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_NGGT0019

Project Registration

Project Title

Toughness of Fittings

Project Reference Number

NIA_NGGT0019

Project Licensee(s)

National Gas Transmission PLC

Project Start

February 2013

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Julian Barnett
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Project Budget

£100,000.00

Summary

Much of the initial assessment of worst case environmental temperature effects on material toughness was carried out by the Welding Institute for application to pressure vessels. Much of this work formed the basis of the subsequent pressure vessel codes. Since that time, there has been an increased understanding of the effect of Joule Thomson (JT) cooling due to pressure reduction during routine and non-routine pipeline operations. To incorporate this latest thinking it is necessary to take account of the transient heat transfer from the pipeline and fittings to obtain a more realistic understanding of minimum temperatures to which they may be subjected.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

The existing suite of National Grid specifications for the toughness of fittings for use on natural gas pipelines specify the temperature at which material toughness tests are to be carried out. The material toughness test temperature needs to be related to the minimum temperature which may be experienced in service.

Historically, the minimum temperature was defined according to low environmental temperatures which may occur at above ground installations. Anomalies arise in the specification of this minimum service temperature, its relationship with the minimum design temperature and the defined material test temperature. Clarification of these temperature inter relationships will improve design and material selection.

Method(s)

Deliverables will include:

- Preparation of a list of pipeline fittings and definitions of the range of operational conditions (pressure and temperature) the fitting may be exposed to under the range of conditions which could occur during commissioning and routine and non-routine operations.
- Review background to the speciation of toughness requirements in existing fitting specifications. Attention will be given to the minimum specified design and test temperatures for each type of fitting and the basis of the specified values, and a comparison with the range of operating conditions.
- Conducting a series of thermal analyses to investigate the material temperatures and the associated stresses which could occur due to Joule Thomson cooling under each condition for various fitting types. This work will include comparison with the results of recent tests at GL Noble Denton Spadeadam using carbon dioxide (CO2).
- Assessment of the influence of warm pre-stressing.
- Defining of any further work required to extend the existing toughness requirements for fittings in natural gas pipelines to CO2 pipelines

Scope

Much of the initial assessment of worst case environmental temperature effects on material toughness was carried out by the Welding Institute for application to pressure vessels. Much of this work formed the basis of the subsequent pressure vessel codes. Since that time, there has been an increased understanding of the effect of Joule Thomson (JT) cooling due to pressure reduction during routine and non-routine pipeline operations. To incorporate this latest thinking it is necessary to take account of the transient heat transfer from the pipeline and fittings to obtain a more realistic understanding of minimum temperatures to which they may be subjected.

Objective(s)

The aim of this programme of work is to carry out the research necessary to investigate and develop a generic methodology which builds on and extends existing methodology. The intent is to demonstrate that a fit for purpose material selection process has been adopted encompassing the latest thinking and techniques.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The programme will define a clear and consistent rationale for specifying the temperature and toughness requirements for pipeline fittings.

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 in service temperature of components resulting in the correct material selection.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

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 - £14k
NIA - £86k

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 use of redundant UK transmission asset base in the CCS will offer considerable savings to these transmission and storage techniques.

The current requirement to take account of the impact of JT cooling on the minimum temperatures which may occur in pipelines and fittings under routine and non-routine operations is likely to require the specification of material for low temperature conditions, which will add to construction project costs. The cost of low temperature fittings is typically a factor of between 2 and 4 times greater than the cost of carbon steel fittings (depending upon size and type). The above scope of work will define a clear and consistent rationale for specifying the temperature and toughness requirements for pipeline fittings which will avoid or justify the need to apply the onerous assumption that the fittings must operate at the low JT temperatures.

Please provide a calculation of the expected benefits the Solution

N/A – Research (TRL 3)

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

The improved material properties understanding resulting from the programme 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 will be providing baseline material data.

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 determination of component service temperature methodologies for pipeline components. As the initial work is research based, quantification of savings can not be predicted until later stage.

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 reuse under differing operating conditions (Carbon Capture & Storage).

Strategic: The analysis will have improve the knowledge base of the behaviour of pipeline steels improving their on going maintenance and integrity.

☑ 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