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

Aug 2018

Project Reference Number

NIA_NGGT0136

Project Registration

Project Title

Destructive Testing of Set-In and Set-on Nozzle connection welds

Project Reference Number

NIA_NGGT0136

Project Licensee(s)

National Gas Transmission PLC

Project Start

August 2018

Project Duration

0 years and 5 months

Nominated Project Contact(s)

Alan Kirkham

Project Budget

£123,516.00

Summary

The objective of the project will be to determine that with the selection of a suitable non-destructive ultrasonic system and using suitably controlled techniques, it is possible to detect defects within the set-in and set-on nozzle connections which could be detrimental to the integrity of that weld.

Preceding Projects

NIA_NGGT0117 - NDT of Welds by Ultrasonic Techniques

Third Party Collaborators

Eddyfi UK Limited

Phoenix Inspection Systems Limited

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Set-in and set-on nozzles connections are two similar, yet subtly different techniques of attaching smaller bore pipework to the main pipe. This pipework could be used to attach a pressure transducer probe for example.

Historically when carrying out Set-in and Set-on nozzle connections, the weld connecting the nozzle to the carrier pipe will only have been inspected for indications of surface breaking and will not have been inspected for defects within the weld metal due to the limitations of traditional Non-Destructive Testing (NDT) methods.

Currently, all other pressure containing welds on the National Transmission System (NTS) are tested for internal and external defects during construction. With the advances in modern ultrasonic testing techniques, there is the opportunity to explore the potential to inspect the nozzle connection welds for defects which could potentially occur within the weld metal itself, known as weld volume defects. These typically indicate a lack of weld fusion or weld inclusion anomalies.

This project will investigate if recent advances in Manual Phased Array Non-Destructive testing, along with a dedicated probe manipulator, can be utilised to locate weld defects by developing a suitable test weld that can then be used to show whether the subsequent techniques are capable of finding the relevant defects.

Method(s)

Using recently developed Non-Destructive manual phased array ultrasonic equipment and probe manipulators, the project will determine whether it is possible to carry out an inspection of set-on and set-in nozzle to pipeline connections.

To enable the project to demonstrate that the defects can be located within the welds using the previously mentioned non-destructive testing technique, the following steps will be carried out:

- Pipeline Maintenance Centre (PMC) will produce several suitable test welds which adequately represent the welds used for attaching nozzle connections to the main pipe, mimicking live NTS pipework.
- The welds will then have artificial defects applied to them, for example a drill hole.
- Controlled inspections will be carried out of the test welds to determine if the artificial defects introduced can be detected, and their size and position determined accurately using a manual ultrasonic technique and the more advanced manual phased array system.
- Produce a detailed report with the information captured from the trial.

Scope

Set-in and set-on nozzle weld connections are the only welds left on the National Transmission System (NTS) that National Grid do not currently have the capability to inspect for internal defects. Currently the inspectors can only check for surface breaking indications which does not give an accurate analysis of the quality of that weld.

Through two previous NIA projects relating to weld inspection technology, National Grid has been able to significantly enhance the suite of NDT techniques available to inspect pipeline welds. This project aims to investigate and prove whether these recent developments in weld inspection technology gives National Grid the ability to inspect the nozzle connection welds, which was not previously possible due to the complex geometry of the connection. This will then subsequently allow National Grid to fully complete this suite of weld inspection tools allowing National Grid to inspect every kind of weld variation on the NTS.

Objective(s)

The objective of the project will be to determine the selection of a suitable non-destructive testing technique that makes it possible to detect defects within the set-in and set-on nozzle connections, which could be detrimental to the integrity of the welds.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will inform the debate concerning the suitability of the latest ultrasonic techniques for weld integrity assessments. The success criteria will be that if following the programme suitable equipment is identified, National Grid will be able to integrate this technology for inspection of welds associated with connection operations.

This would require a change within the requirements of the current National Grid specification for welding of steel land pipelines designed to operate at pressures greater than 7 bar (supplementary to BS 4515-1: 2009), T/SP/P/8 (Welding of steel onshore natural gas installations designed to operate at pressures greater than 7 bar) and T/SP/NDT/2 (Specification for non-destructive testing of welded joints in steel pipelines and pipework).

Project Partners and External Funding

Project Partners:
Pipeline Maintenance Centre (PMC)
Phoenix Inspection Systems Limited (Supplier)
M2M (Supplier)

Potential for New Learning

This work will provide important infield experience to show that it is possible to inspect the welds using the latest ultrasonic non-destructive techniques. The results generated can then determine the quality of the welding and whether the weld contains any defects that would potential cause the weld to fail.

The outcomes of the project will be published on the Energy Network Associations' (ENA) Smarter Networks Portal and the results

presented at the Welding Institute and The British Institute of NDT forums.

If the investigation ultimately proves successful, knowledge dissemination presentations will be conducted using the likes of the Institute of Gas Engineers and Managers and paper evenings.

Scale of Project

If this investigation is successful, the use of phased array equipment can be utilised for set-in and set-on nozzle connections. It could be used by all UK Gas Transmission and Distribution companies on future in service inspection and construction projects.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

If fully successful, this technique could be employed across all the UK for gas transmission and distribution nozzle connection operations.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

£123,516

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)

£39,825/year.

Please provide a calculation of the expected benefits the Solution

This projected use of this NDT methodology is 30 sites per annum.

The difficulty of performing NDT inspections of nozzle connection welding tends to necessitate the use of site radiography. This is a more expensive and risky option than ultrasonic testing.

The use of conventional NDT ultrasonic phased array equipment is projected to be £250/day.
The cost of an uninspected weld failing could be significant. The cost of removing nozzles due to unknown quality is approximately £10,000.

Current Method:
Test Costs: Hydrostatic Testing (£700/site/day) + Site Support (£877.50/day) = £1577.50/day
Base Cost : £47,325/year

Proposed Method:
Ultrasonic Equipment Cost :£250/site/day (inclusive of labour)
Method Cost: £7,500

Financial Benefit:
Projected Savings/year (Base – Method) = £39,825/year

It should be noted that any failure of a weld under hydrostatic testing would incur significant remedial costs which would vary on a site/weld location basis. Ultrasonic testing would give a very effective weld assessment technique.

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

The use of conventional ultrasonic NDT test equipment would be easily deployed across the network. Incorporating the necessity of the ultrasonic testing into the National Grid Standards and Specifications suite would ensure a consistent approach to the on-going assessment of the connection welds. These updated standards will be shared with gas distribution networks which could facilitate a country-wide roll-out.

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

The cost of deployment will be dependent on the choice of suitable NDT equipment, in line with the National Grid specifications and the method of use (direct hire or purchase).

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

If the technology is proved viable, the learning could be used by all gas transmission and distribution operators to provide confidence that the welds produced are free from defects that could prevent the asset operating in a safe manner.

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.

This programme builds on the earlier ultrasonic review conducted under NGGT (NIA_NGGT0093 and NIA_NGGT0117). No other innovation programmes have been registered in employing the techniques and equipment to be evaluated in this programme.

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

The project is innovative as this ultrasonic non-destructive testing technique has not been investigated for its effective use on the complex geometries involved for nozzle connection welds. It has not been trialled on any gas site before due to the technology involved not being as accurate or as developed as it is now.

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

The effectiveness of this method of NDT has not been proven for set-in and set-on nozzle welds, mainly due to the complex geometries involved with this type of connection. To make a viable business decision as to whether this NDT method is effective for the welds in question, a trial is required and evidence will need to be provided; this is the aim of this programme. The use of the NIA framework will mitigate the financial risk to the business of this unproven application and will ensure the results are available to all stakeholders.

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

NGGT operates under a comprehensive standards framework. The latest advances of innovative non-destructive techniques (NDT) analysis equipment offer considerable benefit to the NGGT and other network operators if their capabilities are proven. However due to the lag in standards development, new NDT equipment may not be compatible with the standards as written and hence their use is restricted. A full capability assessment requires a dedicated programme of evaluation by the relevant technical experts. Innovation funding provides a robust framework that enables these assessments to be undertaken and ensures that all the necessary updating of procedures and standards are captured and approved decreasing the business implementation time. Innovation funding ensures the dissemination of the generic findings are communicated to all networks which improves efficiency and ensures that relevant proven equipment is readily deployed.

This project has been approved by a senior member of staff

☑ Yes