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

Jan 2014

Project Reference Number

NIA_NGGT0015

Project Registration

Project Title

The Need for Pressure De-rating Prior To In-Service Welding

Project Reference Number

NIA_NGGT0015

Project Licensee(s)

National Gas Transmission PLC

Project Start

October 2012

Project Duration

1 year and 8 months

Nominated Project Contact(s)

Joanne Harris

Project Budget

£85,000.00

Summary

The expected design pressure was limited to 70 barG with a specified maximum yield stress (SMYS) of 72%. Now National Grid have pipelines that may operate up to 80% of SMYS and pressures for some pipelines have increased to a maximum of 94 barG. To quantify the current specified safety factors, additional analysis, using the latest modelling techniques, is required to ensure that the mechanistic behaviour of the welding of hot-tap connections is better quantified and incorporated in best practice.

Third Party Collaborators

BMT Fleet

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

In service welding is a common maintenance and installation connection practice, generating economic and environmental benefits by not removing pipelines from service. The relevant National Grid standard (T/SP/P/9) specifies that during the welding operation(s), pipeline pressures are “to be reduced to the minimum practicable”.

This programme is a benchmarking study, which looks to address whether elements of this procedure should be amended in light of material and technological developments over the past 20 years.

Method(s)

The de-rating assessment will be performed covering the following topic areas:

- The scope of the P/9 standard will be reviewed to determine the underlying assumptions.
- Other published standards such as BS 6990 and EEMUA 185 will be reviewed.
- Previous studies on hot tap welding and pipeline repair by local deposition of weld metal such as those carried out for the Pipeline Research Council International (PRCI) and the Australian Pipeline Industry
- Association will be reviewed to determine likely temperature distributions during welding under these operations.
- BMT Fleet Technology's industry standard hydrogen diffusion modelling tool will be utilised to study a range of bead on plate and weld geometries to generate typical thermal histories.
- Data on the variation of material properties with temperature will be collected for typical pipeline steels.
- Using these properties and the calculated temperatures, the extent of the softened area and the possible strength reduction will be estimated.
- High temperature tensile testing to confirm material property assumptions.
- Metallography examination of welded specimen cross-section to determine molten metal penetration depth. Results will be used to determine the load bearing pipe wall thickness during welding.
- Results from high temperature tensile testing data and metallography examination will be used in FE analysis to determine whether pressure de-rating during P9 is required for this selected pipe diameters and wall thicknesses.
- The review and the numerical results will be analysed to determine whether P9 should be amended to include pressure reductions when hot tap welding on National Grid transmission or distribution pipelines.

The results will form the basis determining derating magnitudes and implementation of these within the current National Grid T/SP/P/9 standard.

Scope

The expected design pressure was limited to 70 barG with a specified maximum yield stress (SMYS) of 72%. Now National Grid have pipelines that may operate up to 80% of SMYS and pressures for some pipelines have increased to a maximum of 94 barG. To quantify the current specified safety factors, additional analysis, using the latest modelling techniques, is required to ensure that the mechanistic behaviour of the welding of hot-tap connections is better quantified and incorporated in best practice.

Objective(s)

This project to aims to confirm whether hot-tap welding to pipelines operating at pressures above 70 bar can be carried out:

- With a sufficient margin of safety to prevent loss of material strength.
- Minimising consequent 'local bulging' due to the effect of high pipe wall temperatures and the internal gas pressure acting upon the pipe wall.
- Ensuring that considerations of the volume of product flow or 'gas flow rate' are quantified as this has a significant affect on the rate of heating or cooling of the pipe wall during such an operation.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The programme will provide a better understanding of the mechanical behaviour of pipe sections under the circumstances of hot tap welding operations which will either:

- Confirm the existing safety margins already specified in the relevant National Grid standard T/SP/P/9 are appropriate.
- Will provide supporting evidence to be incorporated in an updated T/SP/P/9 standard.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The programme will give assurance that the relevant National Grid standards will correctly determine the safety margins for hot tap welding operations.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

These standards documents provide the safety, legislative and operational framework for the National Transmission System (NTS) in the UK.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

IFI - £45k
NIA - £40k

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 principle driver in this case is 'safety'. This has the potential to avoid loss of life, remedial costs, shipper penalties and loss of company reputation in the event of a pipeline failure while carrying out in-service pipeline welding.

Hot tap welding is carried out approximately five times per year on the NTS. The operations involve pressure reductions resulting in costs which can be as high as £0.5m/day. A better understanding of the required pressure reductions for hot tap welding operations will minimize the exposure to these buy back costs.

There is a business benefit in establishing whether these three procedures, T/SP/P/9, BS 6990 and EEMUA 185 are consistent and appropriate for current National Grid operations.

Please provide a calculation of the expected benefits the Solution

Base cost: £500k
Method cost: £68k

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

The programme results and any subsequent updating of standards will be generic across National Grid.

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

No additional implementation costs are envisaged as the programme results will be articulated through the National Grid standard T/SP/P/9.

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 programme will clarify the methodology to determine the safety margins required for hot tap welding operations.

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

Reliability: The programme will offers considerable benefits in terms of asset modification improving the ability of the National Grid undertake this work effectively and efficiently.

Safety/Strategic: The ability to perform welding operations without the need to impose significant pressure reductions on the network offers efficiency benefits. The increase in mechanistic data will improve safety margins for these operations.

☑ 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

- [x] Yes