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NIA Project Registration and PEA Document

Date of Submission

Nov 2013

Project Reference Number

NIA_NGET0109

Project Registration

Project Title

Bushing and Instrument Transformer Test Tap Connection Condition Assessment Tool

Project Reference Number

NIA_NGET0109

Project Licensee(s)

National Grid Electricity Transmission

Project Start

November 2013

Project Duration

3 years and 7 months

Nominated Project Contact(s)

Sean Coleman & Ian Kerr

Project Budget

£240,000.00

Summary

This project will purchase the equipment required to perform condition monitoring of the specific type of bushings and Instrument Transformers (ITs), this wasn't possible before with current technology in use within the industry. This is innovative because the method will create a solution using existing off the shelf technology, and combine it in a new way to give the desired condition assessment tools.

This is a first proof of concept where the innovative aspect is bringing together several technologies in an integrated way with remote communications.

Nominated Contact Email Address(es)

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Problem Being Solved

Driver 1:

National grid use Current Transformers (CTs) to measure the current on a particular point of a circuit. This measurement is then used to assess whether the current is within appropriate limits.

Following a disruptive failure of a Reyrolle Hairpin type Current Transformer, approximately 200 Risk Management Hazard Zones (RMHZ) were established around affected assets due to concerns over moisture and Dissolved Gas Analysis (DGA) levels. This is relevant as an increased level of moisture and/or DGA within the oil contained within the CT can cause a breakdown in the electrical insulating properties of the oil. This in turn can cause the unit to fail. The RMHZ are to remain in place until either a satisfactory oil sample can be attained, or the unit is replaced.

Driver 2:

A bushing is used to protect the electrical components as they transmit electricity from the inside of the transformer to the outside, where it joins the rest of the transmission network. It does this in such a way that it electrically isolates the transformer casing at the same time. A typical example of a transformer with bushings is shown below: (The bushings are the 6 spiky bits on top)

In the past, there have been several incidents of bushing failures that have caused catastrophic failure of transformers. Below is a series of photos that shows the effects of a transformer failure:

Traditionally, bushings contained oil which could be sampled to give an indication of their condition. New bushing designs have engineered the need for oil out. Therefore, we need a new method of monitoring the condition of these new type bushing.

The problem we are faced with is that the equipment we have identified to do all the different parts of the total solution are not compatible off the shelf. This condition monitoring solution will be able to address both drivers.

Method(s)

Development

The proposed method is to purchase a list of the following equipment from the suppliers identified to create 2 trailers that have the capability of real time condition monitoring:

Elimpus – conversion of 2 trailers to take direct tap inputs and to provide measurement of leakage current and Partial Discharge

Elysis - bushing tap monitor

ISL- communications system to enable cross site monitoring for Elysis and GE

GE - leakage current and PD off the shelf system for 6 transformer bushings, installed including specially designed tap connectors

Optris – 2 x infra red camera with analytical monitoring software; this package will allow remote viewing of images and windowed alarm generation of selected/targeted items in the field of view.

When purchased, National Grid engineers will make changes to the equipment to ensure the equipment 'talks' to each other to give the solution, and then the solution can be implemented into the condition monitoring programme if successful.

Scope

This project will purchase the equipment required to perform condition monitoring of the specific type of bushings and Instrument Transformers (ITs), this wasn't possible before with current technology in use within the industry. This is innovative because the method will create a solution using existing off the shelf technology, and combine it in a new way to give the desired condition assessment tools.

This is a first proof of concept where the innovative aspect is bringing together several technologies in an integrated way with remote communications.

Objective(s)

The objective of the project is to develop a novel integrated solution for condition monitoring on bushings and Instrument Transformers. Then, we need to test the solution to see how effective it is. Lastly, we will develop an implementation procedure to ensure the solution gets fully implemented into the business.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

An implemented Bushing & IT, and CT condition monitoring solution

A business implementation procedure

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project is at an appropriate scale as it will develop a technique that can be applied to CTs and oil-less bushings. We propose to trial this on 1 site where both bushings and CT issues have been identified.

Assuming this project is successful, it is intended that we will start a minor scheme outside of the NIA, in order to roll out this technology to all affected sites. As these condition monitoring trailers are mobile, we will not need to buy 200 (1 for each case) but can re-use the same trailers nationwide.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

This will be performed at a substation that is in England or Wales, and this is yet to be decided; however the methodology is applicable to the whole Transmission Network. There are 200 RMHZ in place, spread across England & Wales.

Revenue Allowed for the RIIO Settlement

Zero

Indicative Total NIA Project Expenditure

NGET NIA project expenditure is £240,000

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:

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)

To replace a bushing and to clean up the incident (as well as other associated costs) would be in the region of £4m as it is known that the bushing failure can cause a transformer to fail as a result.

Please provide a calculation of the expected benefits the Solution

Base = £4m

Method = £179,000 (equipment only)

B-M=£3.8m

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

This affects over 200 sites on the NGET Network

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

Ongoing Labour would be needed to operate these units. In the National Grid tiered approach to condition monitoring, the engineers would be suitably qualified to operate these machines, then feed the information up the tiers to the appropriate level for interpretation. The labor costs for this cannot be quantified yet as the staff are not in post.

Assuming this project is successful, it is intended that we will start a minor scheme outside of the NIA, in order to roll out this technology to all affected sites. As these condition monitoring trailers are mobile, we will not need to buy 200 (1 for each case) but can re-use the same trailers nationwide.

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)

As detailed in the strategy, we are addressing the following categories:

Safety, Affordability, Ageing Assets, Smarter System Management, and will feed into Information Provision as data is collected.

- 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