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

Sep 2017

Project Reference Number

NIA_NGGT0117

Project Registration

Project Title

NDT of Welds by Ultrasonic Techniques

Project Reference Number

NIA_NGGT0117

Project Licensee(s)

National Gas Transmission PLC

Project Start

August 2017

Project Duration

0 years and 8 months

Nominated Project Contact(s)

Alan Kirkham; box.GT.Innovation@nationalgrid.com

Project Budget

£82,231.00

Summary

To enable the project to demonstrate that the defects can be located within the welds of interest the initial work will be to design and produce suitable test blocks which adequately represent the circumferential welds within the hot tap operation. Once the test blocks have been manufactured and artificial defects introduced, the next stage will be to carry out controlled inspections on the test blocks to determine if the artificial defects introduced can be detected and the size and position determined accurately using a manual ultrasonic technique and the more advanced manual phased array system.

Preceding Projects

NIA_NGGT0046 - Manual Phased Array for small diameter offtake weld inspection.

Third Party Collaborators

Olympus Inspection Solutions

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Historically in hot tap pipe connections, because of the limitations with the traditional Non Destructive Testing (NDT) methods the circumferential weld connecting a hot tap Fitting to the carrier pipe have not been inspected for defects within the weld metal but only visually inspected for surface breaking indications. This is at variance to all other pressure containing welds on the Transmission network which are tested for internal and external defects during construction.
As currently, the only NDT testing carried out is limited to surface inspection of the weld cap, with the advances in modern phased

array ultrasonic testing techniques, it should now be possible to inspect these welds for defects which 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 build on previous innovation work (NIA_NGGT0046) to provide definitive evidence that recent advances in Manual Phased Array (MPA) Non-Destructive equipment can be utilised to locate weld defects by developing a suitable test block that can then be used to show whether the subsequent techniques are capable of finding the relevant in weld defects.

Method(s)

Using recently developed Non Destructive manual phased array ultrasonic examination methods and equipment to determine whether it is possible to carry out an inspection of the circumferential fitting to pipe weld produced during hot tap (welded) pipe connections.

December 2017 Update
After initial evaluation and further engagement with the MPA equipment supplier, it has been established that additional probes and software are required to fully establish that the widest range of weld defects can be identified.
The additional equipment requirement is as follows:

- A scanner frame to be able to hold the probes when scanning
- An additional probe which is capable of scanning the whole weld in one pass
- Specialist software to enable the scanning pattern to be determined and then the results analysed

This change control will also incorporate additional time to perform the necessary evaluation of the upgraded MPA system.

Scope

To enable the project to demonstrate that the defects can be located within the welds of interest the initial work will be to design and produce suitable test blocks which adequately represent the circumferential welds within the hot tap operation. Once the test blocks have been manufactured and artificial defects introduced, the next stage will be to carry out controlled inspections on the test blocks to determine if the artificial defects introduced can be detected and the size and position determined accurately using a manual ultrasonic technique and the more advanced manual phased array system.

Objective(s)

The objective of the project will be to determine that with the selection of a suitable non-destructive ultrasonic system and using suitably controlled technique that it is possible to detect defects within the circumferential weld of hot tap operations which could be detrimental to the integrity of that weld.

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 if following the work suitable equipment, National Grid will be able to integrate their use for inspection of the circumferential welds on hot tap operations for detecting weld defects.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

If this investigation is successful the use of phased array can be utilised on hot tap 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 UK Gas Transmission and Distribution Hot Tap operations.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

Current scope of the project the total project cost is estimated at £66,370 covered by NIA funding.

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)

The estimated savings by employing manual phased array ultrasonic techniques would be £300,000 over a 20 year period based on the implementation of the technique across the network.

Please provide a calculation of the expected benefits the Solution

The existing NDT method is to prove all (100%) of all welds by visual inspection followed by hydrotesting. If the projected new weld failure rate is 0.165% (1 failure in 20 years) under hydrotest conditions which could occur due to the lack of suitable NDT inspection, the cost of remediation is estimated to be £450,000. This Base Cost is inclusive of incident investigation, structural integrity assessment, repair(s) to structure, recertification of weld process, re-welding and hydrotest following initial weld failure.
The deployment of the NDT Ultrasonic weld assessment technique is an additional stage to the existing visual inspection/hydrotest method and is intended to prevent (expensive) weld failure under hydrotest conditions.
This equates to an Annual Method Cost: £7,500 based on the Ultrasonic Equipment Cost of £250/site/day (inclusive of labour) for a projected use at 30 sites/annum.
Financial Benefit:
Base Cost – Annual Method Cost x 20 = £450,000 - £150,000 = £300,000
The programme will give in-field asset condition confidence which could be rolled out for the examination other fitting geometries.

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 hot tap welds.

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

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 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 manor.

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

The project will enable National Grid to demonstrate that where possible all areas of potential failure are being inspected and checked to prevent a failure during commissioning of during operation.

☑ 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