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

May 2015

Project Reference Number

NIA_ENWL002

Project Registration

Project Title

Distribution Asset Thermal Modelling

Project Reference Number

NIA_ENWL002

Project Licensee(s)

Electricity North West

Project Start

July 2015

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Electricity North West Innovation Team

Project Budget

£260,000.00

Summary

The project will cover all common types of distribution (11kV or 6.6kV to 415V) transformers and low voltage (415V) cables installed by Electricity North West.

Third Party Collaborators

The University of Manchester

Nominated Contact Email Address(es)

innovation@enwl.co.uk

Problem Being Solved

One of the key challenges facing DNOs today is a significant change in loading on LV networks from increased penetrations of Low Carbon Technologies (LCTs). The DECC projections for Electric Vehicle and Heat Pump uptake will lead to a marked increase in the daily peak demand placed on LV networks and combined with the observed increase in generation from domestic PV result in the potential for a significant change in the manner LV networks are utilised. These changes have the potential to significantly alter the existing power flows, which is expected to increase instances of distribution asset thermal overload risking premature ageing induced by higher operating temperatures and potential asset failures particularly for transformers where resultant hotspots lead to a loss of insulation oil. The forecasted changes in the utilisation of distribution assets is contrasted with the limited understanding of the behaviour and performance and their potential to accept increased loadings whilst still achieving the expected economic lifetime.

A greater understanding of the thermal behavior exhibited by distribution assets could be used by DNOs to maximise their lifetime by applying new understanding to network design, maintenance and asset management procedures.

This project is being raised to complete work on two projects raised under IFI funding; “Distribution Transformer Real Time Thermal

Ratings” and “Dynamic Thermal Analysis of Low Voltage Underground Cables.”

Method(s)

The project will be split in to two distinct methods:

1. Building upon work already completed within the IFI project, a thermal failure model for distribution transformers will be developed taking into account load profiles, transformer manufacturers, designs and ageing conditions. This model can then be used to categorise the DNOs distribution transformer population and identify those types which have an increased probability of failure associated with future loadings scenarios.

2. A prototype network design tool for LV cables using high fidelity Finite Element Analysis (FEA) models will be developed. This tool will assist in establishing how LV cables behave thermally over time when either balanced or unbalanced currents are applied and will provide DNOs with access to a catalogue of simplified thermal models that reflect typical installation scenarios. These models can be used by DNOs to help support network investment planning activities.

Scope

The project will cover all common types of distribution (11kV or 6.6kV to 415V) transformers and low voltage (415V) cables installed by Electricity North West.

Objective(s)

1. To develop a Thermal Failure Model for distribution transformers.

2. To develop an LV cable network design tool based on thermal models of typical installation scenarios

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. A database which describes a distribution transformer’s thermal performance and probability of failure under different loading scenarios which can be used to project future investment plans.

2. An Excel based network design tool for LV cables which will use predefined inputs and FEA models to produce a maximum and minimum operating temperature envelope which can be used to demonstrate whether the cable can accept new LCTs.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project will produce tools and methodologies which can be applied to 90% of distribution transformers and low voltage cables.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project will use data from the Electricity North West distribution network.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£260000

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 not possible to estimate a financial saving at this point. This project will improve understanding of risks associated with the adoption of LCT and deliver improved methodologies to assess our assets for an increasing demand. These improved methodologies will lead to more efficient future business plans.

Please provide a calculation of the expected benefits the Solution

Not Required as this is a Research project.

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

The tools and methodologies produced by this project could be applied to 90% of all DNO distribution transformers and Low Voltage cables.

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

There is no rollout cost. The methodologies will be made available to all DNOs.

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 tools, models and methodologies produced by the University will be made available to all other DNOs to allow them to assess their own asset base and inform future investment plans.

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

The Electricity North West's innovation strategy for RIIO-ED1 has one theme of affordable reliability. Using the improved thermal assessment methodologies produced by this project will allow Electricity North West to target their investment in the right areas. This will lead to a more efficient response to the increase of Low Carbon Technologies and ageing assets.

☑ 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