

NIA Project Registration and PEA Document

Date of Submission

Dec 2013

Project Reference

NIA_NGET0018

Project Registration

Project Title

Potentials and profiles around earth electrodes and opposite-side injection for large-area earthing

Project Reference

NIA_NGET0018

Project Licensee(s)

National Grid Electricity Transmission

Project Start

January 2012

Project Duration

6 years and 7 months

Nominated Project Contact(s)

Dongsheng Guo

Project Budget

£342,000.00

Summary

To determine accurately the extension of hot-zones is crucial in terms of earthing system design and need of mitigation measures. With the wide use of simulation software packages, the credibility of the outcomes has yet to be verified experimentally.

In addition, current testing methods/instruments operate in the range of 10mA to 5A hence the scalability of the measurement (to high fault current) is yet to be established.

Cardiff University had carried out research projects covering the above issues with promising preliminary results. Furthermore, they have acquired necessary site facilities and experience. It is more likely that the above issues will be addressed more efficiently and successfully.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

The impact of rise of earth on the safety of staff, contractors and the general public has been identified as needing research to develop relevant knowledge. The following sets out the issues that need to be researched:

- The accuracy of site measurements has been unsatisfactory hence a novel testing scheme is to be developed.
- The current computer simulation approach has not been validated rigorously with site measurements.
- Earthing impedance shows dependency on frequency, this is not being taken into account in analytic approaches.
- Measurements are always carried out with low current injection. However, pilot experiments showed the non-linearity between earthing impedance and injected current.

Method(s)

The methods that will be used to investigate and solve this problem are;

- Purchase and set up of generator power supply-Llanrumney;
- Set up laboratory tests, test cell and samples preparation
- LLanrumney and laboratory tests – scalability, current and frequency effects (I)
- Dinorwig test site – set up of high current test facility
- Dinorwig tests – interim results on scalability, current and frequency effects
- Preliminary models and equivalent circuits
- Preliminary report on scalability and non-linear effects
- LLanrumney and Dinorwig- Exported potentials and potential fall off tests
- Llanrumney and laboratory tests – scalability, current and frequency effects
- Llanrumney and Dinorwig- Opposite side injection tests
- Llanrumney and Dinorwig- Exported potentials and potential fall off tests
- Presentation of findings
- Final Report

Scope

To determine accurately the extension of hot-zones is crucial in terms of earthing system design and need of mitigation measures. With the wide use of simulation software packages, the credibility of the outcomes has yet to be verified experimentally.

In addition, current testing methods/instruments operate in the range of 10mA to 5A hence the scalability of the measurement (to high fault current) is yet to be established.

Cardiff University had carried out research projects covering the above issues with promising preliminary results. Furthermore, they have acquired necessary site facilities and experience. It is more likely that the above issues will be addressed more efficiently and successfully.

Objective(s)

The objectives for this project are as follows;

- To evaluate the current simulation approaches against site experimental results (at both Dinorwig power station and Cardiff University test sites) in determining the extension of substation hot-zones
- To investigate the scalability of low-current injection testing
- To investigate the non-linear effects, including current and frequency dependency, of earth impedance.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be successful if we can understand in greater detail the issues faced around earth electrodes.

Project Partners and External Funding

Cardiff University

There is no external funding being brought to this project.

Potential for New Learning

It is expected that we will learn about the impacts of opposite side injection on earthing systems. The knowledge of the project will be disseminated on the ENA Smarter Portal as well as on www.nationalgrid.com/innovation. This project will also be disseminated through relevant national and international conferences and industry and academic forums.

Scale of Project

This work is being done on a Laboratory scale

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The work is being done in Cardiff

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI – £135k

NIA - £207k

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)

Safety related project for both staff & non-company personnel. As given in the guidance note provided by the ENA, cost of life is £1.5m, Reportable Injury is £18k, Minor Injury is £330, Ill Health is £16k (derived from the HSE Economic Analysis Unit's Appraisal). This work looks to mitigate those factors that could lead to the situation where a person would be in danger.

Please provide a calculation of the expected benefits the Solution

Research Project -N/A

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

This can be rolled out to all sites on the National Grid Transmission system

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

This will be covered in the project as the technical experts will disseminate into National Grid.

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

n/a

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

This project addresses the safety theme, with focus on safe working processes to protect our staff, contractors and the general public.

- 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.

Having checked our standard supply base, including Universities and EPRI, and the ENA portal, National Grid confirm this work has not been done 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

Yes