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_SGN0012

Project Registration

Project Title

Seeker Particles

Project Reference Number

NIA_SGN0012

Project Licensee(s)

SGN

Project Start

September 2013

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Alex Stewart, Innovation Project Manager

Project Budget

£107,309.00

Summary

The scope of this project is to carry out a conceptual study of the development of discrete particles that intelligently locate and repair leaks within the gas distribution network and various methods of introducing them into the gas network.

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 cast iron is still in use today. At present across Scotia Gas Networks (SGN) there are some 20,000 kilometres (km) of metallic mains that are ageing, requiring inspection, repair or replacement.

Extensive investigation, has demonstrated that the majority of larger diameter 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 are 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 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, and considerable disruption to SGN customers.

Method(s)

Discrete sealing particles have been used to seal leakage issues in the oil and gas industries for a number of years, and have also been applied in the water industry by Yorkshire Water, Scottish Water and Suez. Once introduced into a leaking asset, discrete

sealing particles intelligently locate and seal leaks. However, the Method has never been applied to the low pressure gas pipeline situation of the gas distribution networks (GDNs).

To provide a benefit to GB GDNs, the discrete sealing particles must function across the entire range of the pipeline operating conditions, including all metallic mains diameters. This requires a material, or combination of materials which will be compliant enough to form a robust seal and which will remain in the leak site whilst the low pressure varies according to operating parameters.

The project will use the experience gained by the supplier in developing a remotely deployed particulate sealing product for use in live gas lines at pressures from 10 to 150 bar. It is envisaged that this application will require sealing particles which are suited to a pressure range of 0-7 bar in the local distribution system, with particular emphasis on the lower range. Material selection is critical to the success of this project. It is likely that the initial material selection will include very soft elastomers, compatible with the hydrocarbons in the gas. These elastomers are likely to be augmented with gels which behave like solids in the steady state and flow like liquids when subjected to shear forces such as those induced by the differential pressures across a leak. The gels can also exhibit adhesive properties to ensure that the seal is maintained once the pressure is dropped off the pipeline system.

The material selection will go hand in hand with the study of the most appropriate method of injection into the pipeline, conveyance along the pipeline, entrainment into the leak site, sealing and longevity of seal at the leak site. The removal of the unused particles will be taken into account along with detection techniques to give the location of the leak. The relevant standards and regulations will be taken into consideration from an early stage in the project to ensure that the material selection and techniques will be viable for implementation.

The project will include examination of prior applications and propose a number of technologies for initial investigations of feasibility for use in gas distribution networks. These technologies will be reviewed and shortlisted for adaptation to this application. Representative small scale test rigs will be developed to assess the performance of each technology.

This project represents Stage 1 (Concept Development) of a 4 stage project proposal. The purpose of completing this initial stage as a discrete project is to refine the various concepts and take these to representative small-scale testing facilities for verification.

Scope

The scope of this project is to carry out a conceptual study of the development of discrete particles that intelligently locate and repair leaks within the gas distribution network and various methods of introducing them into the gas network.

Objective(s)

The objectives of this conceptual study are to:

- Define detailed problem definition
- Review relevant prior art
- Provide possible solutions to the scope.
- Carry out conceptual development of the discrete particle sealing
- Develop concept test system and undertake tests
- Report on the concepts developed and testing undertaken, including recommendations of the solutions to be taken forward.

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

- Short study on the types of defects and leakage most commonly experienced, including high level look at industry and SGN standards to ensure that the solutions developed are compatible with these standards.
- Brief review of relevant patents, current techniques and state of the art which ensures no third party IP infringement occurs, protects project partners and aids concept development.
- Realisation and testing of preferred concepts using a mixture of in-house prototyping and third party manufacture.
- Comprehensive report and presentation on concept development and testing undertaken.

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 conceptual study. It was deemed appropriate to limit this project to a relatively small scale study because of the low technology readiness level. SGN have not committed to funding further stages of research and development until feasibility has been established through this project.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This project will be undertaken by Steer Energy at their office in Aberdeen.

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.

Indicative Total NIA Project Expenditure

The total project expenditure will be £107,309, 90% of which is allowable NIA expenditure (£96,578).

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 conceptual development 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:

- Allow both proactive and reactive repair of pipe joints using discrete particles, improving efficiency of mains repair techniques and reducing costs.
- Avoided Public Reported Escapes, and associated costs, including excavation and reinstatement.
- Reduce SGN's costs (and carbon footprint) through reduced leakage of natural gas to atmosphere.
- Reduce excavation and reinstatement in public carriageways associated with current methods of joint repair and limit disruption to SGN's 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 project is designed to reduce leakage of gas distribution networks through the insertion of discrete particles into the live gas environment. The focus area will primarily be metallic mains. SGN have approximately 20,000km of metallic mains across all range diameters. 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 is approximately 80,000km.

These repair and maintenance of these mains are high cost areas for all Network Licensees and the project has been designed to develop potential 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.

The study will provide Network Licensees with a conceptual study of the development of discrete particles that intelligently locate and repair leaks within the gas distribution network. From this study Network Licensees will be able to review the recommendations for future stage proposals and determine how discrete sealing particles are a potential solution for particular low pressure use within a gas pipeline context.

This will then allow Network Licensees to analyse internally where they foresee the benefits and whether they outweigh the costs and disadvantages of current methods of repairing leakage across metallic mains.

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