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

Nov 2013

Project Reference Number

NIA_NGET0112

Project Registration

Project Title

Enhanced AC and DC safety voltage limits assessment

Project Reference Number

NIA_NGET0112

Project Licensee(s)

National Grid Electricity Transmission

Project Start

October 2013

Project Duration

4 years and 10 months

Nominated Project Contact(s)

Jude Robinson: box.eto.innovationteam@nationalgrid.com

Project Budget

£288,000.00

Summary

Currently, we do not specify what the ground surface needs to be when construction of a new substation is being undertaken. This work would give us an appropriate basis to be able to publish a policy document that could state what materials are and aren't appropriate for use in substations where HVDC systems are in use. It would give us a good understanding of the types of problems we are looking for when specifying ground surfaces, and also allow the tool to be used in exercises when deciding what surface to use. Because surfaces would have a standard set of measurements associated to them, which judging would be based on, it would be fairly simple to incorporate new materials into the tool for consideration when they arise. We would simply test the new material electrically, and then input the parameters into the software.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

In the power system, an electrical fault is any abnormal electric current for example, a short circuit is a fault in which the current bypasses the normal route. In the event of a fault, the system is connected to a mesh under the substation floor. This enables the fault to travel to earth. The electrical resistivity of the surface material above the mesh and below your feet is a safety consideration when we design a substation.

The safety publication IEC 60479-1 details the effects of current on human beings and livestock ranging from an electrical frequency of 10hz to 100 hz. The transmission system is operated at 50 hz, so this IEC document is the standard to base our findings on. It details what level of current experienced by the body gives different effects – no effect, mild discomfort through to death.

Currently, there is not a national or international standard on earthing of HVDC systems that addresses the electrical resistivity of

surface materials. This is problematic to National Grid due to the amount of future HVDC systems that will be connected to our AC system, and the type of effect that an AC/DC interaction can bring on to the earthing systems.

Method(s)

RESEARCH

This project is going to develop a standard for which substation ground materials are installed based on their electrical resistivity. This standard will then be issued to contractors doing the works on site, and we can ensure an appropriately costed surface can be installed, that still ensures the safety of workers on and around the HVDC systems.

The method proposed by Cardiff University involves a Literature survey of existing material, Computer simulation and software development of a calculating tool, and Lab tests of materials to provide the parameters for the software to reference.

The lab testing and computer simulation are logical processes to follow also. The lab tests will involve taking standard surfaces (such as aggregates, tarmacs etc) and applying electrical current to them, measuring the resistance they impose on the electricity. These range of values will then be input into a computer software to be developed as part of the project, in order to visualize the data and make it user friendly.

Scope

Currently, we do not specify what the ground surface needs to be when construction of a new substation is being undertaken. This work would give us an appropriate basis to be able to publish a policy document that could state what materials are and aren't appropriate for use in substations where HVDC systems are in use. It would give us a good understanding of the types of problems we are looking for when specifying ground surfaces, and also allow the tool to be used in exercises when deciding what surface to use. Because surfaces would have a standard set of measurements associated to them, which judging would be based on, it would be fairly simple to incorporate new materials into the tool for consideration when they arise. We would simply test the new material electrically, and then input the parameters into the software.

Objective(s)

There are three main objectives that this project is aiming to deliver, with one stretching objective. These are (in no particular order) to produce a standard for ground surfaces in terms of earthing of an AC/DC system. Secondly, to quantify the existing electrical performance of commonly used substation materials. Lastly, to develop a piece of software that calculates and quantify these safety voltage limits.

The stretch target for this project is to make the standard internationally acceptable throughout the electrical community.

The research being done in this project will aim to quantify the electrical resistance of ground surfaces currently installed on the network, and then provide a calculating tool that can produce safety criteria under AC & DC conditions, a variety of site use scenarios and a realistic range of surfacing materials.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be successful if, at the end of the project, we have the tool for quantifying the electrical resistance of the ground surface, a dataset of common materials, and a recommendation for changes that are needed to the National Grid policy document.

Project Partners and External Funding

Cardiff University are doing the work on behalf of NGET.

There is no external funding being bought to this project.

Potential for New Learning

The project has been identified as being able to develop new learning, mainly in terms of quantification of electrical properties of existing materials. The learning will be disseminated throughout the standard channels – ENA Smart Portal, Websites, Conferences, and Scientific Papers etc.

Scale of Project

This project is an appropriately designed laboratory assessment which will have practical application on some of our major capital programme schemes. As such, we cannot reduce the scale any further to provide the benefits to customers that this project will deliver.

We are experiencing more usage of DC interconnectors, DC wind farm connections and DC systems being installed to increase boundary capacity within the GB system. All of these links are connected to the National Transmission System, and provide National Grid with some issues specific to earthing on the AC side of the system.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project is nationally applicable (specifically around areas with DC systems) but potentially internationally applicable in the future, however this will be out of the scope of the project. The main areas we are focussed on are the substations where the Western Link joins the AC system, and areas such as the substations where the IFA & BritNed interconnectors join the AC system.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

288000

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)

It is plausible that the outcome of this work could lead to installation of new flooring being more expensive than the current floorings installed on the system, however this cost would be offset by the value that is bought to the electricity industry in terms of safety & reputation.

Please provide a calculation of the expected benefits the Solution

Research Project - Not required

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

All sites where there are AC & DC system interactions

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

This cost is Incorporated in the project, as the software will be available to all to use as they see appropriate, and be able to make better informed investment decisions for major scheme works.

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

This R&D exercise targets the fundamental material issues as well as the production of a practical tool, which will be made available to the whole electricity industry. The understanding on DC will allow all network operators to meet the challenges introduced by the new HVDC system to UK. All the outcomes are expected to be reflected in relevant national, and potentially international, standards.

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.

There is evidence to suggest that work in this field has been completed before, mainly in China, where HVDC systems are installed as a major means of electrical power transmission. However we do not have access to the information, so a review of published articles is a logical first step in determining what has already been accomplished by others and is accessible to National Grid.

Having checked our standard research suppliers including EPRI, Universities, ENA Smart Portal etc, and with the exception of the work being done in China that we do not have visibility of, we do not believe that this work has been undertaken before.

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

- [x] Yes