

## NIA Project Registration and PEA Document

### Date of Submission

Aug 2013

### Project Reference Number

NIA\_NGET0080

## Project Registration

### Project Title

400kV Synthetic Ester Filled Transformer Pilot Project

### Project Reference Number

NIA\_NGET0080

### Project Licensee(s)

National Grid Electricity Transmission

### Project Start

July 2013

### Project Duration

1 year and 1 month

### Nominated Project Contact(s)

Ruth Hooton, Paul Jarman, & Gordon Wilson

### Project Budget

£213,000.00

## Summary

The risk of transformers filled with mineral oil catching fire as a result of failure is mitigated in line with TS 3.1.3, incurring extra costs in the civil engineering design and construction phases.

Synthetic esters such as Midel 7131 pose fewer issues regarding environmental and fire consequences, whilst offering similar insulating performance. Midel 7131 is biodegradable to IEC 61039 and offers a reduced fire hazard compared to mineral oil (Midel has a flash point of 260°C and a fire point of 316°C compared with a flash point of around 150°C and a fire point below 300°C for mineral oil). It has an IEC fire class K3 rating and a well documented fire safety record over 30 years. Therefore the use of Midel may result in reduced civil design and construction costs along with reduced maintenance costs (i.e. fire protection scheme).

### Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

## Problem Being Solved

In 2004 Vattenfall AB (Sweden) commissioned a Midel 7131 filled transformer operating at 135MVA and 238kV. This is the highest voltage application of Midel globally.

As part of a consortium, National Grid has completed fundamental research at Manchester University into the feasibility of using synthetic ester in 400kV transformers; this indicated that the use of synthetic ester is a viable option. To support this research and prove that a practical solution is possible the construction and HV testing of a transformer rig is the next step before commissioning the design and build of a full size synthetic ester filled transformer.

## Method(s)

The method that has been proposed for this project includes;

- Test report from Alstom
- Technical report from National Grid (in collaboration with project partners)

## Scope

The risk of transformers filled with mineral oil catching fire as a result of failure is mitigated in line with TS 3.1.3, incurring extra costs in the civil engineering design and construction phases.

Synthetic esters such as Midel 7131 pose fewer issues regarding environmental and fire consequences, whilst offering similar insulating performance. Midel 7131 is biodegradable to IEC 61039 and offers a reduced fire hazard compared to mineral oil (Midel has a flash point of 260°C and a fire point of 316°C compared with a flash point of around 150°C and a fire point below 300°C for mineral oil). It has an IEC fire class K3 rating and a well documented fire safety record over 30 years. Therefore the use of Midel may result in reduced civil design and construction costs along with reduced maintenance costs (i.e. fire protection scheme).

## Objective(s)

The objective is for this project to give proof of concept on the use of synthetic ester, rather than mineral oil, in a 400kV application. It will deliver a transformer test rig consisting of a representative sample of a full size winding and filled with synthetic ester which will be subject to HV testing in line with National Grid and IEC specifications (specifically Lightning Impulse Test but other tests may be carried out). The scope of the research scheme shall be sufficient to give Alstom whatever confidence it needs to supply National Grid with a standard size 400/132kV 240MVA transformer to the usual specifications on a standard contractual arrangement, subject to the usual procurement exercise, with the normal guarantees and liabilities.

The project will give confidence that synthetic ester can be specified for application in National Grid transformers up to 400kV. In achieving this National Grid will then have an option to deploy a low flammable liquid transformer to sites where this would provide business benefit e.g. remove the requirement for extensive fire protection; enhanced low-fire risk to address planning issues.

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

n/a

## Success Criteria

This project is successful if we improve the knowledge around the construction and HV testing of a Transformer rig.

## Project Partners and External Funding

Proposed Supplier - Alstom and M & I Materials

## Potential for New Learning

The potential for new learning could include commissioning the design and build of a full size synthetic ester filled transformer.

## Scale of Project

This project focuses on Transformers.

## Technology Readiness at Start

TRL4 Bench Scale Research

## Technology Readiness at End

TRL8 Active Commissioning

## Geographical Area

This project will deliver tools and techniques for use on the whole of the UK Transmission Network (national).

### **Revenue Allowed for the RII Settlement**

None.

### **Indicative Total NIA Project Expenditure**

£213k

## 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)

An estimation of the saving if the problem is solved is £235k.

Over an operational lifetime of 40 years we might achieve a saving in the region of £235k for a single synthetic ester filled transformer (up to £940k for 4 transformers located on same site).

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

Base Cost - £5.235m (indicatively)

Method Cost - £5m

B-M > £235k

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

The method will be applicable to any Transformer.

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

Unclear. If the project delivers successfully, we should be able to answer this.

### Requirement 3 / 1

Involve Research, Development or Demonstration

A RII-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 could be used by relevant Network Licenses as it will mean that the use of a synthetic ester in 400kV transformers is a viable option.

#### 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.

Given a review of all companies IFI report, the project engineer confirms that no duplication of innovation work has occurred.

#### 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