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NIA Project Registration and PEA Document

Date of Submission

Feb 2014

Project Reference Number

NIA_SGN0006

Project Registration

Project Title

Optomole

Project Reference Number

NIA_SGN0006

Project Licensee(s)

SGN

Project Start

March 2013

Project Duration

3 years and 1 month

Nominated Project Contact(s)

Alex Stewart, Innovation Project Manager

Project Budget

£285,940.00

Summary

The purpose of this Project is to develop a mobile, optical methane sensing system that Gas Network Licensees can utilise to quickly and accurately detect the location of natural gas leaks in ducts.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Historically the method of locating escaping gas that has entered ducts such as Telecoms or TV cable ducts is to locate where the gas is escaping from the duct, then excavate to locate the escape, or the point where the gas is entering the ducts. The current method for leak location is to drill holes through the road at 1 meter intervals between the two nearest access points (usually via manholes some 30 meters apart) and perform a point detection until the gas leak location is found. This can take several days, causes significant transport disruption and results in high manpower and associated costs to rectify.

Buried ducts across the country carry cables such as BT utilities, Cable TV, Broadband, Traffic systems and controls. As a known problem over the years, all networks have looked at the problem of duct gas source detection but owing to a number of reasons they have not been successful;

- Due to the small space available in the ducting,
- Ambient environment (the ducting often has water and mud in it),
- Potential spark / explosion risk from electrical sensors operating in a methane/air mixture.

Method(s)

This Project investigates the possibility of identifying the location of gas entry into a duct by inserting a fiber optic gas sensor to locate the point of gas entry. The proposed solution would consist of an instrumentation and control unit which would be portable and robust

enough to be moved from depot to van. A fibre optic cable bundle would connect to this unit and then “rodded” down the length of the ducting, perhaps 30 metres.

Robustness of the cable is a key factor for the sensor cable design. Initially 6 sensors will be set at equidistant intervals in the cable which would detect the concentration of methane along its length. The control unit would pinpoint where highest concentration of methane exists. This will significantly reduce the number and size of excavations and speed up the repair of the gas escape.

Having a collaborative Project allows all Networks to give their input to what is an industry issue. OptoSci’s solution to the problem is to develop an innovative thin optical sensing solution that can overcome the limited space available, cope with the conditions within the duct and give no risk of explosion or ignition..

Scope

The objective is to develop an all optical Tuneable Diode Laser Spectroscopy (TDLS) based methane sensing system that could provide an elegant and cost effective solution to this problem. Optosci has a current product (OptoSniff) which has proved its capability for optical gas leak detection. However it was developed as a fixed point detection system to monitor critical areas with large open spaces such as tunnels and control

rooms. The system to be developed in this Project will utilise similar instrument technology applied in a new way, with a radically different fibre cabling configuration to make it suitable for passing through narrow utility ducts.

The objectives and benefits of the technology would be to:

- Substantially improve the gas leak identification process and hence the integrity, safety and reliability of the gas network.
- Faster leak location reduces fugitive methane (a potent greenhouse gas) emissions to the atmosphere
- Deliver a completely safe method with no spark risk making it inherently safer for the workforce and public
- Provide reductions in excavation and streetworks
- A technique that can be used with the minimal amount of training in order to give workforce

flexibility

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Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Through-out the Project there will be monthly reports from Optosci to update all Project steering group members on the progress of the Project. There will be face to face meetings every 6-8 weeks and key deliverables reviews at key points with accountable parties clearly identified. Each stage will have its own deliverables and targets which the Project will measure itself and report on monthly as it progresses. When issues are identified recovery plans will be adopted to ensure minimal impact on time scales, and avoid additional costs. The Project seeks to deliver:

- A unit cost of £25k
- A no spark solution
- Confidence that speed, manpower, excavation and streetworks disruption reductions can be achieved as compared to current methods

- Ease of use and a target maximum training of 4 hours for competent use of the equipment
- Sufficiently robust hardware
- Suitability of the technique in duct environments
- Demonstrate it can produce objective leak occurrence and location information

Project Partners and External Funding

The Project Partners are listed below. The Project is wholly NIA funded.

OptoSci (no external funding)

Northern Gas Networks (NIA funding £25,550)

Scotia Gas Networks (SGN) (NIA funding £63,964)

National Grid Gas Distribution (NIA funding £165,323)

Energy Innovation Centre Funding (no external funding)

Potential for New Learning

Learning from the Project would include:

- Better understanding of gas flows within buried ducts.
- Reduced time in gas escape classification.
- Faster leak location techniques.
- Optimisation of excavation locations to suite the technique.
- Training requirements.
- Limitations of the technique such as sensitivity or accuracy of leak location identification
- Likely cost and time savings
- The potential for the technique to be used in drains, culverts, and other chambers

Following successful completion of the Project it will be possible for the 3 collaborative Networks (NGG, NGN & SGN) to easily adopt the new system, and inform their supplier contractors to adopt it also.

Scale of Project

The Project has been split into three distinct stages:

- Stage 1 - Sensing Cable Proof of Concept - Design and manufacture of a proof of concept single sensor cable for initial laboratory trial. Evaluation of single sensor cable response & operation during laboratory tests in PVC pipe incorporating variable gas release, suction/fan, mud, water, etc. as required
- Stage 2 - Development & field trial of prototype multipoint sensing cable - Design and manufacture of prototype 3-point gas sensing cable and detailed testing of the system at a GDN nominated trial site
- Stage 3 - Design and Production of rugged 6-point sensing cable suitable for tests to required Industrial Standards

Due to the high proportion of the costs being associated with the research and development of the technology using a lead network on the Project on behalf of the collaborating networks minimises additional costs. The lead network ensures consistency and avoids other networks having to trial the product following completion. 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

TRL3 Proof of Concept

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

GB Only, with four on-site trials, under taken in Glasgow, Scotland during Stage 2 followed by two further on site trials during Stage 3. (locations to be confirmed).

Revenue Allowed for the RIIO Settlement

During RIIO-GD1 it is estimated that SGN, NGN & NGG will attend 135,000 gas escapes per annum which are attributed to gas mains,

spending approximately £135m on mains repairs. As this Project is starting 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 identifying gas leaks and repairing them quicker. Expected savings against specific areas would be quantified in the later stages of the development.

Indicative Total NIA Project Expenditure

SGN Costs

£8,386 IFI Project expenditure
£63,964 NIA Project expenditure
£72,350 total Project expenditure

NGG Costs

£15,589 IFI Project expenditure
£165,323 NIA Project expenditure
£180,912 total Project expenditure

NGN Costs

£ 7,128 IFI Project expenditure
£25,550 NIA Project expenditure
£32,678 total Project 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)

There will be significant savings by using this system against traditional methods, reduced excavation and inconvenience to the customers being the largest, initial forecasts estimate a saving of circa 70% against those costs.

Please provide a calculation of the expected benefits the Solution

Primarily the main financial returns for supporting this Project would be the cost savings associated with the products use in the field by Gas Escape Teams. Detailed below is an indicative cost benefit summary based on the following assumptions which were obtained from the 3 gas Network Licensees who are participating in the Project:

- Estimated gas escapes per annum and per region
- Percentage of gas escapes located from ducts
- Typical cost of each mains escape

An average of the three different assumptions provided by different Network Licensees has been used to calculate the expected financial benefits.

The estimated average number of gas escapes per annum per region is 24,920. An average of 62% of these are located through ducting. The average cost of each mains escape is £900. The following is the example benefit case using this above assumptions:

- Assuming an average cost for each mains escape of £900, the total cost for gas escapes in an average region is £22.43m per annum (24,920 x £900).
- With a conservative estimate of 8% savings from the deployment of the OptoMole solution, cost savings would amount to £1.79m per region per annum or £16.11m potential savings across all nine UK network districts.
- It is estimated that the payback of development and system procurement would occur within 12 months from the end of development.

To give another view of the benefits,

NGG is expected to spend £55m on emergencies per annum.

The base cost is 24% of this figure = £13m and we would expect to save say 8% which equates to approx. £1m per annum. (using 25% figure)

Base cost of £13m less method cost of £12m = Expected Financial Benefit of £1m per annum

SGN is expected to spend £32m on emergencies per annum.

The base cost is 24% of this figure = £7.5m and we would expect to save say 8% which equates to approx.

£600k per annum. (using 25% figure)

Base cost of £7.5m less method cost of £6.9m = Expected Financial Benefit of £600k per annum

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

Each network would purchase their own system(s) and use in house. It is estimated that there are 72 sites across the networks. The method could be rolled out at all sites and it is assumed that as a minimum each site would purchase 1 system with 1 team trained to operate the equipment across all 72 sites.

An estimated 4hours training is required per team.

72 sites x 4 hours = 288 hours of training @ £53/hr = £15,264 sunk costs

NOTE: £53/hr is the estimated hourly total, including overhead, of an Operational Team leader.

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

Optosci forecast that the final unit would cost in the region of £25k. It is assumed that each gas network licensee (of which there are 8) has 9 Operational Depots with 1 Optosci unit being deployed in each.

Est. cost per system x (Individual Network Licensee x Operation Depots / license) = Total Operational spend

£25k x (8 x 9) = £1,800k

There are no training costs and no installation costs.

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 related to each individual; all the equipment supplied following the Project will be the same and easily adopted into the GB gas networks, following appropriate on-site training and support.

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.

A review of all other Network Licensees Innovation Funding Incentive annual reports has been performed and no similar Projects have been identified. A similar review of current academic literature and journals from leading UK and international universities has also been performed to avoid any potential overlap with the current Project. The Energy Innovation Centre have also engaged with the Project supplier and they have provided clarity that no unnecessary duplication of this Project is currently being undertaken in the UK.

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