Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Feb 2014

Project Reference Number

NIA_NGET0136

Project Registration

Project Title

Impact of Seabed Properties on Ampacity and Reliability of Cables (ICASE Award)

Project Reference Number

NIA_NGET0136

Project Licensee(s)

National Grid Electricity Transmission

Project Start

October 2012

Project Duration

3 years and 10 months

Nominated Project Contact(s)

Greg Tzemis

Project Budget

£157,000.00

Summary

This project will utilise existing and new field data for HV cable routes (high resolution seismic, core logs and attendant geotechnical measurements and direct time series of thermal measurements) to understand spatial and temporal variability of the pre- and postinstallation physical environment along cable routes on the UK shelf.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

Commercial interest in the use of subsea electricity transmission has grown significantly in recent years. Such cables form the backbone for offshore renewable energy generation infrastructure. They also offer the potential for a European Supergrid. HV subsea cables are frequently laid in trenches at the seabed and buried within local seabed materials, with little consideration of the thermal regime they will either enter or generate.

The changing nature of the burial environment will have significant implications for cable performance; the thermal rating of these cables is limited by the ability to balance heat generation from electrical losses with transfer to the surroundings. Excessive temperatures distort the electric field in DC cable and prematurely degrade insulation and other components leading to early failure. The stability of the installed cable is dependent on the geotechnical properties of the seabed and these may change significantly both during installation and post-installation operation.

With external cable temperatures approaching 60°C or higher, the host seawater-saturated sediments will endure thermal conditions at 1 to 2 metres depth typically only experienced following ~2 to 3 kilometres of burial at normal geothermal gradients. In the short term this could result in pore water convection and subsequent reduction of bed shear stresses and hence the erosion of the burial material whilst in the medium to long term they could promote diagenetic reactions between the sediment and pore waters such as mineral recrystallization, significant compaction, and partial induration.

Method(s)

Research

This research project will acquire, process and analyse a wide range of seismic and geotechnical datasets for HV cable routes across the UK continental shelf. Particular emphasis will be placed on both the spatial and temporal variability of key parameters such as: mineralogy, grain-size distribution, porosity/permeability, thermal conductivity, bulk density, bed shear stress and erosion. Data both pre- and post-installation will be investigated to look at both the impact of trenching and backfill on these key physical parameters and the variability of these parameters with the changing thermal regime. The project will link closely with a HubNet sponsored studentship (also starting October 2012) focused on the development of numerical and physical models of the changing thermal and physical regimes in these near surface environments. The student will work closely with colleagues from both National Grid and other cable operators.

Scope

This project will utilise existing and new field data for HV cable routes (high resolution seismic, core logs and attendant geotechnical measurements and direct time series of thermal measurements) to understand spatial and temporal variability of the pre- and post-installation physical environment along cable routes on the UK shelf.

Objective(s)

The objectives of the project include:

- Developing an understanding of the influence of geotechnical properties of the seabed on the performance of subsea cable and produce an improved method for specifying future connections.
- Investigating the impact of trenching and backfill on key physical parameters and their influence on cable thermal rating and long-term reliability.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria of this project include:

- Initial report on the influence on cable performance of shallow water geophysical parameters.
- Report on the spatial and temporal variability of key seabed parameters and the design and selection of data.
- Report on the influence of seabed parameters on the operation and long-term reliability of cable assets.
- Final Report

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project will involve a desktop study and lab-based investigation.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The research will be carried out at the University of Southampton.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

The total NIA project expenditure is £88,000

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:

n/a

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)

The estimated costs of a failure on a major HVDC submarine link are in excess of £15m due to the timescales to affect a cable repair. This project will help investigate the performance of cables in a seabed environment and provide knowledge that could reduce the likelihood of some of these failure mechanisms.

Please provide a calculation of the expected benefits the Solution

Not required for research projects.

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

The outcomes of this project will replicable for all Network Licensees with sub sea HVDC cables as they will generate an understanding of best practice when running cables along the seabed.

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

This project will provide the basis for specifying the installation design for future tenders for HVDC schemes and for providing guidance on the operation of existing links. Any change of specification and policy is estimated to cost approximately £10,000 - £20,000.

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 generating key learning surrounding performance and impacts of cabling on the seabed when interacting with the general environment which will be relevant to all Network Licensees with existing or planned sub sea HVDC circuits.

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

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

n/a

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

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

activities

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes