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

Mar 2022

Project Reference Number

NIA_ENWL_031

Project Registration

Project Title

Automated Transformer Monitoring System

Project Reference Number

NIA_ENWL_031

Project Licensee(s)

Electricity North West

Project Start

March 2022

Project Duration

1 year and 6 months

Nominated Project Contact(s)

InnovationTeam@enwl.co.uk

Project Budget

£1,100,000.00

Summary

Across the UK, DNOs are faced with an aging population of network transformers. Impact of renewable generation and LCT technologies on the electrical network on transformers requires a more detail level of detail to assess these impacts on transformers. In addition, this project will create a real-time asset health monitoring system that will provide instantaneous reports of the asset health of each transformer being monitored and also feed directly into the ENWL asset management database to providing more accurate risk models of asset on the ENWL investment replacement scheme.

Preceding Projects

NIA_ENWL004 - Combined On-line Transformer Monitoring

Third Party Collaborators

Camlin

Nominated Contact Email Address(es)

innovation@enwl.co.uk

Problem Being Solved

As more and more low carbon technology is connected to the grid changes in load driven by this evolving usage means that traditional ways of assessing transformer health will be out of date. Additional capabilities in terms of data collection, data modelling and data analysis will be needed in order to assess the full risk to the transformer fleet. Periodic over-loading due to increased demand from electrification of heat and transport of individual transformers combined with more varied load profiles due to increased distributed renewable generation could create dangerous situations for many transformers. As load increases, temperature in windings increases, and moisture is driven out of the paper into the oil. As the oil is also warming, the breakdown voltage is largely unaffected.

However, as load subsequently decreases, the temperature in oil decreases at a faster rate than the water re-absorbs into the paper. The result is a potentially dangerous period of high %RS, and therefore very low breakdown BDV. Therefore, there is a period when there is an elevated, but unseen, risk of catastrophic failure.

Method(s)

This project will explore enhancement of existing transformer monitoring equipment to enable to provide better targeted data collection. It will also establish the integration of the existing monitored transformer fleet into data solutions, create a data model for the new transformer risk assessment, and look to apply advanced analytics capabilities in different ways. The final capability delivered will be a number of holistic predictive models that effectively digitally twin the monitored transformer fleet. These will deliver various capabilities around anomaly detection in transformers affected by local network configurations, connection of DG and LCT and other load-based effects, if relevant.

Scope

This project will run for sixteen months and comprise upgrading existing units to include the enhanced functionality, creation of a secure web portal to provide visibility of asset condition, and analysis of the additional data to refine the models.

Objective(s)

The project will look to enhance and automate transformer condition monitoring and use this to drive the asset management strategy. It will also revise and update the models used to determine the impact of various factors on transformer condition to account for changes in load types.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Not applicable

Success Criteria

· Hardware Installation: Upgrades to the TOTUS fleet (40 systems) to collect and count

additional events such as through faults.

· Data Management: creation of a framework to host ENWL data on the Kelvatek

data platform, to import historical data and to update the data during the project

duration.

· Transformer Reports with Advanced Analytics: create a secure web-based portal to enable ENWL to check the condition of the transformer fleet and indication of the mitigation actions.

· Investigation on Transformer advanced Machine Learning Techniques: This objective utilises machine learning techniques to develop and refine the models used to understand the impact of various factors on transformer condition.

· Conduct Asset Management Integration: Implementation of the data configuration from the monitoring systems into the ENWL asset management database.

Project Partners and External Funding

There are no project partners or external funding

Potential for New Learning

Development of a real-time system that provides enhanced learning of transformer health to support operational teams in maintenance and fault finding on ENWL transformer fleet. This system will also create live, automated reports to field teams without the need of manual intervention. This live reporting will also feed directly into the ENWL asset management database to provide a high level of data for asset replacement strategies for asset investment.

Scale of Project

This project will cover 40 tranformers across the ENW network

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL9 Operations

Geographical Area

North West England

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£1,000,000

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:

Not applicable

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

Not applicable

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)

This project is expected to provide a new innovative way of providing a higher level of condition analysis to make decision and strategies on transformer health condition which could extend the life of the transformer and avoid network failures.

Please provide a calculation of the expected benefits the Solution

It is estimated that by improving the condition monitoring and refining the models a further extension of life of around 5 years can be achieved leading to a saving of £4m across RIIO-ED2. The costs of any interventions, installations etc have been deducted from the cost of replacing the asset on an NPV basis

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

This system will be applicable to all GB Electricity Distribution Network Licensees.

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

The cost of rolling out this solution will be linked to the cost of installing the units on each transformer and the IT costs associated with integrating the data flow into the DNO system. This is estimated to be £45,000 per site

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

☐ 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 learning from this project research and integration will be made available to other network licensees allowing them to apply it to their transformer monitoring strategies.

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 will address the 'Improve Network Reliability' objective which sits in our Optimised Assets and Practices theme.

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.

A review of the Smarter Networks Portal has shown there are no projects looking at the Automated transformer monitoring

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

Not applicable

Additional Governance And Document Upload

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

This project is innovative as it is looking to creates a real-time condition-based online system which will provide live health condition status of the transformer and create an instantaneous report that can be reviewed by operational staff. This system will also feed live transformer health data in the ENWL asset management system.

Relevant Foreground IPR

Not applicable

Data Access Details

Electricity North West's innovation data sharing policy can be found on our website.

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

The issue of an aging asset base of installed transformers is a UK wide one and would benefit from a consistent approach. The costs of defining this approach have not been budgeted for in the ED1 submission

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

This project is looking to research and create online transformer health monitoring system that provides real-time reports and feeds directly into the ENWL asset management system, there is a risk that the failure modes seen do not lend themselves to this approach

This project has been approved by a senior member of staff

☑ Yes