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

Dec 2015

Project Reference Number

NIA_SGN0089

Project Registration

Project Title

Robotic Roadworks (Stage 1)

Project Reference Number

NIA_SGN0089

Project Licensee(s)

SGN

Project Start

December 2015

Project Duration

0 years and 5 months

Nominated Project Contact(s)

Oliver Machan, Innovation Project Manager

Project Budget

£130,654.00

Summary

The scope of the project is to perform a detailed feasibility study to minimize onward project risk and develop operational, safety and procedural guidelines for the Robotic Keyhole System, generate specifications for the device and solidify the design and analyse and perform a preliminary selection of key components for use in the system.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Operations and maintenance costs represent a major portion of any GDNs budget. Gas main excavations as currently performed are very labour-intensive and disruptive, but necessary to repair aging infrastructure and install new asset. Various operational teams are required to perform asset location and mark up, excavation, sheeting and shoring, repair or replace and reinstatement. A single excavation represents a major investment of time, money, personnel, and equipment. The costs of these excavations are ultimately incurred by the gas customer. The cost of labour, the cost to operate and maintain the vehicles and equipment, and the cost of lane rental and permitting will only continue to increase.

In addition, the underground networks of major cities can be very crowded, with gas, sewer, water, electrical, telecommunications, and other utilities running in close proximity to one another. These underground networks are often inadequately mapped and the locations of different utility infrastructure installed below street level are almost never integrated on the same map. This lack of integration can lead to accidental impacts with unknown buried infrastructure during excavation; potentially causing service disruptions, serious damage, and even loss of life and property.

Keyhole excavation has become a standard method used to access buried utility infrastructure. Keyholes drastically decrease the size of the excavation - making them minimally disruptive to customers and the public. Although repairs and maintenance performed via keyhole is a substantial improvement over standard excavation techniques, improvements to the full end to end process would yield

dramatic benefits to end users and to the GDNs.

SGN are now looking to assess the possibility of introducing a more advanced innovative robotic roadworks solution to improve the operational processes, specifically around excavations and the works required in them.

Method(s)

Four areas of research have been identified:

- Area 1 – Robotic Arm
- Area 2 – Sensors
- Area 3 – Tooling: Custom and Modification of Existing
- Area 4 – Support Systems

Leading to the following Tasks being undertaken:

1. Generate list of maintenance and repair operations which may be performed by system in compact excavations and keyholes
2. Generate a list of operations, not currently performed in keyholes, which may be performed in a keyhole when using this new system
3. Generate preliminary robot arm specifications and perform research into suitable arm technology
4. Assess preliminary sensor and tool requirements and develop initial specifications
5. Perform a global search to find potential project partners for tool development
6. Perform preliminary 3D computer modelling of robotic arm capabilities
7. Assess the feasibility of operational and procedural factors associated with a field deployed operation

Scope

The scope of the project is to perform a detailed feasibility study to minimize onward project risk and develop operational, safety and procedural guidelines for the Robotic Keyhole System, generate specifications for the device and solidify the design and analyse and perform a preliminary selection of key components for use in the system.

Objective(s)

The objective of this project is to:

- Carry out a preliminary investigation into performing current operational repair and maintenance activities using a new innovative robotic system.
- Generate a list of potential keyhole and compact excavation repair/maintenance operations that may be used in the system. Additionally, focus will be applied to finding operations, not currently performed in keyholes, which may be performed in a keyhole when using this new system.
- Begin to build a robust cost benefit analysis (CBA) which may be utilized to support an ongoing Stage 2.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project are:

- Generation of preliminary specifications for the system - Robotic Arm, Sensors, Custom Tooling or Adaptation of Existing Tooling, and Support Systems (Keyhole Rotary Cutting Unit, Vacuum, Compressor, Generator, Operator Controls, Etc)
- Evaluation of key system components against technical and operational specifications
- Generation of draft operational specifications and work plans outlining how the Robotic Keyhole System will be deployed in the field to perform keyhole excavations
- Preliminary identification of key components including, Robotic Arm, Tooling, Sensor Packages
- Preliminary 3D Computer Modelling of Robotic Arm Capabilities
- A preliminary analysis of the proposed process with the inclusion of operator intervention points and safety evaluations
- Produce a detailed feasibility report and share the learning with the other network licensees.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project has been designed to be the initial stage of a larger project developing a Robotic Roadworks system. Adopting a stepwise approach allows the costs and risks to be managed whilst at the same time gauging the engineering viability for the following stage.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The feasibility study will be undertaken at the ULC offices in New York state. No trials are anticipated during this stage.

Revenue Allowed for the RIIO Settlement

There are no direct saving benefits anticipated.

Indicative Total NIA Project Expenditure

The total predicted project expenditure is £130,654, 90% of which is allowable NIA expenditure (£117,558).

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)

It is difficult to accurately quantify the actual financial benefit at this stage; as indicated by the low start TRL shows the Method is at an early stage of development and cost estimates will be refined as it is further developed. However, It is envisaged that deployment of this technology may lead to financial benefits in the following areas:

- Reduction in manual excavations in the public carriageway
- Less excavated material send to landfill
- More efficient and cost effective operations methods
- More efficient and costs effective reinstatement methods
- Reduction in the import of virgin or recycled backfill material
- Less disruption to customers and members of the general public

Please provide a calculation of the expected benefits the Solution

N/A

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

This method could be applied across the whole of GB and applies to all network licensees.

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

This is not currently known.

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

By undertaking this development work the gas industry as a whole can share the overall cost, knowledge, risk and subsequent benefit from development and testing.

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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

- [x] Yes