WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

**Date of Submission**

**May 2017**

# NIA Project Registration and PEA Document

*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.

## Project Registration

| **Project Title** | | **Project Reference** |
|---|---|---|
| SF6 Alternatives | | NIA_WPD_025 |
| **Project Licensee(s)** | **Project Start Date** | **Project Duration** |
| Western Power Distribution East Midlands, Western Power Distribution South Wales, Western Power Distribution South West, Western Power Distribution West Midlands | May 2017 | 2 Years |
| **Nominated Project Contact(s)** | | **Project Budget** |
| Jonathan Berry | | £398,000 |

**Problem(s)**

Sulphur Hexafluoride (SF6) is an extremely potent greenhouse gas, the use of which is increasingly becoming restricted and regulated (2014 EU fluorinated greenhouse gases (F gas) regulations). This presents a significant problem to network operators as SF6 is an excellent insulating medium which is used extensively in High Voltage (HV) and Extra High Voltage (EHV) switchgear.

Network operators are responsible for monitoring SF6 that is leaked into the atmosphere. A biannual check is currently stipulated in the regulations for switchgear containing more than 6kg of SF6. If the equipment contains more than 22kg of SF6 then checks require to be made every three months. The majority of HV switchgear contains less than 5kg of SF6, therefore checks are not mandatory; however, regulations are constantly changing and these levels could change in the future.
The regulations were recently amended and a new requirement came into force on 1 January 2017. This new requirement stipulates that any new switchgear being installed with more than 22kg of SF6 must have an automatic leak detection system fitted. With SF6 regulations anticipated to increase further there may be a requirement for every new piece of switchgear to be equipped with leak detection technology in the future. This could result in expensive modifications and systems associated with managing leak detection.

The increased expense in complying with future regulations may lead to higher consumer charges for electricity use.

**Method(s)**

The aim of this project is to evaluate alternative insulating medium in place of SF6. The initial phase of the project will involve a literature review to capture previous learning from other projects and research into SF6 alternatives. The literature review should capture all material properties of SF6 to form a basis for comparison of alternative gases and ultimately the selection of a range of the most suitable insulating mediums for test in the next stage of the project. Following the literature review, the next stage will involve identifying and assessing the alternatives that could be used to replace SF6. A selection of insulating mediums will be chosen for initial testing in SF6 switchgear (such as RMUs which have been removed from the system). The results from the testing trials shall be captured in the final phase of the project and recommendations made for transitioning into business as usual (BaU).

It is anticipated that the development of an SF6 alternative will lead to environmentally friendly HV switchgear. The chosen solution will be applicable as an interrupting medium in gas-filled RMUs and insulating medium in indoor switchgear.

As there is a high volume of SF6 11kV RMUs on most DNOs' networks, the project will focus on these devices and specifically the retrofitting of an alternative interrupting medium to replace SF6. *It is recognised that most 11kV primary switchgear does contain SF6 with most being air insulated with vacuum interrupters. EHV SF6 Gas Insulated Switchgear (GIS) may be investigated in a future project.*

**Scope**

This project will be delivered in three key stages:

1. A comprehensive literature review to capture all previous learning from SF6 research and investigation;

2. Identifying and presenting the key insulating mediums to be assessed through initial trials; and

3. Testing the selected solutions using decommissioned 11kV RMUs and proposing recommendations for integrating alternative SF6 solutions into BaU.

The output deliverables will be captured within reports generated over the lifecycle of the project and summated in a final report delivered at the project closedown.

**Objective(s)**

1. Conduct a literature review on all previous research considering SF6 gas alternatives;

2. Identify alternative solutions from the literature review which can be recommended for initial testing;

3. Conduct initial interruption and insulation tests on the proposed gases and document outcomes; and

4. Disseminate the lessons learnt to internal and external stakeholders.

**Success Criteria**

1. The production of a document(s) which outlines the current status of SF6 alternatives and the identification of potentially suitable alternatives for further investigation;

2. The production of a document(s) which shows the method for selecting RMUs for testing, the technical testing specification, the test results and conclusions (even if these simply eliminate the identified solutions from being suitable for further study); and

3. The implementation of dissemination activities to communicate these findings with relevant stakeholders.

| Technology Readiness Level at Start | Technology Readiness Level at Completion |
|---|---|
| 4 | 7 |

**Project Partners and External Funding**

WSP will be providing Project Delivery Support.

**Potential for New Learning**

The project will improve on the current knowledge of SF6 alternatives. The test results will provide a clear indication on SF6 alternatives in 11kV RMUs. This will support the development of SF6 free switchgear. Reports generated through the project will be disseminated to other DNOs and other relevant stakeholders. The report will also be published on WPD's website and the ENA Smarter Networks Portal.

**Scale of Project**

Trials on approximately three RMU types currently installed on WPD's network. Potential to roll out on all RMUs and other SF6 filled equipment.

**Geographical Area**

As 11kV switchgear is widely used across the electrical industry, the successful implementation of an SF6 alternative in 11kV switchgear will be hugely beneficial for all four licence areas of WPD and the DNO industry as whole. This is particularly important considering the increasingly strict regulation on SF6 usage.

**Revenue Allowed for in the RIIO Settlement**

None

**Indicative Total NIA Project Expenditure**

£358,200

## Project Eligibility Assessment

**Specific Requirements 1**

**1a. A 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 systems and 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 | ☐ |

**Specific Requirements 2**

**2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees** ☒

**Please answer one of the following:**
i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

Other DNOs will be able to gain a comprehensive understanding of SF6 alternatives after reviewing the project's test results through reports and other dissemination material. The case study could also be used as an example to evaluate potential SF6 alternatives.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

Sulphur Hexaflouride is a key gas used to provide insulation in high voltage switchgear. The excellent insulation properties of the gas have helped reduce the size of switchgear, but the environmental impact of the gas is significant as it is a potent greenhouse gas. Alternative insulation methods have been used, such as vacuum, and are now well established at higher voltages. Work continues to develop a solution for distribution voltages and we are very much supporting research. Most recently we have supplied a distribution switch unit for analysis at Cardiff University.

The development of an SF6 alternative will reduce the environmental risk by avoiding the use of SF6 in future switchgear designs. During our normal replacement works, designs using SF6 will be replaced in the same way as oil filled designs have been for many years.

**2b. Is the default IPR position being applied?**

| | |
|---|---|
| Yes | ☒ |
| No | ☐ |

**If no, please answer i, ii, iii before continuing:**
i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

**2c. Has the Potential to Deliver Net Financial Benefits to Customers** ☒

i) Please provide an estimate of the saving if the Problem is solved.

1. Potential for significant reduction in costs of switchgear installation by avoiding the possible installation of a leak detection device.

2. Reduction in operation and maintenance costs reduction by avoiding the need to monitor SF6 leaks.

3. Overall, the potential saving will be in form of CAPEX and OPEX which will ultimately reduce the charges passed to the Electricity customers.

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

N/A

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

SF6 switchgear is widely used across the electrical network, with around 296,000 units containing SF6 in WPD's network alone (amounting to 15.42% of the switchgear assets). It is possible that the method could be applied to all current SF6 switchgear if a suitable SF6 gas alternative is identified.

Other GB DNOs could take the learning disseminated from the project and conduct their own trials. However the learning from this method could be directly applied as GB DNOs will have very similar switchgear to WPD.

If an alternative gas is identified then this could be used as a standard replacement in all new switchgear being purchased.

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

Estimated costs for implementing the Method are thought to be:

1. Cost of re-gasing an item of switchgear - £2k / unit

2. Cost of purchasing and transporting gas volumes - £0.5k / unit

3. Cost of disposing of any SF6 as required - £0.5k / unit

4. Cost of designing any re-gas procedure - £5k (per Standard Technique)

These are indicative only and would be refined as part of the Method. The Business Case for the Method would be reviewed following calculation of more accurate costs.

**2d. Does Not Lead to Unnecessary Duplication** ☒

i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

At present, no DNO in the UK has a flagship project for sourcing an alternative solution SF6 in HV switchgear. This project can potentially lead to the first trial project of retrofitting SF6 alternatives in 11kV switchgear in the UK.

ii) If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A