Date of Submission

18/03/2022

NIA Project Registration and PEA Document

Notes on Completion: Please refer to the **NIA Governance Document** to assist in the completion of this form. Please use the default font (Calibri font size 10) in your submission. Please ensure all content is contained within the boundaries of the text areas. The full-completed submission should not exceed 6 pages in total.

Project Registration

Project Title		**Project Reference**
Automated Transformer Monitoring System		**ENWL 029**
Funding Licensee(s)	**Project Start Date**	**Project Duration**
ENWL	April 2022	16 months
Nominated Project Contact(s)		**Project Budget**
InnovationTeam@enwl.co.uk		£1,100,000

Problem(s)

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grid changes in load driven by this evolving usage means that traditional ways of assessing transformer health will be out of date.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.

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.

Technology Readiness Level at Start

TRL5

Technology Readiness Level at Completion

TRL6

Project Partners and 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

Geographical Area

North West England

Revenue Allowed for in the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£1,000,000

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and 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	☐

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

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.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

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	☒
No	☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe how any potential constraints or costs caused, or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2b. Has the Potential to Deliver Net Financial Benefits to Customers ☒

Please provide an estimate of the saving if the Problem is solved.

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 financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

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 in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

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

2c. Does Not Lead to Unnecessary Duplication ☒

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.

Additional Governance Requirements

The project is innovative (ie not business as usual) and has an unproven business case where the risk warrants a limited Research, Development or Demonstration Project to demonstrate its effectiveness ☒

(i) 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.

(ii) Please identify why the Network Licensee will not fund such a Project as part of its business as 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

iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg 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

Has been approved by senior member of staff ☒

Additional Registration Information

Short Name

Automated Transformer Monitoring System

Introduction

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.

Benefits

Creating a system that uses real-time data to feed directly into ENWL database will aid in decisions around asset investment that will deliverable more long terms benefits and efficiencies to customers. . In addition, an automated online transformer monitoring system allows DNOs to more efficiently target replacement and maintenance programmes which could lead to improved resource management. .

Technologies (Please Select one of the following)

Active Network Management	☐
Asset Management	☒
Carbon Emission Reduction Technologies	☐
Commercial	☐
Comms & IT	☐
Community Schemes	☐
Condition Monitoring	☐
Conductors	☐
Control Systems	☐
Cyber Security	☐
Demand Response	☐
Demand Side Management	☐
Distributed Generation	☐
Electric Vehicles	☐
Energy Storage	☐
Energy Storage and Demand Response	☐
Environmental	☐
Fault Current	☐
Fault Level	☐
Fault Management	☐
Harmonics	☐

Health & Safety	☐
Heat Pumps	☐
High Voltage Technology	☐
HVDC	☐
Low Carbon Generation	☐
LV & 11kV Networks	☐
Maintenance & Inspection	☐
Measurement	☐
Meshed Networks	☐
Modelling	☒
Network Automation	☐
Network Monitoring	☐
Offshore Transmission	☐
Overhead Lines	☐
Photovoltaics	☐
Pre-Heat	☐
Protection	☐
Resilience	☐
Stakeholder Engagement	☐
Substation Monitoring	☐
Substations	☐

System Security	☐
Transformers	☐
Voltage Control	☐
Gas Distribution Networks	☐
Gas Transmission Networks	☐
Electricity Transmission Networks	☐