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_SGN0016

Project Registration

Project Title

Starline/Marwin Valve Bolt Replacement

Project Reference Number

NIA_SGN0016

Project Licensee(s)

SGN

Project Start

December 2013

Project Duration

3 years and 11 months

Nominated Project Contact(s)

Mark Skerritt, Innovation Project Manager

Project Budget

£75,149.00

Summary

The scope of the project is as follows:

- Developing the Equipment

- Design and develop proof of concept design
- Develop prototype design with aid of finite element stress analysis
- Produce prototype design
- Undertake high pressure performance/strength test on prototype.

- Undertake a field trial in a location in Scotland.

- Producing a Work Procedure that provides detailed step-by-step instructions on the use of the equipment

- Produce a draft Work Procedure for review by SGN subject matter experts
- Produce final version of Work Procedure incorporating feedback from subject matter expert review.

- Producing a formal report on the development of the equipment

- Produce a draft report
- Produce final version of report.

Additional time is required due to unexpected technical issues; it has been very complex obtaining a suitable section of pipe work that meets the criteria for acceptance testing. A site was selected but due to operational requirements there was a limited amount of time that the site could be decommissioned to remove the test pipe work. The operation to remove the section of pipe work has now been

completed and we can now move towards the testing phases of the project.

A further six month extension (revised end date from October 2015 to April 2016) was required due to delays involving the material selection and identification of a manufacturer for the clamp; primarily because of the need to ensure it meets the stringent design and integrity requirements set against it, leaving no doubt that it is ultimately safe for application on an affected high pressure Starline/Marwin ball valve. This has taken more time than anticipated due to the specialised materials being used, the high degree of manufacturing accuracy needed and the complexity of the associated processes, particularly the heat treatment processes involved with the clamp's manufacture.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Scotia Gas Networks (SGN) has identified that some of the bolts on Starline/Marwin ball valves across their Scotland license area are suffering from corrosion and are in need of replacement. These ball valves are small in size and are used in purge and vent lines on Pressure Reduction Installations (PRI) operating at high pressure (up to 70bar).

The conventional way to safely replace corroded bolts would be to depressurise the pipework, isolate the stream and swap the existing bolts for new ones. This is known as stream isolation and replacement and is relatively low cost and non-disruptive. However, due to their location on the pipework, many Starline/Marwin valves cannot be isolated and replaced in this manner. Therefore, the only way to replace the majority of Starline/Marwin bolts would be to isolate and depressurise the entire PRI, which is an extremely costly and time consuming operation, due to the fact that isolation may (on certain sites) involve an interruption to supply in excess of 20,000 customers.

A partial solution has been to encase the corroded valve with a clamp, which helps prevent further corrosion. This clamp costs approximately £10,000 with a 2 month lead time as every one to date has been a bespoke design. For such reasons, SGN are looking to develop a more advanced solution. The new solution must be less costly, less time consuming and allow the bolts to be replaced safely whilst they remain pressurised and in compliance with SGN's obligations under Pressure System Safety Regulations (PSSR).

Method(s)

SGN will employ technical consultants, DNV GL, to design, produce and test a prototype for a full bolt replacement solution which could potentially be used to replace badly corroded bolts on 1" Starline/Marwin valves whilst they remain pressurised (at pressures greater than 7 bar)

The prototype solution will be tested and proved in a live working environment in SGN.

The solution will allow the Network Licensee to comply with PSSR obligations and to carry out the replacement safely and at a lower cost than currently permitted through existing methods.

Scope

The scope of the project is as follows:

- Developing the Equipment

- Design and develop proof of concept design
- Develop prototype design with aid of finite element stress analysis
- Produce prototype design
- Undertake high pressure performance/strength test on prototype
  - 1. Operational Test – Where internal pressure is adjusted, enabling replacement of bolts with more appropriate corrosion resistant bolts.
  - 2. Value Clamp Integrity Test – Only clamp holds unit together whilst pressure system is adjusted, demonstrating clamps' strength and retained integrity for the valve in comparison with an untouched 'existing' Starline valve.

- Undertake a field trial in a location in Scotland.
- Producing a Work Procedure that provides detailed step-by-step instructions on the use of the equipment

- Produce a draft Work Procedure for review by SGN subject matter experts
- Produce final version of Work Procedure incorporating feedback from subject matter expert review

- Producing a formal report on the development of the equipment

- Produce a draft report
- Produce final version of report

Additional time is required due to unexpected technical issues; it has been very complex obtaining a suitable section of pipe work that meets the criteria for acceptance testing. A site was selected but due to operational requirements there was a limited amount of time that the site could be decommissioned to remove the test pipe work. The operation to remove the section of pipe work has now been completed and we can now move towards the testing phases of the project.

A six month extension (revised end date from October 2015 to April 2016) was required due to delays involving the material selection and identification of a manufacturer for the clamp; primarily because of the need to ensure it meets the stringent design and integrity requirements set against it, leaving no doubt that it is ultimately safe for application on an affected high pressure Starline/Marwin ball valve. This has taken more time than anticipated due to the specialised materials being used, the high degree of manufacturing accuracy needed and the complexity of the associated processes, particularly the heat treatment processes involved with the clamp's manufacture.

A further eighteen month extension (revised end date from April 2016 to October 2017) is now required following completion of the initial design and selection of the preferred manufacturer. An ABS (Acrylonitrile Butadiene Styrene, a robust oil based plastic) 3D print was created; however, the consequence of realising this prototype was that it highlighted a previously unforeseen safety and technical issue with the initial design. It became apparent there was limited space to physically remove the corroded bolts and to resolve this issue the initial design had to be updated, making the bolt replacement process easier and more effective. This important design change resulted in significant delays to the Finite Element Analysis (FEA) and the final manufacture of the clamping tool. An initial FEA has now been completed, however, the results indicated a failure in the design, which will need addressing to allow the project to progress as planned. The current assessment is that it should be possible to overcome the current design failure by undertaking a further redesign of the clamp and once compete, undertaking a new FEA to ultimately theoretically demonstrate the credibility of the new design. However, it is now considered necessary to allow for more time than originally estimated for carrying out the redesign work and additional FEA; as well as undertaking the Offsite trials and for SGN to fully evaluate, appraise, and ultimately approve, the new tool for use on its live, high pressure gas sites.

This additional change to the original Project end date will be beneficial as it will allow the 2nd success criteria to be met. Alterations made to the prototype will ensure it can operate sufficiently to support the replacement of corroded bolts on Starline/Marwin valves whilst pressurised and therefore will meet regulatory safety standards when operating on the GB gas network.

Despite the Project change, the original budget and expected benefits will not be affected.

Objective(s)

The objectives of the project are to:

- Design and develop proof of concept of a solution which enables the bolts in a 1" Starline/Marwin valve to be replaced whilst pressurized.
- Develop working prototype and carry out off site testing.
- Carry out a field trial to comprehensively review the new solution in a live gas environment.
- Carry out a detailed cost benefit analysis for field trials.
- Provide relevant information to the other Network Licensees.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project are to:

- Consider a criterion relating to development of the product as well as practices.
- Develop operational practices to support the replacement of corroded bolts on 1" Starline/Marwin valves whilst pressurised.
- Identify the extent to which bolt replacement using the new Method minimises the impact and loss of supply to the network.
- Produce and disseminate learning around the expected cost and time reductions.

In order to determine whether this project has been successful or not at various stages, the project must progress through a number of stage gate milestones. SGN's Project Manager will evaluate the performance against the requirements before approving progress to the next stage.

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 replacing bolts on 1" Starlin/Marwin valves.
- Understanding of the costs and benefits of the method and product.
- Whether the methodology has the potential to be adapted to suit other sizes of ball valves.
- Whether the methodology has the potential to be adapted to suit other types of valves.

Scale of Project

The project involves testing and designing a prototype in a laboratory followed by one field trial on a site in Scotland. 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.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The laboratory testing will take place in DNV GL's Spadeadam testing facility in Cumbria. The field trial will take place at a suitable site location in Scotland. This is yet to be identified.

Revenue Allowed for the RIIO Settlement

While no savings on this expenditure are expected during project implementation, there is potential for this technology, if proved successful, to result in considerable future savings during RIIO-GD1 in the capital and operational costs associated with Starline/Marwin valve bolt replacement, while improving asset integrity.

Indicative Total NIA Project Expenditure

The total project expenditure is £64,660, 90% of which is allowable NIA expenditure (£58,194).

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)

In addition to the operational and safety benefits of this project, the development of this product has the potential to deliver substantial financial benefits. The current partial solution requires a bespoke casing to be designed and fitted to each valve in order to prevent further corrosion. The cost of this is around £10,000 per valve. The high cost is due to the need for a bespoke design for each valve; this also means there is a 2 month lead time for each casing ordered. This project aims to develop a full replacement solution which could potentially reduce this cost by around 50%. However, it is difficult to accurately quantify the actual financial benefit at this stage; as indicated by the low start TRL shows the Method is at an early stage of development, cost estimates will be refined as it is further developed

Please provide a calculation of the expected benefits the Solution

Base case costs: £10,000 per valve – design, manufacture and fitting of bespoke casing

Method costs: £5,000 per valve – full replacement solution, including fitting

Therefore; £10,000-£5,000 = £5,000 (Benefit Estimation for Development) per valve.

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

There are five sites in SGN's Scotland license areas which have 1" Starline/Marwin valves. Each site has around 60 of these valves (300 total); two thirds of which are in critical locations and cannot be replaced by stream isolation. Out of the 200 valves in critical locations, it is estimated that some 50% of these valves are corroded and require replacement. Consequently, this leaves a total of 100 valves which cannot be replaced by conventional methods. Furthermore, it is envisaged that there are a similar number across SGN's Southern licence area.

Similar to SGN, the other Network Licensees have not specifically identified an allowance for valve bolt replacement in their RIIO-GD1 proposals, however it is likely that the other networks have a proportion of these valves that are corroding and requiring replacement. If not, the learning from this project may still
provide a methodology which could be applied to other valve sizes and/or types. Therefore, this project does have the potential to be rolled out across GB and provide future savings in the capital and operational costs associated with valve replacement, while improving asset integrity.

It must be noted that these figures and assumptions are based on averages and estimates rather than real network data and the nature of valve replacement across all Network Licensees and sites 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 design, build and test a new technology solution and understand the potential benefits.

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

As the number of 1" Starline/Marwin valves is unknown across GB it is difficult to determine the exact roll out costs. Only the anticipated SGN roll out can be determined. It is estimated that there are some 100 1" Starline/Marwin valves in SGN which could potentially have their bolts replaced using the solution developed by this project in the next price control review. The cost of purchasing and installing this innovative solution is unknown at this stage but it is initially estimated to be around £5,000 per valve. On this basis, it is assumed that it would cost around £0.5m to implement the technology during RIIO-GD1 as opposed to using current partial solution, which would be in the region of £1m.

There will be costs associated with sharing the results and learning of this project. SGN will continue to share project progress throughout the duration of the project with the other Network Licensees.

Upon successful completion, Network Licensees will make a decision on whether to implement this solution throughout their organizations. Excluding the cost of purchasing the equipment, it is anticipated that the only foreseeable costs will revolve around the training costs for operatives. At present it is unclear as to how many operatives will be trained and how Licensees would choose to deliver training.. More accurate quantification of roll out costs will be possible if the TRL of the Method is advanced.

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 learning from this project will benefit Network Licensees who currently have 1" Starline/Marwin valves on their network. If the project leads to successful development of a more cost effective and less disruptive solution to the problem of replacing corroded bolts, other Network Licensees will be able to use the learning generated to embed this new solution in their businesses, This will enable cost reductions and improvements to customer experience by reducing disruption and the time which customers are without a gas supply. In addition, learning about the Method's potential to be scaled up and adapted to other valve sizes and potentially other types of valves will enable Network Licensees to take decisions about investment in further development.

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 and current NIA projects has been performed and no similar projects have been identified. A similar review of current academic literature has also been performed to avoid replicating previous work.

SGN have also engaged with the project supplier and the supplier has 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