

NIA Project Registration and PEA Document

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.

Project Registration

Project Title		Project Reference
Optimising Oil Regeneration for Transformers		NIA_ENWL014
Project Licensee(s)	Project Start Date	Project Duration
Electricity North West Limited	Feb 2016	6 Years
Nominated Project Contact(s)		Project Budget
Paul Marshall paul.marshall@enwl.co.uk		£1,500,000

Problem(s)

As part of operating an efficient network Distribution Network Operators need to maximise the use of existing assets. This forms a key part of Electricity North West's Innovation strategy for RIIO ED1.

Electricity North West has proposed that approximately 50% of the 132kV and 33kV transformers due for renewal in the RIIO-ED1 period will now be refurbished and their oil regenerated to reduce their current Probability of Failure and extend asset life.

This approach aims to maximise the life span of the transformers past their original design life thus deferring their replacement and also avoiding de-rating based on age.

There is a need for further research and development to explore the maximum life of a transformer and understand the optimum point that oil regeneration can be applied in the life cycle of the transformer to take full advantage of the technique and maximise the life of the transformer.

An optimal lifetime window for conducting oil regeneration exists according to theoretical analysis but the extent of this window could vary with ageing characteristics of the insulation, operational conditions of the transformer etc

Method(s)

The project will build upon earlier First Tier research into oil regeneration towards the end of transformer life by further exploring oil regeneration in transformers at the various mid points of their nominal life to determine whether deploying the technique earlier will extend the transformer's operable life further.

The project will carry out field trials to identify the optimum point at which oil regeneration can be used in the life cycle of a transformer. To ensure a representative sample of the transformer population is analysed, a varying number of transformers with different manufacturing periods, designs and operating environments will be selected at near identical twin transformer sites.

The oil will be regenerated on one of the twin transformers and both transformers shall be left to naturally age and be monitored over the projects duration to investigate the new expected lifespan of the mid life oil regenerated transformer compared to the untouched twin transformer. The results will inform the optimum intervention strategy which can then be utilised in future asset investment plans.

Scope

Previous research carried out under an IFI project suggested that oil regeneration carried out in a window at the end or near the end of a transformers nominal life would extend life by approximately 10 years. The First Tier project deployed online monitoring equipment at five sites where the oil regeneration technique was used.

The NIA project will build on this research by exploring the optimum point to apply oil regeneration to a transformer fleet. It is acknowledged that the life of oil impregnated paper insulation determines the maximum potential life of a transformer, although other factors may cause it to fail earlier. This project scope will aim to determine if mid life oil regeneration can reduce the rate of paper degradation, and thereby further extend the lifespan of the transformer compared to oil regeneration at end of life.

For this project, ten 33kV paired transformers and three 132kV paired transformers (13 sites, 26 transformers) which are at various stages of their design life will be identified.

At each site, only one of the transformers will undergo oil regeneration.

Online monitoring equipment will be installed on both transformers at each site to allow comparison of their oil condition and to determine the theoretical life extension over time. These results will be fed into the previously funded data visualisation software to allow consistent comparison.

Electricity North West will work closely with industry experts to validate the data and calibrate the life extension results.

The project will allow Electricity North West to develop its understanding of the effects of life extension on transformer failure modes and maintenance requirements and to identify the optimum window for oil regeneration in the life cycle of transformers.

Objective(s)

This project is split into three distinct phases:

Phase 1 Research into and design / sourcing of an oil regeneration unit to carry out the oil regeneration at the 13 sites
This phase to be completed by September 2016

Phase 2 implement Oil regeneration at 13 mid life transformer sites and install condition monitoring equipment
This phase to be completed by August 2017

Phase 3 is the data analysis and optimisation of the oil regeneration practice
This phase to be completed by February 2022.

Success Criteria

Specification and sourcing of oil regeneration unit capable of delivering the required oil quality in a controlled manner.

Complete oil regeneration and condition monitoring equipment at 13 transformer sites at mid life

Data acquisition, analysis and validation to identify the optimum point of oil regeneration in a transformer life cycle

Technology Readiness Level at Start

3

Technology Readiness Level at Completion

8

Project Partners and External Funding

Camlin

Potential for New Learning

Oil regeneration unit specification

Explore and identify the optimum point of oil regeneration for a transformer

Contribute towards the RIIO ED-2 Transformer Management strategy

Scale of Project

The project has been designed to allow a robust statistical sample of transformers sites – any reduction in the sample size would provide too little data for accurate comparison and would be open to a individual set of results having a major impact on the overall outcome.

As changes in oil chemistry can be slow, the 6 year duration of the project is considered important to allow modelling of the effects of oil regeneration over time.

Running the project over a 6year period will allow seasonal changes to be taken into account and to show a deviation in oil results over a number of years.

Geographical Area

Electricity North West licence area

Revenue Allowed for in the RII Settlement

Zero

Indicative Total NIA Project Expenditure

£1,500,000

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 project will produce all Policies and Procedures relating to the installation and operation of the condition monitoring equipment which will be made available to all DNOs. In addition we will also provide the necessary information to allow DNOs to conduct their own analysis of the data and decide when intervention needs to occur

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

Maximizing the use of existing assets and optimizing the oil regeneration window

2b. 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 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

2c. Has the Potential to Deliver Net Financial Benefits to Customers

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

It is estimated that the saving will be £15 million by carrying out oil regeneration and extending the life of 132kV and 33kV

transformers at the middle/optimum point of their design life by 20 years within the RIIO 2 period for Electricity North West.

ii) 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).

The savings have been estimated based on the transformers that are around mid life in the RIIO ED2 (94 x 33kV and 15 x 132kV) being regenerated and a further life extension past their original design life of an assumed 20 years, minus the cost of the regeneration process on a Cost Benefit analysis provides a £15 million saving in the RIIO 2 period.

iii) 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.

The optimum oil regeneration window will differ dependent upon the transformer type and its operating conditions. This approach will aim to develop a range of optimum oil regeneration windows for approx 100 of Electricity North West's 132kV and 33kV transformer fleet of 460 transformers, which is 22% of our current fleet in the RIIO 2 period. As all DNOs have a similar age and type profile to ENW, it is assumed that this could be rolled out to all network licensees.

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

The cost of rolling this approach out across GB would be the cost of purchase and mobilisation costs of a new mobile regeneration unit(s) to each licensees, development/adaption of oil handling in the Licensees sites and some condition monitoring to validate the process. Therefore it is estimated at £1 million per Licensee and £14 million across GB.

2d. Does Not Lead to Unnecessary Duplication



i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

Electricity North West is the only DNO to use oil regeneration as an Asset Management strategy and therefore is at the frontier of oil regeneration life extension. This research further pushes the frontier of oil regeneration life extension and thus does not duplicate any existing research in this field.

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

n/a