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

Mar 2014

Project Reference Number

NIA_SGN0003

Project Registration

Project Title

SynthoTrax I-Seal Robot (Technical Feasibility Study)

Project Reference Number

NIA_SGN0003

Project Licensee(s)

SGN

Project Start

January 2013

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Ryan Smith, Innovation Delivery Manager

Project Budget

£70,252.00

Summary

The scope of this project is to carry out a technical feasibility study to investigate the technical potential to develop a robotic system that can remotely travel to, locate, and seal leaking joints from a single live access point.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

From the 1850's up until the 1950's cast iron mains were used extensively across the United Kingdom (UK) gas distribution network. Now the gas industry has moved away from this source of material and is using steel and polyethylene. However a significant portion of larger diameter cast iron is still in use today. At present across SGN there are approximately 843 kilometres of metallic mains >12" diameter that are ageing, requiring inspection, repair or replacement.

When installed, these sections of mains were connected at the joint by a bell and spigot. To seal the joints, jute - a plant fibre used in making burlap and twine - was packed into the back of the joint, and molten lead was poured into the front of the jute packing creating a gas-tight seal. Over time, however due to ground movement, winter freeze-thaw cycles and the fact that jute is drying out causing it to shrink and/or crack, we
are experiencing leaking joints.

There is evidence that all Tier 3 mains (18-48" diameter) are less likely to fail through cracks and fractures, and more likely to fail due to leaks within the existing joints. In the past Network Licensees would either fully replace these ageing assets or aim to maintain them.

However, the availability of maintenance options has been fairly limited. Repair techniques have included mechanical joint clamps and encapsulants and since the 1980's anaerobic sealant has been injected into the jute packing. While cheaper than full replacement, these repair techniques do have a number of disadvantages including high costs due to significant excavations and potential shut

downs, causing customer dissatisfaction and road closures, and the associated restoration following the works.

Method(s)

In 2009, Synthotech Limited, a innovative engineering company with a proven history of design, development, manufacture and supply services started work on a robotic platform; originally developed to provide an inspection system for 18” to 48” diameter gas mains and a laser scanning system for 355mm to 630mm polyethylene gas mains operating at pressures up to 2bar.

This technical project explores the feasibility of expanding the capability of this robotic platform, “SynthoTrax”, so that it can operate on a live network and seal leaking joints on larger diameter gas pipes internally, reducing the need for excavations to repair joints.

The purpose of the feasibility study is to investigate the potential to extend the capability of the prototype SynthoTrax architecture to enable remote internal joint sealing of gas pipes that:

- Are between 18” and 48” diameter metallic mains
- Can operate at low pressure (•75mbar) and medium pressure (>75mbar, <2bar)
- Can remediate up to 400m of main from one excavation
- Potentially drill if required

The feasibility will also look into the individual system components, including a review of all other globally available technology:

- Access Fitting
- Access System
- In-pipe robotic platform
- Sealant Application System
- In-pipe CCTV
- External Support Systems

To ensure that this project meets the success criteria, regular meetings have been set up between the nominated project contact for SGN and the supplier. In these meetings project progress will be discussed and feedback in relation to the feasibility study will be frequently provided.

Scope

The scope of this project is to carry out a technical feasibility study to investigate the technical potential to develop a robotic system that can remotely travel to, locate, and seal leaking joints from a single live access point.

Objective(s)

The objectives of this feasibility study are to provide possible solutions to the scope, broken into the following sections:

- Access Fitting
- Access System
- In-pipe robotic platform
- Sealant Application System
- In-pipe CCTV
- External Support Systems

In addition, the study will assess whether there are feasible development solutions available globally that can meet the elements of the complete performance specification.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success of this project will be determined against the quality and content of the technical feasibility study, as well as the project duration. The expected outcomes, representing successful project delivery, will be:

- A detailed report on the required developments of current technology available to be able to meet the scope listed above

- Assessment of the associated cost of developing the current technology available to meet the specification provided
- A cost comparison against current repair techniques
- An identified method of progressing the technology

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project has been designed initially to carry out a technical feasibility study. It was deemed appropriate to limit this project to a relatively small scale study because of the low technology readiness level. SGN have chosen not to commit to funding a larger scale project until the feasibility has been established.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This project will be undertaken at Synthotech's research facilities in Harrogate, North Yorkshire.

Revenue Allowed for the RIIO Settlement

During RIIO-GD1 it is estimated that SGN will spend approximately £255.7m and £209.6m on emergency and planned repairs respectively on all mains. As this project is a feasibility study for a technology at a low TRL, it is not yet possible to determine whether revenue savings are likely during RIIO-GD1. However it is assumed that if progressed successfully through to development and field trial in future stages this type of solution will have
potential to provide Network Licensees with an excellent outperformance opportunity with regards to repairing and/or avoiding the need to replace their ageing cast iron network in the future. Expected savings against specific areas would be quantified in these later stages of development.

Indicative Total NIA Project Expenditure

The initial phase of this project was funded from SGN's Innovation Funding Incentive (IFI) in 2012/13 (£52,920).

The total outstanding expenditure is expected to be £17,332, of which 90% is allowable NIA expenditure.

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)

As this project solely focuses on the feasibility study of the technology, it is difficult to quantify the potential financial benefits at this stage.
It is envisaged that deployment of this technology would lead to financial benefits in the following areas:

- Avoided Public Reported Escapes, and associated costs; including excavation and reinstatement.
- Risk reduction and risk management demonstration.
- Leakage reduction within the national leakage model.
- Avoided condition replacement.

Please provide a calculation of the expected benefits the Solution

N/A This is a research project.

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

This project is designed to reduce leakage of gas distribution networks through inspection, repair and replacement of assets from inside the gas main using robotic technology. The focus area will primarily be between 18" and 48" diameter cast iron mains. SGN have approximately 614km of cast iron mains across this range diameter. As a result, based on a 4:2:1:1 split, the total length of mains across GB that this method could ultimately apply to in future years can be estimated at approximately 2456km.

It must be noted that these figures are necessarily based on averages and a number of unqualified assumptions, and therefore subject to a large sensitivity margin. However, these large diameter mains are high cost areas for all Network Licensees and the project has been designed to develop potential robotic solutions to clearly defined industry challenges. Therefore, this confirms how replicable the project is across the industry and how easily the technology could be rolled out.

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

There are no costs associated with sharing the conclusion and recommendations of this study with the other Network Licensees, which will be the first step towards roll out across GB. As stated above, the very early technology readiness level means that it is not possible to estimate the costs of deployment at this stage.

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

All Network Licensees will be able to use the learning generated as the outcomes will be presented in a clearly defined report that focuses on providing possible solutions to address the objectives.

For each section, there will be a recommendation and/or a developmental requirement. Furthermore, the study will compare the relevant equipment and the multiple suppliers available that could potentially deliver the necessary Network Licensee requirements. Licensees will be able to use these outputs to determine whether future stages in the development of this technology could provide benefits that outweigh the costs and disadvantages of current methods of joint repair in cast iron gas mains 18”-48” diameter.

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

☑ Yes