2 Project Details

2.1 Assessment of Alternatives

2.1.1 Introduction

2.1.1.1 In 2013 MORL was offered an updated grid connection point in to the existing 275 kV overhead line south of New Deer to replace the previous connection point at Peterhead Power Station. This was driven through the Connections Infrastructure Options Note (CION) process, which determined that consumers would benefit from a more economic and efficient connection if MORL was connected to the grid where it passes New Deer. This was on the basis that this connection involved a shorter length of export cable route (85 km from the southern boundary of the three consented wind farm sites (Telford, Stevenson and MacColl) area to New Deer compared to 135 km to Peterhead). This shorter length means that an AC connection is technically feasible (which was not to Peterhead due to the greater length of the route). AC Transmission Infrastructure (TI) is both less expensive and more readily available (with the lead in timescales for DC equipment being two years longer than AC) meaning that the interface with the national grid at New Deer was judged to be both more economic and efficient. Thus MORL's connection agreement at Peterhead has been replaced with one at New Deer (see Figure 1.1-3, Volume 3). The amended grid connection was initially for up to 1,500 MW to the existing overhead transmission line running to the south of New Deer, owned and operated by SHE-Transmission PLC (SHE-T). MORL received a revised offer on the basis of a modification application in June 2014 altering the grid connection to 1,000 MW. This capacity has been assessed through a technical investigation driven by MORL and supported by SHE-T as the maximum MW which can be connected using AC TI at the present time. The change in grid connection requires alternative offshore and onshore works proposals to be developed.

2.1.1.2 MORL commissioned an Export Cable Feasibility Study (Metoc-Hyder, 2011) (see Technical Appendix 2.1 A of the MORL ES). This study was primarily desk-based (with site visits to the identified landfall points) which sought to identify options and assess feasibility for 2 km route corridors for export cable (onshore and offshore) and landfall points along the northern Aberdeenshire and Moray coastlines taking into account the likely environmental issues and engineering and health and safety constraints. The onshore export cable route also incorporated the Holford Rules (guidelines on overhead line routeing) for overhead lines, with adaptations for underground lines. The study identified 13 offshore cable routes, 11 potential landfall points, and three primary onshore route corridors which diverged to connect with eight of the potential landfall points (the onshore corridor width for the study was 2 km, which meant all 11 landfall points were covered in the onshore corridor study) (see Figure 2.1-1, Volume 3).

2.1.1.3 Based on environmental, technical and economic criteria, the initial 13 offshore routes identified were narrowed down to eight landfall points (Portgordon, Sandend, Inverboyndie, Fraserburgh Beach, Fraserburgh Golf Car Park, Philorth, Inverallochy and Rattray). These eight landfall points and associated onshore and offshore routes were then taken forward into a stage 1 concept engineering study by JP Kenny (JP Kenny, 2011; Appendix 2.1 B, Volume 8 of the MORL ES). As part of the preparation of the JP Kenny report, there was consultation on the routes identified by Metoc-Hyder with local fisheries groups and the Scottish Fishermen's Federation (SFF).

2.1.1.4 The abovementioned studies assumed an onshore grid connection point at Peterhead. Following the determination in 2013 from the CION process to alter the connection point to New Deer, MORL commissioned a consultant engineer, PCS to undertake an assessment of potential grid connection points in the New Deer area

(PCS, 2013) (see Technical Appendix 2.1 A (Technical Grid Connection Study) of this ES). This study identified seven general substation locations in close vicinity to the existing overhead line that were suitable for MORL's requirements. MORL then commissioned a feasibility study to assess these locations, and the proposed cable routes, from an environmental and planning perspective (RPS, 2013) (see Technical Appendix 2.1 B (Environmental and Planning Study) of this ES).

2.1.2 Offshore Export Cable Route Selection

Criteria based on SHE-T guidelines, United Kingdom Cable Protection Committee (UKCPC) recommendations and other best practice were used to define potential marine export cable routes (see tables 2.1-1 and 2.1-2 below). These criteria were used in the concept engineering study (Metoc-Hyder, 2011), to identify onshore and offshore cable route options and landfall points.

Table 2.1-1 Concept Engineering Weighted Risk Matrix

Key Driver	Classification of Contribution		
	-3	0	+3
Safety Relative to ALARP	Elements of increased personnel risk and complex technical safety would be difficult to achieve ALARP.	Tolerable level of personnel and technical risk requires some mitigation to achieve ALARP.	Especially safe in operation, personnel exposure.
Consenting	Risk of a severe / significant effect - potential show stopper.	Risk of moderate / minor effect which could result in acceptable permit conditions.	Opportunity for environmental enhancement.
Cost	Significant risk of exceeding target costs requiring significant project management resource.	Tolerable risk of effect on target costs requiring some project management resource.	Potential opportunity to reduce costs.
Execution Schedule	Significant effect on First Generation date.	Ability to meet First Generation date.	Accelerate First Generation date.
Wind Farm Performance	Risk of serious adverse effect on performance, availability and energy losses.	Potential minor effect on performance, availability and energy losses.	Negligible effect on performance, availability and energy losses.
Technical Risk	Unproven technology with very little track record.	Technology with only / short track record.	Proven technology with track record.

Table 2.1-2 Criteria Used to Define the Potential Marine Export Cable Routes

Criteria	Factors to be Considered
Cable Route Length	Minimising cable length should minimise environmental impacts, cable manufacturing and installation costs. The carbon footprint associated with cable manufacture and installation is also directly dependent on the cable route length. The optimal route will ultimately be the shortest feasible route which takes into account the environmental and technical constraints listed below.
Minimise Complexity of Installation Works Through Choosing Optimum Water Depths **Minimise Length of the Intertidal Area** **Maximise Extent of Cable Route in Water Depths Between 10-200 m**	Landing a cable through intertidal areas is typically the most challenging aspect of a cable installation as it represents the inter-face between land and vessel based operations. Both land and marine operations need to be coordinated and the handling of the cable, from the vessel on which it is being held to shore, managed. The tidal regime of the area may also severely constrain the time available for installation operations. A water depth of 10 m is used as an average cut-off for a typical large cable handling vessel. If a route contains sections in shallow water then the larger main installation spread may be unable to operate, requiring an additional cable handling vessel. Sections of cable may also need to be cut and rejoined. Cables need to be designed to resist installation forces, including tensile strains produced during installation and any subsequent recovery for repair. For power cables, the tensile strength is distributed through the cable structure with much of it being provided by the external ‘armour’ wires. In water depths of 200 m or less only one layer of armour wires will generally be needed. In water depths greater than 200 m, it is possible that two layers of armour wires may be needed increasing the capital cost of the cable. Waters deeper than 200 m are, therefore, avoided where possible.
Maximise Potential for Cable Burial	In order to ensure optimal burial depths can be achieved and maintained for as much of the route as possible, known areas of exposed bedrock, or bedrock with thin covering of sediment, should be avoided during cable routeing. Should bedrock be present the choice of routeing must be justifiable through other factors. Similarly possible areas of glacial till or boulder clay, which could make installation more challenging, should be avoided.
Minimise Potential for Cable Re-Exposure During Operation	Avoid areas of high sediment mobility, such as mobile estuaries, mobile sandbanks and sandwaves, which could result in subsequent exposure and / or spanning of the cable. In certain cases deeper burial beneath the mobile layer can be achieved by dredging through sandwaves or using specialist tools such as the “vertical injector”. Deeper burial increases insulation of the cable and can reduce efficiency of electricity transmission due to thermal heating effects, depending on seabed characteristics and cable capacity. Some cables can be “over-engineered” to resolve this issue, although this may not be possible depending on the cable capacity. Furthermore, whilst routine maintenance work can be undertaken to re-bury exposed cables, cables in highly mobile environments are at risk of damage and or failure which is not an ideal long term scenario, both in terms of cable protection and the environmental impacts associated with ongoing maintenance works. In protected and / or sensitive seabed areas environmental and consenting issues could complicate the feasibility of regular maintenance works, causing delays or restrictions to maintenance work.

Criteria	Factors to be Considered
Avoidance of Sensitive Environmental Areas. Where It Has Not Been Possible to Avoid Conservation Areas, Route Length Within These Areas to be Minimised	Avoid existing Natura 2000 sites (SACs and SPAs), national protected sites (SSSIs, Marine nature reserves), possible future SACs and SPAs (Annex I habitat, areas of search for offshore SACs). Where routes within protected sites are unavoidable, the interest features of the site should be considered to determine whether the cable can be installed and operated without causing significant environmental effects. The following general principles can be followed in discussion with the relevant conservation bodies: • Seasonal sensitivities: For example if a site is designated for wintering birds, the Project's installation programme can be scheduled to avoid impacts during the sensitive period. With such mitigation measures implemented routeing within the area may be acceptable. If the site is designated for both wintering and breeding birds the seasonal restrictions that are likely to be applied to the Project may be too onerous for the installation to be feasible. • Mobile species: From the point of view of cable installation and operation, the key impact on mobile species (seabirds at sea, fish, mammals) is disturbance during installation activities, which is generally a minor impact that can be managed. However, if the species is breeding, impacts can be more significant. • Benthic species: For benthic species or habitats, significant impacts may be harder to avoid and therefore the cable should be routed away from sites designated for such features if possible. This is particularly true for habitats which do not recover well from disturbance, such as rocky or biogenic reef (mussel beds, *Sabellaria* etc), piddocks in clay, or saltmarshes. Lower significance impacts are likely for mobile sands and muds supporting invertebrates, which do have higher recovery rates, and therefore routeing in such areas may be more feasible. • Spawning and nursery areas: Areas where fish spawn on the seabed (such as herring) should be avoided if possible. Pelagic (in the water column) spawning areas are widespread and cable routing can be undertaken in these areas without significant environmental effects. • EMF and Heating: Possible issues associated with EMF and heating impacts on sensitive species should also be considered. The significance of this potential impact cannot be determined at this stage, but EMF impacts are likely to be more of a concern in rivers / estuaries where salmon and trout migrate.
Avoidance of Areas Where There Is an Increased Risk of Damage to the Installed Cable	The following areas should be avoided due to the increased risk of damage to the buried cable: • Known dredging areas should be avoided by a minimum of 500 m where possible; and • Known anchorage areas should be avoided by a minimum of 500 m where possible. Areas containing high levels of munitions contamination should be avoided by cable routeing. Munitions are known to migrate along the seabed depending on hydrodynamic conditions and sediment transport pathways operating in the area of concern. Therefore the presence of munitions on the seabed, outside of such areas, cannot be discounted and a survey should be targeted towards establishing the presence and location of munitions on the seabed where the cable passes in the vicinity of disused munitions disposal sites.
Minimise Crossings With Cables and Pipelines	The number of crossings with existing and proposed cables and pipelines should be minimised. Undertaking crossings with existing cables necessitates placement of rock berms or mattresses to ensure the cable is protected at the crossing, where burial is not possible. Installation of a crossing increases the environmental impacts of the Project. It results in a permanent structure on the seabed, which will smother the marine life beneath it, and introduces a different type of sediment which may locally alter the marine ecosystem. The rock berms on the seabed can also represent an obstruction to fishermen, who may risk snagging their gear. Crossings are also financially costly, and may involve lengthy legal discussions with the cable or pipeline owner. A Crossing Agreement (CA) is a voluntary agreement with the crossed party, although it is generally required under the Crown Estate lease, and proceeding with crossings without having obtained the necessary agreements is not recommended. If any pipelines or cables are to be crossed that the crossing angle should be as close to 90º as possible. Any cables and pipelines not crossed should be avoided by a 500 m exclusion zone. Cable routing parallel with existing cables and pipelines should be avoided if possible. Cables and pipelines will have a seabed lease which gives a 250 m no-works zone and a further 250 m notification zone either side of the cable. This is necessary to allow access for repairs, and also should a repair be undertaken, the cable will be re-laid on the seabed in a loop, potentially increasing its proximity to the other cables than previously. Specific measures for individual pipelines and cables will need to be confirmed with the owner / operator.

Criteria	Factors to be Considered
Avoid Existing and Proposed Seabed Developments.	Areas which are currently licensed for other uses or involve physical infrastructure on the seabed need to be avoided. This includes: • *Licensed dredging areas:* The licence holder has exclusive rights to the seabed in the licence area. • *Oil and gas infrastructure*: Operational wells platforms operate a 500 m exclusion zone which should be avoided by cable routing. Cable routing is not excluded through oil and gas fields, or licence blocks, as oil and gas developers do not have exclusive seabed rights to the entire block. Plugged and abandoned wells should be avoided as they represent seabed structures over which the cable cannot be buried, but the 500 m exclusion zone is not required. • *Existing and proposed sites for offshore renewables* (e.g. wind farms, or wave or tidal arrays) should be avoided by a 500 m exclusion zone. Cable routing through the R3 development zones should be avoided if possible, due to the current uncertainty as to where specific wind arrays will be placed and the possible need for additional crossings. However, the Crown Estate has confirmed that the offshore wind developers do not have exclusive rights to the seabed in the R3 zones and cable routing through the zones is permitted. The cable route should seek to develop a route which minimises interactions with the future development of the zone, such as routing adjacent to an existing cable, or through the area of highest shipping activity within the zone. Whilst shipping activity precludes turbine placement, installation of a cable in this area is likely to be acceptable as the buried cables are not an obstruction to shipping. Routing adjacent to an existing cable is converse to the point above regarding avoidance of running adjacent to existing cables, however it may be an acceptable compromise for routing through R3 zones.
Minimise Interference With Shipping and Navigation	Cable installation in certain areas may be unacceptable to the relevant port authorities due to conflicts with their normal operations. This should be determined through discussion with the relevant port authorities. However, should cable installation works restrict key approach channels to major ports, even for a short period of time, this may be considered unacceptable. Port authorities issue licences to undertake marine works in their area of jurisdiction and they can reasonably refuse. Cable installation may also not be permitted across areas where regular channel maintenance dredging is undertaken by a port authority. This would also be undesirable from the perspective of maintaining cable burial depths and should also be avoided for this reason.
Marine Archaeology	The cable route centre-line should avoid wrecks by a 100 m exclusion zone. Positions of known wrecks, and previously unrecorded wrecks will need to be confirmed during cable route survey, and micro routing may be required as a result. Certain wrecks are given additional protection under the Protection of Wrecks Act or the Protection of Military Remains Act, and such wrecks may have a specific exclusion zone designated around them, which would need to be avoided for any seabed disturbing works being undertaken as part of the cable installation.
Military Practice Areas	The existence of military practice and exercise areas does not generally preclude the installation or operation of marine cables. However, consultation with the MOD has been undertaken to confirm this, where relevant.

2.1.2.1 Phase 1 of the Metoc-Hyder concept engineering study utilised GIS data and constraint mapping was generated to conduct a detailed desktop route selection process. From this study it was concluded that four landfall points be taken forward to the next stage of Concept Engineering (JP Kenny, 2011) - Sandend, Inverboyndie, Fraserburgh Beach and Rattray North and South.

2.1.2.2 Concept engineering stage 2 looked at the remaining four routes developing indicative cost estimates and comparing each option against relative complexity, risk and cost. Following confirmation of the grid connection point at New Deer, the two preferred landfall points were selected, as noted below. These were selected following the results from the Metoc-Hyder, JP Kenny, PCS and RPS reports and using the criteria described above:

- Inverboyndie; and
- Sandend.

2.1.2.3 The sites further to the east of these landfall points were discounted for constructability issues, primarily in relation to the offshore export cable route, which would have been required to extend around to the east of the Southern Trench, a deep area of the Moray Firth and would therefore be in excess of 100 km.

2.1.2.4 Inverboyndie and Sandend are considered the preferred options with minimal impact on the environment and the shortest overall cable route.

2.1.2.5 EIA studies commenced along onshore routes for both the Inverboyndie and Sandend landfall points. Balfour Beatty were also commissioned to provide technical advice on the onshore cable routes and substation locations. Following the EIA studies, landowner negotiations, technical advice and offshore geophysical and geotechnical studies, Inverboyndie was selected as the optimum landfall point. As well as offering the shortest possible export cable route both offshore and onshore, the geophysical and geotechnical surveys undertaken in 2014 suggest that this landfall point is adequate from a technical standpoint and offers sufficient space at Inverboyndie Beach for the cables to come ashore. The benefit of the shorter export cable route means that the footprint of the TI is smaller and therefore minimises potential likely environmental effects.

2.1.3 Onshore Export Cable Route Selection

2.1.3.1 The key considerations that were followed where possible to identify potential onshore underground export cable routes include:

- Consider avoiding areas of environmental designation in which underground cable construction, operation or decommissioning might affect the purpose of designation;
- Consider the ground and slope conditions along the route into which the cable system must be installed. Consider whether the ground is stable and whether it can reasonably be expected to remain stable and suitable for the service life of the cable system. Consider if the ground is suitable for use in reinstatement to avoid the need for imported backfill;
- Consider the practicality of moving any obstructions which would constrain the cable route;
- Consider whether the cable route will have an adverse effect on the local and surrounding environment. Consider whether this effect can be mitigated by route selection;
- Consider whether the cable route can be viewed from above, and if so, what length will be seen, at what distance, over what type of ground cover, with what probability of successful long term reinstatement;
- Consider whether the cable route is one within which it is safe to construct a cable system. Consider, if constructed, will the cable system provide the required service life? Will the system be economic and maintainable? Will the installation be safe and have an acceptable level of reliability when in operation for owners, operators and third parties?;
- Consider the disruption the construction, operation and decommissioning of a cable route would cause to third parties, is it possible to mitigate and is it possible to do this by route selection?;
- Consider avoiding wet areas and habitats that are sensitive to the construction, operation and decommissioning of underground cables, particularly habitats that are difficult to reinstate successfully;
- Consider avoiding areas known to be occupied by protected species and / or their habitats;

- Consider following existing linear features particularly those that have already created habitat disturbance such as existing overhead lines or habitat and hydrological disturbance such as roads or railways;
- Consider access for construction and operation. Consider use of existing roads and tracks and consider the existing road network in terms of the effects of road closure and disruption. Consider the use of existing crossings / structures at roads and railways. For river crossings consider height and steepness of banks, substrate and width of river and use of existing structures;
- Detailed Routing Considerations;
  - Preferable to avoid areas of flooding for joint bays;
  - Preferable to avoid steep side slopes (cross slopes) and gradients;
  - Preferable to follow existing linear features particularly those that have already created disturbance, such as roads or existing overhead line wayleaves;
  - Preferable to make as much use of existing access as possible but preferable to avoid reliance on rural roads that would require alteration;
  - Preferable to avoid loss of landscape features such as individual trees, hedges, semi-natural and other woodlands and commercial forestry, preferable to utilise existing gaps;
  - Preferable to cross water courses and other infra-structure at the most accessible points;
  - Preferable to avoid known archaeology;
  - Preferable to avoid water supplies;
  - Preferable to avoid areas where excavation or ground levels may change in the future;
  - Preferable to avoid areas with unstable, contaminated or high thermal resistivity ground; and
  - Preferable to avoid settlements, particularly those with a concentrated pattern of development.
- Deviation Considerations:
  - Avoid if possible unknown archaeology when it is identified;
  - Avoid if possible the root zones of semi-mature and mature trees;
  - Avoid if possible cable route obstructions such as large boulders;
  - Avoid if possible ground with high thermal resistivity;
  - Avoid if possible unsafe, unstable or contaminated ground;
  - Avoid if possible protected species and / or their habitats particularly during the breeding season;
  - Avoid if possible close proximity to existing overhead lines, cables and other system equipment which may require system outages; and
  - Avoid if possible close proximity to other utilities and services.

2.1.3.2 The onshore route from Inverboyndie identified during the Export Cable Feasibility Study (Metoc-Hyder, 2011) and modified to connect to the proposed substation locations near New Deer were also deemed to satisfy all routing constraints and to meet engineering and health and safety operational and construction requirements during the concept engineering study (JP Kenny, 2011). The Technical Grid Connection Study (PCS, 2013) and Environmental and Planning Study (RPS, 2013) and early EIA studies (particularly LVIA, ecology and archaeology) further informed route selection (where possible). In addition to the abovementioned technical and environmental considerations, selection of the final onshore export cable route corridor (see Figure 1.1-5, Volume 3) was influenced by discussions with landowners along the route.

2.1.4 Onshore Substation Site Selection

2.1.4.1 MORL will require one AC substation, covering an area of up to 270 x 135 m at the connection point to the south of New Deer (Figure 1.1-5). This substation will ultimately be transferred to the ownership of an OFTO entity along with the offshore substations, and the offshore and onshore export cables. In order to allow the connection of the modified Project to the national grid, an additional substation must also be installed which will ultimately be owned by the regional TO and will feed into the existing 275 kV overhead line. This additional substation will be up to 270 x 170 m. Both substations will be a maximum of 13 m in height. The onshore substation site identified by MORL allows for the co-location of the MORL substation and the additional substation within a compound, which together will occupy an area no more than 10 hectares in size (the substation compound). The substation compound will be located adjacent to the existing 275 kV overhead line.

2.1.4.2 The site for the substations was selected following technical and environmental studies (PCS, 2013; RPS, 2013), advice (technical advice from Balfour Beatty, LVIA advice from OPEN and general environmental advice from EIA consultants) and landowner discussions. At an early stage, following environmental and technical assessments, MORL took the decision to embed mitigation into the design of the substation by electing to install Gas Insulated Switchgear (GIS) as opposed to Air Insulated Switchgear (AIS) at the substations. As well as reducing the footprint significantly (approximately 25%), GIS has more equipment housed within a building than AIS therefore having a reduced visual impact. AIS is a more commonly used type of substation, and can be seen nearby at locations such as Kintore and has recently been consented at Rothienorman. GIS, on the other hand, has a smaller footprint, is more contained and allows for greater levels of visual and noise screening. The substation area will be used to provide landscaping to further screen the substations.

2.1.4.3 Of the shortlisted substation locations, the proposed substation area (Figure 1.1-6, Volume 3) was selected for the following reasons:

- Distance from residential properties;
- Proximity to existing overhead 275 kV line;
- Existing screening;
- Space for additional screening works;
- Ground, slope and gradient conditions;
- Accessibility;
- Technical principles associated with the Holford Rules for Substation Locations;
- Landowner discussions.