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 2014

Project Reference Number

NIA_SGN0057

Project Registration

Project Title

Aerosol Sealant - Stage 1A - Initial Development

Project Reference Number

NIA_SGN0057

Project Licensee(s)

SGN

Project Start

August 2014

Project Duration

1 year and 9 months

Nominated Project Contact(s)

Stephen Tomlinson, Innovation Project Manager

Project Budget

£174,206.00

Summary

This project aims to build on the work carried out under the project entitled “Seeker Particles” (NIA_SGN0012).

As part of the Seeker Particles project, a number of ambitious and highly innovative technology opportunities were identified. This proposal outlines the requirements in order to take one of those innovative technologies, namely aerosol based particulate sealants, and demonstrate ‘Proof of Concept’ for its use in gas pipelines and risers. It will use both experimental and numerical modelling approaches to address the key technical challenges required to bring this technology to market.

• Design and fabrication of a bench-top aerosol remote sealing test system

• Adapt the aerosol numerical model to the conditions prevalent in natural gas distribution systems and vertical risers, and validate this model.

• Assess aerosol penetration length as a function of process parameters (flow rates, particle size distribution, drying time)

• Characterise the deposition of sealant particles on interior surfaces and leak sites as a function of the distance from the injection point

• Characterize the geometry and flow conditions in low pressure sections of Scotia Gas networks

• Conduct witness testing for SGN staff and/or contractors.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

There are a number of contributory factors to Scotia Gas Networks' (SGN's) direct carbon footprint; however, approximately 95% is from Natural Gas Leakage. The majority of leakage is from lead yarn and mechanical joints within low pressure distribution networks.

One of the highest operating cost areas for SGN is in response to Public Reported Escapes (PRE's), it is estimated, based on data from 1998-2008 that joint repairs accounts for around 85% of all repairs.

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Method(s)

During the "Seeker Particles" project (NIA_SGN00012), an existing US patent detailing a method for sealing remote leaks in an enclosure using an aerosol was reviewed. It outlined an invention whereby a previously prepared aerosol was injected into the enclosure to be sealed, and the gas flow deposited particles on the pipe walls enabling them to bridge and substantially seal each leak.

This technology is now used routinely across the US to seal leaking ducts associated with Heating and Air Conditioning systems.

The goal of this project is to adapt this type of sealant technique to repair leaking natural gas distribution mains and network riser infrastructures. Aerosolised sealants will be introduced into the systems and tailored for remote deposition at small leaks (e.g. pitting holes and joint leaks).

The initial development work required to bring this technology to industrial use has been effectively split into two stages, followed by field trials.

The work to be covered in Stage 1A is to:

- Build on understanding of aerosol transport and leak deposition in ducts and risers
- Incorporate recent envelope sealing research on sealant materials that do not remain permanently tacky
- Refine and utilise CFD modelling techniques to characterise sealant transport, deposition and drying processes

The work will focus on applying the technique to network risers, but will also draw on the outcomes of other planned project work to carry out development of the solution for pipelines.

The fundamental innovation that will be tested in this project is a novel methodology for performing remote sealing in natural-gas distribution systems.

Scope

This project aims to build on the work carried out under the project entitled "Seeker Particles" (NIA_SGN0012).

As part of the Seeker Particles project, a number of ambitious and highly innovative technology opportunities were identified. This proposal outlines the requirements in order to take one of those innovative technologies, namely aerosol based particulate sealants, and demonstrate 'Proof of Concept' for its use in gas pipelines and risers. It will use both experimental and numerical modelling approaches to address the key technical challenges required to bring this technology to market.

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- Characterize the geometry and flow conditions in low pressure sections of Scotia Gas networks
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In June 2015 the project duration was extended by 6 months and the key project activities above were modified to reflect a change in the project supplier's main subcontractor from a USA based to a UK based company. The change in subcontractor was made due to failure to reach a satisfactory legal agreement. Although the problem, objectives and success criteria remain unchanged, the scope has been modified as the result of the change in subcontractor is that the project is now a development project rather than a technology transfer project-from the US HVAC industry to the GB gas industry. The original scope included experimental validation of modelling; the project will now use the modelling itself to provide indicative results.

The benefit of this change is a potentially more useful project as it is not now restricted to researching one technology (based on the US patent).

The project costs remain unchanged.

Objective(s)

Determine the feasibility of adapting existing air conditioning duct sealant techniques to repair leaking natural gas distribution mains and network riser infrastructures with deposits only occurring at leaks requiring sealing, while producing seals that can withstand normal operating pressures for natural gas distribution systems, and with minimal service disruption.

Recommendations for and progression to next stage of technology development.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- IP reviews and recommendations for next stage.
- Refinement of a model to determine aerosol transport and deposition.
- Development of experimental test apparatus.
- Completed tests and analyses.
- Final project report.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This is a small scale initial development project that will be carried out off network. Due to the low TRL it is not possible to accurately

comment on the potential future scale until the completion of the project.

However, should the initial development provide positive outcomes, any future methods/products arising from the successful completion of this phase and all required future phases will be applicable throughout GB.

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 and their associates at their respective sites.

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 ot yet possible to determine whether revenue savings are likely during RIIO-GD1.

Indicative Total NIA Project Expenditure

The total project expenditure is £174,206, 90% of which is allowable NIA expenditure (£156,786).

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)

This project is at a low TRL and it is therefore not possible to provide an accurate estimate of the potential saving to customers.

However, the estimated repair cost of leakage from our distribution mains and network risers, based on the total repex allowance of £108m for risers over RIIO-GD1, is in the region of £13.5m per annum. Depending on findings and outcomes of this project and its potential follow on projects, environmental emissions due to leakage in distribution mains and network risers could potentially be reduced to zero.

Please provide a calculation of the expected benefits the Solution

N/A – low TRL

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. This is a conservative estimate as it does not take account of network riser repair activities.

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 from this project as the outcomes will be presented in a clearly defined report that will be available to them on request.

The successful completion of this project will provide all UK GDN's with an understanding of the potential of using aerosol technology to seal gas leaks in distribution mains and network risers

Although the TRL is too low at this stage to provide an accurate cost benefit analysis, future phases, if carried out, will determine potential benefits, this will then allow the Network Licensees to make informed choices as to whether to invest in this technology.

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