

NIA Project Registration and PEA Document

Date of Submission

Dec 2015

Project Reference Number

NIA_SSEPD_0022

Project Registration

Project Title

Ester Fluid Transformer Re-Design

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NIA_SSEPD_0022

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

December 2015

Project Duration

1 year and 2 months

Nominated Project Contact(s)

SSEN Future Networks Team

Project Budget

£115,000.00

Summary

During this project Scottish and Southern Energy Power Distribution (SSEPD) propose to carry out the development of a 33/11kV power transformer using IEC 60076-14 limits to allow for using an ester-based fluid as an insulating medium at higher running temperatures. Completion of this project should provide us with a solution which can be used in situations where there are high safety and environmental concerns whilst providing a unit which can be reduced in size and cost.

The project will include the following stages;

- Business representatives liaising with the manufacturer to investigate a range of potential designs
- We will undertake a process of assessing and selecting the most suitable designs for a Continuous Maximum Rated (CMR) unit and a Continuous Emergency
- Rated (CER) unit based on potential operational and financial requirements
- The selected supplier will then be tasked with the manufacture of selected designs
- A complete unit will then be subject to enhanced transformer type testing processes before being deemed suitable
- Once testing is complete we will re-assess the potential impact on the business and re-visit initial cost benefit analysis
- Online dissolved gas analysis and fibre optic monitoring of winding temperatures will be installed for a period of 3 years
- The new design, if suitable, will be proposed to relevant departments for use in business as usual

The project management methodology followed in the project, included regular project reviews in order to assess progress and review the benefits case. Following a detailed project review, it has been found that the cost benefit analysis has changed in comparison to the original one. The changes constituted of reduced base cost (due to updates in internal company frameworks) and increased method cost (due to cost of additional materials required). As a result, the updated cost benefit analyses demonstrated that the investigated innovative technology will not offer financial benefits to the company and the customers. Considering the cost of stopping the project at an early stage, as compared to progressing with a project that will not deliver financial savings, it was decided that it is on the best interest of the company and the customers to stop the project prematurely and re-focus the efforts in other innovation projects with higher potential of delivering benefits.

Nominated Contact Email Address(es)

fnp.pmo@sse.com

Problem Being Solved

Use of mineral insulating oil, as used in existing transformers, has potential disadvantages in terms of environmental compatibility, fire safety and sustainability. The solution to this issue has traditionally been the use of ester-based fluids such as Midel 7131. Although these products are seen to provide environmental and safety benefits they are also significantly more expensive than traditional mineral oil thus negating large scale use.

Power transformers are designed to IEC 60076-2 which limits winding temperatures to 140°C to stay safely below the ignition temperature of mineral oil. These design parameters are currently used for both mineral oil and ester-based fluid filled transformers.

Method(s)

This project seek to investigate the potential of designing power transformers for use at distribution level to IEC 60076-14 limits which will allow higher operational temperatures for fluids with higher ignition points.

Scope

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Objective(s)

Phase 1 Objectives

- The project will determine if the re-design of transformers to higher temperature limits and use of ester-based fluids can reduce the manufacturing and installation costs of transformers
- The project will determine if the new design limits are compliant with current Eco-design standards

Phase 2 Objectives

- The project will prove the new design in a live environment
- If successful the new design will be rolled out as business as usual

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Phase 1 will seek to investigate the cost and operational implications of re-design and use of transformers built to IEC 60076-14 limits for use of ester-based fluids as an insulating medium.

Phase 2 will seek to investigate any detrimental affects on transformer performance over a 3 year monitoring period.

The success of the project will be to understand the implications of transformer re-design to allow for running at higher temperature limits.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The scale of this project is seen to be adequate to investigate the design of a transformer to new specifications.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL9 Operations

Geographical Area

This project will be carried out in both SHEPD and SEPD offices with work in the manufacturer's factory and laboratory.

Revenue Allowed for the RIIO Settlement

£270,000 will be included for transformer replacement at Dorchester Primary Substation

Indicative Total NIA Project Expenditure

Total NIA expenditure will be £115,000 of which 90% (£103,500) is Allowable NIA Expenditure.

Project Eligibility Assessment Part 1

There are slightly differing requirements for RII-1 and RII-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RII-2 / RII-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 RII-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 (RII-1 projects only)

Subject to a successful demonstration unit, SSEPD has estimated that approximately 60 transformer replacement projects in RII-ED1 could benefit from the new equipment. This will equate to a potential saving of £1.8m throughout the remainder of the price control. Going forward into business as usual could potentially see an estimated financial saving of around £300,000 per year.

Please provide a calculation of the expected benefits the Solution

Using present day transformer designs and mineral oil insulation costs approximately £240,000 per unit. The proposed method would reduce the cost of using an ester-based fluid transformer from £275,000 to around the same as traditional methods but would in most instances remove the requirement for new oil containment works at around £30,000 per site.

Base Method = £270,000

Method Cost = £240,000

Financial Benefit = Base Cost – Method Cost

Financial Benefit = £270,000-£240,000

Financial Benefit = £30,000

Following a detailed project review, the cost benefit analysis has been updated and is demonstrated below.

Base Method Cost = £233,227.74

Method Cost = £276,000

Financial Benefit = Base Cost – Method Cost

Financial Benefit = £233,227.74 - £276,000

Financial Benefit = -£42,772.26

Recognizing that part of the method cost will be reduced in case the innovative transformer becomes BAU, a projection of the associated cost in BAU was also undertaken. The benefits case was improved in comparison to the previous one, but it was still negative.

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

The method will be replicable across all Network Licensee areas where there is a requirement to replace power transformers.

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

Each unit replaced across GB following successful application of the equipment in this project would be in the order of £240,000 per unit and volumes would be at the discretion of the respective DNO's. This cost per unit will be lower than the traditional base cost of approximately £270,000.

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 learning that will be generated will be available to other DNOs in order for them to assess whether or not the tested transformer design would be suitable for use on their own networks.

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