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

Feb 2014

Project Reference Number

NIA_SGN0019

Project Registration

Project Title

Large CISBOT (Cast Iron Joint Sealing Robot)

Project Reference Number

NIA_SGN0019

Project Licensee(s)

SGN

Project Start

August 2013

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Ryan Smith, Innovation Delivery Manager

Project Budget

£834,600.00

Summary

The scope of this project is to carry out a detailed technical assessment and field trial of the joint sealing robot 'Large CISBOT', which has the potential to repair or rehabilitate a number of cast iron joints under live conditions in a more cost effective manner than existing methods. The project will consider the potential for repair of 18" to 48" diameter cast iron mains.

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 Great Britain (GB) gas distribution network. Since then 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, this is know as a 'lead yarn joint'. Over time, 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. Through extensive investigation, it is clear 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, which is a high cost activity, or aim to maintain them to prolong the asset life. To date the options available to repair large diameter joints have been limited to the use of mechanical joint clamps, encapsulation, or injection of anaerobic sealant into the jute packing. While cheaper than full replacement, these repair techniques have a number of disadvantages including the costs incurred due to significant excavations and material requirements. As Tier 3 mains are predominantly found in city locations, any work carried out on them results in a considerable impact on our customers.

An effective method of repair requiring less excavation would be a means of addressing this problem.

Following the successful completion of SGN's Synthotrax I-seal Robot feasibility study, the findings confirmed that Robotic technology offers a step change in the methods used to repair and prolong the life of the ageing cast iron network. An assessment of the available technology in the market was carried out, with ULC Robotics identified as the best placed partner to use to develop the technology further due to their utilization of robotic technology in the US on 16", 20" and 24" CI mains.

Method(s)

ULC Robotics have developed a cast iron joint sealing robot known as Large CISBOT. This advanced robotic technology can repair cast iron pipe by internally injecting all of the joints in a given block or area with an anaerobic sealant. The robotic joint sealing operation is performed live through one small excavation, from the rear of a single box truck, and greatly reduces inconvenience to the public, makes the work less visible and decreases the amount of excavation required by other joint repair or pipe replacement methods such as encapsulation or lining. This trenchless technology provides potential for significant cost savings by decreasing the expenditure necessary for taking the main out of service, multiple excavations, restoration and required permitting for these activities.

The key stages of the project are listed below:

1. Pre-deployment risk and technical assessment
2. Pre-site inspection using VGC Crawler (camera inspection device)
3. Development and provision of large CISBOT for field trial in the UK.
4. Development of the fittings required to facility attachment of the large CISBOT launch mechanism to the gas main
5. Development of the large CISBOT launch mechanism under gas free conditions in to the gas main
6. Shipping and delivery of the CISBOT.
7. Field trial of CISBOT including operation of unit on site to determine the technologies compatibility with the GB network.
8. Technical assessment of the ATEX (ATmosphere EXplosibles directive) aspects and quantified risk assessment of the operation of CISBOT.
9. Commercial appraisal of the most suitable operating model.
10. Quantification of anticipated cost benefit.
11. Project Management within approved parameters.
12. Project report.

Scope

The scope of this project is to carry out a detailed technical assessment and field trial of the joint sealing robot 'Large CISBOT', which has the potential to repair or rehabilitate a number of cast iron joints under live conditions in a more cost effective manner than existing methods. The project will consider the potential for repair of 18" to 48" diameter cast iron mains.

Objective(s)

The objective of this project is to develop an innovative solution for the repair of leaking lead yarn joints within SGN's cast iron mains population. The project will evaluate the effectiveness of the repair technique and associated inspection method to determine extension to asset life and to understand the potential cost benefit.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be deemed to be successful if the following outcomes are achieved:

- Practical assessment of the Large CISBOT's performance when repairing large diameters mains using the trenchless technique
- Commercial appraisal of the most suitable operating model
- Assessment of whether repair to Tier 3 Cast Iron Joints under live gas conditions using CISBOT is possible
- The production of a technical, risk and commercial assessment of the operation of CISBOT
- Understanding of the opportunity to reduce excavation requirements in relation to joint repair
- Understanding of the potential reduction in the amount of material sent to landfill
- Understand the potential to prolong the life of the ageing cast iron mains

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, before carrying out a practical trial of the CISBOT in a live gas main.

The project duration allows SGN to carry out all the acceptance testing and evaluation work prior to approving the use of this technology within the GB gas distribution network. A field trial is required to allow us to assess the benefits of this innovative solution and deliver learning as outlined above.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The robotic technology will be transported from the USA and delivered to a designated site that has been chosen by Southern Gas Networks on a 24” cast iron main on the London network.

Revenue Allowed for the RIIO Settlement

At a project level there will be no RIIO-GD1 allowed funds avoided for the trial sites. The potential for future savings will be determined by the outcomes of the project .

Indicative Total NIA Project Expenditure

The total predicted project expenditure is £834,600, 90% of which 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)

The benefits of CISBOT deployment in terms of cost savings will vary depending on location and number of joints per site. Based on performance in trials and commercial service in NE (North East) USAs and Canada, the average cost savings over and above the traditional sealing method was 35 – 40%. How replicable these savings will be in the GB environment remains to be determined.

It is difficult to accurately quantify the potential financial benefits at this stage. However, It is envisaged that deployment of this technology may 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 of ageing high cost metallic mains.

Please provide a calculation of the expected benefits the Solution

The cost savings shown have been calculated using the total quantity of 16", 20" and 24" mains the large CISBOT will be used on utilising the financial benefits highlighted above.

The anticipated annual savings using the Large CISBOT against the OFGEM target for Tier 2 and 3 mains replacement per year and repairs carried out as a result of leakage will be £359,000.

This estimate is subject to a large sensitivity margin as it is based on averages and also depends on the actual outcomes of the project. The actual cost benefits of the project will be captured, analysed and form part of the final report.

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 16", 20" and 24" diameter cast iron mains, which SGN have approximately 265km of across its network. Based on a 4:2:1:1 split the total length of mains across GB that this method will apply to is approximately 1060km, with an annual saving of £1.436 million.

While this estimate provides an indication of potential applicability, it is important to note it is necessarily based on a number of

unqualified assumptions and therefore subject to a large sensitivity margin.

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

It is anticipated that the use of this technology will be through a managed service, the cost implications will be identified as part of this project.

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):

- [x] 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)
- [x] 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 with the outcomes 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. 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

- [x] Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Is the default IPR position being applied?

- [x] 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