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NIA Project Registration and PEA Document

Date of Submission

Feb 2024

Project Reference Number

NIA2_NGET0057

Project Registration

Project Title

Understanding the impact of Electromagnetic Fields from Interconnectors (BLUEFIN)

Project Reference Number

NIA2_NGET0057

Project Licensee(s)

National Grid Electricity Transmission

Project Start

March 2024

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Muhammad Shaban

Project Budget

£488,557.00

Summary

High voltage cables produce electromagnetic fields (EMF) external to the cable due to the current flowing through their metallic components, primarily the main conductors. Accurately quantifying and understanding the impact of anthropogenic EMF on marine life is important from a project consenting perspective to ensure that the transition to net zero through the increased use of interconnector systems does not result in ecological harm. This project will focus on the effects of EMF on marine sediment dwelling invertebrates and intends to identify organism sensitivity to EMF by quantifying organism changes in species behaviour, physiology, and associated effects on ecosystem properties.

Nominated Contact Email Address(es)

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Problem Being Solved

Recent interest in the electromagnetic impact of submarine cable systems has been primarily motivated by the growth in floating offshore wind systems, which are typically HVAC. However, it is more likely for organisms to respond to a DC system, which produces steady fields that are more comparable to that of the ambient condition due to the Earth's magnetic field and the movement of seawater (inducing electric fields). As such a targeted investigation of the impact of interconnector systems that are overwhelming HVDC, although a notable exception would be the HVAC interconnector to the Isle of Man, is extremely pertinent.

Coastal and shelf-sea sediments host a diverse and productive seafloor ecosystem in which species living in or on the seafloor play an essential role in modulating sequestration, transformation and storage of nutrients and carbon that underpins the entire food web. Many of these bottom living species are invertebrates that are sedentary or slow moving and therefore cannot avoid disturbance and we have very little understanding of the long-term sub-lethal effects of EMF on these animals.

Method(s)

Work package 1:

This work stream will involve discussions with National Grid staff to understand the typical design of current HVDC systems (e.g., Western Link and/or the under development Eastern Link).

Work package 2:

This work package will undertake a more focused meta-analysis on this database specifically targeted at assessing the relevance of this extant body of work to DC cables and include species specific and life cycle stage analysis to inform consenting methodology. It will also include a discussion on the nature of the typical installation conditions for marine HVDC cables.

Work Package 3:

This workstream will involve construction of the experimental system building on existing capacity developed under the NERC BOWIE project. This will include the set-up of temperature-controlled tanks capable of holding sediment and individual invertebrate species, as well as the cable system developed in WS1. Once the experimental system has been set-up in the laboratory and the experimental EMF device (WS1) successfully tested, it will be necessary to collect sediment and target marine invertebrates.

Work Package 4:

This workstream will involve determination of benthic invertebrate behavioural and physiological responses to a range of electromagnetic fields that are produced by HVDC cable systems under different environmental (seasonal) conditions. Research on marine organisms has shown that species sensitivity to disturbance may be exacerbated at different times of the year due to variations in food supply or temperature variations that may be causing additional stresses on an organism's physiology. Therefore, experiments will be set-up to answer key questions.

Work Package 5:

The impact of HV submarine cables of marine organisms. Key findings across all deliverables will be presented in a workshop with NGET staff. A discussion on implications for consenting of submarine projects will be presented, motivated by the results of experiments undertaken in work stream 5. Guidance will also be provided on the interpretation of extant literature on the impact of EMF on marine organisms. Consequences of project findings for future installations, e.g., Eastern Link and Southeast HVDC, will be summarised.

Scope

This is a research project to understand the EMF impact generated by HVDC cables on the seabed species. Over the 2-year project, we will construct a device to produce EMF for ecology experiments, carry out literature review on impacts of EMF on Marine Organisations, collect organisms and set up the experiments, quantify the marine organism response to EMF, and provide the recommendations based on the outcomes of the study. As a responsible business, NG must identify the potential risks to marine life due to the EMF impact and the mitigation techniques that can reduce the impact.

National Grid in parallel with this research are in the process of issuing group wide guidance on EMF marine impacts. The outcomes of this research will feed into this guidance.

Objective(s)

This research will help us in addressing the two main recommendations from the Crown Estate OWEC workshop as well as managing this risk to the business in the following ways:

- Understanding EMFs from marine cables to inform consenting impact studies.
- Literature review to inform current consenting impact assessments.
- Address stakeholders concerns about uncertainty in the science and gaps in knowledge.
- Provide high quality research where currently there is considerable uncertainty.
- Ensure as a business we are adequately addressing environmental impacts of our proposed marine projects whilst enabling the transition to Net Zero.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The scale of offshore development planned is unprecedented and there is concern that electric and magnetic fields (EMFs) produced by subsea cables may have an impact on marine life. Several external stakeholders, such as The Crown Estate, Cefas, Marine Scotland and commercial fisheries have expressed concern that these impacts are not being addressed adequately during the consenting process for new assets. To address this concern The Crown Estate, have included EMF impacts as part of their Offshore Wind Evidence and Change Programme (OWEC).

This project ensures that NGET are at the forefront of global developments in enhancing network capacity to meet the increasing demands of customers as well as reducing the impact of our activities on external stakeholders. With the latest research conducted investigating the impact of EMF on marine life, NGET will be able to plan effectively and efficiently which could deliver savings.

Furthermore, the leveraged funding mechanism ensures that expensive research can be carried out at subsidised rates, thereby ensuring the best value for consumers' money. The project will not restrict benefits delivered to vulnerable consumers based on any vulnerability class.

Success Criteria

This project will be successful if project provides the insights to the following.

- A breakdown of methods for calculating, modelling, and measuring EMFs emitted by subsea cables.
- A summary of appropriate approaches for modelling and measuring subsea power cable EMFs to assist in the assessment of effects on marine life.
- Short and longer-term recommendations for how to improve and standardise research in this field to allow greater sharing of data and evidence.
- Recommendations for future research in this field.

Our overall objective is to develop an understanding of the impact of EMF and then issue group wide guidance on EMF marine impacts with analytical and experimental data backed up by this study.

Project Partners and External Funding

The following project partners will be supporting the project:

- The laboratories at Southampton University will make use of some of the existing resources and laboratory general facilities at no extra cost to the project.
- NGET is providing all the funding for the project and is the lead project partner. SSE intends to endorse and provide support to the Project with no financial contribution.

Potential for New Learning

Without including additional EMF assessments within our planning applications, statutory stakeholders are likely to submit objections which can lead to delays in gaining consent. Delays in consent can impact our ability to meet connection dates, have reputational impacts, incur additional costs in late submission of data and could lead to additional mitigation being requested which again would introduce additional costs. Any delays or additional mitigation could add significant costs to a project. EMF mitigations included re-routing, additional cable installations or increased burial depths, all of which would add millions on to project costs. There is very limited amount of work being done in this area and especially the existing one focus on theoretical research. This work will provide the basis of our understanding of the capabilities of HVDC technology and its impact on marine life. The work will be valuable resource for National Grid and will be an asset in publishing our group wide guidance on EMF impact.

Scale of Project

Laboratory studies will be undertaken to demonstrate the testing and studies. As such there is no scope to reduce the scale of the project any further. A device will be built which will be able to produce adjustable EMF and five different species will be collected to perform experiments on.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Laboratory studies to be performed at The University of Southampton.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£439,701

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project facilitates energy system transition by helping NGET to understand the electric and magnetic fields (EMFs) produced by subsea cables impact on marine life. Accurately quantifying and understanding the impact of anthropogenic EMF on marine life is important from a project consenting perspective to ensure that the transition to net zero through the increased use of interconnector systems does not result in ecological harm.

How the Project has potential to benefit consumer in vulnerable situations:

N/A

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

Not required as starting TRL3 (Research Project)

Please provide an estimate of how replicable the Method is across GB

Due to HVDC connecting interconnectors to the transmission system, this work will impact all TOs using subsea cable for HVDC transmission. NG and SSE both support this piece of study and are keen to learn the findings. Major calculations, analytical findings, and other relevant material will go into a guidance NG is planning to publish which can be adopted by a GB wide system.

Please provide an outline of the costs of rolling out the Method across GB.

N/A

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

- A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).
- A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)
- A specific novel operational practice directly related to the operation of the Network Licensees system

- A specific novel commercial arrangement

RIIO-2 Projects

- A specific piece of new equipment (including monitoring, control and communications systems and software)
- A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven
- A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)
- A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology
- A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution
- A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The project will deliver the methodology, prototypes, and specification for business solution to investigate the EMF impact on 3rd parties. The finding will help us reduce the consenting process and address the issues raised by relevant stakeholders. The disseminated results will be shared with all licensees so that the reasons for the conclusions may be understood. It will be the responsibility of others to determine to what extent it applies to other equipment types and different voltages but the underlying work from this project is likely to help.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

- Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

There is no overlapping between this work focusing on the impact of EMF on marine life and another study. There are no other projects in development looking at EMF or its impact. The risk of duplication will be addressed through dissemination of progress with other licensees and being open to co-operate with licensees working in this space.

It should also be noted that the Southampton University has a live project, BOWIE (Benthic Offshore Wind Interactions and Effects) funded by the Natural Environment Research Council (NERC) and the Crown Estate worth ~£2M (~£1M UoS). There is an opportunity for significant knowledge exchange between projects, and an accelerated rate of delivery is anticipated for this project because of this. This project builds on, but does not duplicate the work done in BOWIE.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

There are currently no NIA/SIF projects looking at the impact of EMF on Marine life within the UK. There is significant knowledge gap about the impact of EMF on bottom living species that are sedentary and cannot avoid disturbance. We need to develop

understanding of long-term sub-lethal effects of EMF on such species. As a responsible business, NG need to cover the knowledge gap to address the issue and optimise the busy seabed usage. The study will help us in addressing the recommendations provided by Offshore wind evidence + change programme set up by The Crown Estate. There is no overlapping between this work focusing on the impact of EMF and technical requirements and work currently under way in different trials and studies.

Relevant Foreground IPR

The technology is a low TRL level and there is currently little information available without carrying out a proper feasibility study. The work has not been undertaken elsewhere before and the results could have significant impact on business planning. The results will benefit other energy networks making NIA the most appropriate route.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at <https://www.nationalgrid.com/uk/electricity-transmission/innovation>
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

Please identify why the Network Licensees will not fund the project as part of it's business and usual activities

The nature of a research programme means it inherently carries a risk that the research may be unsuccessful and/or identify unforeseen barriers to implementation and National Grid is unable to consider research of this scale as business-as-usual. The NIA funding offers the most appropriate route for NGTO to design experiments, review existing techniques, and perform well designs experiments on certain species. As relatively little is known about the technology and its low TRL level, this justifies the use of NIA.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The technology is a low TRL level and there is currently little information available without carrying out a proper feasibility study. The work has not been undertaken elsewhere before and the results could have significant impact on business planning. The results will benefit other energy networks making NIA the most appropriate route.

This project has been approved by a senior member of staff

Yes