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

Jul 2022

Project Reference Number

NIA_SPEN_0074

Project Registration

Project Title

Project Conan (T2)

Project Reference Number

NIA_SPEN_0074

Project Licensee(s)

SP Energy Networks Transmission

Project Start

April 2022

Project Duration

2 years and 6 months

Nominated Project Contact(s)

Gavin Montgomery

Project Budget

£365,000.00

Summary

This project will develop non-destructive conductor assessment to analyse the condition of ACSR and AAAC OHL conductors.

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

Currently, significant portions of networks are comprised of Aluminium Conductor Steel Reinforced (ACSR) conductors. The remaining portions are predominantly made up of All-Aluminium Alloy Conductor (AAAC) and a small number of newer High Temperature Low Sag (HTLS) conductor types. Usually, once ACSR conductors are proven to be in poor condition and deemed to be replaced, an equivalent AAAC is usually specified.

As conductors in overhead line networks age, they will require gradual replacement to maintain network resilience. To enable accurate condition-based replacement rather than age-based replacements, it is essential that the networks can utilise the best science and Technology available to obtain reliable data on conductor conditions.

There are currently two principal methods for assessment of condition:

- Destructive – Provides a direct assessment of strength and condition by removal of a small conductor sample
- Non-destructive – Performs surveys using equipment, capable of travelling along installed conductors to measure the condition, without affecting the conductor's integrity or performance.

Destructive tests only consider a small conductor sample, whilst also causing significant cost and disruption to the network. On the other hand, non-destructive tests assess a much greater volume of conductor with lower cost and disruption. This allows repeat testing over time.

Devices that are currently used for non-destructive testing, all have limitations which can make them unfeasible for deployment across the network. “Cormon” devices, designed by CEGB in the 1980’s, still remain in use but they are obsolete, unserviceable, unreliable and have limited capabilities. Another device, the Canadian “Linevue” is not easily available in the UK and has one considerable drawback; it cannot provide data which can be used for monitoring and predicting before replacement is already urgent, in accordance with the normal UK-wide practice.

There are currently no devices available in the UK which can reliably and efficiently provide non-destructive conductor assessment information that are suitable for predictive condition-based intervention. There are also no known concepts or methods for measurement of AAAC condition, which makes up a growing proportion of UK networks.

To date, there is also no published scientific information available to provide a reliable basis for interpreting condition results of either ACSR conductors or AAAC or using them for condition-based decisions.

Method(s)

This project will address the problem by developing the first device which reliably and efficiently provides non-destructive conductor assessment information suitable for predictive condition-based intervention. It will also develop concepts or methods for measurement of AAAC condition and develop the first body of scientific information to provide a reliable basis for interpreting the condition of ACSR or AAAC results, upon which to make consistent, traceable condition-based decisions.

As part of this project, EST will utilise the learnings from disassembling, understanding, renewing and servicing the Cormon equipment to further accelerate the development of a new device, Conan. This device utilises electromagnetic induction and eddy current detection techniques alongside a state-of-the-art central control system, that can accept multiple inputs from varied sensor types, to assess the condition of conductors.

The development of the new Conan device aims to:

- Have real time results and high operational reliability and efficiency which will enable a new testing practice where high volumes of testing are possible. This also allows users to interrogate and investigate data in real time
- Be scientifically tested and proven interpretation of the results and their meaning, thus providing a never before possible level of certainty on conductor condition
- Have high accuracy results from multiple sensor types including cameras (visible, IR and UV wavelength as suggested options)
- Be compatible to integrate sensors or control requirements as plug in additions which future proofs for any amendments or new requirements
- Have the ability to measure AAAC conductors
- Have the capability of being supported and deployed by drone or helicopter
- Enable deployment and operation of devices under energised conditions

The main outputs from the project will be:

- New device with the capability to accurately and efficiently assess conductor conditions, ready for commercialisation
- New scientific method for making conductor replacement decisions, which will be supported by documentation.
- Device that is compatible with the working prototype of AAAC detector head.

Scope

The project will be delivered in 6 stages outlined below:

Stage 1 - Technology review and concept selection

- Review, development and optimisation of sensing system
- Finalise functional design specification
- Generate and select conceptual design
- Produce DFMEA (Design failure mode and effect analysis) to review project risk

Stage 2 - Detailed design

- Complete electrical and mechanical design for AAAC detector head
- Finalise wiring diagram for new system
- Complete manufacturing drawings for new system.
- Create technical file for future UKCA and CE marking

Stage 3 - Prototype fabrication and functionality testing

- Manufacture system subassemblies.
- Complete software programming
- Bench testing of subassemblies.
- Assemble tested subassemblies in to completed prototype

Stage 4 Performance & practical testing

- Practical testing and prototype amendments

Stage 5 - Network Trials

- Network trial design
- Execution of network trials
- Final prototype amendments

Stage 6 - Preparation for commercialisation

- Technical report of scientific findings
- Compile technical documentation for UKCA and CE marking and declaration in place
- Training and maintenance documentation

Objective(s)

The objectives and measure for each stage of the project are outlined below:

Stage 1 – Technology Review and Concept Selection

Prepare initial ‘breadboard’ design of AAAC detector head

Measure: Confirmation of design calculations with working practical set-up
Produce the final Conan concept in accordance with the agreed technical and user requirements

Measure: Final concept chosen in line with all requirements in Functional design specification (FDS)

Stage 2 – Detailed Design

Finalise detailed electrical and mechanical design for Conan and for AAAC detector head

Measure: Function-specific dimensions and electrical input/interface confirmed

Stage 3 – Prototype Fabrication and Functionality Testing

Develop a working AAAC detector head prototype

Measure: Demonstrable capability to measure cross sectional loss or surface pitting on a typical AAAC conductor

Produce Conan prototype(s) that are appropriate for bench and lab-based functionality testing

Measure: One or more physical prototypes of components or assemblies to be produced as required by test plan

Stage 4 – Performance and Practical Testing

Complete laboratory and workshop-based performance tests on Conan device

Measure: The tests pass the performance requirements stated in the pre-populated and agreed matrix and design plan

Complete practical tests

Measure: The tests pass the performance requirements stated in the pre-populated and agreed matrix and design plan

Stage 5 - Network Trials

Trial the performance of device on an appropriate real network environment

Measure: Reviewed against a pre-populated and agreed performance requirements matrix and test plan

Stage 6 - Preparation for commercialisation

Communicate knowledge describing the engineering and science behind the developed techniques

Measure: A technical report presenting findings and results.

Produce standardised maintenance and training procedure

Measure: Production of a maintenance manual and training documentation and delivery package

Perform work on UKCA and CE mark approval – compile technical file

Measure: Have declaration for UKCA and CE marking for the Conan device

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register.

This project has been assessed as having an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to reduce the amount of disruptions to customers in the home. Other considerations including the projects impact on supply, have been made in carrying out this assessment.

Success Criteria

The success criteria and measure for each stage of the project are outlined below:

1. The Conan device must demonstrate capability to make condition measurement and assessment of ACSR conductor from several inputs including electromagnetic response measurement and camera feed.
2. The device must be in accordance with applicable standards/legislations such as BS60204-1 and BS8888, Lifting Operations and Lifting Equipment Regulations (LOLER), Provision and Use of Work Equipment Regulations (PUWER).
3. AAAC detector head should be proven in lab environment
4. The project should establish a new scientific method that will assist network owners with making conductor replacement decisions.
5. The device must allow improved communication of results and reliability using modern industrial electronics systems.
6. Must have ‘plug and play’ functionality to ensure suitable sensors and attachments can be added with minimal redesign
7. Must incorporate high-definition visual camera to allow visual checks for bulges, broken strands or other issues.
8. Conan should be operable under live energised conditions.
9. Conan should be easy to use, reliable and user friendly. The user interface must be easy to use and understandable.

Project Partners and External Funding

SSEN will be taking an observational role on the project with no financial contribution. The project supplier will be Energyline Science and Technology Ltd.

Potential for New Learning

It is envisaged that the learnings and results from developmental work will provide an understanding of the capabilities and limitations of electromagnetic based sensing techniques on detecting corrosion in both ACSR and aluminium based conductors.

Development of a new traceable, evidence-based methodology/information upon which conductor condition replacement decisions are to be made.

Scale of Project

The project comprises development of the Corman replacement, ‘Conan’, device.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

N/A

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£320,000

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:

n/a

How the Project has potential to benefit consumer in vulnerable situations:

The project has the potential to reduce outages and the impact of outages caused by Transmission OHL Conductor condition.

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

Base Cost (Main Conductor Sampling):

Unit cost - £11,398

Volume per annum - 20

Base cost per annum = £227,966

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

Method Cost (Cormon Testing):

Unit cost - £1,580

Volume per annum - 20

Base cost per annum = £31,593

Financial Benefits per annum

Base Cost – Method Cost = £196,373

Return on investment is made within 2 years

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

The device will be replicable across licensees in GB which have similar OHL conductors

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)

n/a

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.

A review of the smarter grid portal has revealed there are no other projects or initiatives in the UK which are developing a device similar to the Conan device.

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

N/A

Additional Governance And Document Upload

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

There are currently no devices available in the UK which can reliably and efficiently provide non-destructive conductor assessment information that are suitable for predictive condition-based intervention. There are also no known concepts or methods for measurement of AAAC condition, which makes up a growing proportion of UK networks. To date, there is also no published scientific information available to provide a reliable basis for interpreting condition results of either ACSR conductors or AAAC or using them for condition-based decisions. By answering these challenges the project is considered innovative.

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 innovative nature of the work means that there are commercial risks which have not been included within our business as usual investment plans.

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

Specific risks that exist: Development of enhanced features bring a technical and commercial risk which could not be supported within business as usual activities. Development of an AAAC detector head will require novel approach to develop a graduated assessment technique which is comparable with present ACSR techniques. There is a technical and commercial risk associated with this development. Enabling the flight ready capability and deployment under live conditions has a regulatory/technical risk. This is not the core element of the project.

This project has been approved by a senior member of staff

☑ Yes