nationalgrid

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

Dec 2013

Project Reference

NIA_NGET0014

Project Registration

Project Title

Transformer & System Reliability

Project Reference

NIA_NGET0014

Project Licensee(s)

National Grid Electricity Transmission

Project Start

October 2010

Project Duration

3 years and 7 months

Nominated Project Contact(s)

Paul Jarman

Project Budget

£275,000.00

Summary

At present the risk and criticality approach to transformer maintenance and replacement is based on a relatively crude 3 point scale of critically and a matrix. This method may be capable of improvement if a real network model is used together with an understanding of possible interactions between failures. Generally a transformer outage is manageable, but two or more simultaneous outages on certain parts of the network could have severe consequences. Identifying these situations and the sensitivity to linked failures is important for the correct and timely replacement of the most critical units. As far as can be determined there is nothing significant published on the interaction of transformer reliability and overall system reliability, This project will address this area.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

At present the risk and criticality approach to transformer maintenance and replacement is based on a relatively crude 3 point scale of critically and a matrix. This method may be capable of improvement if a real network model is used together with an understanding of possible interactions between failures. Generally a transformer outage is manageable, but two or more simultaneous outages on certain parts of the network could have severe consequences. Identifying these situations and the sensitivity to linked failures is important for the correct and timely replacement of the most critical units.

Method(s)

The project will employ two PhD students at the University of Manchester working closely together. One in the transformers group under Prof Wang focusing on the development of an asset health index to includie probabilities of linked failures and one in the systems group under Prof Milanovic on incorporating the asset health index and other transformer health dimensions into an assessment of network reliability rates and deriving criticality indices.

Year One – Network model including topology and running arrangement for London using real conditions data including trips, breaker fail etc. including load dependant sympathetic and hidden failure coefficients. Report into reliability under intact and outage conditions.

Year two – Criticality and sensitivity studies of model to parameters such as temperature, transformer condition, transformer design, cooling etc. and protection reliability.

Year three – System reliability sensitivity to replacement policy, maintenance policy and network configuration (optimizing network configuration is out of scope but examining the effect of different connection topologies may be possible).

Scope

At present the risk and criticality approach to transformer maintenance and replacement is based on a relatively crude 3 point scale of critically and a matrix. This method may be capable of improvement if a real network model is used together with an understanding of possible interactions between failures. Generally a transformer outage is manageable, but two or more simultaneous outages on certain parts of the network could have severe consequences. Identifying these situations and the sensitivity to linked failures is important for the correct and timely replacement of the most critical units. As far as can be determined there is nothing significant published on the interaction of transformer reliability and overall system reliability, This project will address this area.

Objective(s)

This project will deliver a methodology for assessing the maintenance and replacement strategies for transformer replacement against system reliability requirements. In particular the derivation of transformer replacement priority from asset health index and perceived system criticality can be greatly refined using a detailed knowledge of transformer failure modes (common mode, sympathetic and hidden failures). The availability of such a methodology will ensure an optimum and justifiable prioritisation of transformer replacement maintenance.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be a success if we can understand the issue of transformer & system reliability in greater detail, or provide reasons & understanding as to why this is not possible.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is on a laboratory scale.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The work will be completed in Manchester.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

IFI - £190k

NIA - £85k

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)

This project looks at a systematic failure of transformers, under the conditions where one has already failed. At a minimum there would be two transformer failures before this system would be in place, so 2x£5m (cost of a transformer indicatively) would be avoided.

Please provide a calculation of the expected benefits the Solution

Research Project - N/A

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

This will be applicable to the whole of the GB Transmission System.

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

There are no additional costs for roll out. The learning will be embedded in the business as part of the project.

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

n/a

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 addresses the theme of reliability improvements with specific focus on optimising asset management for the transformer population.

☑ 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