs / PAM Operators undertook visual

observations and acoustic monitoring for marine mammals during the installation of 102 three legged jacket foundations between the 25<sup>th</sup> April 2018 and the 30<sup>th</sup> January 2019. There were 675 hours and 38 minutes of visual observations and 880 hours and 46 minutes of acoustic monitoring conducted throughout the survey. During this time there were only three marine animal sightings, two of which were while the vessel was in transit and the other was on site and resulted in a delay to soft-start operations. No acoustic detections were made. This indicates that the mitigation implemented during piling at the East Anglia ONE windfarm was effective and there was no risk of physical or auditory injury to marine mammals.

### 5.2.6 Reporting

52. 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, 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 mitigation zone 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.
53. 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.

### 5.2.7 Communication and Responsibilities

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

## 6 References

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