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

Jun 2018

Project Reference Number

NIA_SHET_0023

Project Registration

Project Title

Line Inspections by Semi-Autonomous Systems (LISAS)

Project Reference Number

NIA_SHET_0023

Project Licensee(s)

Scottish and Southern Electricity Networks Transmission

Project Start

June 2018

Project Duration

2 years and 6 months

Nominated Project Contact(s)

Colin Mathieson

Project Budget

£230,000.00

Summary

Using robotic devices carrying onboard monitoring equipment which can travel along the OHL without requiring continual human interfacing could allow the conductor to be accurately monitored with substantially more coverage. The SSEN networks have a high proportion of tension towers which prevents a number of the monitoring devices presently in use in the UK from operating as intended. Furthermore the remote locations in which SSEN operates puts further constraints on any potential robotic technology, in that the device weight and support systems must be minimized and considered. Equipping the robotic devices with cameras would also allow further data on Lower fittings/insulators while undertaking these works. Robotics would minimize climbing risk and in theory operate on live lines thus minimizing outage costs.

Nominated Contact Email Address(es)

transmissioninnovation@sse.com

Problem Being Solved

Accurate and consistent OHL Conductor and Lower Insulator condition data is difficult to obtain. Frequently,gathering this data requires Testing and Sampling. Present methods of Testing and Sampling can provide unrepresentative data, require climbing and working at height and, can be very costly (in both operations and outage requirements). This inaccuracy and unrepresentative data becomes more onerous at higher voltages where longer planning periods are required to undertake Testing & Sampling, further increasing in cost to the consumer.

While drone and flight technology is providing increasing levels of data quality and quantity on Towers, Poles and fittings; the conductors cannot be monitored with this technology at present. This presents a problem in accurately populating CNAIM and other Asset Register systems, which,in turn,limits accurate long term planning.

Furthermore the ability to undertake sampling analysis is UK is generally being lost to retirement of specialists and closure of testing facilities.

Using robotic devices carrying onboard monitoring equipment which can travel along the OHLwithout requiring continual human interfacing could allow the conductor to be accurately monitored with substantially more coverage. The SSEN networks have a high proportion of tension towers which prevents a number of the monitoring devices presently in use in the UK from operating as intended. Furthermore the remote locations in which SSEN operates puts further constraints on any potential robotic technology, in that the device weight and support systems must be minimized and considered.Equipping the robotic devices with cameras would also allow further data on Lower fittings/insulators while undertaking these works. Robotics would minimize climbing risk and in theory operate on

live lines thus minimizing outage costs.
Additionally, with the new types of composite conductor being proposed Robotic OHL conductor condition monitoring present opportunities to develop possible solutions to the condition monitoring of this new technology.
All three license holders in SSEN (Scottish Hydro Electric Transmission, Scottish Hydro Electric Power Distribution, Southern Electric Power Distribution) have Steel Tower lines which require conductor condition monitoring.

Method(s)

LISAS shall be a condition monitoring robot which can traverse an OHL via an attachment to the conductor. The key component of this is to ensure that the robot can work around the majority of insulators and Tower/Pole architecture without intervention by personnel on the line.
Furthermore sensors onboard shall be capable of providing condition data on a variety of OHLs and will also take detailed photos of OHL fittings where possible to provide condition analysis on the ground.It is intended that these measurement devices shall be modular to allow interchange if required.
Initially LISAS would need to be placed on OHL by personnel but these would then be able to work for a significant proportion of time without additional intervention until it is removed from the OHL at end of its battery life/fuel source.The capability to self-attach to the conductor shall be considered if suitable technology is presented.
Small mobile base stations(generally a van or truck)would collect data form the robot then transmit to a base location for analysis and review by engineering staff. This would then be linked to CNAIM/NOMs input data where applicable

Scope

The Project is proposed to operate in 4 phases:
• Specification: SSEN will develop a LISAS specification which captures the SSEN performance requirements. This will involve reviews of existing robotics and present forecasts of the technologies capabilities with recognized external industry leaders. This will be supplemented with a market Request for Information to further inform the specification.
• Tender of LISAS: This will see the specification developed further and used to procure a robot device. This development will include factory testing and delivery acceptance testing in the UK.
• Trial of Robotic technologies:Trials shall be representative of the conditions Robotic OHL Condition Monitoring solutions may be expected to operate when in service.This will involve SSEN field trials on both Transmission and Distribution networks which will provide initial Process and Procedure documentation. • Output, Process & Procedural Review: Post trial, Process and Procedure for use of LISAS will be evaluated and recorded to enable future OHL robotics to be adopted as BAU. Additionally the output data from the OHL robotics shall be reviewed against specification to understand the accuracy of the data against a sample. A report will be delivered detailing the lessons learnt and successes of the project.

Objective(s)

The project has the following objectives:
• To provide process and procedure for use of OHL Robotic Devices
• To provide a clear specification for OHL Robotic Condition Monitoring
• To trial a robot which is capable of traversing an OHL with minimal Personnel input.
• To evaluate known sample data against recorded data from an OHL Condition Monitoring Robot

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

There are a number of Success Criteria which are as follows:
• The Development of Process and procedure for LISAS is a measure of success. As the robotics industry develops,this technology will be more common place.The development of this Process and procedure will enable similar future technologies to be more readily adopted.
• LISAS being able to traverse significant proportions of OHLand work around Tension Towers and poleswith minimal personnel input.
• LISAS providing more representative and accurate condition data on OHLs than current sampling is capable of

Project Partners and External Funding

n/a

Potential for New Learning

The field of robotics in the power industry is expected to develop over time with more technology development in the sector expected. This project shall provide valuable experience in the field of robotics which can help future adoption in asset monitoring areas other than OHL.
The collection data at a significantly increased proportion of the conductors will provide comprehensive data analytics which can help forecast more accurate life expectancy.
Additional information on Fittings and Lower insulators will also support further learning on fittings condition which cannot be viewed by Drone or Inspections accurately at present

Scale of Project

This project proposes a number of trials in both Transmission (SHE Transmission) and Distribution (SEPD). This is highly dependent on the robotic solutions used.
Phase 1 requirements are as follows:
• 15 Hours SSEN Engineering Staff
• 30 Hours External Consultation Staff
Phase 2 requirements are as follows:
• 15 Hours SSEN Engineering Staff
• 30 Hours External Consultation Staff
Phase 3 requirements are as follows:
• 4 line gangs 12-16 people for 2 weeks each (likely to be consultants).
• 2 routes in SHE Transmission (275kV and 132V)
• 2 routes in SEPD (132kV and 33kV)
• 2 Possible further Live Line working dependent on the Trial units and the success of the devices on the initial trials
Phase 4 requirements are as follows:
• 20 Hours SSEN Staff
• 20 Hours External Consultation Staff

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL9 Operations

Geographical Area

The two licence areas which are of focus are SEPD and SHE Transmission. These licenced areas have the majority of Steel Towers in the SSEN Networks. This will result in operations, mostlikely,in the South Caledonia (Dundee), North Caledonia (Aberdeenshire), Wessex (Bournemouth) and Ridgeway (Oxford) Regions. All of which have significant numbers of Steel Tower OHLs.

Revenue Allowed for the RIIO Settlement

n/a

Indicative Total NIA Project Expenditure

Project Total (2018/21) Expenditure £230k to complete the project.Of Which £207k is allowable NIA expenditure. This includes the procurement of OHL Robotic devices for use in multiple trials to gain sufficient experience to achieve objectives.

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 ability to forecast and plan works accurately through condition data may allow the deferral conductor assets replacement. Ultimately benefiting the consumer through extended operation of existing assets.
Furthermore additional condition information will provide the ability to accurately plan intervention, minimize faults, and thus CI/CML losses.
Finally outage minimization will be a key output of the works. Should the robotic devices be capable of Live working this will significantly reduce the costand wider impacts of taking outages for sampling

Please provide a calculation of the expected benefits the Solution

Method: Due to the lack of experience within the industry the costing is based on 3 scenarios to frame possible outputs. All scenarios are costed on the basis of Spans per day being achieved. Outage costs are not considered as the potential variance in cost is significant and so being used as a baseline for measurement would not prove consistent results. The overall expectation is that minimization of outages would further benefit the consumer.
OHL Robotics –CAPEX = £100,000 Technical Support Per Annum= £20,000
Baseline for conventional condition assessments: 300 samples(notionally Spans)to end of RIIO T1, cost per sample £3,450 Baseline cost: £1,035,000
Worst Case Scenario: Assessment operation cost £1300 1 Span per day Estimated benefits: £180,000
Expected Scenario: Assessment Operation Cost £1300 5 Spans per day Estimated benefits: £886,000
Best case Scenario: Assessment Operation Cost £1300 10 Spans Per day Estimated Benefits: £945,500

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

For any Network Licensees who Operate Steel Tower OHLs or EHV Wood Pole lines this may be applicable. The Learning and process will be shared to provide access for other licensees to develop their own process and procedure.
Efforts will be taken to provide details to the ENA to understand if revisions to Safety Rules are required

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

With significant lessons learnt from the NIA project the majorityof costs will be subject to the individual Licensee requirements. The envisaged costs for procurement of a single unit is £50,000. Operations costs for a year of service is estimated at £100,000. This includes personnel and transport costs and maintenancecosts for robotic device. Therefore the total upfront costs are expected to be £50,000 with the future costs dependent on the Licensees use of the asset.

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

As robotic technologies develop the learning on Process andprocedure for use of robotics may be applicable to other asset groups. As such other within the industry may benefit from these works.
Ultimately this may lead to changes in safety rules to facilitate the use of Robotics on OHLs and other assets. This specifically relates to the common safety rules utilized by DNO networks operators.

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

☑ 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.

Present OHL robotic devices are not suited to the SSEN Networkdue to their performance and demanding support infrastructure. Thus these units require significantly greater support efforts which increases operational cost and difficulties. Furthermore the belief is that this technology will be able to be used on Wood pole lines and Steel towers further which has not been deployed in the UK to date.
To achieve SSEN’s requirements will drive significantly more onerous technology requirements for device mobility and then electrical immunity to operate on live lines. As such the present use of robotics is not suitable for SSENs requirements

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

Robotics in OHL condition assessment are used by some network operators in the UK. These units are,in general, not suited to the SSEN network due to the remote locations and difficult terrain which SSEN operate. This project is designed to provide a robot which can operate on or around Tension towers with minimal personnel input. Moreover it is believed that the development of the units will allow for conductor condition monitoring on wood pole lines. The minimization of climbing activities lowers risk significantly. Another difference to existing equipment is the ability to minimize outage demand. it is envisaged that robots may be able to operate with the OHL in service. This would be a significant departure from existing technology and practice. As such this presents the following project aims in justifying this project as innovative: • LISAS which are capable of operating over and round obstacles and tension towers without personnel support. • LISAS which can operate on live lines thus minimizing outage requirements. • LISAS which can operate on both Steel Tower Routes and wood Pole routes

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

This project requires significant testing and development of LISAS to deliver outputs as planned and to ensure safe working practices. These costs will be substantial and require significant external input. As such it would be inappropriate to undertake this as a BAU project due to the uncertainty of the level ofresults

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

NIA funding alleviates risk in areas such as: • Technical Development:Such asensuring that devices have electromagnetic immunity to operate as desired which will have significant testing requirements. • Operational: Development of process and procedure will be onerous as the requirements for development and testing in test facilities and on live networks will be expensive and difficult. It is appropriate that this project is undertaken using innovation funding given the level of risk involved but also the opportunity to provide benefits for all UK network operators

This project has been approved by a senior member of staff

☑ Yes