natural power

CREATING A BETTER ENVIRONMENT

EPS Risk Assessment for Extension of Works

Caithness to Moray HVDC Project

25 July 2018

Document Number 1174549

ABB High Voltage Cables

Document history

Author	Anna Sweeney	25/07/2018
Checked	Stuart McCallum	25/07/2018
Approved	Stuart McCallum	25/07/2018

Client Details	
Contact	Siv Segerbratt
Client Name	ABB High Voltage Cables
Address	371 23, Karlskrona, Blekinge, SWEDEN

Issue	Date	Revision Details
A	19/07/2018	For issue
B	23/07/2018	Duration of works updated
C	25/07/2018	Client comments addressed

For full details on our ISO and other certifications, please visit: naturalpower.com/company

Local Office:

Unit 8
Horsley Business Centre
Horsley
Northumberland
NE15 0NY
Tel: +44 (0) 1661 312 100

Registered Office:

The Natural Power Consultants Limited
The Green House
Forrest Estate, Dalry
Castle Douglas, Kirkcudbrightshire
DG7 3XS

Reg No: SC177881
VAT No: GB 243 6926 48

Contents

Executive Summary

ABB High Voltage Cables (ABB) is currently installing High Voltage Direct Current (HVDC) and fibre optic cables between Caithness and Moray, Scotland, on behalf of Scottish Hydro Electric Transmission PLC (SHE Transmission). This interconnector will aid distribution of energy from current and proposed renewable energy projects in Northern Scotland to areas of electricity demand.

The objective of this document is to outline activity associated with the proposed backfill, rock placement, excavation/burial work, and possible cable replacement works, and assesses the potential effects that this may have on European Protected Species (EPS).

The following potential impacts on EPS likely to be present in the Moray Firth were assessed:

- Increased anthropogenic noise from backfill, rock placement, excavation/burial and cable replacement works;
- Increased anthropogenic noise from geophysical equipment which emits sound;
- Increased vessel noise; and
- Collision with vessels.

Following the JNCC *et al.* (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit) it can be concluded that, with mitigation for the Ultra-Short Base Line (USBL) systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from any backfill and rock placement work are unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) (referred to as the Offshore Regulations).

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from the proposed backfill, rock placement, excavation and cable replacement works are unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) (referred to as the Habitats Regulations). In relation to regulation 39(2) of the Habitats Regulations, the percentage of the reference population of each species which has the potential to be disturbed by use of the USBL systems and beacons is considered to be negligible (less than 1 % for the three main cetacean species which occur in the Moray Firth) and therefore not detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS).

It is therefore considered that an EPS licence (in order to permit the disturbance of cetacean EPS along the route of the Caithness to Moray HVDC in connection with the use of USBL systems and beacons) is required and is likely to be awarded on the basis of passing the key EPS tests.

SHE Transmission and NKT are committed to working responsibly. Therefore, in addition to the pre-work searches which will be implemented prior to use of the USBL systems and beacons, the following mitigation measures will also be adhered to:

- A nominated competent observer (e.g. an MMO if on board, or another assigned person) on the bridge of all vessels will keep watch for marine mammals and basking sharks during transits to and from the work site. Any sightings will be communicated to the Master of the vessel and the following actions, as per the Scottish Marine Wildlife Watching Code, implemented:
  - The Master of the vessel will ensure that marine mammals and basking sharks are avoided to a safe distance (100 m or more) in all possible circumstances; and
  - The Master of the vessel will minimise high powered manoeuvres where this does not impair safety.

1. Introduction

ABB High Voltage Cables (ABB) is currently installing High Voltage Direct Current (HVDC) and fibre optic cables between Caithness and Moray, Scotland, on behalf of Scottish Hydro Electric Transmission PLC (SHE Transmission).

Although the latest construction programme predicted completion by August 2018, some limited work is now likely to be required through 2018 to 2019. This document is to outline the activities that will occur past the 31st of August 2018 to allow for an extension of the current European Protected Species (EPS) licence (MS EPS 01 2018 1 which expires on 31st August).

The objective of this document is to:

- Describe the work proposed beyond the 31st August 2018;
- Assess any potential impacts on European Protected Species (EPS) of this work; and
- Determine the need for an EPS licence under the Conservation (Natural Habitats, &c.) Regulations 1994 (Council Directive 92/43/EEC; referred to as the Habitats Directive).

It should be noted that of the activities assessed as required under the current licence (*EPS Risk Assessment for Work Proposed in 2018*' (Document number: 1156585)), the following are all complete ':

- Cable pull-in at Portgordon; and
- Vibrocore works.

Furthermore, rock placement and backfill operations commenced in Q1/Q2 2018 but are yet to be concluded. Therefore, these continue to be assessed within this risk assessment, however the assessment below will be of a reduced activity length compared to that reported in *EPS Risk Assessment for Work Proposed in 2018*' (Document number: 1156585).

2. Extension of Proposed Work

There is potential for the following activities to be undertaken in the remainder of 2018 and in 2019:

- Backfill operations;
- Rock placement;
- Excavation work (of laid cable) and burial works;
- Cable replacement work; and
- Associated surveys for each activity.

Each campaign will either utilise existing survey data from previous campaigns or, or collect new survey data upon arrival at the field. A Multibeam Echo Sounder (MBES) survey is the typical method for mapping the current seabed conditions. Each campaign will also record the 'As Left' conditions by carrying out another MBES survey at the end of the campaign. Ultra-Short Base Line (USBL) will be used for works where Remote Operated Vehicle (ROV) or other tooling is utilised that require live positioning record. Frequencies and noise levels depend on the vessel's USBL system and will be part of the actual engineering documents for each campaign, however for the purposes of the assessment an assumed worst case has been used for source level and frequency.

2.1. Backfill

Backfill operations will be conducted from an Anchor Handling Tug Supply (AHTS) vessel or similar. The mechanical backfill will use a SCAR plough which will be used in backfill mode and will return the trenching excavation materials from along the cable route to over the exposed cable to provide suitable cover.

A work class ROV will be used during the backfill operations to:

- Monitor the launching, towing, and recovery of the SCAR plough system;
- Investigate targets or obstructions on the seabed in the path of the SCAR plough;
- Complete seabed surveys; and
- Assist with contingency operations.

During the nearshore (<15 m LAT) backfill, a multicat vessel is anticipated to be required to support the positioning and towing of the SCAR plough by the AHTS vessel. The multicat will use USBL positioning to monitor the progress of the SCAR plough during the operations.

Surveys will be performed as soon as possible after backfill has been completed over any section of the cable route; this is to allow the release of the guard vessels and to open up the area for marine users. Surveys may be undertaken by a separate vessel (i.e. a small survey vessel/ autonomous underwater vehicle (AUV)) – particularly in the nearshore areas.

The work will require the use of an MBES system for pre/post-work surveys, USBL positioning systems and beacons to monitor positioning of the SCAR plough and ROV, a Doppler Velocity Log (DVL) for positioning and navigation, and Obstacle Avoidance Sonar (OAS) to monitor progress during the works.

2.1.1. Proposed Vessels

Details of the vessels proposed for use during backfill are provided in Table 2.1 below.

Table 2.1: Vessels potentially used for backfill

Vessel	Use
Anchor Handling Tug Supply (AHTS) Vessel	Towing of the plough/ROV surveys
Shallow draft multicat vessel	Assist in launching and monitoring the scar plough

Vessel	Use
	until the water depth is suitable for the ROV
Small survey vessel/AUV*	Pre/post backfill surveys

not necessarily required

2.2. Rock Placement

The rock placement work will comprise stabilisation and protection work in discreet areas along the entirety of the route (i.e. from Portgordon, Moray to Noss Head, Caithness). The exact locations where rock placement will be needed are not yet finalised as they are dependent on other ongoing work. Water depths where rock placement is required vary from 6m LAT up to 100m LAT. The rock placement activities will be executed by Dynamic Positioned Fall Pipe Vessels (DPFPVs). Larger rocks (i.e. those that cannot be placed by fall pipe) will be placed on to the rock berm through use of a crane and large rock grab.

The rock placement is required in areas where no trenching is foreseen, where the soil conditions are deemed unsuitable for trenching and where the required burial depth is not met (or where it is not anticipated that it will be met) after the backfill operations.

The work will require the use of a MBES system for pre and post-work surveys, USBL positioning systems and beacons (to monitor positioning of the ROV), a DVL for positioning and navigation, and OAS to monitor progress during the work.

2.2.1. Proposed Vessels

The DPFPVs are purpose built vessels for the accurate placement of rock/gravel material in a controlled manner by using a fall pipe. The fall pipe is deployed through a moonpool in the centre of the vessel. It is envisaged that DPFPV *Seahorse* will be the main vessel for this work (as per the scope complete in 2017), however other comparable vessels may be used. DPFPV *Seahorse* is also equipped with an inclined fallpipe system (IFPS) which is used for hard to reach locations in shallow waters or close to structures. For the placement of any large rocks, a crane vessel (anticipated to be of equivalent size or smaller than the DPFPV) equipped with a rock grab will be used. Small survey vessels / AUV's may also be used for the pre/post survey activities.

Table 2.2: Vessels potentially used for rock placement

Vessel	Use
Dynamic Positioned Fall Pipe Vessels (DPFPVs)	Rock placement offshore
Crane barge	Large rock placement and nearshore works
Small survey vessel*	Pre/post operational surveys

not necessarily required

2.3. Excavation and Burial Works

Additional excavation/burial works will likely be required and will take one of the forms previously assessed such as the mass flow excavation system; jet trenching; an air lift/excavation system operated by an ROV or a subsea excavation vehicle. The exact locations for excavation and inspection are yet to be decided however it is anticipated that excavation/burial work may be required between KP 83-86, and between KP 11-16 (although this activity may be required at other locations).

A survey of burial depth is also due to be undertaken in the nearshore Portgordon area (KP 1.6-3.5) using cable tracking equipment or a Pangeo acoustic profiler operated from an ROV. Alternatively, a diver survey may be utilised to undertake the burial depth survey using a hand held cable tracker. Depending on the outcome of the survey, additional burial work may be undertaken in line with that proposed at other locations, however due to the shallow water, the dredge heads may be positioned by divers for some or all of the remedial scope.

The excavation system(s) will be deployed from an AHTS vessel (or similar) and will be used to erode seabed material to expose or bury the cables. Pre/post work surveys are likely to be required.

It is assumed the work may require the use of a MBES and/or scanning sonar system for pre and post-work surveys, USBL positioning systems and beacons (to monitor positioning of the ROV), a DVL for positioning and navigation, and OAS to monitor progress during the work.

2.3.1. Proposed Vessels

Previously the works have been carried out by an AHTS vessel or a self-propelled crane barge with assistance from a tug when laying out its anchors in the nearshore areas. It is anticipated that the same/similar vessels will be used for other work of this type, although it is recognised that it will depend on the exact excavation method decided and the working environment. Small survey vessels / AUV's may be utilised to survey the work if required.

Table 2.3: Vessels potentially used for excavation/burial works

Vessel	Use
Anchor Handling Tug Supply (AHTS) Vessel	Deployment of excavation/burial systems
Shallow draft multicat vessel	Deployment of excavation/burial systems for works in shallow water
Small survey vessel/AUV*	Pre/post backfill surveys

**not necessarily required*

2.4. Cable Replacement Works

The cable replacement procedure will utilise an ROV and/or divers. The replacement works are proposed to occur between KP11-16 and 83-86 and will be confirmed after completion of testing and surveys.

The Cable Lay Vessel (CLV) will position itself as near to replacement locations as water depth and cable parameters allow. An ROV/diver will be deployed and used for survey and recovery of the cable. The ROV/diver will conduct a visual/sonar survey. The divers/ROV will be fitted with USBL positioning beacons.

The cable will be paid out from the CLV once replaced and jointed. The ROV/diver will monitor the replacement operations as well as the as laid position of the cable in the trench. This process will be repeated for each section as required.

After the cables have been replaced successfully, the ROV (or potentially small survey vessel/ AUV) will complete an 'as laid' survey to inspect the cables laid.

It is assumed the work may require the use of a MBES and/or scanning sonar system for pre and post-work surveys, USBL positioning systems and beacons (to monitor positioning of the ROV), a DVL for positioning and navigation, and OAS to monitor progress during the work.

2.4.1. Proposed Vessels

The cable replacement will require the use of the CLV. Additional vessels (e.g. shallow draught multicats/workboats and diver/ROV support vessels) may also be required to aid the replacement due to water depth. Small survey vessels / AUV's may be utilised for pre/post lay surveys.

Table 2.4: Vessels potentially used for cable replacement works

Vessel	Use
Cable Lay Vessel (CLV)	Cable replacement works
Shallow draft multicat vessel and/or workboats	Diver/ROV support for works in shallow water
Small survey vessel/AUV*	Pre/post work surveys

**not necessarily required*

2.5. Estimated Duration of Work

All work is planned to be carried out between 1st September 2018 and the end of May 2019.

The estimated duration of each of the proposed activities/tasks can be found in Table 2.5 below. It should be noted that activities may be undertaken concurrently.

Table 2.5: The estimated duration of each of the activities proposed to be undertaken

Task	Estimated duration (days) excl. weather/other delays*
Backfill	66
Rock placement	60
Cable replacement works	23
Excavation/burial works	48

**Maximum duration (excluding weather/other non-working days) not anticipated to exceed 200% of estimated durations stated above*

3. Legal Requirement

All species of cetacean in waters around the UK are considered EPS under Annex IV of Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (known as the **Habitats Directive**) which covers animal and plant species of community interest in need of strict protection.

The need to consider EPS in waters off Scotland comes from two articles of legislation:

- The Conservation of Habitats and Species Regulations 2017 (known as the **Habitats Regulations**) which transpose the Habitats Directive into national law. This legislation covers waters within the 12 nautical mile limit (known as territorial waters); and
- The Conservation of Offshore Marine Habitats and Species Regulations 2017 (known as the **Offshore Regulations**) which transpose the Habitat Directive into UK law for all offshore activities. This legislation covers UK waters beyond the 12 nautical mile limit.

Both of these Regulations provide for the designation and protection of European sites (in this case Special Areas of Conservation (SACs)) and the protection of EPS.

Both the Habitats Regulations 2017 (under regulation 43) and the Offshore Regulations 2017 (under regulation 45) state that it is an offence to:

- Deliberately capture, injure or kill any wild animal of a EPS;
- Damage or destroy, or do anything to cause the deterioration of, a breeding site or resting place of a EPS; and
- Deliberately disturb EPS (in particular any disturbance which is likely to impair their ability to survive, breed or reproduce, or rear or nurture their young, or which might affect significantly the local distribution or abundance of the species to which they belong).

Licences may be granted which would allow otherwise illegal activities to go ahead.

Three tests must be passed before such a license can be granted:

1. The license must relate to one of the purposes referred to in regulation 44 and 46 of the Habitats Regulations and Offshore Regulations respectively;
2. There must be no satisfactory alternative (regulation 44, 10a and 46, 8a of the Habitats Regulations and Offshore Regulations respectively); and
3. The action must not be detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS) in their natural range (regulation 44, 10b and 46, 8b of the Habitats Regulations and Offshore Regulations respectively).

Favourable Conservation Status (FCS) is defined in the Habitats Directive as the following:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable element of its natural habitats;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

The proposed cable route and landfall locations are located both within and outwith the 12 nautical mile limit of STW. Therefore, the proposed work has the potential to affect cetaceans within both Scottish territorial and offshore waters. Both the Habitats and Offshore Regulations therefore apply.

3.1. Guidance

For offshore waters, i.e. waters beyond the 12 nautical mile limit

Draft guidance entitled 'The Protection of Marine European Protected Species from Injury and Disturbance' was first published in March 2010, with a subsequent revision dated June 2010, by the JNCC, Natural England and the Countryside Council for Wales (now Natural Resources Wales) (JNCC *et al.,* 2010). This document has been used when a view is needed as to whether there is potential for an offence of deliberately disturbing or injuring/killing a marine EPS to occur outwith 12 nautical miles as a result of any activity associated with the proposed work.

The guidance considers certain activities that produce loud noises in areas where an EPS could be present to have the potential to result in an injury or disturbance offence unless appropriate mitigation measures are implemented. The risk of an offence being committed is dependent on a number of factors including the following:

- Presence/absence of EPS;
- Noise associated with the activity and resulting impacts on EPS species;
- Frequency of occurrence of EPS;
- Density of occurrence of EPS; and
- Length of exposure of EPS to noise associated with proposed activities.

The JNCC *et al*. (2010) guidance document also considers that the potential for disturbance from some activities can be considered "trivial". Activities which might be considered trivial include those that lead to "*sporadic disturbances without any likely negative impact on the species*". This applies only to the Offshore Regulations.

For an activity to be considered "non-trivial", the JNCC guidance states that "the disturbance to marine EPS would need to be likely to at least increase the risk of a certain negative impact on the species' FCS".

For STW, i.e. waters within the 12 nautical mile limit

As a consequence of Regulation 39 (2) in the Habitats Regulations, disturbance that might be considered trivial through consideration of the JNCC guidance (JNCC *et al.,* 2010), and thus not be deemed to cause an offence under EPS legislation offshore (i.e. outside the 12 nautical mile limit), may require an EPS licence within STW. Marine Scotland and Scottish Natural Heritage (SNH) produced guidance for Scottish inshore waters in March 2014 ('The protection of Marine European Protected Species from injury and disturbance'; Marine Scotland and SNH, 2014). Marine Scotland recognises that this guidance represents a very precautionary approach to the interpretation of the Habitats Directive with regard to EPS '…This guidance reflects a precautionary approach…', and requires the careful examination of the potential impact of proposed offshore activities, and the resultant noise produced, on individual animals likely to be present at the location.

The guidance states that the two main potential causes of death or injury are physical contact (with a vessel) and anthropogenic noise. Likelihood of disturbance for individuals includes factors such as:

- Spatial and temporal distribution of the animal in relation to the activity;
- Any behaviour learned from prior experience with the activity;
- Similarity of the activity to biologically important signals (particularly important in relation to activities creating sound); and
- The motivation of the animal to remain within the areas (e.g. food availability).
- Assessment of likelihood of potential impacts should include the following considerations:
- Type of activity;
- Duration and frequency of the activity;
- Extent of the activity;

- Timing and location of the activity; and
- Other known activities in the area at the same time.

4. EPS in the Moray Firth

Four marine mammal species occur in the Moray Firth all year round – bottlenose dolphin (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*). Two of these are EPS (bottlenose dolphin and harbour porpoise). A fifth EPS occurs in late summer – minke whale (*Balaenoptera acutorostrata*) – although spring and early summer sightings are now being made more regularly. Other EPS including short-beaked common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), white-beaked dolphin (*Lagenorhynchus albirostris*), humpback whale (*Megaptera novaengliae*), killer whale (*Orcinus orca*) and long-finned pilot whale (*Globicephala melas*) occur in the Moray Firth on a more occasional basis.

Due to sightings with in the Moray Firth (but outside the works area) in 2017 and 2018 sperm whales (*Physeter macrocephalus*) and fin whales (*Balaenoptera physalus*) have been added to the possible species list as an occasional visitor.

The density estimates and reference populations for the three main cetacean species which occur in the Moray Firth are shown in Table 4.1 below.

Table 4.1: Density and abundance estimates for the three main cetacean species occurring in the Moray Firth

Common name	Latin name	General information	SCANS III density estimate (individuals per km^2)	Reference population abundance	
Minke whale	*Balaenoptera acutorostrata*	Occur regularly in small numbers within the Moray Firth	0.010	23,528	IAMMWG (2015)
Bottlenose dolphin	*Tursiops truncatus*	Coastal distribution	0.004	195	Cheney *et al.*, 2012
Harbour porpoise	*Phocoena phocoena*	Distributed throughout the North Sea	0.152	227,298	IAMMWG (2015)

Source: SCANS III density estimates from Hammond et al. (2017)

In comparison to marine mammal species such as seals, breeding seasons/areas for the cetacean species are not discrete.

Local Special Areas of Conservation (SACs) have been designated for bottlenose dolphin (Moray Firth SAC) and harbour seal (Dornoch Firth and Morrich More SAC). The Inner Hebrides and Minches SAC for harbour porpoise was approved by Scottish Ministers and submitted to the European Commission as a candidate site in September 2016. Five other harbour porpoise SACs were consulted on in 2016 were given Ministerial clearance and submitted to the European Commission for approval to designate on 30 January 2017. All six are outwith the Moray Firth; they are in the Hebrides, Welsh, Northern Irish, English and offshore waters. Even if additional SACs are proposed, the risk assessments undertaken in Section 5 of this document will still be appropriate. This is because they have been undertaken using a species-based approach (rather than an area-based approach).

Whilst not considered specifically in this assessment due to their low likelihood of occurrence, any assessment of, or mitigation measures put in place for, the species assessed are considered to be appropriate/relevant for other less commonly occurring species of cetacean in the Moray Firth. Such mitigation measures are also relevant for seals and basking sharks (*Cetorhinus maximus*), neither of which are EPS.

5. Risk Assessment

There is potential for cetacean EPS to be impacted during the proposed work on the Caithness to Moray cable route in 2018 and 2019.

The main potential routes to impact are considered to be:

- Increased anthropogenic noise from backfill, rock placement, excavation/burial work and cable replacement works;
- Increased anthropogenic noise from the geophysical, positioning, monitoring and navigational equipment carried by the vessels, ROVs and other remote systems – hereafter referred to as 'geophysical equipment which emits sound';
- Increased vessel noise; and
- Collision with vessels.

5.1. Introduction to Anthropogenic Noise Related Impacts

Ambient noise in the ocean is sound that is always present and cannot be attributed to an identifiable localised source. Examples of ambient noise sources include noise from rain falling on the ocean, bubbles in the ocean, breaking waves, seismic disturbances of the sea floor and noise emitted by marine wildlife.

Anthropogenic noise is sound that is produced as a consequence of human activity, and has the potential to affect EPS occurring in the Moray Firth if the frequencies generated lie within their auditory range. Sound travels much further underwater compared to airborne noise, therefore resulting effects on marine mammals may be at distance from the sound source.

Three potential routes to impact have been identified which result from increased anthropogenic noise in the marine environment (increased anthropogenic noise from operations (backfill, rock placement, excavation/burial work and cable replacement works), geophysical equipment which emits sound and vessels).

Due to the high sensitivity of marine mammals to anthropogenic noise related impacts, background information on the auditory ranges of marine mammal species groups is presented in the following sub-sections.

5.1.1. Marine Mammal Hearing Sensitivities

It is widely documented that marine mammals are sensitive to underwater noise, with their sensitivity being dependent on the hearing ability of the species. The auditory range of high frequency cetaceans such as harbour porpoises is from 0.2 – 180 kHz (Table 5.1).

Table 5.1: Auditory range and peak sensitivity for the three different cetacean hearing groups

Hearing group	Relevant species	Estimated auditory bandwidth (kHz)
High frequency cetaceans	Harbour porpoise	0.2 – 180
Mid frequency cetaceans	Bottlenose dolphin, white-beaked dolphin	0.15 – 160
Low frequency cetaceans	Minke whale	0.007 - 35

Source: Southall et al. (2007); NOAA (2016)

5.1.2. Overview of Potential Effects of Underwater Noise on Marine Mammals

The potential effects of underwater noise on marine mammals are:

- Lethal effects and physical injury;
- Auditory injury; and

- Behavioural response.

Underwater noise may also mask naturally occurring sounds and/or impact marine mammal prey species.

The following thresholds have been used for assessing the potential impacts of sound from the proposed backfill, rock placement, excavation/burial work and cable replacement works on cetacean EPS.

Lethal Effects and Physical Injury

Lethal effects may occur where peak to peak levels exceed 240 dB re 1 µPa, and physical injury may occur where peak to peak levels exceed 220 dB re 1 µPa (Parvin *et al.,* 2007).

Auditory Injury

Underwater sound can cause injury to the auditory system of marine mammals either following a brief exposure to extremely high sound levels, or following more prolonged exposure to lower levels of continuous sound (Richardson *et al.,* 1995).

Southall *et al.* (2007) provide indicative thresholds for Sound Exposure Levels (SELs) that have the potential to cause auditory injury (Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS)) in marine mammals. These thresholds are based on unweighted, instantaneous peak sound pressure levels (SPLs) and M-weighted SELs where:

- SEL: Expression of total energy of a sound wave which incorporates both the SPL and duration; and
- M-weighted function: Frequency weighting applied to the SEL allowing functional hearing bandwidths of different marine mammal groups (low frequency cetaceans e.g. minke whales, mid frequency cetaceans e.g. bottlenose dolphins and high frequency cetaceans e.g. harbour porpoises) and taking a relevant or derived species audiogram into account.

Thresholds of 198 dB re 1 μPa^2s are defined by Southall *et al.* (2007) for all cetacean groups exposed to pulsed noise and 215 dB re 1 μPa^2s for non-pulsed noise for predicting thresholds for the onset of PTS.

More recent work (King, 2013) undertaken on behalf of the Department for Energy and Climate Change (DECC) reviewed the Southall *et al.* (2007) paper in light of updated studies and found that the thresholds required updating. The study found that certain species (e.g. harbour porpoise) are more susceptible to TTS as a result of noise exposure, whilst other odontocetes such as bottlenose dolphins are likely to have higher thresholds. As such, King (2013) recommends the use of species-dependent ranges of 162–183 dB re 1 μPa^2s for TTS onset and 177-198 dB re 1 μPa^2s for PTS onset to indicate significant impacts for pulsed noise.

The US National Marine Fisheries Service (NMFS) issued guidance for assessing the effects of anthropogenic sound on marine mammal hearing in 2016 (NOAA, 2016). These thresholds differ from to Southall *et al*. (2007) as the frequency weighting bands for each hearing group have been refined, and subsequently narrowed (Table 5.2 and 5.3).

This assessment considers the well-established Southall *et al*. (2007) thresholds, as well as the more conservative National Oceanic and Atmospheric Administration (NOAA) (2016) thresholds.

Table 5.2: Comparison of PTS thresholds – SPLs (dB re 1 µPa) – in response to a single pulse exposure (assesses the potential for injury to occur instantaneously)

Functional hearing group	Non-pulsed sound	Pulsed sound	
	Southall *et al*. (2007)	Southall *et al*. (2007)	NOAA (2016)
Low frequency cetacean e.g. minke whale	230	230	219
Mid frequency cetacean e.g. bottlenose dolphin, white-beaked dolphin	230	230	230
High frequency cetacean e.g. harbour porpoise	230	230	202

Table 5.3: Comparison of PTS onset thresholds – SELs (dB re 1 μPa^{2}s) – in response to a single pulse exposure within a 24 h period (allows assessment of whether the total energy that an animal receives as it flees the area will cumulatively lead to an effect over the period of time assessed)

	Non-pulsed sound		Pulsed sound	
Functional hearing group	Southall *et al*. (2007)	NOAA (2016)	Southall *et al*. (2007)	NOAA (2016)
Low frequency cetacean e.g. minke whale	215	199	198	183
Mid frequency cetacean e.g. bottlenose dolphin, white-beaked dolphin	215	198	198	185
High frequency cetacean e.g. harbour porpoise	215	173	198	155

Behavioural Response

Behavioural responses may arise where an activity is audible and at a level above background. The $dB_{ht\ (species)}$ metric (Nedwell *et al.,* 2007) was developed as a means of quantifying the potential for a behavioural effect on a species in the underwater environment, and although this approach has now been supplemented with additional methods of evaluation, as the only comparable values available for the site have been modelled using the $dB_{ht\ (species)}$ metric (Barham and Mason., 2015) these have therefore been applied.

The $dB_{ht\ (species)}$ metric assumes that as any given sound will be perceived differently by different species (since they have differing hearing abilities) the species name must be appended when specifying a level e.g. $dB_{ht\ (harbour\ porpoise)}$. Table 5.4 (below) summarises the $dB_{ht\ (species)}$ assessment criteria. Nedwell *et al.* (2007) suggest the use of a 130 $dB_{ht\ (species)}$ level as a suitable criterion for predicting the onset of traumatic hearing loss in marine mammals from a single pulse of noise (see Table 5.4). This is similar to that used for human exposure in air.

Table 5.4: Assessment criteria to estimate the potential responses by EPS to underwater noise

Level in dB_{ht} (species)	Reaction
0	None
0 to 50	Mild reaction in minority of individuals, probably not sustained
50 to 90	Stronger reaction by majority of individuals, but habituation may limit effect
90 and above	Strong avoidance reaction by virtually all individuals
Above 110	Tolerance limit of sound; unbearably loud
Above 130	Possibility of traumatic hearing damage from single event

Source: Nedwell at al. (2007)

5.1.3. Increased Anthropogenic Noise from Backfill, Rock placement, Excavation/Burial Work and Cable Replacement Works

5.1.3.1. Overview of potential impacts

The proposed backfill, rock placement, excavation/burial work and cable replacement works has the potential to increase levels of anthropogenic noise in the marine environment (and therefore the potential to affect marine mammals).

5.1.3.2. Prediction of potential impacts

Barham *et al*. (2014)'s underwater noise assessment for the Caithness to Moray project provides estimates of typical levels of underwater noise generated by various offshore activities.

Estimated unweighted source levels for backfill and rock placement works have been used to establish the potential for lethal effects and physical injury from these activities. Such information is not available for excavation/burial and cable replacement works therefore suction dredging and cable lay values have been used as respective proxies.

M-weighted SEL ranges have been used to assess the potential for PTS onset as a result of backfill, rock placement, excavation/burial work and cable replacement works.

90 dB_{ht} (species) impact ranges have been used to assess the potential for displacement as a result of backfill, rock placement, excavation/burial work and cable replacement works.

Lethal effects and physical injury

There is no potential for lethal effects or physical injury (for which the thresholds are 240 dB re 1 µPa and 220 dB re 1 µPa respectively (see section 5.1)) from the backfill, rock placement, excavation/burial work and cable replacement works due to be conducted (Table 5.5). No comparable predictions exist for the excavation/burial equipment, however suction dredging is considered a suitable proxy and the Barham *et al*. (2014)'s underwater noise assessment for the Caithness to Moray project noted that this activity was less impacting than cable laying (when modelled for bottlenose dolphins).

Table 5.5: Estimated source levels

Task	Estimated unweighted source level (dB re 1 µPa @ 1 m)
Backfill	172
Rock placement	172
Cable replacement (cable lay used as a proxy)	171

Source: Barham et al. (2014)

Auditory injury

Assuming that marine mammals will flee[1] from the noise source, rather than remain stationary, it is unlikely that they will receive a level of noise at which auditory injury is expected to occur from the backfill, rock placement, excavation/burial work and cable replacement works due to be conducted. This is because the M-weighted SEL ranges out to which auditory injury is predicted show that auditory injury is only likely to occur at ranges of less than one metre (Table 5.6). This is the case across all cetacean groups.

Table 5.6: M-weighted SEL ranges out to which auditory injury is expected

Task	M-weighted SEL impact range (m)		
	Low frequency cetacean e.g. Minke whale	Mid frequency cetacean e.g. Bottlenose dolphin	High frequency cetacean e.g. Harbour porpoise
Backfill	< 1	< 1	< 1
Rock placement	< 1	< 1	< 1
Cable replacement (cable lay used as a proxy)	< 1	< 1	< 1
Excavation/burial works (suction dredging used as a proxy)	< 1	< 1	< 1

[1] Based on the Fleeing model in Barham *et al.* (2014) which allows assessment of whether the total energy that an animal receives as it flees the area will cumulatively lead to an effect over the period of time assessed.

Source: Barham et al. (2014); ICOL (2013)

Behavioural response

The potential for a behavioural response due to increased anthropogenic noise from the backfill, rock placement, excavation/burial work and cable replacement works has been estimated based on predicted 90 dB_{ht} (species) impact ranges; see Table 5.7.

The areas of potential impact from each activity were estimated using the 90 dB_{ht} (species) impact ranges as the radius in the formula πr^2. The SCANS III density (Hammond *et al*., 2017) and IAMMWG (2015) abundance estimates quoted in section 4 were used to estimate the numbers of individuals within the areas of potential impact and the percentages of reference populations which have the potential to be affected. The estimated number of individuals which have the potential to be affected is less than one for all species.

Table 5.7: Predicted dB_{ht} (species) impact ranges

Task	90 dB_{ht} (species) impact range (m)		
	Minke whale	Bottlenose dolphin	Harbour porpoise
Backfill	59	81	140
Rock placement	70	31	99
Cable pull in (cable lay used as a proxy)	18	9	29
Excavation/burial works (suction dredging used as a proxy)	16	7	21

Source: Barham et al. (2014); ICOL (2013)

5.1.3.3. Significance of potential impact

There is no potential for lethal effects or physical injury as a result of increased anthropogenic noise from the backfill, rock placement, excavation/burial work and cable replacement works due to be conducted.

There is negligible potential for (1) auditory injury or (2) animals to exhibit a behavioural response as a result of increased anthropogenic noise from the backfill, rock placement, excavation/burial work and cable replacement works due to be conducted.

5.1.3.4. Conclusions for increased anthropogenic noise from the backfill, rock placement, excavation/burial work and cable replacement works

Following the JNCC *et al.* (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit), it can be concluded that the backfill, rock placement, excavation/burial work and cable replacement work is unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Regulations.

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit), it can be concluded that the backfill, rock placement, excavation/burial and cable replacement works is unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Habitats Regulations. In relation to regulation 39(2) of the Habitats Regulations, the number of individuals of each species which have the potential to be disturbed is considered to be equivalent to zero and therefore not detrimental to the maintenance of the population of the species concerned at a FCS.

Because the risk of offence is considered to be negligible, neither mitigation nor an EPS licence will be required for the backfill, rock placement, excavation/burial work and cable replacement works itself.

5.1.4. Increased Anthropogenic Noise from Geophysical Equipment Which Emits Sound

5.1.4.5. Overview of potential impact

The use of geophysical equipment which emits sound has the potential to increase levels of anthropogenic noise in the marine environment (and therefore the potential to affect marine mammals). All geophysical, positioning, monitoring and navigational equipment carried by the vessels, ROVs and other remote systems (SCAR plough, excavation system) have been examined and those which emit sound assessed.

5.1.4.6. Prediction of potential impact

A summary of the types of geophysical equipment (on the vessels, ROVs and other remote systems e.g. SCAR plough, excavation systems) which emit sound and are likely to be used during work proposed is given in Table 5.8 below along with the typical source pressure levels and frequency ranges of each type of equipment. An assessment of whether each type of equipment is likely to have the potential to induce the onset of auditory injury or a behavioural response has been made, with justification provided in the sections below.

Table 5.8: Details of the proposed types of geophysical equipment which emit sound

Equipment Type	Typical Source Pressure Level (dB re 1 µPa @ 1 m)	Potential for auditory injury?	Typical Frequency Range (kHz)	Potential for a behavioural response?
USBL System (Transducers)	< 220	Potential risk	18-36	Y
USBL Beacons (Transponders)	< 206	Potential risk	18-36	Y
Multi Beam Echo Sounder (MBES)	< 221	Negligible risk	>200	N
Obstacle Avoidance Sonar (OAS)/Multi Beam Imaging Sonar	< 207	Negligible risk	200-1100	N
Dual Head Scanning Sonar (DHSS)	< 210	Negligible risk	200-2250	N
Doppler Velocity Log (DVL)	< 217	Negligible risk	600 or 1200	N

Lethal effects and physical injury

The source pressure levels of the proposed geophysical equipment which emits sound are lower than the lethal effects criteria (240 dB re 1 µPa). Therefore there is no potential for lethal effects as a consequence of increased anthropogenic noise from geophysical equipment which emits sound.

Sound emitted by the USBL system and MBES has the potential to cause physical injury at very close range (their source pressure levels are equal to or slightly greater than the 220 dB re 1 µPa threshold at 1 m). However it should be noted that, in shallow (< 200 m) water, the risk of causing injury to marine mammals from multi beam surveys is considered to be negligible (JNCC, 2017). This is because the (high frequency) sounds produced during multi beam surveys are likely to attenuate quickly.

Auditory injury

If the Southall *et al*. (2007) threshold for auditory injury (230 dB re 1 µPa; see Table 5.2) is used, the sound produced by the proposed geophysical equipment would not be considered to have the potential to induce the onset of auditory injury in any functional hearing group.

Using the NOAA (2016) thresholds (Table 5.2), none of the proposed geophysical equipment which emits sound has the potential to induce the onset of auditory injury in mid frequency cetaceans. However, high frequency cetaceans may be susceptible to the onset of auditory injury as a result of the sound produced by much of the geophysical equipment (the PTS onset threshold for high frequency cetaceans is an SPL of 202 dB re 1 µPa). This is also the case for low frequency cetaceans for the USBL and MBES (the PTS onset threshold for low frequency cetaceans is an SPL of 219 dB re 1 µPa).

It should be noted that, in shallow (< 200 m) water, the risk of causing injury to marine mammals from multi beam surveys is considered to be negligible (JNCC, 2017). This is because the (high frequency) sounds produced during multi beam surveys are likely to attenuate quickly. This is also assumed to be the case for the high frequency sound produced by the other pieces of geophysical equipment listed in Table 5.8. The exception to this is USBL systems and beacons, which produce relatively low frequency sounds.

Behavioural response

With the exception of the positioning equipment (USBL systems and beacons), the sound emitted by the geophysical equipment will not be audible to marine mammals because the frequencies over which the equipment operates (Table 5.8) are higher than the higher frequency hearing cut-offs for each of the functional hearing groups (Table 5.1).

It is possible that the USBL systems and beacons may be detected by cetacean EPS and therefore their use may have the potential to cause disturbance. The most likely response will be temporary behavioural avoidance (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises; Thompson *et al.,* 2013). Using information from this study, where harbour porpoise avoidance from geophysical (seismic) survey vessels in the Moray Firth was observed out to 10 km, the number of individuals which have the potential to be affected has been estimated (Table 5.9). This is considered to result in highly conservative estimates because the noise levels produced by the oil and gas exploration geophysical surveys will be well in excess of those produced during use of the positioning equipment (USBL systems and beacons) described here. Notwithstanding this, the percentage of the reference population estimated to have the potential to be affected was less than 1 % for the three main cetacean species which occur in the Moray Firth.

Table 5.9: The number of individuals estimated to have the potential to be disturbed by the positioning equipment (USBL systems and beacons)

Species	Range of potential impact (km)	Area of potential impact (km^2)	Number of individuals within the area of potential impact	Percentage of reference population which has the potential to be affected
Minke whale	10	314	3	0.013 %
Bottlenose dolphin	10	314	1	0.644 %
Harbour porpoise	10	314	48	0.021 %

Source: SCANS III density estimates used in calculations from Hammond et al. (2017) and reference population abundance estimates used in calculations from IAMMWG (2015)

5.1.4.7. Significance of potential impact

There is no potential for lethal effects as a result of increased anthropogenic noise from geophysical equipment which emits sound.

Sound emitted by the USBL system has the potential to cause physical injury at very close range and induce the onset of auditory injury in low and high frequency cetaceans. However, with implementation of the mitigation measures outlined in section 7.1, there is negligible potential for physical or auditory injury as a consequence of increased anthropogenic noise from geophysical equipment which emits sound.

The positioning equipment (USBL systems and beacons) may be detected by cetacean EPS and therefore have the potential to cause animals to exhibit a behavioural response. However, the most likely response will be temporary avoidance of the area (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises; Thompson *et al.,* 2013). The resulting impact is considered not significant in terms of EPS legislation (i.e. it will not be detrimental to the maintenance of the population of the species concerned at a FCS in their natural range).

5.1.4.8. Conclusions for increased anthropogenic noise from geophysical equipment which emits sound

Following the JNCC *et al.* (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), use of geophysical equipment which emits sound is unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Regulations.

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), use of geophysical equipment which emits sound is unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Habitats Regulations. In relation to regulation 39(2) of the Habitats Regulations, the percentage of the reference population of each species which has the potential to be disturbed (see Table 5.99) is considered to be negligible (less than 1 % for the three main cetacean species which occur in the Moray Firth) and therefore use of geophysical equipment which emits sound is not considered to be detrimental to the maintenance of the population of the species concerned at a FCS.

It is therefore considered that an EPS licence (in order to permit the disturbance of cetacean EPS along the route of the Caithness to Moray HVDC in connection with the use of USBL systems and beacons) is required and is likely to be awarded on the basis of passing the key EPS tests.

5.1.5. Increased Vessel Noise

5.1.5.9. Overview of potential impact

Increased vessel noise has the potential to cause behavioural responses in marine mammals, physical impacts such as permanent or temporary hearing loss, and mask naturally occurring sounds. Additionally, increased noise from vessels has the potential to impact marine mammal prey species.

Shipping noise from the area is likely to dominate underwater noise during the proposed backfill, rock placement, excavation/burial work and cable replacement works. Noise varies from vessel to vessel because they can generate different frequency characteristics and sound levels depending upon factors such as their propulsion systems. Therefore, assessing the impact of vessel noise during the proposed work is a key factor when assessing underwater noise impacts on marine mammals.

5.1.5.10. Prediction of potential impact

Barham *et al*. (2014)'s estimates for large vessels (which assume that an MBES is being used) are deemed to be a suitable (or conservative) categorisation for all vessels which will be used in 2018.

Lethal effects and physical injury

The estimated unweighted source level for noise from a large vessel is 168 dB re 1 µPa @ 1 m (Barham *et al*., 2014). There is therefore no potential for lethal effects or physical injury, for which the thresholds are 240 dB re 1 µPa and 220 dB re 1 µPa respectively (see section 5.1).

Auditory injury

The M-weighted SEL ranges out to which auditory injury is expected to occur for noise from large vessels is predicted to be less than one metre for all three functional hearing groups (Barham *et al*., 2014).

Behavioural response

The predicted 90 dB_{ht} (species) impact ranges from Barham *et al*. (2014) are presented in Table 5.10. The number of individuals which have the potential to be affected by increased vessel noise has not been estimated because the ranges of potential impact are so small. Coupled with an existing high number of vessel movements within the Moray Firth, it is considered that sound from vessel activity associated with the proposed backfill, rock placement, excavation/burial work and cable replacement works will not significantly add to the background noise levels from vessels already present in the Moray Firth (MORL, 2012).

Table 5.10: Predicted 90 dB_{ht} (species) impact ranges for noise from large vessels

Species	Range of potential impact (m)
Minke whale	6
Bottlenose dolphin	12
Harbour porpoise	22

Source: Barham et al. (2014)

5.1.5.11. Significance of potential impact

There is no potential for lethal effects or physical injury as a result of increased vessel noise.

There is negligible potential for (1) auditory injury or (2) animals to exhibit a behavioural response as a result of increased vessel noise.

5.1.5.12. Conclusions for increased vessel noise

Following the JNCC *et al*. (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit), it can be concluded that increased vessel noise is unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Regulations.

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit), it can be concluded that increased vessel noise is unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Habitats Regulations. In relation to regulation 39(2) of the Habitats Regulations, the number of individuals of each species which have the potential to be disturbed is considered to be negligible (because the ranges of potential impact are so small) and therefore not detrimental to the maintenance of the population of the species concerned at a FCS.

Because the risk of offence is considered to be negligible, neither mitigation nor an EPS licence will be required as a result of increased vessel noise from the backfill, rock placement, excavation/burial work and cable replacement works.

5.2. Non-Anthropogenic Noise Related Impact Assessments

5.2.1. Collision with Vessels

5.2.1.1. Overview of potential impact

Vessel strikes are a known cause of mortality in marine mammals and basking sharks (Laist *et al.,* 2001). Collisions between vessels and large whales are generally lethal (Laist *et al.,* 2001). Non-lethal collisions have also been documented in a variety of species (Laist *et al.,* 2001; Van Waerebeek *et al.,* 2007). Injuries from such collisions can be divided into two broad categories: blunt trauma from impact and lacerations from propellers. Injuries may result in individuals becoming vulnerable to secondary infections or predation.

Avoidance behaviour by cetaceans is often associated with fast, unpredictable boats such as speedboats and jet-skis (Bristow and Reeves, 2001; Gregory and Rowden, 2001; Leung Ng and Leung, 2003; Buckstaff, 2004), while neutral or positive reactions have been observed with larger, slower moving vessels such as cargo ships (Leung Ng and Leung, 2003; Sini *et al*., 2005).

5.2.1.2. Prediction of potential impact

Much of the proposed backfill, rock placement, excavation/burial work and cable replacement works will require single large vessels which will follow the pre-defined cable corridor except during transit and when manoeuvring. The small to medium sized vessels required for/to assist with the nearshore work will either be stationary or travelling at low working speeds, or transiting in a predictable manner.

5.2.1.3. Significance of potential impact

Because the large vessels will be following a pre-defined linear route when working, and the small to medium sized vessels will either be stationary or travelling at low working speeds, it will be easy for animals to predict and avoid them which will greatly reduce the risk of collision. The potential for collision with the vessels undertaking the backfill, rock placement, excavation/burial work and cable replacement works is therefore considered to be negligible.

During transits, a nominated competent observer on each vessel will keep watch for marine mammals and basking sharks. The Master of the vessel will follow the Scottish Marine Wildlife Watching Code (as detailed in section 7.3 below).

5.2.1.4. Conclusions for collision with vessels

Following the JNCC *et al*. (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit), it can be concluded that the presence of additional vessels is unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Regulations (because the risk of collision is negligible).

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit), it can be concluded that the presence of additional vessels is unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Habitats Regulations (because the risk of collision is negligible). In relation to regulation 39(2) of the Habitats Regulations, the number of individuals of each species which have the potential to be disturbed is considered to

be negligible (because the risk of collision is negligible) and therefore not detrimental to the maintenance of the population of the species concerned at a FCS.

Because the risk of offence is considered to be negligible, neither mitigation nor an EPS licence will be required as a result of the risk of collisions with vessels associated with backfill, rock placement, excavation/burial work and cable replacement works.

During transits, a nominated competent observer on each vessel will keep watch for marine mammals and basking sharks. The Master of the vessel will follow the Scottish Marine Wildlife Watching Code (as detailed in section 7.3 below).

6. Assessment of Potential Offence

Following the JNCC *et al.* (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from the proposed backfill, rock placement, excavation/burial work and cable replacement works are unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) (referred to as the Offshore Regulations).

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from the proposed backfill, rock placement, excavation/burial work and cable replacement works are unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) (referred to as the Habitats Regulations). In relation to regulation 39(2) of the Habitats Regulations, the percentage of the reference population of each species which has the potential to be disturbed by use of the USBL systems and beacons is considered to be negligible (less than 1 % for the three main cetacean species which occur in the Moray Firth) and therefore not detrimental to the maintenance of the population of the species concerned at a FCS.

It is therefore considered that an EPS licence (in order to permit the disturbance of cetacean EPS along the route of the Caithness to Moray HVDC in connection with the use of USBL systems and beacons) is required and is likely to be awarded on the basis of passing the key EPS tests.

7. Mitigation

Operation of the USBL systems and beacons during the backfill, rock placement, excavation/burial work and cable replacement works has the potential to cause (1) physical injury at very close range and (2) induce the onset of auditory injury in (low and high frequency) cetacean EPS. Therefore mitigation in the form of pre-work searches will be undertaken prior to use of the USBL systems and beacons during all backfill, rock placement, excavation/burial work and cable replacement works in order to reduce the potential for physical and auditory injury to negligible levels.

7.1. Pre-Work Searches

The methodology for the pre-work searches (which will be undertaken in order to reduce the potential for marine mammals to occur in close proximity to the USBL systems and beacons prior to their initiation) is based on the recommendations outlined in the JNCC guidelines (2017).

Clear channels of communication between the MMO/PAM operator and relevant crew will be established prior to commencement of any operations. The crew will inform the MMO/PAM operator (or nominated lead) sufficiently in advance of any proposed work so that a full pre-work search can be completed prior to work commencing.

At least one dedicated MMO/PAM operator will be available to undertake pre-work searches of 30 minutes in length. Visual searches of a 500 m radius mitigation zone will be conducted when weather conditions, daylight and sea state allow. During the hours of darkness, or when visual observation is not possible due to weather conditions or sea state, a proven PAM system (and operator) will be used.

If marine mammals are detected within the mitigation zone during a pre-work search (either visually or acoustically), the start of work will be delayed until their passage, or the transit of the vessel, results in them being outside the mitigation zone. There will be a minimum of 20 minutes from the time of the last detection within the mitigation zone to the commencement of the work.

As per the 2017 JNCC guidelines, unplanned breaks refer to instances where the USBL system/beacons cease pinging unexpectedly during operations. In these instances:

- Work will resume without a pre-work search after unplanned breaks of 10 minutes or less provided that no animals are detected in the mitigation zone during the breakdown period; and
- A full pre-work search will be conducted before work resumes after unplanned breaks of longer than 10 minutes. Any time the MMO/PAM operator has spent observing prior to the breakdown period will contribute to the pre-work search time.

7.2. Soft Starts

It is understood that it is not possible to soft start the USBL system or beacons therefore no soft starts will be employed for these pieces of equipment. Where it is possible to do so, soft starts will be employed on other pieces of geophysical equipment. When initiating equipment with a soft start, power should be built up slowly from a low energy start-up over at least a period of 15 – 25 minutes until operational level is reached (as per section 2.1.3 of the JNCC guidelines for geophysical surveys). The soft start will be achieved by ramping up the power in a uniform manner.

7.3. Transit Watches

In addition to the mitigation proposed above, the following measures will be adhered to:

- A nominated competent observer on the bridge of all vessels will keep watch for marine mammals and basking sharks during transit to and from the work sites. Any sightings will be communicated to the Master of the

vessel as soon as is practicable and the following actions, as per the Scottish Marine Wildlife Watching Code[2], implemented:

- The Master of the vessel will ensure that marine mammals and basking sharks are avoided to a safe distance (100 m or more) in all possible circumstances; and
- The Master of the vessel will minimise high powered manoeuvres where this does not impair safety.

[2] which can be downloaded from https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/scottish-marine-wildlife-watching-code

8. Cumulative Effects

It is recognised that other similar activities may be ongoing in the Moray Firth and that the construction programmes have the potential to overlap (e.g. the Beatrice Offshore Wind Farm cable Installation activities). However, because the only residual (i.e. post-mitigation) effect of the proposed backfill, rock placement, excavation/burial work and cable replacement works is likely to be temporary avoidance of the area where the USBL systems and beacons have been used (affecting a negligible percentage proportion of the reference populations), no cumulative effects are considered likely to arise as a result of the installation of the Caithness-Moray HVDC Cable route with any other project.

9. Conclusions

The continuation of the proposed backfill, rock placement, excavation/burial work and cable replacement works on the Caithness to Moray HVDC cable interconnector will be undertaken between 1st September 2018 and the end of May 2019.

Cetaceans have been recorded within the Moray Firth all year round. Minke whales are present in spring and summer, bottlenose dolphins are resident and harbour porpoises are present year-round. Other species (including common, Risso's and white-beaked dolphins and humpback, killer, long-finned pilot, sperm and fin whales occur on a more occasional basis. It is possible that any of these species may be present during at least some part of the proposed backfill, rock placement, excavation/burial work and cable replacement works (along with any other cetacean EPS that could be present in the area, even if only transiently).

Following the JNCC *et al.* (2010) guidance (relevant to work on the section of the cable route which occurs in waters beyond the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from the proposed backfill, rock placement, excavation/burial work and cable replacement works are unlikely to result in the disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) (referred to as the Offshore Regulations).

Following the Marine Scotland and SNH (2014) guidance (relevant to work on the sections of the cable route which occur in waters within the 12 nautical mile limit) it can be concluded that, with mitigation for the USBL systems and beacons (which will reduce the potential for physical and auditory injury to negligible levels), potential impacts from the proposed backfill, rock placement, excavation/burial work and cable replacement works are unlikely to result in the harassment, disturbing, injuring or killing of an EPS as defined under regulation 39(1) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) (referred to as the Habitats Regulations). In relation to regulation 39(2) of the Habitats Regulations, the percentage of the reference population of each species which has the potential to be disturbed by use of the USBL systems and beacons is considered to be negligible (less than 1 % for the three main cetacean species which occur in the Moray Firth) and therefore not detrimental to the maintenance of the population of the species concerned at a FCS.

It is therefore considered that an EPS licence (in order to permit the disturbance of cetacean EPS along the route of the Caithness to Moray HVDC in connection with the use of USBL systems and beacons) is required and is likely to be awarded on the basis of passing the key EPS tests.

10. References

Barham. R., East, S. and Mason, T. (2014). Underwater noise assessment for the Caithness to Moray transmission cable installation. Subacoustech Report No. E483R0104.

Bristow, T. and Reeves, E.I.S. (2001). Site fidelity and behaviour of bottlenose dolphins (Tursiops truncatus) in Cardigan Bay, Wales. Aquatic Mammals 27: 1-10.

Buckstaff, K.C. (2004). Effects of watercraft noise on the acoustic behaviour of bottlenose dolphins, Tursiops truncatus, in Sarasota Bay, Florida. Marine Mammal Science 20: 709-725.

Gregory, P.R. and Rowden, A.A. (2001). Behaviour patterns of bottlenose dolphins (Tursiops truncatus) relative to tidal state, time of day and boat traffic in Cardigan Bay, West Wales. Aquatic Mammals 27: 105-113.

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M.B., Scheidat, M., Teilmann, J., Vingada, J., Øien, N. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Available from: https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf

IAMMWG. (2015). Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough.

ICOL. (2013). Inch Cape Offshore Wind Farm Environmental Statement.

JNCC, Natural England and Countryside Council for Wales. (2010). The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. January 2010.

JNCC. (2017). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys. August 2017.

King, S.L. (2013). Seismic Survey Licensing: Sub-bottom Profile Surveys. SMRU Ltd Report No. SMRUL-DEC-2013-024.

Leung Ng, S. and Leung, S. (2003). Behavioural response of Indo-Pacific humpback dolphin (Sousa chinensis) to vessel traffic. Marine Environmental Research 56: 555-567.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. (2001). Collisions between ships and whales. Marine Mammal Science 17: 35-75.

Marine Scotland and SNH. (2014). The protection of Marine European Protected Species from injury and disturbance: Guidance for Scottish Inshore Waters. March 2014.

MORL. (2012). Moray Offshore Wind Farm Environmental Statement. Moray Offshore Renewables Ltd.

NOAA. (2016). National Marine Fisheries Service. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

Nedwell, J.R., Turnpenny, A.W.H., Lovell, J., Parvin, S.J., Workman, R., Spinks, J.A.L. and Howell, D. (2007). A validation of the dB_{ht} as a measure of the behavioural and auditory effects of underwater noise. Subacoustech Report No. 534R1232.

Parvin, S.J., Nedwell, J.R. and Harland, E. (2007). Lethal and physical injury of marine mammals, and requirements for Passive Acoustic Monitoring. Subacoustech Report No. 565R0212.

Richardson, W.J., Greene Jr., C.R., Malme, C.I. and Thompson, D.H. (1995). Marine Mammals and Noise. Academic Press.

Sini, M.I., Canning, S.J., Stockin, K.A. and Pierce, G.J. (2005). Bottlenose dolphins around Aberdeen harbour, north-east Scotland: a short study of habitat utilization and the potential effects of boat traffic. Journal of the Marine Biological Association of the UK 85: 1547-1544.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4): 411-521.

Thompson, P.M., Brookes, K.L., Graham, I.M., Barton T.R., Needham, K., Bradbury, G., Merchant, N.D., (2013). Short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises. Proc R Soc Lond B Biol Sci., 280: 20132001-10.1098/rspb.2013.2001.

Van Waerebeek, K., Baker, A.N., Félix, F., Gedamke, J., Iñiguez, M., Sanino, G.P., Secchi, E., Sutaria, D., van Helden, A. and Wang, Y. (2007). Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, an initial assessment. Latin American Journal of Aquatic Mammals 6(1): 43-69.

What we do

- Leading independent renewable energy consultancy
- Analysis, engineering, planning & permitting, environmental, project management and due diligence services
- Onshore wind, offshore renewables, solar, hydro, renewable heat and grid & infrastructure
- Established in 1995, 11 offices globally, 340+ staff

Our global expertise

Natural Power delivers services and operates assets globally for our clients, with eleven offices across Europe and North America and agencies active in South America and Asia Pacific.

UK & Ireland

Registered Office, Scotland
The Greenhouse
Forrest Estate, Dalry
Castle Douglas, DG7 3XS
SCOTLAND, UK

Stirling, Scotland
Ochil House
Springkerse Business Park
Stirling, FK7 7XE
SCOTLAND, UK

Inverness, Scotland
Suite 3, Spey House
Dochfour Business Centre
Dochgarroch, Inverness
IV3 8GY, SCOTLAND, UK

Dublin, Ireland
Suite 6, The Mall, Beacon
Court, Sandyford, Dublin 18
D18 83W8
IRELAND

Aberystwyth, Wales
Harbour House
Y Lanfa, Aberystwyth
Ceredigion, SY23 1AS
WALES, UK

London, England
WeWork, Moorgate
1 Fore Street Avenue
London, EC2Y 9DT
ENGLAND, UK

Newcastle, England
Unit 8, Horsley Business
Centre, Horsley
Northumberland, NE15 0NY
ENGLAND, UK

Europe

Paris, France
4, Place de l'Opéra
75002 Paris,
FRANCE

Nantes, France
1, boulevard Salvador Allende
44100 Nantes
FRANCE

Ankara, Turkey [Agent]
re-consult Bagi's Plaza
-Muhsin Yazıcıoğlu Cad. 43/14
TR / 06520 Balgat-Ankar
TURKEY

The Americas

New York, USA
63 Franklin St
Saratoga Springs, NY 12866
USA

Seattle, USA
2701 First Avenue, Suite 440
Seattle, WA 98121
USA

Valparaiso, Chile [Agent]
Latwind Energías Renovables
Lautaro Rosas 366
Cerro Alegre Valparaiso
CHILE

natural power

naturalpower.com
sayhello@naturalpower.com

For full details on our ISO and other certifications, please visit: **naturalpower.com/company**