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

May 2016

Project Reference Number

NIA_SPT_1604

Project Registration

Project Title

Introduction of Environmentally Friendly Alternatives to SF6

Project Reference Number

NIA_SPT_1604

Project Licensee(s)

SP Energy Networks Transmission

Project Start

May 2016

Project Duration

4 years and 1 month

Nominated Project Contact(s)

James Yu (Future Networks Manager) & Kevin Butter

Project Budget

£380,000.00

Summary

The employment of this new gas presents a number of challenges to SPT. All persons who carry out installation, servicing, maintenance, repair or decommissioning of SF6 filled equipment in SPT are Certified Persons who are trained and competent on all activities associated with working on SF6 filled equipment in accordance with the European Commission Regulations. However, there is no current knowledge on the use of alternative gasses such as g3. The trial will allow the following skills in SPT to be developed:

i. Clarification of Certification requirements for personnel and how these will differ from training and Certification for handling SF6.

ii. An understanding of the physical, chemical and environmental characteristics of g3.

iii. Clarification on the relevant environmental issues associated with use of g3

iv. How the quality g3 will be checked during maintenance and other interventions.

v. The important properties that have to be measured. Use of analyser equipment.

vi. Types of impurities which may be present, and what impact will they have on the performance of the gas.

vii. Recovery of g3and purification of g3.

viii. Requirements for the re-use of g3

ix. Safety precautions for working on open compartments used for g3

x. What Personal Protective Equipment is required to handle new g3

xi. The stability of the g3 mixture over long term service

xii. Impact on design pressure of GIS enclosures

xiii. Compatibility issues with types of bursting disc, gaskets and filing valves

xiv. Impact on continuous gas monitoring systems

xv. How will gas leaks be detected and what instruments are compatible to allow this testing to be carried out

xvi. Types of gas analysers that can be used

xvii. Use and management of dedicated g3 filling equipment ("gas carts")

Third Party Collaborators

General Electric

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

SP Transmission Limited (SPT) have implemented a project to reinforce the 400kV and 275kV substations at Kilmarnock South to facilitate the planned amount of renewable generation capacity contracted to be connected to the transmission system in South West Scotland.

A new 400kV double busbar GIS substation will be provided and built with a footprint designed to accommodate a total of 15 bays with an initial provision of 3 bays equipped with 400kV GIS switchgear. The employment of GIS offers benefits over AIS such as reduced space requirements (10% of AIS at 400kV) high reliability, improved safety, long service, reduced maintenance requirements, and low life cycle costs.

The main disadvantage of GIS is the use of large quantities of SF6. SF6 is an excellent insulator, and is widely used in the electrical industry in high-voltage air or gas insulated switchgear, but it is a greenhouse gas with an extremely significant impact on global warming. It is one of the six gasses listed in the 1997 Kyoto Protocol designed to lower greenhouse gas emissions worldwide.

As part of the RIIO T1 Business Plan, SPT aspires to identify measures to improve overall business carbon footprint where appropriate. SPT manage their SF6 inventory in accordance with industry good practice, but until recently, there was no alternative to SF6 that featured equivalent switching and voltage-withstand capabilities.

Method(s)

A number of companies are looking to develop environmentally friendly SF6 alternatives. GE Grid Solutions are one company who is leading this field and can now offer a revolutionary SF6-free solution, g3 which has been jointly developed with 3MTM, a leader in environmentally sustainable solutions. g3 has 98% less impact on global warming than SF6. With performances comparable to SF6, it is a suitable technology for the development of today's new generation of clean high- and high voltage equipment. GE Grid Solutions has been contracted to install the new 400kV GIS switchgear including a Gas Insulated Busbar (GIB) at Kilmarnock South and has confirmed that one 400kV (GIB) can be installed with g3 as part of an innovation pilot.

Scope

The employment of this new gas presents a number of challenges to SPT. All persons who carry out installation, servicing, maintenance, repair or decommissioning of SF6 filled equipment in SPT are Certified Persons who are trained and competent on all activities associated with working on SF6 filled equipment in accordance with the European Commission Regulations. However, there is no current knowledge on the use of alternative gasses such as g3. The trial will allow the following skills in SPT to be developed:

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Objective(s)

To fully realise the benefits that g3 can offer through an understanding of its practical application and implications in its use as an alternative to SF6 through demonstration in a working environment.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

If successful this work package will allow the use of g3 filled equipment to be employed on the SPT transmission system. The implications on the use of this innovative gas on the equipment itself will be understood and staff training requirements will be identified. The necessary tools and equipment for handling g3 will be developed.

Project Partners and External Funding

None

Potential for New Learning

Significant learning will be realised through the deployment of this innovative gas alternative to the greenhouse gas SF6 in an operational setting. This learning will include the practical steps to fully realise the potential benefits that this innovative gas alternative can offer.

Scale of Project

The deployment is limited to one 400kV busbar section as dielectric only, and 15 bays of 132kV GIS as dielectric and arc interruption.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Kilmarnock South Substation, South West Scotland, within SPT's licence area; Lister Drive Substation, Liverpool in SPM licence area.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£380,000

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)

In order to estimate savings any additional costs of deploying and maintaining a g3 insulated system must first be established. This project will help towards identifying some of these associated costs.

Please provide a calculation of the expected benefits the Solution

The lifetime cost associated with leakage of SF6 for Alstom 400kV GIS solution was estimated at £197,230 based on the Ofgem penalty of £1,254/kg. (This compares to a lifetime cost of £25,604 for g3).

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

It is hoped that through the trial that the g3 gas can used as a direct replacement for SF6 in 132kV, 275kV and 400kV Gas Insulated Switchgear assets as an insulating medium. GE is also testing the gas as an interrupting medium in circuit-breakers at 132 kV, and with the information gained in the trail we will have a better understanding of its use in GIS for interrupting and insulation (i.e. a complete GIS installation). Some additional testing will be required, but if g3 is proved successful then it can be specified for all future GIS installations, allowing SPEN to move away from the use of SF6 gas in the case of GIS.

We have 20 GIS installations at 132kV to 400kV in SPEN, and there is a possibility that these could all be modified for g3 should the business need arise.

If the interrupting capabilities g3 are proven, then it can also be considered for live tank and dead tank circuit-breakers thereby eliminating the use of SF6 in all future transmission switchgear.

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

Given that new alternative gas insulation solutions could be more expensive at the outset it is difficult at this stage to quantify rollout costs.

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

User experience in operation and maintenance of g3 will be of value across the electricity industry in the search for alternatives to SF6

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.

It is recognised that NGET has a project NIA_NGET0163 that looks at SF6 management and alternative gases which includes g3.

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