

NIA Project Registration and PEA Document

Date of Submission

Jul 2024

Project Reference Number

NIA_SPEN_0094

Project Registration

Project Title

SF6 Retro-Fill

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NIA_SPEN_0094

Project Licensee(s)

SP Energy Networks Distribution

Project Start

July 2024

Project Duration

2 years and 6 months

Nominated Project Contact(s)

Ahmed Salama

Project Budget

£5,800,000.00

Summary

This project seeks to develop an SF6 free retrofill solution for GE T155-3 GIB model. The final solution, if successful, is expected to be available for other model owners as business as usual.

The project will include the development of a new gas mixture that can replace the actual SF6 installed on those assets without replacement of seals. Finally, in order to test the gas, two site trials will be carried on Chiperlagen 275 and Kilmarnock South 400/275 kV with HV testing to confirm functionality before getting back into service.

Preceding Projects

NIA_ENWL004 - Combined On-line Transformer Monitoring

Third Party Collaborators

General Electric

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

SF6 has been used within the electricity industry since 1950 and has allowed the development of HV networks. The gas has become the most common arcing insulation method used in HV CB in UK and used within other electric assets to provide a secure level of insulation for compact solutions.

Despite the excellent insulation capabilities of SF6, it has a GWP of 23500 and a degradation lifetime of 3200 years. As a result, SP Energy Networks has detected SF6 as one of the main sources of emissions and by 2030, SF6 is predicted to account for 92% of scope 1 emissions.

Analysis indicates that even if we limit the installation of SF6 and fix our leaks to an acceptable level, we will not meet our targets – unless we actively reduce the SF6 bank within our assets.

As a result of the environmental impact of the gas, SP Energy Networks has committed to not installing assets containing SF6 wherever feasible. For existing assets, SP Energy Networks have agreed to repair SF6 leaks back to acceptable levels; condition assessment will include the impact of leaks and gas volumes; and when replacing the asset, SF6 free solution will be prioritised.

However, even though we are looking at accelerating the SF6 removal as part of the transition to Net Zero goals, most of assets using this technology are still too new to be replaced. This creates the need to explore alternative solutions to meet our sustainability objectives.

Method(s)

1. Development of a low GWP gas that can replace SF6 inside the T155-3 GIB model.
2. Test and validate the gas under lab conditions
3. Refill and test Chipperlaigen 275kV
4. Refill and test Kilmarnock South 400kV GIB
5. Handover of required equipment and documentation for proper maintenance

Scope

The objective of the project is to:

- Fill the GIB with a new gas, without the need to disassemble and replace the gas seals, only changing minor components. The project will complete two site trials to assess the practical aspects of implementing this new low GWP gas technology.
- Develop a new gas mixture for GE T155-3 GIB model that can replace the SF6 gas inside the assets without altering its design specifications and without the need for disassembly. Perform field trials of the gas at Chipperlaigen 275kV and Kilmarnock South 400kV.

Objective(s)

- Test and validate the new SF6 gas solution to refill T155-3 GIB model.
- Influence manufacturer in the development of the solution to satisfy UK network requirements.
- Incentivise OEM to propose SF6 free solutions over existing assets.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations.

This is because it is a transmission project.

Success Criteria

- The delivery of the above objectives, within budget and within agreed timelines, as is reasonable depending on the knowledge at this stage of the development phase.
- Production of the final technical reports containing all the learnings and recommendations.
- The refilled asset are able to operate under normal conditions. (ie. Successfully pass HV testing, acceptable leaking ratio)

Project Partners and External Funding

GE will be the developer of the gas and the contractor for refilling the assets. They have been chosen as they are the manufacturers of the asset.

Potential for New Learning

- A new commercial solution with potential market in UK will be developed.
- Better understanding of the SF6 replacement gas thanks to the full manufacturer engagement.
- The developed product will be adapted to the UK Network requirements, and therefore relevant to all other TOs who own T155-3 assets.

Scale of Project

The solution is applied to the full GIB because there is a lot of risk in having different gases in the same asset during maintenance routines.

3 GIBs have been selected for data consistency. (ie. If only 2 GIBs are selected and data is different, there would be a lot of uncertainty)

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL9 Operations

Geographical Area

The project will be carried out on the GIBs located at Chipperlaigan 275 kV (1 circuit) and Kilmarnock South 400/275 kV (2 circuits) substations

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£5,800,000

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:

The T155-3 model is relatively new, and its asset portfolio still in good condition due to its age. This asset is expected to be operational beyond 2050, therefore it would not commercially or environmentally sustainable to replace all those the T155-3 that have already been installed. The proposed innovation enables the removal of contaminant gases from the network while maximising the use of the asset to meet our Net Zero Goals.

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)

N/A

Please provide a calculation of the expected benefits the Solution

The expected benefit obtained from this project will be the resultant reduction of CO2 emissions. This has been calculated by comparing the expected social benefit of CO2 emission reduction against the total cost of solution development and installation.

The social benefits of the SF6 retrofill solution have been computed based on the expected leaks of the assets, which is 0.5% as per the manufacturer's specifications. The costs of those leaks were quantified using the expected carbon cost in the coming years and were converted to NPV using the 3% interest established on the Green Book. The same process has been applied to compute the expected volume and costs of the leaks of the new gas. For the new gas a different mass was in the calculation and a GWP of 1000, which is an average obtained from similar gases, since the final product is not yet developed.

Finally, the additional expected CO2 impact and the investment costs are added resulting in a net positive value of £709,255 of expected social benefits. A worst-case scenario, which assumes that the risk mitigation budget is required for developing the gas, has been estimated to have a net positive social benefit of £132,255.

Those benefits are only applicable to SPT. However, since the solution can be applied in other TO assets, the benefit to the GB network is expected to be much higher.

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

The solution proposed will be replicable and applicable for other TOs that have model T155-3 GIB assets.

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

As the solutions is the same for all the model fleet, the cost is not expected to differ for other TOs. Since this is a prototype, cost could even be reduced when commercial solution becomes available. However, cost variation can be expected depending on the length of

the GIB and substation particularities.

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 success of this innovation project will allow other TOs to retrofit their T155-3 GIB assets as Business as Usual. The fact that the solution is developed inside the UK network guarantees that it will be developed according to its standards. Also, it will be easier for other TOs to reach for information and provide feedback throughout the duration of the project thanks to the multiple cooperations groups that the national TOs are involved in.

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

Is the default IPR position being applied?

- Yes

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

While our partner GE would retain the IPR for the new developed gas. The studies and findings from the trials would be available to other Network Licensees so that they could understand the effectiveness of the developed SF6 replacement and decide if it they would like to adopt that solution.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

N/A

Please justify why the proposed IPR arrangements provide value for money for customers.

N/A

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.

We have reviewed the ENA portal and have not identified any other past or ongoing projects that would give rise to unnecessary duplication of research effort.

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

Potentially, there may be other retrofill solutions with other models at the same time. This is acceptable because site trials need to be performed on a model-by-model basis since each design has its own specifications.

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

Until now, GE has never been able to provide a retrofill solution to their assets to make them more sustainable, as other OEM has started offering. This innovation project will be the first site trial performed with a new gas solution customised to their assets. If successful, it will allow any Licensee to retrofill T155-3 GIB model to meet their Net Zero Goals without having to replace their newly installed assets. This project will unlock the potential application of the retrofill solution on different models of that series, like the current transformers and isolators.

Relevant Foreground IPR

GE has required as a condition that the IPR developed of the gas retrofill solution will be under their ownership. SPEN has no problem with this since asset retrofill is not a part of its business.

Data Access Details

Access to this data must be requested by contacting SPInnovation@spenergynetworks.com Please provide the following information in your request:

Affiliation, position and contact details of requesting party

Relevant project and type of data required

Reasons for requesting this data and evidence that this data will be used in the interest of the UK network electricity customers

How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

There is no allowance within our RIIO-T2 settlement for carrying out this innovation project.

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

As this is a prototype gas, there remains some uncertainty of its behaviour once installed in the assets. This would present too much commercial and technical risk for conventional TO plans. Therefore, this activity could only be undertaken with the support of NIA.

This project has been approved by a senior member of staff

Yes