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

Nov 2020

Project Reference Number

NIA_SPEN_55

Project Registration

Project Title

On-Site Non-Intrusive Polychlorinated Biphenyls (PCB) Tester

Project Reference Number

NIA_SPEN_55

Project Licensee(s)

SP Energy Networks Distribution

Project Start

October 2021

Project Duration

1 year and 8 months

Nominated Project Contact(s)

ShengJi Tee

Project Budget

£785,534.00

Summary

This project will develop a non-intrusive testing device which can be used on-site to determine whether PCBs are present in transformer oil.

Third Party Collaborators

Energy Innovation Centre

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

PCBs have long been recognised as posing a threat to the environment due to their toxicity, persistence and tendency to bio-accumulate (i.e. ability to build up in animal bodies, particularly at the top of the food chain).

In June 2019, the European Commission published Regulation (EU) 2019/1021 (EC No 850/2004) on Persistent Organic Pollutants which states:

“Member States shall identify and remove from use equipment (e.g. transformers, capacitors or other receptacles containing liquid stocks) containing more than 0.005% (50ppm) PCBs and volumes greater than 0.05dm3 (50ml), as soon as possible but no later than 31st December 2025.”

The hard deadline of removing any apparatus with oil contaminated with PCBs at 50-500 parts per million (ppm) by 31st December

2025 is a significant change. This has also been implemented in the UK through the UK Statutory Instrument 489 and Scottish Statutory Instrument 434.

GB DNOs have large fleets of oil filled Pole Mounted Transformers (PMTs). To meet their legal responsibilities, they need to confirm the levels of polychlorinated biphenyls (PCB) contamination within ~165,000 units to enable the right level of asset management including the required asset replacement planning and appropriate disposal. GB DNOs have developed a statistical model that categorises the risk of the individual PMTs having PCB contaminated oil. This method has been approved by the Environment Agency (under Regulatory Position Statement 246) and will assist the DNOs in managing their assets while facilitating a net zero carbon future.

As oil sampling cannot be performed on PMTs, their PCB concentration can only be determined through intrusive opening of the assets that eventually renders premature replacement due to inevitable compromises in mechanical and electrical integrity of the assets. Therefore, in addition to the statistical model, GB DNOs are keen to explore an on-site and non-intrusive PCB tester that will establish PCB concentrations comparable to IEC 61619 which will also then feed into and substantiate the statistical model for targeted interventions.

Method(s)

The transformer oil is a mixture of thousands of constituents mainly saturated hydrocarbons, their degradation products which are oxygenated analogues and degradation products of the solid insulation which themselves are also hydrocarbons and their oxygenated and sulphur analogues. Chlorinated hydrocarbons are only present if PCBs are present in the oil. We are therefore proposing to target chlorine concentration measurement remotely based on radionuclide decay (electron capture mode) using gamma ray detection.

The proposed solution is intended to be a non-intrusive method of determining the PCB levels in the field without the need to return samples to the laboratory. The method does not require obtaining an oil sample from the asset or any interference with the fabric of the asset. Furthermore, as radioactive nuclei are of a natural existence, no additional radioactivity is introduced above the already naturally occurring levels in the methodology described.

Scope

This project will cover:

- Equipment sourcing
- Theoretical undertakings and equipment calibration
- Algorithm verification and laboratory trials
- Field trials and training

Objective(s)

Development of an on-site non-intrusive PCB tester based on radionuclide decay using gamma ray detection

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

An on-site non-intrusive tester capable of determining the PCB concentration in parts per million (ppm) in pole mounted transformers

Project Partners and External Funding

This project will be developed by the ENA PCB Cohort working group with EA Technology Ltd.

Project partners:
- SP Energy Networks (SPEN): SPD and SPMW
- Northern Powergrid (NPg): NPgN, NPgY
- Scottish and Southern Energy Networks (SSEN): SSEH, SSES
- UK Power Networks (UKPN): EPN, SPN

Contractor: EA Technology Ltd.

SPEN £155,968 (External Budget*), £36,104 (Internal Budget), £192,072 (Total Budget)
NPg £158,857 (External Budget*), £158,857 (Total Budget)
SSEN £158,857 (External Budget*), £31,049 (Internal Budget), £189,906 (Total Budget)
UKPN £187,500 (External Budget*), £57,200 (Internal Budget), £244,700 (Total Budget)
Grand Total £785,534

* The external budget includes contingencies by each network company.

Potential for New Learning

Depending on the success of the on-site non-intrusive tester, the use of the device can be extended from pole mounted transformers to any other assets deemed at risk of PCB concentration. This will aid reducing the number of interruptions to customers, while ensuring network companies maintain a sustainable and resilient electrical network.

Scale of Project

This project involves laboratory and field-based trials. Upon fruition and approval of the method/detector by the environmental agencies, it will be adopted by the electrical networks in the United Kingdom.

It involves sourcing a gamma ray detector, undertaking theoretical evaluation of algorithms for non-intrusively detecting and quantifying the PCB content in oil, calibration of the gamma ray detector, verification of the algorithm and laboratory trials, before moving on to actual field trials and training of field colleagues on the use of the detector.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

This project will not focus on any specific geographical area. The work will however have an impact on all Distribution Network Operators (DNOs).

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£706,981 (90% of the costs quoted in Section “Project Partners and External Funding” as 10% of the costs are to be funded by the participating DNOs)

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)

The solution provides a mean to assess the PCB concentration in pole mounted transformers without the need for outages and premature replacements. Note that oil filled units manufactured prior to 1987 are assumed to be contaminated with PCBs unless proven otherwise (as per Government's guidance).

As premature replacements can be avoided through a targeted intervention, the unnecessary cost that will be borne by the customers will be averted. These will also reduce the number of customer interruptions (CIs) and customer minutes lost (CMLs).

The targeted intervention facilitated by the successful deployment of this project alongside the ENA approved statistical model will also help maintain a resilient and sustainable network that is safe and delivers value to current and future customers.

Please provide a calculation of the expected benefits the Solution

The expected financial benefit is in excess of £150m, particularly if the solution is deployed to determine the PCB status of pole mounted transformers that cannot be excluded from the statistical model as being PCB risk free.

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

The number of pole mounted transformers in SP Energy Networks that are potentially at risk of PCB contamination (pre-1987 or unknown) is in the region of 35,000. As pole mounted transformers are used across the GB network, the proposed solution will not just benefit SP Energy Networks, but also other DNOs (total ~159,000 pole mounted transformers in GB).

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

This is to be determined upon project fruition and successful testing of the on-site non-intrusive tester.

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

n/a

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

To comply with the PCB legislations (removal of PCB contaminated assets by 2025), the biggest challenge lies in the volume of pole mounted assets and the lack of a non-intrusive way of determining the PCB levels in them. With a non-intrusive tester, PCB levels can be determined without prematurely retiring pole mounted transformers. The records of the PCB levels can also be used to then inform the statistical model (also a joint effort by the ENA Liaison and Cohort working groups). This will aid a targeted intervention on pole mounted transformers, ensuring minimal disruptions to customers while maintaining the safe, resilient and sustainable operation of the network.

☑ 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.

There is currently a WPD-led NIA funded project, called “PCB Sniffer” with reference of WPD_NIA_042 (also agreed by the ENA Liaison and Cohort working groups) that involves literature review and laboratory trials on possible PCB detection through oil vapour fluorescence spectroscopy.

This proposal is not a duplication of the said WPD-lead project. The project being proposed is about developing an on-site and non-intrusive PCB tester that works based on gamma ray detection of radionuclide decay. It does not involve physical intrusion of the pole mounted transformers (for instance, no need for physical oil sampling or accessing the headspace of a transformer to source oil vapour).

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

Network Licensees.

The proposal has been agreed by the ENA Liaison and Cohort working groups comprising of all DNOs. The environmental agencies are also members of the ENA Cohort working group. The groups acknowledged the similarity between the proposed work and the WPD-led initiative but also acknowledged the value and the difference the proposed work entails. Given the scale of the problem (potential £825 million cost to GB electricity networks) and the accessibility issues with pole mounted transformers, the non-intrusive tester proposed, that adopts gamma ray detection, promises to reduce interruptions to customers while supplementing an ENA approved statistical model for targeted interventions to maintain a resilient and sustainable network.

Additional Governance And Document Upload

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

The proposal has been agreed by the ENA Liaison and Cohort working groups comprising of all DNOs and TOs. The environmental agencies are also members of the ENA Cohort working group. The groups acknowledged the similarity between the proposed work and the existing WPD-lead initiative but also acknowledged the value and the difference the proposed work entails. Given the scale of the problem (potential £1.9 billion cost to GB electricity networks) and the accessibility issues with pole mounted transformers, the non-intrusive tester proposed, that adopts gamma ray detection, promises to reduce interruptions to customers while supplementing an ENA approved statistical model for targeted interventions to maintain a resilient and sustainable network.

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

The ENA PCB Liaison and Cohort working groups have identified pole mounted transformers as the biggest risk of PCB legislation compliance across the UK. As such, this is the most appropriate route for this project to ensure that this can be effectively handled.

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

The techniques to be used in this project are low TRL level; as such, there are technical and operational risks to the use of the device which requires work. As such, this work is needed to prepare for business adoption.

This project has been approved by a senior member of staff

☑ Yes