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NIA Project Registration and PEA Document

Date of Submission

Mar 2014

Project Reference Number

NIA_SGN0031

Project Registration

Project Title

Stent Bag

Project Reference Number

NIA_SGN0031

Project Licensee(s)

SGN

Project Start

November 2013

Project Duration

6 years and 5 months

Nominated Project Contact(s)

Alex Stewart, Innovation Project Manager

Project Budget

£189,320.00

Summary

The scope of this project is to design, develop and test an innovative stent bag system that can maintain gas supplies during high volume gas escapes and reduce the potential loss of supply to customers.

The project will:

- Design and develop proof of concept
- Conduct a feasibility study after completion of design
- Develop a prototype design
- Conduct a field trial for product verification
- Produce a work procedure and report on the development of the equipment
- Conduct a full scale assessment prior to phase 2 and transfer to business as usual.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Impact damage to a pipeline or a gas main from excavators and mini diggers can lead to a significant escape of gas, a loss of supply and incur a significant financial cost with considerable environmental damage. Recent examples of this are the two third party interference damage incidents in Scotland in 2012/13, each of which involved a loss of supply to between 3,000 and 4,000 customers.

Depending on the extent of the damage, the first choice option for dealing with third party damage is to try to maintain the gas supply to customers. The current method for achieving this is to temporarily repair/control the leaking pipe with a repair clamp and/or sandbags and then construct a bypass around the damage, subsequently cutting out the damaged section. The caveat to this method is that it must be carried out within a critical time window before too much gas escapes through the damaged pipe and a loss of supply occurs.

If the supply is lost in this way, air can be drawn into the gas system which can create potentially explosive atmospheres within the network. Therefore often the only available method for safely dealing with network damage is to close a valve upstream and turn off the supply to customers until the damage has been remediated. After the damage has been remediated, supply to customers is restored by means of a purge and relight at every affected household. This is a costly and time consuming operation.

This project specifically aims to provide a solution this problem by developing a method which could be used to extend the critical time window for dealing with gas mains damaged by a third party or otherwise. This solution would also simultaneously mitigate the escape of gas to the environment and negate the requirement for a costly customer restoration programme.

The idea for this project was originally received via our internal suggestion scheme called 'Ignite', following the two recent damages in Scotland. The original idea has since been developed to form this project.

Method(s)

In order to protect the network and minimise our impact on the environment, this project aims to develop a method to vastly reduce the amount of gas loss when dealing with broken or damaged mains up to 2barg but continue to allow sufficient gas flow to protect the downstream supplies.

The method proposed by this project is to insert a stent into the damaged main. Stents are commonly used in the medical industry, typically used during heart surgery to maintain a blood flow. Applying the same methodology as a medical stent, a similar solution could be applied to the gas industry.

A stent tube would be inserted into the damaged main via a drill point immediately upstream of the damage. The stent would then be inflated, creating a seal around the inside of the pipe and preventing gas from escaping. Due to the ring shape design of the sent gas would continue to flow through the annular space and therefore maintain the supply to customers.

The project shall involve the collaboration with both Sarco Stopper Limited and Advanced Engineering Solutions Limited (AESL) to support the development and technical evaluation of equipment that will generate pressure stabilisation and limit the loss of gas on high pressure metallic mains breakages.

Scope

The scope of this project is to design, develop and test an innovative stent bag system that can maintain gas supplies during high volume gas escapes and reduce the potential loss of supply to customers. The project will:

- Design and develop proof of concept
- Conduct a feasibility study after completion of design
- Develop a prototype design
- Conduct a field trial for product verification
- Produce a work procedure and report on the development of the equipment
- Conduct a full scale assessment prior to phase 2 and transfer to business as usual.

The project has been delayed at the design concept stage. This delay was, primarily, due to unexpected technical issues when attempting to transfer the existing medical technology application to be used on a larger format in 3" mains and above. The design has had to be modified several times in order to meet the requirements resulting in the need to extend project duration. The increase in costs is attributable to the additional design requirements and an increase in market costs of materials costs from the time of the original project pricing.

The project problem, objectives and success criteria remain unchanged.

This change to allow completion of the field trial testing is beneficial as it will ensure full assessment of whether the equipment is fit for purpose and there is no change to the expected benefits.

When constructing the prototype and carrying out initial testing, challenges were identified with the material manufacturing process and the initial inflation method used. In order to overcome these unforeseen challenges changes were required to be made to both the materials used and the construction method of the actual Stent bag itself. These changes have resulted in the construction of a newly designed bag, as well as improvements in the inflation method, flow stability and sealing capability. However, an additional 12 month extension to the end date of the project is essential to complete the final stages of the project.

A further change was required after the initial field trial showed there was a potential issue with the bag sticking on entry and withdrawal due to the sharp cut edge of the drilled hole. The bulk and size of the bag, although tested offsite, proved very problematic when a live field trial was attempted. This change resulted in a slight delay to the project completion of 3 months and an additional

expenditure of £44,708 to redesign the fitting and entry system as well as additional offsite testing prior to the final field trial. These changes are beneficial as they give assurance of the performance and reliability of the final Stent Bag design and allow completion of the objectives as planned with no changes to expected benefits.

Objective(s)

The aim of this project is to design and field trial a prototype piece of equipment that will facilitate the repair of a damaged gas main whilst maintaining the supply of gas through the pipe. The salient objectives are:

- Review relevant specifications and manufacturer information
- Produce a proof of concept and design study
- Produce a feasibility study based on proposed design
- Sarco to produce prototype product
- Propose of appropriate test programme to investigate performance
- Conduct field trial (location yet to be determined)
- Produce training material in support of field trial.
- Produce report detailing the findings of the field trial
- Evaluate the performance of the Stent Bag through field trial

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project are:

- Development of a piece of equipment that will generate pressure stabilisation and limit the loss of gas on high pressure metallic mains breakages
- Assess extent to which the speed of a repair operation can be improved during a damage incident
- Assess extent to which the speed of a supply restoration operation can be improved during a damage incident
- Assess extent to which a reduction in customer interruptions can be achieved during a damage incident
- Assess extent to which a reduction in associated costs can be achieved during a damage incident
- Assess extent to which a reduction in the amount of natural gas released to atmosphere can be achieved during a damage incident
- Production and dissemination of learning around the project outcome and expected operation of equipment

In order to determine whether this project has been successful or not it will be reviewed at key milestones; this will ensure value for money is received by the customer, with the avoidance of unnecessary expenditure.

Project Partners and External Funding

None

Potential for New Learning

This project aims to develop a solution to an existing problem that has never been adequately addressed before. The Project is expected to develop the following new learning for Network Licensees:

- Awareness of a method and product for maintaining gas supplies whilst containing a gas release caused by damage to metallic mains operating up to 2barg
- Awareness of a method and product that could possibly be adapted to suit gas mains of other materials
- Awareness of a method and product that could possibly be adapted to suit pipelines operating above 2barg
- A practical evaluation of the tested technology

After the trials have been carried out SGN will be able to share the findings from the evaluation of the Method and highlight any advantages of utilising this technology as opposed to the current working practice for network pressure support in the event of mains damage.

Scale of Project

The project involves designing a prototype and testing on a field trial on a site yet to be determined. There would be less potential for learning if the scale of the project was any smaller than this. Similarly there would be no merit in having a larger scale project as this

would not provide value for money.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The technical assessment of the Stent Bag equipment for use on SGN assets will be carried out at Advanced Engineering Solutions Limited (AESL) offices in Cramlington, North East England.

This project trial location is yet to be determined. The suitable site will be chosen based on a number pre-defined criterion which will be developed as part of the project.

Revenue Allowed for the RIIO Settlement

SGN's RIIO-GD1 allowance for Emergency and Repair activities for both Southern and Scotland is £255.7m and £209.6m respectively. A proportion of these allowances will cover costs associated with damage incidents. While no direct savings are expected during project implementation, it is likely that some of this expenditure could be reduced by the introducing the Stent Bag system during future incidents that occur across our networks.

The level of potential savings will depend on the success of the new technique and is unknown at this stage.

Indicative Total NIA Project Expenditure

The total project expenditure is £144,612, 90% of which is allowable NIA expenditure (£130,151).

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)

SGN's RIIO Allowances for Emergency and Repair activities, which this system will aid, are £255.7m and £209.6m for Southern and Scotland respectively. It is envisaged that the Stent Bag system would be used in major incidents. In the past two years SGN have had two major incidents in Scotland resulting in a loss of downstream supplies to customers. The period of loss is variable, but has an effect not only on customers but also on SGN's planned work. This is because resources are inevitably diverted from planned work to deal with such incidents, making the situation safe before re-establishing the supplies. Customers are paid £30 per 24 hour interruption period compensation by SGN for losses so any reduction in the time period would have a direct reduction in compensation payments. Use of the Stent Bag system in major incidents would be expected to have the following financial benefits:

- Improvements in the loss of downstream pressures.
- Reduction in disruption to customers, reducing failure to supply payments and also customers' costs due to loss of business during supply loss.
- A reduction in the amount of time taken to resolve the incident, reducing failure to supply payments and man hours required to resolve incident.
- Minimising the disruption to current operational activities and limiting the need for displacement of resources.

Please provide a calculation of the expected benefits the Solution

Potential savings have been estimated using the assumption that SGN have two major incidents per year on average (consistent with previous experience) and costs from a recent incident in Clackmannanshire, Scotland in 2012/13. This incident resulted in a total cost to SGN in excess of £500,000, including approximately £200,000 for failure to supply payments and loss of business for the 3500 customers who were affected. It is envisaged that the Stent Bag system could generate savings of approximately 20% in customer payments and loss of business.

Therefore; £200,000-20% = £160,000, which equates to a £40,000 saving on average per incident (Benefit Estimation for Development) and an £80,000 saving per year.

It is difficult to accurately estimate potential savings from use of the Stent Bag system due to the infrequent and unpredictable occurrence of major incidents. It must be highlighted that the savings estimated are necessarily based on assumptions. The actual cost savings will fluctuate per incident, depending on the type of incident, location, timing and number of customers affected. The field trial findings from this project will enable SGN to determine exactly what kind of incidents that this system can be utilised to support and

provide a more accurate analysis of the system's potential to deliver net financial benefits.

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

The Method is potentially applicable to a major incident at any site in GB. Based on the quantity of incidents where it is expected SGN will be able to use this technology, and extrapolating from a 4:2:1:1 split with reference to the size of each network, it is assumed that National Grid have in the region of 4 incidents per year where Stent Bag system can be used and Wales & West and Northern Gas would have approximately 1 per year each. This gives an estimated total of 8 incidents across Great Britain (GB) where this technology could be applied each year.

It must be noted that these figures are based on averages and estimates rather than real network data and the nature of incidents will vary, which could affect the potential to apply the method and the benefits of applying it. The main focus of this project is to test the technology and understand the potential benefits.

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

Until the product is developed fully, it is difficult to determine an accurate price for the roll out of the equipment. Further development through this project will enable assessment of the cost of the equipment and costs associated with its deployment.

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

After the trials have been carried out SGN will be able to share the findings from the evaluation of the Method and highlight any advantages of utilising this technology as opposed to the current working practice for network pressure support in the event of mains damage. The learning from this project will benefit Network Licensees as it will provide them with a clear evaluation of current techniques for dealing with loss of supply during incidents against the new Stent Bag system. If successful the learning from the project (new system development and evaluation of trial results) will allow Network Licenses to make informed decisions on the introduction of this equipment into their operational activities. Where introduced, the learning will enable them to begin accurately measuring the reduction in the volume of gas released to atmosphere as well as determining the potential improved impact it has on customers.

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' IFI Annual Reports has been performed and no similar projects have been identified. A similar review of current academic literature and journals has also been performed to avoid any potential overlap with the current project.

The supplier has provided clarity that no unnecessary duplication of this project is currently being undertaken in GB.

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