

Non-technical Summary

Introduction

Background

Scottish and Southern Energy's (SSE) transmission business Scottish Hydro Electric Transmission Limited (SHETL)¹ is developing proposals to upgrade the electricity transmission infrastructure in the north of Scotland to meet demand for connection from various renewables proposals. To help meet these requirements a proposal has been developed for a high voltage direct current (HVDC) link to connect onshore grid infrastructure in Caithness with offshore grid infrastructure in the Moray Firth.

This document is the Non-technical Summary of the Environmental Statement (ES) for the proposed subsea cables and offshore hub platform. These facilities will form an essential part of the overall electricity transmission link for the north of Scotland and the Northern Isles which includes:

- a new alternating current (AC) to direct current (DC) converter station near Spittal in Caithness (Caithness Converter Station);
- onshore buried HVDC and fibre optic cables from the converter station to the coast north of Wick (Caithness Underground Cables);
- a directionally-drilled landfall at the coast near Long Berry, north of Wick;
- subsea HVDC, 33kV AC and fibre optic cables from the coast to the outer Moray Firth; where they connect to:
- the Moray Firth HVDC Hub platform, to act as the offshore connection point.

See Figure 1 for an overview of these proposals.

Key features of the proposals

The landfall at Long Berry is located on a cliff with extensive bedrock areas along the shore and in shallow coastal waters out to some 700m from the coast. Therefore, directional drilling will be used to provide the connection between the onshore cables and the subsea cables. The works associated with the marine cables are considered to start where the directionally drilled boreholes emerge at the seabed, some 820m from shore, southeast of Noss Head, near Wick. At this point the seabed sediments are sufficiently deep to allow cable burial to be achieved. The works extend to the hub location some 34km southeast that lies some 30km from the coast in the outer Moray Firth (see Figure 2).

The key features of the proposals include the following:

- landfall boreholes through which the cables emerge at the seabed;
- cables arranged along three parallel routes to the hub platform; and
- a steel jacket platform onto which the various cables are linked.

¹ Scottish Hydro Electric Transmission Limited (SHETL) owns and maintains the 132kV and 275kV electricity transmission network in the north of Scotland. SHETL is owned by Scottish and Southern Energy Power Distribution, which is a trading name of SSE Power Distribution Limited.

Figure 1 Overview of the Moray Firth Hub & Caithness HVDC Connection

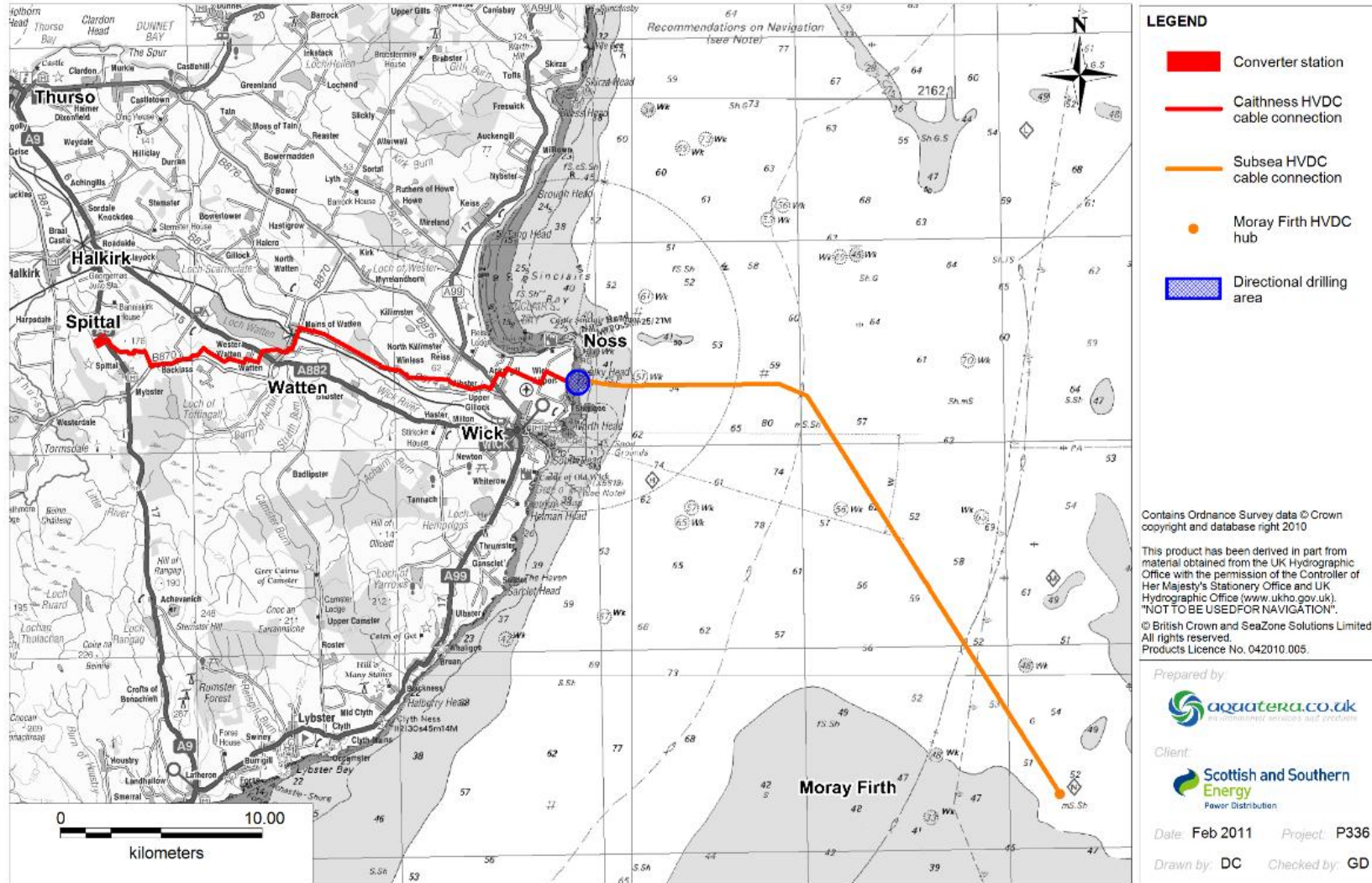
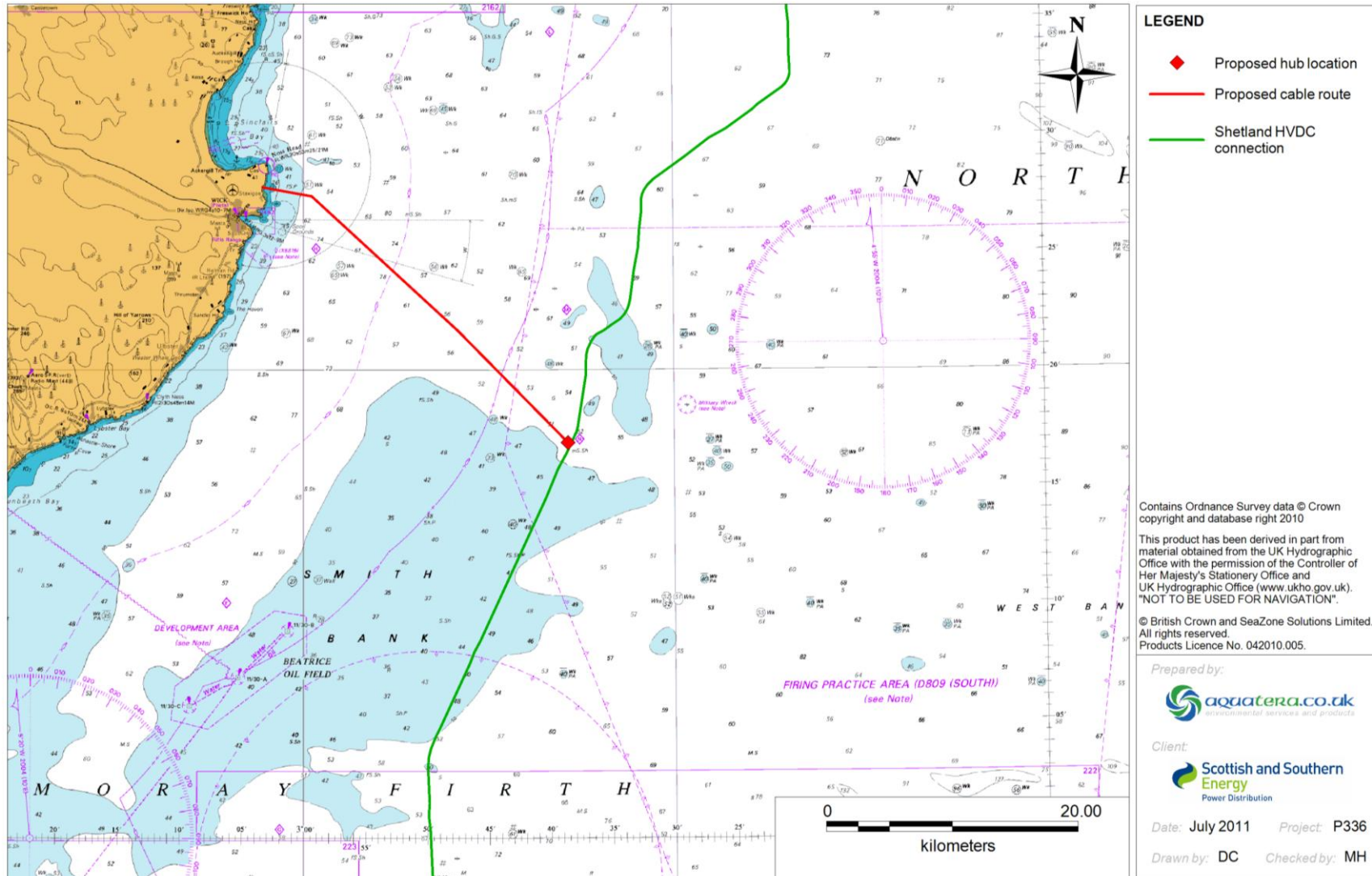


Figure 2 The proposed location of the Hub & Subsea Cables



The hub platform will have capacity for the consented Shetland HVDC cable between Kergord and Blackhillock to be routed through it. Capacity may also be available for possible connections from other nearby offshore wind farms in the future.

The construction phase of the offshore works is anticipated to take some 2½ years, beginning in 2013 with the cables and hub being commissioned in 2016.

Regulatory Framework

SHETL and statutory consultees including Marine Scotland considered the proposals could have a capacity for significant impacts due to their scale and nature, and therefore a formal EIA process has been undertaken. The approach to the assessment has been informed by Scottish Government and other EIA guidance for marine projects.

The Scottish Government is responsible for licensing activities carried out in Scottish Waters from 0-12 nautical miles (nm) under the Marine (Scotland) Act 2010². A Memorandum of Understanding (MoU) has been established between the UK Marine Management Organisation and Marine Scotland allowing the latter to exercise all the responsibilities of the Competent Authority from 12-200nm. Although this proposal extends across the 12nm line, the arrangements outlined mean a single marine licence from Marine Scotland on behalf of Scottish Ministers under the Marine (Scotland) Act 2010 is all that is required. Requirements for licences to disturb European Protected Species (EPS) will also be determined by Marine Scotland in consultation with SNH as the findings of the EIA process are reviewed.

A separate Environmental Statement (ES) has been produced for the Caithness Converter Station³, and a planning application was submitted to The Highland Council on 5 July 2011 (ref. no. 11/02459/FUL). The Caithness Underground Cables are an onshore permitted development, and an Environmental Report for these proposals⁴ has been included in an annex to the Caithness Converter Station ES.

Habitats Regulations Assessment

Information has also been collated as part of the EIA to inform the appraisal by Marine Scotland of the likely significant effects of the Hub & Subsea Cables proposals on sites of European nature conservation value to meet the requirements of the Habitat Regulations⁵. This information has also been provided in a Habitat Regulations Assessment (HRA) document which is provided in an annex to the ES. This HRA has concluded that the integrity of all protected sites in proximity to the works would be maintained and the conservation objectives of all sites met.

Need for the proposals

SHETL has developed reinforcement proposals for the North of Scotland and the Northern Isles area, which includes the Hub & Subsea Cables proposals, as a response to its statutory obligations as the holder of a Transmission Licence for the region.

² The provisions of the Marine (Scotland) Act 2010 were previously regulated under Part II of the Food and Environment Protection Act 1985 (FEPA) and under section 34 of the Coast Protection Act 1949 (CPA)).

³ Aquatera, 2011a. Moray Firth Hub & Caithness HVDC Connection: Caithness Converter Station Environmental Statement. Report produced by Aquatera Ltd for SHETL.

⁴ Aquatera, 2011b. Moray Firth Hub & Caithness HVDC Connection: Caithness Underground Cables Environmental Appraisal. Report produced by Aquatera Ltd for SHETL.

⁵ The Conservation (Natural Habitats, &c.) Regulations 1994 place a statutory duty on the competent authority, in this case The Highland Council, to consider the likely significant effects of the project on sites designated for their nature conservation interest.

Parts of this reinforcement were recognised in the National Planning Framework for Scotland 2⁶ and also in the Electricity Networks Strategy Group (ENSG) report⁷. The need for reinforcement arises from the high volume of renewable generation contracted to connect to the grid and in the application process. This includes:

- multiple applications for connection of renewable generation schemes onshore in Caithness; and
- the initial stages of connection applications for marine energy projects in the Pentland Firth and Orkney Waters strategic area.

As part of an optimised and integrated electrical design, it is proposed that the project will allow the possibility for connecting the following:

- an HVDC connection from Shetland to Blackhillock which would be routed through the hub; and
- possible future offshore wind projects in the Moray Firth.

The Shetland to Blackhillock connection is consented. SHETL will apply for all necessary amendments to the existing permissions from Marine Scotland and Moray Council to allow the connection to be routed through the hub and for the cables to have the capacity to transfer the additional power from the Caithness connection to Blackhillock. If the proposed major wind farm in Shetland is not consented, it is proposed that a connection from the hub on to Blackhillock would be achieved using part of the consented Shetland connection infrastructure (that is the section from the hub onward via Port Gordon to the converter station at Blackhillock). All necessary amendments to consents would again be applied for.

In determining the preferred reinforcement option for the area, a range of alternative schemes have been fully assessed by SHETL from a technical, cost, timing and environmental point of view.

Project design process and comparison of alternatives

An iterative approach has been adopted to progressing the design of the proposals by the project engineers and environmental team, with the objective that the overall project could be shaped by minimising environmental impact.

Following current best practice, the design development process involved extensive consultation with relevant statutory bodies and non-statutory organisations. The design development process undertaken for the Moray Firth Hub & Caithness HVDC Connection comprised the following six key stages:

- establishing strategic needs;
- defining site and corridor search areas;
- preliminary screening of possible sites and route corridors;
- detailed assessment of route corridors and sites;

⁶ This framework identifies 'Electricity Grid Reinforcements' as a 'National Development' (paragraph 104). Although this project is not specifically defined as a 'National Development' there is recognition that additional projects will be necessary to realise the renewable potential of the Outer Hebrides, Orkney and Shetland through grid reinforcement, subsea links, new connections and route modifications (Scottish Government, 2009. National Planning Framework for Scotland 2. Published June 2009).

⁷ Electricity Networks Strategy Group (ENSG), 2009. ENSG Summary Report: 'Our Electricity Transmission Network: A Vision for 2020', (URN/09/752). London: DECC.

- selection of preferred sites and routes; and
- selection of suitable technology solutions.

During the early development stages of the proposals a number of cable route options, hub location options and cable protection strategies were considered and compared. This comparison of routes and sites was based upon existing data and information supplemented by remotely-operated vehicle (ROV) and wider seabed survey works.

Technology solutions for the cable emergence points, cable burial, and cable protection were identified based upon previous project experience.

The final selected locations for these proposals achieve the following:

- intertidal habitats and communities have been bypassed by selection of directional drilling as the landfall method;
- the cable emergence points have been selected to lie beyond the areas of bedrock along the coast, away from coastal seal haul outs;
- the cable route has been selected to avoid intensively used shipping areas and fishing areas;
- the cable route has been selected to avoid known rock outcrops and wrecks; and
- the platform location and cable route have been selected to avoid preferred sand eel habitat, such as dynamic seabed areas with sand waves, as much as possible.

The project proposals

The works for the Hub & Subsea Cables proposals are considered to start from the boreholes just short of breakthrough to the seabed and to continue to the installation of the offshore hub platform.

The key components of the proposed hub and subsea cables development are:

- up to five locations where boreholes emerge at the seabed;
- cables emerging from the boreholes and then arranged along three separate routes, one carrying the two HVDC cables and a fibre optic cable, another carrying a 33kV AC cable and a further possible route carrying an additional 33kV AC cable if required;
- burial of the cables to a target depth of 1m into the seabed along most of the 34km cable route;
- use of crushed rock placed on the seabed to protect the cables at the emergence points and along any unplanned sections where burial cannot be achieved. It is envisaged that the width of protection material over the seabed may be 5m;
- crossing of a 1km wide horse mussel bed over which the cables will be laid across, inside protective sleeving. The width of the sleeving and therefore the affected area will be around 30cm per cable;
- use of up to 20 concrete mattresses to protect all of the cables as they enter the j-tube guides⁸ to direct them up onto the hub platform; and

⁸ J-tubes are vertical sections of pipe shaped like the letter 'J' which will act as guides for conveying offshore cables onto the platform

- installation of a steel jacket platform onto which the various cables are linked. The top of the platform will not exceed 60m by 70m and 40m in height and will have a gap of some 20m above the sea.

Vessels will be required during construction and to a much lesser extent for maintenance. These support vessels are likely to include dynamically positioned (DP) vessels with powerful propulsion systems capable of holding the vessels on station without using anchors.

SHETL will prepare a Construction Environmental Management Document (CEMD) detailing approaches to construction that follow best practice and recognised sustainable construction methods. The CEMD will set out procedures to ensure all activities with potential to affect the environment are appropriately managed. All environmental risks and necessary protection measures will be required to be identified and integrated in the contractor's method statements for all major construction activities.

Effects of the proposals

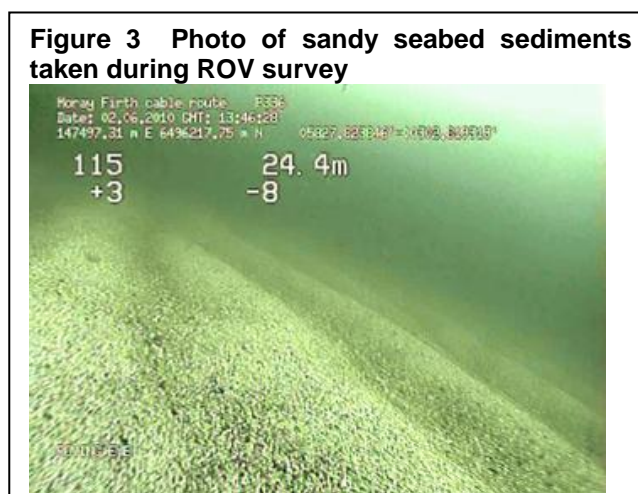
The baseline conditions and environmental effects of the proposals have been considered under three main topic areas covering the physical, ecological and human environments.

The Physical Environment

The assessment of the physical environment included consideration of the following topics:

- seabed character;
- seabed sediment quality;
- water quality; and
- air quality.

The route chosen for the cables and the site chosen for the hub platform have taken into account seabed character and mostly lie in areas without any particularly discernible features. The seabed is relatively flat and the seabed sediments along the cable route are mainly sandy gravel (up to 100% shell fragments) and sand, with some patches of silty clay. The presence of relatively strong tide-driven currents has created sand ripples in some sections; however, larger sand waves are found in only a short section (<1km) of the route. Approximately 1km from the cable emergence points, there is a horse mussel bed approximately 1km in width.



During the cable burial process the seabed will be disrupted and it is expected that immediately after burial a discernable trough or trench will be visible across the seabed. However, this trench will affect a small percentage of the wider seabed area and these discontinuities in the seabed will gradually be reworked by currents, wave action and seabed animals until within a few months or years the track of the cable is not expected to be distinguishable.

The presence of the cables in their metal sleeving lying on the horse mussel bed will change the character of the seabed permanently, but over a localised area. This may be a significant impact in the short term; however, the horse mussels may eventually grow over the metal sheathing, and the change may no longer be discernable.

The area of the outer Moray Firth in which the project is located has low levels of contaminants in water and sediments and good air quality. According to SEPA⁹ the ecological status of surface waters flowing into the sea in the two river basin districts closest to the cable emergence points is high (near natural), and coastal waters are also classified as being of high quality. The activities associated with the construction of the hub and subsea cables are not expected to introduce contaminants or otherwise degrade the quality of the sediments or water. Measures will be in place to reduce the risk of accidental fuel spills occurring and to ensure that there is an appropriate and rapid response in the case of spill.

The seascape in the vicinity of the project is not designated as an area of particular scenic or seascape value. There are a number of existing industrial activities that can be seen from shore. Construction activities and the presence of the offshore hub are not expected to have significant effects on the seascape.

The Ecological Environment

The assessment of the ecological environment considered the following topics:

- the interests of designated nature conservation sites;
- seabed communities;
- fish: marine and migratory;
- seabirds and water birds; and
- marine mammals and otter.

The proposed offshore cable route and hub platform lie outside any sites designated for nature conservation interests at European (EU), national or local levels. However, there are potential interactions with protected species including those which are qualifying interests for protected sites of European importance (Special Areas of Conservation (SACs)¹⁰ and Special Protection Areas (SPAs)¹¹).

Intertidal communities and plankton are unlikely to be impacted by the proposals. The intertidal zone is by-passed by directional drilling from land and any effect on plankton arising from proposed activities would not be significant.

Environmental baseline investigations were carried out in 2010 along the offshore cable route and at the hub location with a primary focus on seabed communities and fish recorded during ROV surveys.

Most notably the seabed investigation indicated the presence of an extensive horse mussel bed lying 2km offshore (approximately 1km from the cable emergence points) between Noss

⁹ SEPA, 2010a. RBMP Water Body Information sheets. [online] Available at: www.sepa.org.uk/water/river_basin_planning.aspx [Accessed 11.4.11].

¹⁰ SACs are strictly protected sites designated under the EC Habitats Directive (Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna). The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).

¹¹ SPAs are strictly protected sites classified in accordance with Article 4 of the EC Birds Directive. They are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species.

Figure 4 Photo of horse mussel bed from ROV survey



Head and the entrance to Wick harbour. Horse mussel beds are a UK BAP priority habitat¹². Potential impacts on the horse mussel bed will be minimised through laying the cables across the bed with protective metal sleeving, rather than burying them through the bed. In addition, vessels will be prohibited from dropping anchor on the horse mussel bed.

No other sensitive seabed habitats were noted during the surveys. In deeper areas where mixed sandy sediments dominate there are few

organisms on the seabed, and at the platform location there were no sensitive habitats noted.

While disturbance of the seabed from cable laying and burial has the potential to result in impacts on fish, the relatively coarse nature of the sediment along much of the cable route suggests that any sediment plume generated will quickly resettle to the seabed. It is unlikely that sediment will be raised more than 5m from the seabed during cable burial and it is expected to be generally less than this. As a result, fish are not expected to be significantly affected by this disturbance.

The proposals are not predicted to have any significant impacts on birds in the area. The cable route corridor and hub platform location have been chosen to avoid known or likely important feeding areas for seabirds, including the Smith Bank, which is some 15km south of the hub. The relatively close proximity of this area also indicates that good alternate feeding areas are nearby for any birds displaced from the operational area due to construction vessel activity.

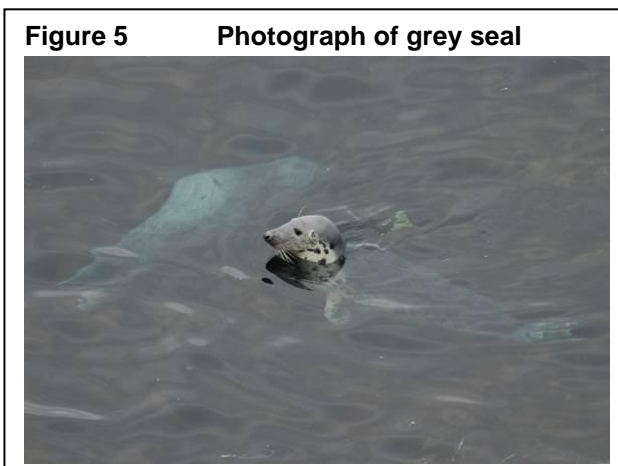
No indirect impacts as a result of impacts on seabird prey and in particular sand eels are expected as potential habitats for these species (i.e. sand waves) have been largely avoided, and therefore there are not expected to be any concentrations of these species along the corridor or at the hub location.

Any disturbance impacts on birds from vessels during the construction phase will be limited in duration. Although support vessels will be used extensively during construction, these vessels will only be working along most sections of cable for a short time (hours to days). It is likely that the birdlife present in the area will have already habituated to shipping activity since the Moray Firth is well used by existing shipping traffic.

Although the area around the proposed hub platform and cable route is not known as a focal point for cetaceans, bottlenose dolphin may feed in or pass through the cable route corridor and the area of the offshore hub platform, although they are mainly observed in the inner Moray Firth and along the southern Moray coast. In addition, harbour porpoise is commonly encountered in the area, being seen throughout inshore and offshore waters of the Moray Firth.

¹² UK BAP list of priority species and habitats which identifies species in need of conservation action at a national level using the application of criteria based on international importance, rapid decline and high risk.

Noise from vessels and from piling activities at the hub platform could have significant impacts on fish and marine mammals, although the duration of the activities will be short-term. In particular, any animals within the immediate vicinity of piling operations as they begin could suffer hearing injuries as a result. A Marine Mammal Protection Plan will be developed as part of the CEMD that includes soft-start procedures in which noisy activities are started gradually, as well as visual monitoring by Marine Mammals Observers (MMOs) within a 500m radius of the piling. Implementation of these measures will ensure that residual effects as a result of noise are not significant.



Both common and grey seal are found in the Moray Firth, and a grey seal haul out is located at Sealky Head, 1km from the cable emergence points.

Ducted propellers in thruster systems on DP vessels have been implicated as the likely source of some recorded seal deaths around the UK, although this has not been substantiated. Nevertheless, the potential for such impacts has been minimised by development of the Marine Mammal Protection Plan which will include provision for an MMO to monitor operations near

shore and ensure appropriate measures are undertaken when seals are observed near to DP vessel activities. This and other measures will ensure that there are no significant effects on seals if any vessels with ducted propellers are used during project activities.

Measures will be in place to reduce the risk of accidental fuel spills occurring and to ensure that an appropriate and rapid response takes place in the case of spill.

Once operational, the subsea cables will emit some electromagnetic fields (EMF); however, this is expected to be at a low level that will not have adverse effects on the ecological environment. As a new structure in the sea, the offshore hub will provide a place for shoaling fish as well as a landing site for birds. However, these impacts are expected to be minor and non-significant given the size of the structure and the fact that there are other similar structures in the area.

The Human Environment

The assessment has considered other sea users and activities in the area, which include fishing, shipping, the military, oil and gas leased areas, recreational users, and the offshore renewables industry. Local residents and the local supply chain have the potential to be impacted by the proposals. In addition, wrecks and other archaeology on the seabed are potentially sensitive to the proposals.

The majority of fishing vessels catching within the vicinity of the proposed marine facilities are small creel boats (<15m length) targeting lobster and other shellfish in inshore waters. It is estimated that approximately 40 to 50 creel boats are currently working the Moray Firth north coast. The cable route and hub location are not actively fished by larger vessels (>15m). The loss of access to fishing grounds during cable installation activities, potential hazards due to accidental loss of materials overboard and presence of the cables creating a risk of snagging to fishing gear are potentially significant issues for fishing in the area.

A fisheries liaison officer will be appointed to make timely contact with all fishermen using the affected areas and will engage in early discussions with fishermen prior to periods of

temporary restriction and to ask them to remove all creeling gear from the project area for the duration of the cable installation activities.

To reduce the risk of fishing gear snagging on the cables, cables will be protected at the emergence points using rock placement and cables will be buried to a target depth of 1m wherever possible. Regular safety monitoring will be performed to ensure the cables remain buried. In addition, SHETL will promote cable awareness in the area through the UK Hydrographic Office and will also take steps to ensure notification to fishermen of the presence of the cables through notification of The International Cable Protection Committee¹³ and the Kingfisher Information Service¹⁴.

The proposals avoid main shipping areas, and the closest shipping route passes at a mean distance of 2nm to the southeast of the hub platform. There is a potential for shipping vessels to collide with work vessels during construction. However, although there are nearby shipping routes, the density of shipping is low and the amount of sea space available is large so maintaining a safe course away from operations is easily achieved. In addition, work vessels will be present for a short period of time, so the risk will be present over a 3-4 month period only. A number of measures will be in place to ensure the risk of collision remains low including:

- providing advance notice of operations to the main operators of ships in proximity to the site; and
- employing a guard vessel during platform installation to monitor traffic and take controlling measures in the event of a collision course being set.

The hub and part of the adjoining cable route are located within a wide area identified for military exercises.

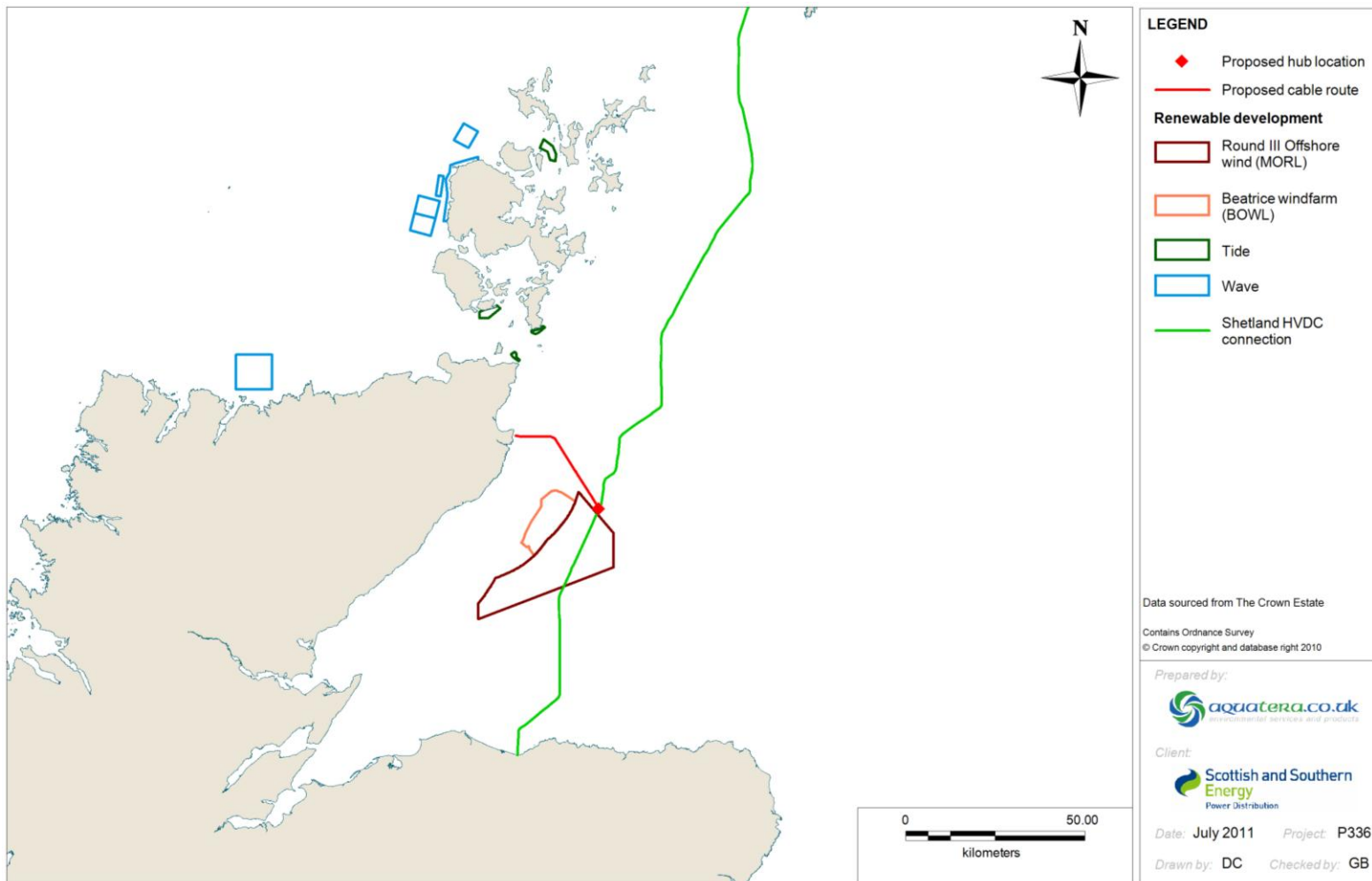
Current oil and gas activity in the Moray Firth centres on the Beatrice, Jacky and Lybster fields. Future oil and gas exploration in the vicinity of the hub platform and along the cable route cannot be ruled out. The proposed hub location lies within block 12/22 which has a promote licence awarded to Caithness Petroleum. The proposed cable route also runs through several blocks, two of which are under potential offer in the 26th Offshore Licensing Round. Any future oil/gas activity within these blocks could be potentially affected by the long-term presence of the buried cables as well as the long-term presence of the hub. This may require any facilities for exploration or exploitation of discovered oil or gas resources needing to be offset from the area of the proposals.

A number of offshore renewable energy projects are planned in the Moray Firth, the Pentland Firth and Orkney waters. The most imminent of these projects and the closest to the proposed offshore cable route and hub are the Shetland-Moray Firth HVDC cable link and the Beatrice Offshore Windfarm Limited (BOWL) and Moray Offshore Renewables Limited (MORL) offshore wind farms. The Shetland-Moray Firth HVDC cable link is due to be constructed in 2014-2016 and will be connected in due course with the hub. The BOWL and MORL offshore wind farms are scheduled for development in the period 2013-2016 and have the potential to link with the hub platform in future.

¹³ <http://www.iscpc.org>

¹⁴ <http://www.kisca.org.uk>

Figure 6 Location of offshore renewable projects in the vicinity of the proposals



The development will be advantageous to renewables development in the Moray Firth, Caithness, Orkney and Shetland since it will help to establish greater energy export potential, but project specific connections to the offshore hub or other connection points are still required. Existing offshore infrastructure in the region of the planned facilities consists mainly of cabling and pipelines interconnecting the platforms in the Beatrice and Jacky Fields, linking in the two Beatrice demonstrator wind turbines and connecting this infrastructure to shore (including the export pipeline to Nigg). Details of the planned shore connection and inter-array cables for the BOWL and MORL offshore wind farms are not yet known. Port infrastructure in the region that may be used during the construction and operation of the proposed cable and hub platform includes harbours at Wick, Scrabster, Cromarty Firth and Orkney/Scapa Flow and Peterhead/Aberdeen.

There is little recreational use of the waters around the cable route and hub. The majority of recreational vessel traffic in the region is found in the inner Moray Firth, such as wildlife tours to view dolphin. Royal Yachting Association routes in the Moray Firth include two routes that traverse the cable route but none that come close to the hub. Construction activities may be a temporary nuisance to any recreational activities that do take place in the vicinity. To address this, advance notice of operations will be given to mariners, and a guard vessel will be employed during platform installation. Although the platform will be visible from areas along the coast near Wick, due to its distance from land it will appear as a small object at sea, similar to others.

There are no areas, sites or wrecks protected, designated or controlled under the Ancient Monuments and Archaeological Areas Act 1979, the Protection of Wrecks Act 1973, the Protection of Military Remains Act 1986 or the Marine (Scotland) Act 2010 within 250m of the proposed offshore cable route. In the unlikely event that submerged archaeology or wartime debris are located during installation of the subsea cables and hub, a reporting protocol as detailed in the CEMD will be implemented.

Cumulative effects

Consideration of combined effects upon baseline interests from different mechanisms, or different stages of the project, as well as in combination with existing activities did not show any new areas of significant impact.

A number of future projects were considered to have potential to interact with the current proposals, include wind farms, oil and gas projects and other renewables projects. Given current schedules, it is likely that construction and operation of projects will be taking place simultaneously to some degree, but there is still a strong geographical separation between projects.

The cable laying activities and hub construction can take place with minimal potential for adverse cumulative effects with other planned activities such as offshore wind farm construction and oil and gas exploration activities. Construction activities will be over a widely spaced set of sites, for a short duration. The various stages of the proposals themselves have little cumulative potential due to their wide geographical separation and low intensity of impacts. Significant cumulative noise impacts could result if other noisy projects were under construction within 5km of the proposals. However, noise impacts from these proposal will be of short duration, and at this stage no projects have been identified which are likely to be under construction at the same time at that range.

Review and comments

The Environmental Statement can be viewed during the consultation period during normal working hours at Marine Scotland:

Marine Scotland
375 Victoria Rd
Aberdeen AB11 9DB

Copies of the Environmental Statement can be purchased on request to the following address:

Scottish Hydro Electric Transmission Limited
Major Projects Support Group
Inveralmond House
200 Dunkeld Road
Perth. PH1 3AQ

The cost, including postage, is £200 for a hard copy of the ES and £20 for a copy of ES on CD-ROM. Please note that VAT will be charged on the supplied CD ROM.

The Environmental Statement can also be viewed on the SSE website at <http://www.sse.com> (follow links to Media Centre>Project Portfolio>Caithness HVDC Connection).

The Environmental Statement comprises four volumes:

- Volume 1: Main Environmental Statement and Non-technical Summary
- Volume 2: Figures for the Environmental Statement
- Volume 3: Annexes to the Environmental Statement
- Volume 4: Appendices relating to the technical chapters in the ES