NIA Project Registration and PEA Document

Date of Submission

May 2014

Project Reference Number

NIA_SGN0044

Project Registration

Project Title

Acoustek

Project Reference Number

NIA_SGN0044

Project Licensee(s)

SGN

Project Start

May 2014

Project Duration

2 years and 1 month

Nominated Project Contact(s)

Alex Stewart, Innovation Project Manager

Project Budget

£646,991.00

Summary

The system has been successfully commercialized for use in offshore natural gas pipelines and for surveying the relatively small tubes within shell and tube heat exchangers (used in the petrochemical and chemical sectors). The purpose of this Project is to extend the technique and develop a tool that is capable of surveying pipes with an internal diameter of 2"- 48" such that it can be used to survey the pipelines used in domestic gas distribution networks. The Project is being delivered by the University of Manchester.

The scope of the work to achieve this is:

- Laboratory work that will be completed to better understand the behaviour of acoustic signals within gas distribution pipelines and determination of the most suitable method to connect the equipment to live distribution pipelines.

- Development and lab testing of a prototype system

- Testing on abandoned mains

- Theoretical modelling to enable system response to be predicted, to enable field results to be interpreted

- Field trials

- Optimisation in response to field trials

- A field trial of the system by Network Licensee operational staff

- System optimisation in response to Network Licensee staff trial

Nominated Contact Email Address(es)

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Problem Being Solved

During the life of a pipeline there are occasions when a Network Licensee is required to excavate in order to enable the following activities:

· Locate blockages or obstructions which may have caused water ingress or debris build up and require removal

· Locate specific parts of buried assets i.e. valves, bends, tees etc. which require pin pointing for maintenance

· Determine valve open/closed status

The only existing method is to insert remote video cameras at regular intervals along the pipeline being surveyed. Typically, for remote video surveys, holes must be dug approx every 50 metres (m). Surveying long lengths of pipeline (> 100m) using this method is impractical. Other than remote video cameras there is currently no method to identify the exact location of problems or features of interest. Current techniques are typically multiple excavations supported (if appropriate to the problem under investigation) by pressure testing in the locality until the obstruction or asset can be found. There is a significant opportunity to reduce excavation, costs and time if a method to rapidly identify the location of features and causes of network problems can be developed.

Method(s)

The technology used in the Method uses sound waves (Acoustic Pulse Reflectometry or APR) to identify the location and nature of a feature of interest in a pipe such as those referred to in the problem statements above. The sound wave (typically a sweeping frequency) is injected into the pipeline under investigation. The ultrasound waves are reflected back to the instrument and by using advanced signal processing techniques the nature and location of a wide range of pipe features can be determined (essentially the same general technique used by bats and sonar).

The proposed Method would consist of an instrumentation and control unit which would be portable and robust enough to be deployed and used by a single person. A flexible hose, would then attach, through a bespoke fitting, to a live distribution pipeline through any available connection point of typically 25 millimetres (mm) (or potentially smaller). Connections could be via access points such as customer service pipes, network pressure test points, and siphon pots or data logger posts potentially eliminating the need for excavation in some situations. The equipment would be operated via a computer, which would instantly interpret and display the results of the survey, highlighting any detected abnormalities in the pipeline. The information would enable the operator to pinpoint the area that requires remedial action if troubleshooting the location of water for example. In pipelines where there are complexities such as tees or branches, it may be necessary to use the technique in more than one location and triangulate the information to establish the location of a feature.

The location accuracy of the method would be approximately 1% of the distance to the feature i.e. a feature 20m from the point of injection of the sound wave would be located to a positional accuracy of approximately 20 centimetres (cm). This method will:

• Enable faster location of water and blockage location, reducing inconvenience to customers. A survey of a 500m length of pipeline would take less than 1 minute
• Enable the identification of water issues before they create problems for customers
• Provide reductions in excavation and streetworks
• Be very well suited to keyhole excavation
• Enable accurate measurement of distances to buried network assets or features including pipe joints, changes in pipe wall material and repairs
• Provide a technique that can be used with the minimal amount of training in order to give workforce flexibility
• Be effective on both PE and metallic pipe in any ground condition
• Not require mechanical insertion of an object into the pipe being assessed (as would a camera)

Scope

The system has been successfully commercialized for use in offshore natural gas pipelines and for surveying the relatively small tubes within shell and tube heat exchangers (used in the petrochemical and chemical sectors). The purpose of this Project is to extend the technique and develop a tool that is capable of surveying pipes with an internal diameter of 2"- 48" such that it can be used to survey the pipelines used in domestic gas distribution networks. The Project is being delivered by the University of Manchester.

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Objective(s)

The objectives are to:

· Identify the capabilities and limitations of using APR in gas distribution pipelines. In particular, this will develop a better understanding of the internal characteristics of gas distribution pipelines (i.e. build-up of deposits, water, and potentially other characteristics such as pipe wall condition and crack location etc) and the effect that they have on the attenuation of acoustic signals

· Determine whether the signals produced by the instrument can be interpreted and how effectively water, obstructions and holes can be detected, located and characterised as the behaviour of acoustic signals in distribution network pipes is not well understood

· To determine the practical location range and accuracy of the above for different pipe diameters and scenarios

· Determine the most appropriate manner by which the instrument is connected to the pipeline.

· Develop the necessary data processing algorithms to enable features in the pipeline to be readily detected and identified. For example, distinguishing between the signals received from a partial blockage and a hole

· Trial the technology in the laboratory environment, abandoned mains and live network

· Produce three intrinsically safe prototype devices

· Train Network Licensee personnel in the use of the prototypes to enable them to trial the Method directly

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Specific success criteria for the Project are:

· The prototype system is able to provide feature detection location up to 500m (250m either side) of the access point, and

· that the Project establishes exactly what the capabilities and limitations of this system are

· that Network Licensees are confident at the end of the Project that they (or their nominated contractors) are able to use the prototype device in an operational environment without the support of University of Manchester staff

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The proving of the technology will be taken in stages that progressively involve network resources as confidence in the technology grows at each stage. This will be limited initially to laboratory testing and testing on up to 10 abandoned mains. If successful, two further stages will be undertaken on up to 15 and 20 sites, progressively involving the training and involvement of Network Licensee staff in line with the performance improvement of the Method. If the success criteria are achieved in a smaller number of site trials the number of trials will be reduced to save unnecessary expenditure.

The number of prototypes will be limited to three. One will be held by the Project development team for laboratory development testing during field trials and to trial modifications. The other two will be shared in use between the Network Licensees, obtaining a spread of different user and application experiences. Site trials have been minimised as far as possible. Any further reductions in the size of the proposed trials would result in insufficient results and data to give balanced results & dissemination of data.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

To ensure minimal use of Network Licensee resources and excavation costs, field testing conducted within the Project will be co-ordinated at locations where existing excavation or site investigations are taking place. Such trials could therefore be in any Network Licensee area.

Revenue Allowed for the RIIO Settlement

During RIIO-GD1 it is estimated that SGN, NGN, WWU & NGG will attend approximately 8000 supply or flow problems of which 40% will be attributed to water ingress or internal blockages. It is estimated Network Licensees will spend approximately £16m on rectifying these. During the same period Network Licensees will also undertake a number of asset identification projects spending an estimated £5m on locating specific parts of buried assets. It is assumed that if progressed successfully through this project, the Method will have potential to provide cost savings in identifying and rectifying flow and supply problems more quickly. Expected savings against specific areas would be quantified in the later stages of the Project using case study examples generated from the trials. It is not anticipated that there will be cost savings within the trials as they would be additive to existing practices.

Indicative Total NIA Project Expenditure

The total Project cost is £646,991 of which 90% is allowable NIA expenditure (£582,292). The costs are being shared proportionally amongst the Network Licensees as follows:

SGN external expenditure - £118,977, SGN internal expenditure - £39,500

NGG external expenditure - £288,186, NGG internal expenditure - £96,081

NGN external expenditure - £ 59,489, NGN internal expenditure - £19,750

WWU external expenditure - £ 18,774, WWU internal expenditure - £6,233

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)

There will be significant savings by using this system against traditional methods, reduced excavation and customer inconvenience being the largest, initial forecasts estimate a saving of circa 60% against those costs.

Please provide a calculation of the expected benefits the Solution

Base case costs:

The Base case scenarios are very diverse so the Base case costs shown here are for a typical example, the resolution of water ingress issues in a domestic scenario based on information from the SGN Glasgow operational depot:

Base cost

Assuming a mean average of 3 excavations/water incident at £1000/excavation = £3000

Method cost

Assuming an average of only 1.2 excavations/water incident (i.e. most of the time just one excavation is required but occasionally more than one) at £1000/incident = £1200

Total Method cost = £1200

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Saving summary: Base cost – Method cost = £3000-£1200 = £1800

In the SGN Glasgow operational depot alone there were 270 water ingress related issues in 2010/11. So the annual saving related to

this depot alone = £1800 x 270 = £486,000 – £8,000 (cost of equipment/training) = £478,000/annum

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

All Network Licensees have problems similar to those illustrated in the Problem statements. The Method can be replicated across all operational depots across all GB Network Licensees. Additionally in circumstances where Network Licensees subcontract services from third party contractor companies, the Method could also be adopted by these parties.

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

It is assumed that all operational depots would adopt the Method as they all experience the same range of Problems. An indication of roll out costs therefore would be :

- each depot purchases the system at a cost of £5000

- cost of training per depot £3000 (staff time + external trainer costs)
- 10 depots per Network Licensee area

Total cost = 10 x 8 x £8000 = £640,000

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

The end of Project report will be shared with all Network Licensees detailing the performance of the Method, the experiences and knowledge gained from each site trial and its limitations. The training needs for the Method will be established during the Project enabling the training of staff from other Network Licensees to be able to trial or adopt the Method. Network Licensees would be able to attend the training or trials taking place in other Network Licensee areas during the Project if they wished in order to observe and learn about the Method. This would enable other Licensees to have a deeper understanding of the circumstances and applications for the use of the Method in their own Network.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

None.

☑ 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