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 2024

Project Reference Number

NIA_SGN0049

Project Registration

Project Title

Thermoplastic liners for Transmission Feasibility

Project Reference Number

NIA_SGN0049

Project Licensee(s)

SGN

Project Start

February 2024

Project Duration

0 years and 4 months

Nominated Project Contact(s)

James Heywood

Project Budget

£36,533.00

Summary

The aim of the project is to complete a literature review and a technical design assessment to ascertain if existing pipe lining technology could be used in SGN's LTS network to safely transport hydrogen blends up to 100%. Internal lining technology has been underexploited in the past within onshore gas transportation. This is because permeation through the lining materials into the annular space can cause the liner to collapse. This would be more prevalent due to the properties of hydrogen. Several venting solutions have been attempted but are not suitable when transporting hydrogen. The future strategy of this project to the GB gas network will be to develop lining technology as a viable solution to extend the life of existing assets where the current material is not suitable to transport hydrogen.

Third Party Collaborators

Die Draw

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

SGN is currently exploring opportunities to build a green future and start working with hydrogen in blends up to 100%, in order to start working towards that future. One of the issues is that hydrogen permeates traditional materials that are used in underground assets and can cause embrittlement of steel, resulting in potential damage to the pipelines and compromised asset integrity. This project proposes to apply the experience of DieDraw regarding their thermoplastic lining technology and determine if it could be used in hydrogen transportation applications for the LTS network.

DieDdraw has been installing thermoplastic liners since the late 1980s as a means of corrosion protection for metallic pipes. The liner materials used have usually but not exclusively be PE 80 (MPDE) and PE 100 (HDPE), though other thermoplastic pipe materials

have been trialled and occasionally installed. This modification makes it ideal for hydrogen transportation as it mitigates to the issues around hydrogen embrittlement of some current steel pipelines.

Thermoplastic liners would extend asset life and could enable the repurposing of unsuitable assets, providing a long-term solution for delivering large quantities of gaseous hydrogen.

Method(s)

The feasibility study will look to address a series of details regarding the use of thermoplastic liners that will ultimately provide confidence in the solution. The projects' focus will be to examine the technical background, previous applications of the technology in other industries and risks specific to operations in the gas industry and will be completed with the delivery of the following:

A literature review that covers:

- Project background
- Historical use of PE 100 pipes for gas service
- Important test requirements for PE 100 gas pipes
- Experience of liners for high pressure gas
- Risk of buckling collapse
- Venting of gas
- End terminations and fittings
- Liner design basis
- Suitability and compatibility of liner pipe material for hydrogen use
- Gas constituents and partial pressures
- Liner time and temperature dependent materials properties
- Permeability coefficients for gaseous species through PE 100 pipe.

A technical design assessment

- Liner collapse condition and equation(s)

Description of the collapse condition and selection of appropriate equation.

- Assessment of annular volumetric space between liner and steel host
- Diffusion of gaseous species through the liner
- Calculation for time and temperature dependent volumetric liner collapse

The quantity of gas transported by permeation through the wall of high-pressure hydrogen liners under various operating conditions.

- Technical assessment of current suitability of PE 100 liners for hydrogen use
- Conclusions and further development work required.

Scope

The scope of work includes reviewing the project background, including historical use of the technology, risks involved and the suitability of the solution for transporting hydrogen. From this literature review, a gas diffusion assessment will be undertaken, and recommendations will be provided regarding further development work that needs to be completed.

Objective(s)

The objective is to develop a study on the suitability of a PE 100 liner for repurposing pipeline to use with hydrogen blends. Die Draw has been able to provide confidence that their PE lining would be impermeable to hydrogen, proving suitable for pipes carrying

hydrogen blends.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

NA

Success Criteria

Deliver the following:

- Provide a detailed analysis of current history of the solution and the anticipated risks when applied to the gas industry and in particular, the expected techniques that must be used when dealing with hydrogen blends.
- Technical design assessment
- Potential next steps in regard to small scale testing

Project Partners and External Funding

Die Draw Ltd

Potential for New Learning

Although this solution has been successfully deployed in the oil and water industries, it hasn't been utilised in the gas industry before. Thus, it will provide methods of integration of new technology into the GB pipeline system, as well as delivering a better understanding of the methodology to develop new pipelines to operate with blends of hydrogen up to 100%.

Scale of Project

Thermoplastic lining has the opportunity to be a feasible long-term solution for repurposing existing assets to transport and store hydrogen blends. Proving its feasibility as a solution in the gas network could impact the wider GB network.

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL2 Invention and Research

Geographical Area

Not applicable- desktop exercise

Revenue Allowed for the RIIO Settlement

£36,533

Indicative Total NIA Project Expenditure

External: £27,400

Internal: £9,133

Total: £36,533

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:

Thermoplastic lining could provide a solution that extends the life of assets that have deemed as unsuitable for operation with hydrogen. The project could also help identify suitably impermeable lining materials.

How the Project has potential to benefit consumer in vulnerable situations:

The project will help facilitate safe pipeline operation and deployment of hydrogen for consumers, fulfilling their needs. It will also provide an environmental benefit, by reducing the length of pipeline that will have to be excavated and replaced through repurposing of existing assets.

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)

NA

Please provide a calculation of the expected benefits the Solution

NA

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

This method of protecting existing assets could be replicated across all gas networks in GB.

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

Costing for this type of activity is defined on a project-by-project basis. This is because the variables including types of steel and blends using hydrogen, as well as the extent of new pipelines being implemented will determine the overall cost of each project

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

- ☐ 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 project will provide unique and referenceable information for Network licensees and Industry on transmission pipelines with 100% hydrogen. It is a solution that has been successfully deployed in the oil and water industries but never fully applied to the gas industry in the capacity of facilitating the transmission of hydrogen blends in the network

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

Not applicable

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.

There is currently no framework for the application of this technology in the gas industry in Great Britain. The findings of this project will be shared with all the key stakeholders

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

NA

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

This technology has been under-exploited in high pressure gas transportation. This project seeks to find an appropriate solution to mitigating hydrogen diffusion when it is transported by existing assets. Should this technology be developed, it would prove key to developing liners for high pressure hydrogen transportation.

Relevant Foreground IPR

Die Draw Ltd will consider any new findings from the Project as potential IPR. Any outputs that could fall under this category will be provided under standard NIA terms and conditions

Data Access Details

NA

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

This project isn't being funded as business as usual because it is deemed an essential part of the 100% hydrogen trials process which is a key step towards conversion of the existing gas network to 100% hydrogen.

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

The conversion of the GB gas network to 100% hydrogen is key on the road towards net zero. A reliable supply and the assurance of safe operations for workers and the public are crucial to support the viability of the hydrogen transition. The NIA framework can support works that ensure results that play an essential part in the roll-out of hydrogen.

This project has been approved by a senior member of staff

☑ Yes