

## NIA Project Registration and PEA Document

### Date of Submission

Apr 2014

### Project Reference Number

NIA\_NGET0146

## Project Registration

### Project Title

Assessment of Electronic (analogue and Numeric) Protection equipment end of life mechanisms

### Project Reference Number

NIA\_NGET0146

### Project Licensee(s)

National Grid Electricity Transmission

### Project Start

April 2014

### Project Duration

0 years and 11 months

### Nominated Project Contact(s)

Barrie Ellison

### Project Budget

£313,000.00

## Summary

The scope of the project will establish the techniques and processes to be used on these equipment types.

These techniques and processes will be applied to a specific number of relay types to validate the process and evaluate the lives of these specific equipment types.

The specific equipment types selected will be those predominantly in service on the transmission network which current policy would require to be replaced in the next 5 years.

The establishment of a successful evaluation process for asset life would then be utilised as a research method to evaluate asset lives on other specific equipment types.

### Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

## Problem Being Solved

National Grid has some 1,200 circuit bays associated with its main interconnecting transmission circuits these bays predominantly utilize electronic (analogue or numeric) based equipment to provide fault detection and initiate fault clearance. The current anticipated life of this equipment and replacement policy is based on manufacturers' information and operational experience to date. Application of this policy requires a third of the equipment in these bays to be replaced in the next 8 years with significant access and resource requirements. Due to the critical fault clearance function of protection equipment replacement is undertaken prior to failure and the assessment of asset life is undertaken during the constant (random) failure period of equipments lives. This means that significant statistical failure data for this specific population of equipment will not be available to confirm end of life and investigative processes need to be established and utilised to validate or revise existing lives. It is in the consumers' interest to avoid premature asset replacement and as we are approaching the time frame for significant replacement quantities it is important to ensure our evaluation of

asset life are robust. A quantitative process is required to establish the aging mechanisms applicable to the specific types of electronic protection equipment concerned. This includes determination and application of appropriate invasive examinations and tests to be applied to the equipment to determine deterioration rates and ultimately anticipated lives. This process can then be applied to each specific equipment type as required to inform asset life and modify replacement plans accordingly.

## Method(s)

### Research

The proposed research will utilise industry and academic resource with expertise in protection equipment design to investigate the technology used in the design of the existing equipment and establish the life limiting critical elements and deterioration mechanism leading to failure (Including the effect of failure mechanism; i.e. resulting in failure to operate or in unwanted operation).

### Scope

The scope of the project will establish the techniques and processes to be used on these equipment types.

These techniques and processes will be applied to a specific number of relay types to validate the process and evaluate the lives of these specific equipment types.

The specific equipment types selected will be those predominantly in service on the transmission network which current policy would require to be replaced in the next 5 years.

The establishment of a successful evaluation process for asset life would then be utilised as a research method to evaluate asset lives on other specific equipment types.

## Objective(s)

The objectives are:

- To identify the critical life limiting elements within electronic protection devices
- Establish assessment and testing criteria to determine deterioration mechanisms and rates.
- Undertake testing on specific equipment types to establish current and expected deterioration.
- Evaluate results of testing to determine asset lives for the equipment types concerned
- Based on these results it will consider and recommend if the life limiting factors can be addressed by methods other than equipment replacement .

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

- Establishment of a process to evaluate electronic protection equipment design, identify the life limiting critical elements and deterioration mechanisms leading to failure.
- Identify tests and assessment techniques to evaluate the current state deterioration, the affecting factors, expected deterioration rates and time to failure.
- Successful application of these tests and assessments on specific equipment types.
- Evaluation of the anticipated asset life for the specific equipment types tested
- Provision of options to address life limiting factors

## Project Partners and External Funding

n/a

## Potential for New Learning

n/a

## Scale of Project

The project will be completed as laboratory exercise using equipment removed from service.

It will consider 3 specific electronic protection equipment types.

The research process established should be able to be applied to all electronic protection equipment types. 50 types are currently identified, 28 of which are affected by end of life in next 5 -10 years. Benefits would be realized by undertaking further research that applies this process on these additional equipment types.

The process and information ascertained would ultimately impact on the replacement requirements on up to 400 circuit bays in the next 10 years.

**Technology Readiness at Start**

TRL4 Bench Scale Research

**Technology Readiness at End**

TRL6 Large Scale

**Geographical Area**

The specific equipment types concerned are employed on widespread basis across the entire Transmission network.

The process will be useable across all electronic protection equipment types.

**Revenue Allowed for the RIIO Settlement**

Zero

**Indicative Total NIA Project Expenditure**

The total NIA Project expenditure will be £313,000

## 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)

The evaluation of life limiting mechanisms will enable the more efficient targeting of expenditure on replacement/life cycle management of equipment using this technology and may enable transmission networks to be operated reliably at a lower cost.

Protection replacement costs are significant and require significant resource and system access to complete.

Current lives use for electronic protection replacement are short and with 1200 circuit bays requires significant expenditure and resources. The ability to confirm more accurately the potential remaining asset life will enable a more robust replacement plan, ensure reliability is maintained and any extension to life would provide significant reductions in replacement expenditure.

Forecast protection replacement expenditure for the next 7-8 years is £101m for ~ 300 circuit bays

If the research is successful and life extension is realized then a number of these replacements can be deferred and this cost is expected to be reduced.

Savings provided will be less costs to undertake research: Initially £313k to undertake initial research and establish process, and potentially a further £500k to undertake research on additional equipment types over 3 years (assuming ongoing costs/timescale for the remaining types can be reduced by 50% once processes and tests are established).

#### Please provide a calculation of the expected benefits the Solution

The average protection replacement costs is currently in the order of £330k per circuit bay.

The current expected life for protection of 20 years requires an average annual expenditure of £19.8m to address the existing 1200 feeder circuit bays.

If the research demonstrated that the current life could be extended by 5 years then the average annual expenditure would be reduced to £15.8m: a reduction of £3.9m per year for 5 years.

Note: The actual change in replacement expenditure is directly affected by the increase (or reduction) in expected remaining reliable

protection lifetime determined by the research concerned for the types of equipment studied.

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

The process would be applicable to all electronic protection equipment types across the National Grid network (1200 circuit bays on interconnecting transmission circuits). The process could also be applied to electronic equipment installed on other types of circuit bays e.g. Transformers, Reactors (additional 1100 circuit bays)

The information ascertained could be applied by other licensees' using the same equipment types

The process could be applied to electronic protection equipment specific to other licensees'.

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

This is unknown as it is dependent on the quantity of equipment and diversity of equipment types on other licensees' networks.

### **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**

The information ascertained regarding end of equipment life and its application to replacement plans could be applied by other licensees' where they are using the same equipment types

Where other licensees are using different equipment types then the process could be applied to electronic protection equipment specific to those other licensees' to obtain similar results.

#### **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.**

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