Energy Networks Innovation Process Project Closedown Report Document

Date of Submission: 01/07/2024

Project Closedown Report Document

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Project Title (*This cannot be changed once registered*)

CageCapture™ SF6 Flange Guard

Project Reference

NIA_SSEN_0058

Funding Licensee(s)

Scottish Hydro Electric Power Distribution
Southern Electric Power Distribution
London Power Networks
South Eastern Power Networks
Eastern Power Networks
Northern Powergrid (Northeast)
Northern Powergrid (Yorkshire)

Project Start Date

September 2022

Project Duration

17 months

Year

2024

Nominated Project Contact(s)

Tim Sammon, Innovation Programme Delivery Manager at SSEN

1. Scope

Stage 1 We will develop prototype flange guard for SF6 capture and recovery developed and tested in relevant lab environment.

Stage 2 We will install up to 9 prototype flange guards for SF6 capture and recovery tested in real world environments (up to 3 locations, preferably in different environments i.e. near the coast, city, etc).

As detailed in section 3.2 the project has the potential to deliver up to £4m in financial benefits to GB distribution customers based on capture of leaked SF6 gas.

2. Objective(s)

Objectives	**Measures**
Stage 1	
Produce CageCapture™ absorption	Produce the CageCapture™ absorption at scale and carry out analytical tests of the material produced.
Proof of concept SF6 recovery	Analytical tests of recovered SF6 will be undertaken to demonstrate the success of the CageCapture™ device.
Assembled prototypes	Up to 40 prototype devices will be produced in the laboratory environment.
Stage 2	
Deploy prototype for testing	Successful installation and real world testing of up to 9 CageCapture™ devices.

3. Success Criteria

Success criteria (SF6 Capture)	Measure
Flange guards must fit on different infrastructure types	Multiple, flexible designs are produced
Flange guard media must capture SF6	Capture capacity determined and tested, with a target to capture up to 10% of leaked SF_6 per device
Recovery of SF_6 possible from media	Tests for recovery produces positive results
Easy to deploy	Evaluation of up to 9 installs with subject matter experts in real world environment testing results in positive feedback
Resilience to environment (water, hydrocarbons, temperatures up to 60° C, salinity)	Lab tests and real environment testing
Detection (SF6 Detection)	
High capture capacity	Successfully capture up to 80% of leaked SF6 per device
In situ SF6 recovery possible from DNO assets	Evaluate factors in lab and real environment testing to demonstrate performance based on lab results and feedback from asset teams.

4. Performance compared to the original project aims, objectives and success criteria

Details of how the Project is investigating/solving the issue described in the NIA Project Registration Pro-forma. Details of how the Project is performing/performed relative to its aims, objectives and success criteria.

- Raw materials procured and Cage (CC3) material manufactured in kilogram (kg) quantities suitable for scale up and prototype manufacture.
- Test equipment was designed, built and tested.
- Lab based evaluation of SF_6 capture (adsorption) of proposed cage (CC3) material completed.
  - Adsorption curves completed for pure and dirty manufacturing methods
  - Adsorption of co-crystalised cage (CC3 & CC19) in various proportions evaluated
  - Results of pure CC3 material showed best results and is in line with required capture %
- Costs for full scale prototypes determined based upon adsorption % and confirmed leak volumes and are within proposed budget.
- Proof of concept SF_6 recovery tests completed and have verified feasibility. Possible recycling of cage material to be investigated but may be impractical. Further investigation required.
- Testing of cage material (CC3) in combination with loading media. Combinations with activated carbon and Polyactic acid (PLA) being explored to improve cost effectiveness of solution (activated carbon) and suitability of 3D printed manufacture PLA.
- Prototype manufacture for real world deployment no longer being pursued.

In summary, cost and performance of the material is within targeted values. Environmental impact was not completed as the detection project could not deliver an adequate method of identifying leaks, while the capture project demonstrated good absorption rates in the lab environment, there was no clear route to prototype that could be used in the real world. A small enough working prototype could not be produced that would be viable for use. After site inspection, it was also found that the flanges within the equipment it was being used, were sealed and switchgear would need to be re-rated once the device had been used which would negate the benefits of using it. For this reason, it was not viable to continue to pursue prototypes.

5. Required modifications to the planned approach during the course of the project

The Network Licensee should state any changes to its planned methodology and describe why the planned approach proved to be inappropriate. Please confirm if no changes were required

The project closed down seven (7) months early due to the inability of the linked detection project to deliver (CageCapture SF6 paint detection project looked to develop a paint that would indicate SF6 leaks in equipment). Thus hampered the ability to employ the capture element. While the capture project demonstrated good absorption rates in the lab there was no clear route to prototype this in real world, and for the reasons stated above relating to the use in sealed switchgear, the project was closed early.

6. Lessons learnt for future projects

Describe how the project (methodology, stakeholder engagement etc.) changed, or provided opportunities, from your expectation at the start of the project and therefore could be useful for a future project. In addition, please discuss the effectiveness of the research development or demonstration undertaken.

This was early stage research, in approaching this subject again a wider market survey of available products should be undertaken. It was believed that the delivery partners product was most advanced in development and initiative than what was presented during the project scope. The delivery partner had insufficient knowledge of substation configuration which led to a naiveite around developing the product. The lessons learned here is that the networks should have educated the deliver partner in substation configuration at the outset of the project. However, as the outset was during covid restrictions, site visits proved too difficult.

7. The outcomes of the project

When available, comprehensive details of the Project's outcomes are to be reported. Where quantitative data is available to describe these outcomes it should be included in the report. Wherever possible, the performance improvement attributable to the Project should be described. If the TRL of the Method has changed as a result of the Project this should be reported. The Network Licensee should highlight any opportunities for future Projects to develop learning further.

Lab trials have demonstrated that the cage capture material is successful in capturing SF6. However, following site inspections it was found that it would not be physically possible to place the proposed flange guard within the switchgear. It was also determined that the project was in the early stages of research to warrant further investment in developing prototype capture products.

8. Data Access & Quality Details

A description of how any network or consumption data (anonymised where necessary) gathered in the course of the Project can be requested by interested parties. Please include a link to the publicly available data policy.

For information on how to request data gathered in the course of this project, see the Network Innovation Competition (NIC) and Network Innovation Allowance (NIA) Data Sharing Procedure at https://ssen-innovation.co.uk/innovation-strategy/.

9. Foreground IPR

A description of any foreground IPR that have been developed by the project and how this will be owned.

This section is not applicable as there was no foreground IPR developed with the project.

10. Planned implementation, recommendations or next steps

Please describe the next steps to implement this innovation project. What policies and standards need to be updated or created as part of this implementation.

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11. Other comments

Not applicable

12. Standards Documents

Identify any industry standards that may require updating due to the outcomes or understanding developed from this innovation project. If no standards will need to be updated, please state - not applicable

Not applicable