Renewables Grid Initiative

Subsea cable interactions with the marine environment
Expert review and recommendations report

Abridged version - January 2016

Executive summary

Grid development is vital in order to achieve European energy objectives for a competitive and integrated energy market. Power transmission via subsea cables is required to interconnect terrestrial grids, to supply offshore facilities and to connect renewable energy sources such as offshore wind, wave and tidal power with the grid.

This report provides an overview of the top-priority challenges that need to be tackled in Northern European Seas with respect to subsea cable development and associated environmental impacts in the marine environment. It outlines a set of nine options and actions for the subsea cable industry to take forward, including improved procedures at the outset of project planning and knowledge sharing; improved guidance on environmental impact assessment (EIA), including EIA scoping and cumulative effect assessment (CEA); and focus on research areas that would lead to a better understanding of different consenting requirements across countries; and addressing knowledge gaps identified by current literature, the industry and relevant stakeholders.

These recommendations have been informed through a literature review, as well as primary stakeholder data collection. In December 2015, a total of 140 individuals participated in a targeted online survey that sought opinions on key environmental impacts and knowledge gaps associated with the subsea cable industry. A total of 26 interviews were then conducted by NIRAS personnel, targeting industry representatives and relevant stakeholders, as well as marine environment specialists, providing an insight into specific issues encountered in practice, how these translate into consenting constrains and how these issues should be explored.

Overall, there was a common perception that knowledge gaps in relation to potential environmental impacts of subsea cables are associated with uncertainties around how electro-magnetic fields (EMF) and, to a lesser extent, heat emissions produced by subsea cables affect marine receptors' behaviour. There were contrasting opinions on whether these emissions were a realistic issue. Uncertainty around the quantitative impact of cable installation and decommissioning phases, in relation to seabed disturbance and sediment suspension, was also highlighted by both the interviewees and current literature, indicating a need to better understand these impacts to inform future use of specific installation / decommissioning techniques.

Environmental assessments of subsea cable deployments were generally considered to be effective and fit-for-purpose, although participants indicated that further guidance should be produced, specifically in order to inform the scoping process and to focus environmental assessments. Cumulative effect assessment was also identified as a process requiring further guidance in terms of approach and scope.

Among potential impacts of subsea cables identified, conflict with other marine stakeholders was considered as a key issue that subsea cable developers currently face. There was a general consensus that the improvement of tools for stakeholder engagement and information sharing would be welcomed by both the industry and other marine users.

Finally, in relation to consenting facilitation, it was considered that a better understanding of consenting regimes and requirements across countries would help to reduce consenting risks and potential delays, particularly in relation to shared offshore grids and interconnector deployment.

Background and objective of this report

In autumn 2015, RGI commissioned the company NIRAS Consulting to undertake a review on key environmental issues associated with subsea cable deployment via a literature overview and expert testimonials through both questionnaires and interviews undertaken with key representatives from the industry, relevant stakeholders and marine environment specialists. This report identified key knowledge gaps and informed a set of options and actions for the subsea cable stakeholders to take forward.
The full report can be downloaded here.
This document is an abridged version of NIRAS' report.

Literature review

The full report provided an literature overview of: i) relevant regulatory frameworks that support the development of offshore grids, including the legislation at an international and EU level that needs to be considered regarding the planning and environmental assessment of subsea cables; ii) technical aspects related to subsea cables, including cable types and methodologies used for cable deployment, maintenance and decommissioning; iii) environmental impacts and effects of subsea cables; iv) cumulative effects within the North Sea; v) data collection opportunities. This document focuses on the knowledge gaps surrounding the potential impacts of subsea cables in the marine environment. An overview of how cumulative effects should be considered and a look into data collection opportunities are also provided.

Below is an overview of how the effects of subsea cable installation and operation interact with environmental receptors (X = direct effect, 0 = indirect effect).

Subsea cable impacts	Intertidal habitats	Offshore benthic habitats	Fish ecology	Marine mammals	Birds	Commercial fisheries	Navigation and shipping
Seabed disturbance	X	X	X		0	0	
Increase in suspended sediment concentrations and deposition	X	X	X		0	0	
Potential contaminant release from sediment	X	X	X	X		0	
Electromagnetic fields	X	X	X	X		0	
Thermal radiation	X	X					
Underwater noise and disturbance from vessel and installation activity			X	X	X	0	X
Exclusion of other industries from the area						X	X

Seabed disturbance

It is considered that direct impacts of subsea cables on seabed disturbance are well understood, with evidence on potential pathways for effect associated with specific machinery and sediment types currently available. There is however, limited information on quantification of material arising from cable burial operations. Additional research has, however, been identified as required by the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) regarding the regeneration period and capacity of sensitive habitats like Posidonia meadows, mudflats and reefs. Intertidal habitats are known to be of special concern given that these are areas usually designated for protection of coastal natural structures and important habitats for coastal fauna, such as intertidal birds, as well as human visitors. The disturbance is generally restricted to a narrow strip of seabed, normally limited to an area 2-3 m either side of the cable, or in the order of 10 m width if the cable has been ploughed into the seabed.

Increase in suspended sediment concentrations and deposition

There is a need for further research on the quantification of material that is actually released in suspension by different machinery types. This could benefit from monitoring and modelling techniques to identify the fate of suspended material.

Electromagnetic fields (EMF)

The current level of research results in the implications of the potential effects of EMF (if any) originating from subsea cables remain unclear, with no significant impacts found to date. The majority of literature currently focuses on the elasmobranchs and lampreys that have specialized electroreceptors, however there is little understanding on how EMFs can affect other species such as cetaceans or migratory fish.

Even for studied species, research is mainly limited to a particular life history stage or natural behaviours and interactions. Research evaluating biological responses to anthropogenic EMFs is almost absent, and it still remains unknown whether any effect, if present, would be either positive or negative.

There has been no targeted monitoring specifically investigating whether distributions of crustaceans and molluscs have been affected by the presence of subsea cables, monitoring to meet other objectives has not revealed any evidence to show such an effect. Nevertheless there are uncertainties around the significance of this potential impact.

Thermal radiation

There is a lack of field data on the effect of thermal radiation on benthic habitats, making it difficult to draw conclusions. This results in organisations, such as OSPAR, recommending the precautionary principle based on the assumption that there will be changes in physiology, reproduction or the mortality of certain species. The current suggestion is that the thermal effect is a small increase in temperature within a few centimetres of the cable

Underwater noise and disturbance from vessel and installation activity

Noise produced by different installation machinery needs to be further assessed in order to inform potential impacts on fish species and marine mammals. Only one study has looked at the noise emissions from cable installation as highlighted in the OSPAR Guidelines on Best Environmental Practice (BEP) in cable laying and operation. This is mainly due to the fact that noise is not considered a key environmental issue in association with subsea cables, especially when compared to seismic surveys, pile driving or military action.

Cumulative effects within the North Sea

Cumulative effects are defined as 'net effect of cumulative pressures' from past, present and reasonably foreseeable activities, including consideration to both direct and indirect effects from multiple activities, such as commercial fishing. With the future plans of developing the offshore grid in Europe and in particular the North Sea, it becomes increasingly important to consider the potential for cumulative effects from these developments. However, there is no defined statutory approach or consensus on how a cumulative effect assessment should be undertaken for subsea cable deployments, and there are a number of uncertainties that need to be clarified to the industry, including:

- Scoping of impacts to be considered, which will rely on evidence provided to support the EIA;
- Definition of temporal and spatial scale – which may need to be adapted to each receptor being considered;
- Identification of other projects, plans or licensable activities;
- Data confidence associated with other projects, plans or licensable activities;
- Assessment methodology (qualitative vs. quantitative assessment)

The contribution of subsea cable effects to cumulative or in-combination effects caused by installation, maintenance or decommissioning activities is generally considered to be limited because of the short-term nature of burial/recovery activities. During cable operation, given the current knowledge available on the actual significance of anthropogenic sources of underwater noise and EMFs, it is only possible to make educated assumptions about these cumulative effects. Of greatest concern are those species whose early life stages could experience repeated exposure to the same subsea cable. However, in many cases, changes in sensitivity to EMFs/thermal radiation is not well understood over life stages.

Data collection opportunities

The demand for marine data has led to the development of a number of marine data portals where project's information and environmental data are shared. The following examples are of particular relevance:

- The European Marine Observation and Data Network (EMODnet), a long-term marine initiative from the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE) underpinning the Marine Knowledge Strategy 2020. EMODnet includes a total of seven portals that will be fully deployed by 2020: bathymetry, geology, seabed habitats, chemistry, biology, physics and human activities.
- The European Directory of Marine Environmental Data (EDMED) is an inventory of marine data and data holding centres, considered as a European Standard for indexing and searching data sets related to the marine environment. There are currently 35 European partners working on the expansion of EDMED coverage.
- SeaDataNet is a pan-European standardized system for managing the large and diverse data sets collected by the oceanographic fleets and the automatic observation systems part of national oceanographic data centres of 35 countries, currently active in data collection.
- The INSITE programme (INfluence of man-made Structures In the Ecosystem) is a major industry-sponsored project with the overall aim of providing stakeholders with the independent scientific evidence-base needed to better understand the influence of man-made structures on the ecosystem of the North Sea, which will run until end of 2017.

Expert inputs and recommendations

Online survey

An online survey was developed to gather an initial insight into a wide constituency of stakeholder views on the environmental effects of subsea cables. A total of 140 individuals participated in the survey

The answers to the online survey suggested the following:

- Seabed disturbance is considered a key concern for the marine industry.
- The knowledge gap of highest concern is the effect of EMF; seabed disturbance was deemed to be the second.
- There is a relatively broad perception that seabed disturbance is both a topic with a paucity of understanding of its effects; and an issue which affects subsea cable development the most. While there appears to be a lack of knowledge or awareness around EMF, it is widely considered that it is not affecting the development of projects.
- Both offshore benthic habitats and marine protected areas were considered by respondents to be areas which are sensitive to the development of subsea cables and where there is a lack of understanding around the effects of subsea cables.

It should be noted that there was some variation across stakeholder categories (e.g. TSOs, cable operators, regulators, NGOs) in relation to: i) knowledge gaps surrounding the environmental effects of subsea cables and; ii) environmental receptors were most sensitive to the impacts of subsea cables. For instance, 75% of the NGO and installation company respondents thought marine protected areas (MPAs) were sensitive to the effects of subsea cables while only 19% of consultants held such a view. Intertidal habitats were selected as an issue by 50% of regulators, installation companies and NGOs but only by 6% of TSOs. A high proportion of NGO respondents (75%) also felt there was a lack of understanding surrounding the effects on MPAs, while no installation companies thought there was a gap in the knowledge.

Telephone interviews

A total of 26 interviews were carried out, with stakeholders ranging from transmission system operators, regulators, consultancies, developers and operators, academics, NGOs and cable installation and manufacturing companies. Below is a summary of key issues touched upon during the interviews.

How can environmental assessments be improved?

Environmental assessments are regarded as effective and useful. Habitat Regulation Assessments are considered to be scientifically rigorous with strong legal mechanisms attached. EIAs are also deemed to be effective in that they are widely used and based on empirical information. Strategic Environmental Assessments (SEA) would be more effective if they were more widely utilised by more offshore industries. There must be a legally binding plan in place for an SEA to be required, certain countries (e.g. UK) do not have such a plan for grid infrastructure and therefore an SEA is not carried out. DG Energy have recently invited tenders for an Environmental Baseline study for the development of Renewable Energy Sources, Energy Storage and a Meshed Electricity Grid in the North and Irish Seas, which includes an SEA for grid expansion across the North and Irish Seas (Ref: ENER/B1/2014-703).

Presently the interviewee consensus view is that the current assessments are quite broad; and focusing the assessments more on key impacts would be beneficial. For assessments to be more focused, an agreement would need to be reached between competent authorities and all the relevant stakeholders, on what impacts need to be assessed and the appropriate level of detail. Areas, which are least sensitive to the impacts of subsea cables, may well be able to be dealt with in less detail (e.g. visual and seascape, birds, marine archaeology).

Differing requirements between countries and authorities can prove an issue due to changing parameters, scopes and required level of detail.

What is the current level of knowledge surrounding the environmental impacts of subsea cables?

The participants' general opinion was that there is a reasonably good level of knowledge surrounding their associated environmental impacts. The adverse environmental effects of installation are relatively well understood and are lesser than those of other similar offshore industries such as oil and gas pipeline installation. Concerns unique to subsea cables include the effects of thermal radiation and electromagnetic fields emitted during the operational life of a cable.

There were inconsistencies on specific issues that some participants believed to be well understood and others believed there to encompass a knowledge gap. These differences in opinions may be due to project-specific experiences.

Clarification of the actual impact of the installation equipment appears to be needed as well as information on how the installation impact varies with different benthic habitats. The majority of techniques have been utilised for some time, but there is a lack of agreed guidance (OSPAR, 2012 Best Environment Practice, is available but has been disputed by industry members) on the realistic extent of the impacts. There is also a lack of knowledge of what guidance is available.

EMF is a potential impact that is unique to subsea power cables and is a topic that is consistently highlighted to illustrate the level of disagreement over its understanding and significance. Three viewpoints emerged on EMF:

1. EMF research is not definite but there is no evidence of an impact from EMF;
2. The information on EMF is speculative and the research tends to suggest there is no impact but research would ideally clarify this; and
3. We don't know the impacts of EMF more research is needed.

There is a lack of field studies on the impacts of EMF which, regardless of whether there is an issue or not, allows the question to be repeatedly raised. A more coordinated approach by the authorities and other stakeholders to addressing this reoccurring question would be useful, reducing the pressure on one particular sector to solve the issue outright.

It was also mentioned in some interviews that the general lack of research into thermal radiation is an issue and that there is uncertainty surrounding the modelling of thermal emissions, although this topic is not as widely mentioned or discussed as EMF. It is accepted that despite the uncertainty any impacts are highly localised.

The inconsistencies in understanding the effects of subsea cables suggest that greater knowledge sharing is needed. The collation of existing knowledge and project experiences may well be preferential before additional scientific research is initiated.

Sensitive species and critical species during consenting

Species seen as sensitive to the impacts of subsea cable development by the interviewees, corresponded with the species that proved an issue during consenting. EMF sensitive species were highlighted, along with marine protected areas and benthic habitats such as coral reefs, seagrass beds, mussel beds and intertidal habitats. It was reiterated by several interviewees that the scale of subsea cable development impacts are very localised; resulting in a potentially concentrated impact on sensitive species, with a

reduced effect across a greater area.

How can grid assets be used to collect data and monitor the marine environment?

Participants were generally unaware of any cases when the subsea cable itself has been used to collect marine data. A clear idea on the purpose of this subsea cable monitoring would be needed. If the purpose is to collect general environmental data, then there is a question around what is the benefit of utilising subsea cables specifically for this purpose. The type of data that could potentially be collected would need careful consideration and the data we have currently should be collated in order to avoid the unnecessary and expensive replication of data.

There are cases where marine infrastructure, other than subsea cabling, has been used to collect environmental data, some of which could well be applied to the cable industry. Radars and cameras have been used to monitor bird behaviour (Offshore Renewables Joint Industry Project), vessels have been used to collect water samples. During the interviews, fibre-optic cables were highlighted as having been used to monitor seismic activity and temperature. Reports of met-ocean (meteorological and oceanographic) data being collected from infrastructure were also mentioned. Projects from the oil and gas industry have shown cooperation around data access. Remotely operated underwater vehicle used for maintenance surveys on offshore platforms have in some cases been made the video footage available for biological monitoring (SERPENT). Pre-construction surveys aimed at identifying suitable cable routes and post-construction surveys of cables aimed at assessing the burial depth of cables could well be combined with biological monitoring. Organisations from all the different stakeholder categories would have to be brought together to discuss and agree on the scope of the assessment to provide consistency across developments.

How can environmental and permitting issues be minimised?

In general the environmental impacts of subsea cables are accepted to be localized and small scale and an acceptance of this viewpoint may be beneficial to the industry, especially around the landfall aspects of the cables where there can be greater opposition to cable installation.

There seems to be a lack of clarity on the actual extent of effects resulting from different installation tools and how this relates to different habitats. Improved publically available guidance on this subject would be welcomed by the industry. What has been suggested is a synthesis document that could form the basis of assessments and be referred to by both the authorities and other industry members. This could also include precautions surrounding any sensitive receptors.

A standardised approach to environmental surveying and assessment would provide a level of consistency to the procedures surrounding subsea cable development.

The sharing of experience has been highlighted as a way of understanding what data is available, providing a consensus among stakeholders on what the relevant impacts of subsea cables are, improving communication between stakeholders and assisting with the development of collaborative procedures. The post-construction reports are rarely made available and these are very important for feeding back impact information to environmental reports. A desire for an international platform for experience exchange has been referred to by every stakeholder category.

The importance of stakeholder consultation is clear. Transparency with other industries is also crucial, especially those that may be directly affected by the installation of subsea cables (e.g. commercial fisheries and shipping) since this can play a key role in reducing any objections to the cable development.

Different participants placed a varying level of emphasis on the importance of cumulative effects. The majority of interviewees did not think the cumulative impacts of subsea cables are of particular concern compared to the activities of other industries such as commercial fishing. Those who mentioned cumulative impacts, it was often relating to the increased disturbance to the landfall/intertidal aspect of projects. Guidance specifying how to assess cumulative impacts is currently lacking. Lessons may be able to be drawn from other industries such as the oil and gas industry, which have a high number of pipelines in the marine environment, especially within the North Sea. A formal procedure for assessing the cumulative impacts may benefit authorities and commercial industry alike.

What are the priorities for the future?

There is a difference in viewpoints surrounding those that feel future research is needed and those that feel additional research will not clarify any questions that we do not already understand. Nevertheless additional monitoring data would help to further the understanding of the environmental effects of subsea cables. The focus should be on standardised studies that drawn conclusions which can be referred to within policy and development projects, rather than a constant production of scientific material. Interviewees suggested there is the potential for biological monitoring to be combined with post construction monitoring, currently focused on cable burial depth.

The sharing of data is an important area that seems to be lacking within the subsea cable industry and indeed across other offshore industries. There is a desire for the open access of data and for all monitoring data to be published. The UK Marine Data Exchange portal is an example of how effective sharing of commercial monitoring data can be achieved. Many organisations are resistant to sharing data due to a competitive interest in the data collected, and a perception of "mis-use" of data if used out of context. The exchange provides access to survey data and reports collated during the planning, building and operation of offshore renewable energy projects and developers are obliged to submit the data collected as part of the consent conditions. A pan-European project of this kind would be more challenging to orchestrate with multiple different jurisdictions, although the precedent for Pan-European environmental data sharing does exist (for example WISE). The data collation, curation and easy access are aspects that could be learnt from.

Options and actions

There are a number of research studies and initiatives currently looking at how different human activities impact the marine environment, including the subsea cable industry. In this respect, a review of current knowledge and key gaps on the interactions of subsea cables with the marine environment has enabled the identification of priority actions that will assist the industry to secure its success. The following key options and actions should be considered by the subsea cable industry and key stakeholders:

Procedures

- Encourage the involvement of stakeholders from the outset of project planning.
- Encourage knowledge sharing, through proactive engagement, between stakeholders on project planning and environmental constraints to ensure a stronger collaborative approach.
- Investigate further the use of a singular data register outlining what environmental data are available – and to whom, which organisations have ownership of specific data sets and what data are available for purchase.

Guidance

- Develop an installation tool factsheet, which outlines the estimated level of disturbance for each tool and which installation tools are suitable for different habitat types. Similar guidance could be developed for decommissioning techniques, exploring what factors determine that subsea cables and associated structures are removed or kept on site.
- Update currently available "good-practice" guidelines with stakeholder consultation and input to encourage industry engagement
- Encourage the development of guidelines by relevant credible entities on the scoping of subsea cables environmental assessments, in order to focus the assessments on the key issues.
- Encourage the development of cumulative assessment guidelines taking into account the realistic effects of subsea cables and using lessons learnt from other industries.

Focused research areas

- Undertake a review of the differing requirements for environmental assessments across European maritime jurisdictions identifying opportunities for streamlining.
- Undertake a definitive study on EMF and Thermal emissions, bringing together a broad spectrum of relevant stakeholders in an expert workshop followed up with a synthesis of evidence and issues that is endorsed by the study participants; with the aim of reducing the perceived uncertainty over EMF and Thermal emission impacts.