Energy Networks Innovation Process

Annual Project Progress Report Document

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Project Title (*This cannot be changed once registered*)	Project Reference
CageCapture™ SF6 Flange Guard	NIA_SSEN_0058

Funding Licensee(s)	Project Start Date
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)	September 2022

Project Duration	Year
24 months	2023

Nominated Project Contact(s)

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1. Scope

Stage 1 We will develop prototype flange guard for SF_6 capture and recovery developed and tested in relevant lab environment.

Stage 2 We will install up to 9 prototype flange guards for SF_6 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 SF_6 gas.

2. Objective(s)

Objectives Measure Stage 1 Produce CageCapture™ absorption Produce the CageCapture™ absorption at scale and carry out analytical tests of the material produced. Proof of concept SF_6 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

The project will be deemed successful if a prototype coating for SF_6 capture is developed with real world environment testing results. Minimum success criteria (Must and should) Measure Flange guards must fit on different infrastructure types Multiple, flexible designs are produced Flange guard media must capture SF_6 Capture capacity determined and tested, with a target to capture up to 10% of leaked SF6 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 Desirable criteria (Could) Measure High capture capacity Successfully capture up to 80% of leaked SF_6 per device In situ SF_6 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 kg quantities suitable for scale up and prototype manufacture.
- Test equipment 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 re-cycling of cage material to be investigated but may be impractical. Further investigation required.
- Testing of cage material (CC3) in combination with loading media is in progress. Combinations with activated carbon and PLA being explored to improve cost effectiveness of solution (activated carbon) and suitability of 3d printed manufacture (PLA).

In summary, the project is proceeding to schedule and budget and has hit all technical and performance milestones to date. Cost and performance of the material is within targeted values so overall the outcome is looking positive. Environmental testing to be completed in Phase 2, from Sept 23 to Mar 24 in line with planned schedule.

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 are required.

- Laboratory test rig(s) to be constructed to perform representative and simulated environmental testing as a replacement to the originally planned full scale “real world” field tests. This is being done to help validate results in a controlled environment and reduce potential delays caused by the specification, procurement and installation of full scale parts in the field.
- Environmental conditions are to be simulated in a laboratory environment to imitate live field trials as best as possible. Environmental conditions for testing are to be specified by the network partners.
- A (scaled) mock-up of the proposed solution will also be built to demonstrate the practicalities and method of the installation.
- Prototype manufacture for real world deployment no longer being pursued, instead prototypes will be tested in lab simulated real world conditions.

6. Lessons learnt for future projects

Recommendations on how the learning from the Project could be exploited further. This may include recommendations on what form of trialling will be required to move the Method to the next TRL. The Network Licensee should also state if the Project discovered significant problems with the trialled Methods. The Network Licensee should comment on the likelihood that the Method will be deployed on a large scale in future. The Network Licensee should discuss the effectiveness of any Research, Development or Demonstration undertaken.

- Consideration should always be given as to how field test results can be validated (e.g., how much SF6 is actually leaking compared to what has been captured).

A detailed costing and design of full scale prototypes will be generated as part of the current project, therefore identifying and enabling a clear route to full scale “real world” trials after the completion of this project.

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.

The project is in its early phase and no outcomes are available currently. All outcomes will be reported when available.

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. This requirement may be met by including a link to the publicly available data sharing policy.

For information how to request data gathered in the course of this project, see 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.

Type of IP (e.g. knowledge and knowhow, patents, trademarks)	Description	Owner	Should this be treated as confidential?
Patents	Patents for material, production methods and use.	CageCapture	No
Knowledge and Knowhow	Methods for loading CageCapture material onto media/materials	CageCapture	Yes