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

Aug 2018

Project Reference Number

NIA_UKPN0040

Project Registration

Project Title

Transformer Care

Project Reference Number

NIA_UKPN0040

Project Licensee(s)

UK Power Networks

Project Start

August 2018

Project Duration

3 years and 2 months

Nominated Project Contact(s)

Michael Quinn

Project Budget

£218,393.00

Summary

UK Power Networks has an aging transformer population. 61% of all grid and primary transformers are over 50 years old, which is close to the average expected lifetime of a typical transformer. As per standard practice, the lifecycle of such assets would generally be extended via a combination of close monitoring of asset health and refurbishment. Currently, close monitoring is done through oil samples and periodic external inspections which provides an indication of transformer condition but not a definitive assessment of it's condition and expected faults.

With the proposed further investment in online condition monitoring solutions through current and voltage variance monitoring faults can be predicted in advance and transformers can be maintained prior to fault occurrence. Several methods and products for condition monitoring are currently available in the market; however, most involve invasive probes. Traditional monitoring equipment requires invasive probes to be submerged in the oil to be able to work. This requires the oil in the transformer to be lowered/drained this therefore disturbs the core and requires a longer outage on the transformer. In addition to being relatively more intrusive, the traditional method implementation costs are significantly higher than our innovative solution.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

UK Power Networks has an aging transformer population. 61% of all grid and primary transformers are over 50 years old, which is close to the average expected lifetime of a typical transformer. As per standard practice, the lifecycle of such assets would generally be extended via a combination of close monitoring of asset health and refurbishment. Currently, close monitoring is done through oil samples and periodic external inspections which provides an indication of transformer condition but not a definitive assessment of it's condition and expected faults.

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Method(s)

Enging are a specialist manufacturer of condition monitoring equipment and has developed a new non-invasive type of condition monitoring equipment which involves taking measurements from CTs (current transformers) and VTs (Voltage transformers) on the HV and LV side of a transformer and feeding this into a self-learning algorithm. The algorithm will pick up any small changes in current and voltage that are outside the normal operating range of a transformer. The software will also identify any losses within the transformer besides those expected. This technology can also be used to predict future faults occurring within the transformer/tap changer this is due to small variations in voltage and current before they become significantly large to cause a transformer fault. The solution therefore extends the life of the asset by switching the asset out through providing alarms to control engineers and allowing a repair to be carried out before the fault develops to an irreparable level.

As most of UK Power Networks sites do not have VTs on the incomer/HV side of the transformer, it is not possible to gain the incoming voltage reading. Enging has, however, developed a solution that will take measurements from the outgoing LV side and measurements from the tap position reading to feed into the software as a way around the issue to establish the voltage on the HV side of the transformer.

The main activities involved in this project are:
- Installation of the proposed innovative monitoring equipment on site.

- Monitoring of the performance of the equipment installed and analysing the variances in current and voltage to predict faults

January 2021 change summary:

The project duration is extended by nine months to enable sufficient trial data to be collected during the trial period. The additional time will allow the existing challenges in facilitating an internet connection in the trial site to be resolved. This will enable access to the powerful algorithm which will provide valuable insights at the end of the project.

Scope

The project will trial new monitoring equipment developed by Enging and establish its suitability for condition monitoring of transformers. Deliverables: The scope of work consists of:

- Selection of suitable trial site which currently hosts traditional monitoring equipment
- Installation of the new equipment at the selected site
- Calibration of the monitoring equipment to ensure accuracy
- Assessment of the equipment performance during the trial to establish the benefits to DNOs, both technically and financially
- Comparison of the results of the new equipment against the traditional monitoring equipment

Objective(s)

Deliverables:

- To establish if the new technology is a comparable alternative to existing technologies and can be used as a BAU application. If this solution can provide similar results of condition monitoring when compared with traditional monitoring the solution will be more viable as the cost of the solution and ease of installation is a lot cheaper.
- To establish if the technology can detect faults before existing condition-monitoring equipment can detect them.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following will be considered when assessing whether the project has been successful:

- New condition monitoring equipment has been installed at the trial site and operating correctly

- Improved condition monitoring results with the new condition monitoring equipment when compared with traditional monitoring equipment.

- Publish a final report on the performance of the new monitoring equipment and the benefits of using such equipment compared to current monitoring methods and to summarise learning for other DNOs.

Project Partners and External Funding

This an Energy Innovation Centre (EIC) project. There are no project partners and Enging is the supplier providing the technology.

Potential for New Learning

The main learning that will be shared with other DNOs will include:

- An alternative method of condition monitoring. This method will allow an alternative way of monitoring the condition of the asset without the need for invasive probes. This solution will also be a lot cheaper to install as the oil in the transformer will not need to be drained to install probes inside.

- Establish whether faults can be predicted by looking at the waveforms on a transformer. This is the premise that the equipment is based on. The device will need to pick up small changes in current and voltage between the HV and LV sides of the transformer outside the norm for the transformer.

Scale of Project

The trial will be carried out on one grid site with existing condition monitoring equipment. Enging equipment will be installed on all transformers on that site.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The trial is proposed to take place in a primary or grid site in the London Power Networks licence area, subject to outage constraints.

Revenue Allowed for the RIIO Settlement

Over the ED1 and ED2 period, the expected benefits/savings associated with this (assuming it is installed on all transformers over 40 years old, which is built into this cost benefit analysis) will be upwards of £700k. As the £700k benefit includes the cost of installation of all devices on the transformers over 40 years old the benefits would increase after ED2 as the number of devices that would need to be installed would be decreased.

This solution for monitoring transformers was not part of the revenue allowed for in ED1 as it's a new method that was not used previously on Transformers and was not part of the business as usual activities previously.

Indicative Total NIA Project Expenditure

The total indicative NIA expenditure is £218,393

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)

The benefits of this innovation project are based on the following:

If the project is rolled out company wide on relevant assets, then faults can be detected on transformers before the fault develops further and causes irreparable damage. The asset can be switched out before the fault develops further and a repair carried out. If a repair cannot be carried out then a planned replacement can be carried as opposed to it faulting and then having to replace as an emergency replacement.

If this project is rolled out across the business then it could save around £0.5-1.5million (cost of installation of new transformer due to fault). This saving is based on the equipment picking up an issue and then carrying out an inspection to fix the issue before the issue develops into a greater issue/ transformer failure, therefore saving the cost of replacing the transformer if the issue were to develop further. If the equipment is not in place then the saving cannot be made.

Please provide a calculation of the expected benefits the Solution

Annual Base cost = £5,687.98K
Method Cost = £5,326.02k
Benefit = Base Cost – Method Cost = £361.96k

The above costing are based on the following;

The annual base cost will be the cost of failures over the course of the remainder of ED1 and ED2. The method cost will be the cost of installing the equipment across all Transformers over 40 and reducing down the number of failures by a third.

It is worth noting that the number of installs of the equipment will be reduced dramatically after ED2 so therefore there will be a lower method cost which will increase the benefit.

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

This method is applicable to all the Network Licensees and could be adopted for all sites if required.

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

It will cost around £8k to purchase the equipment per transformer. As there are roughly 8,000, transformers across all DNOs this would in total cost £64million approximately across Great Britain 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

Subject to the equipment being proven following two years of trial on site then the equipment could be installed across all DNOs transformer fleets where necessary as a cheaper alternative to traditional monitoring equipment. This learning will be disseminated though a final report at project completion and a full cost benefit analysis carried out for a wider roll out across the network.

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.

No current innovation funded project is planning to carry out this trail at the time of producing this document.

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

This project is innovative as this type of condition monitoring has not been used on transformers before. This is due to traditional condition monitoring involving invasive probes and measuring/predicting faults through current/voltage measurements is relatively a new theoretical method across all industries and not widely practically used yet. It is however used on key motors in the water industry.

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

In section 3.2 of the NIA Governance document, the DNOs are encouraged to pursue different types of Methods and Solutions. Due to the risk involved in the project and not fully knowing whether the benefits can be delivered across our licence areas, these activities would not form part of our business as usual activities. In order to progress an innovative project which carries significant risk in implementation, additional innovation funding is required as a stimulus.

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

The NIA guidance encourages Network Licensees to ensure that projects funded across NIA cover a broad range. As this equipment has not been used in GB before it is an unproven technology this therefore comes with risks. Specifically commercial risks needs to be assessed/monitored as the technology is unproven and there will be a significant expense to trial the monitoring equipment and this is why this cost is being requested through the NIA.

This project has been approved by a senior member of staff

☑ Yes