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 2023

Project Reference Number

NIA_NGN_425

Project Registration

Project Title

Hydrogen compatibility of components - Phase 2: Further analysis

Project Reference Number

NIA_NGN_425

Project Licensee(s)

Northern Gas Networks

Project Start

August 2023

Project Duration

1 year and 3 months

Nominated Project Contact(s)

cblanco@northerngas.co.uk - Camila Blanco

Project Budget

£126,841.00

Summary

The output of NIA_NGN_276 highlighted a range of materials that, through assessment of relevant literature, have been categorised as having a high potential for degradation in hydrogen, rendering the asset assembly unsuitable for use with hydrogen without further mitigation. The assessment of materials utilised an assumption-based approach that classified a material as unsuitable due to a lack of literature, or possible variance in actual operation between literature and physical networks operating parameters.
A number of the materials highlighted are prevalent on existing gas infrastructure. The aim of this project is to undertake follow-up review of the outputs and results from the subsequent network assessments, including recommendations to undertake further evaluation of materials of construction, risk mitigation options and propose a testing plan for certain materials.

Third Party Collaborators

HSE Science Division

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

The output of NIA_NGN_276; suitability of components, highlighted a range of materials that, through assessment of relevant literature, have been categorised as having a high potential for degradation in hydrogen, rendering the asset assembly unsuitable for use with hydrogen without further mitigation. The assessment of materials utilised an assumption-based approach that classified a material as unsuitable due to a lack of literature, or possible variance in actual operation between literature and physical networks operating parameters. A number of the materials highlighted are prevalent on existing gas infrastructure and could pose a risk going forward with conversion of wider aspects of the gas distribution networks.

Method(s)

The project will be delivered through the below 7 Work Packages:

WP1: Review of NGN NIA 276 assessment outcomes

· Obtain individual assessments which failed the assessments from NGN

· Review inputs of each

· Assess materials rating for each component in the asset assembly which fails the assessment

· Collate an initial list of prioritised failed components and materials

· Sensitivity study for evaluation in natural gas (e.g. known and specific locations; location; failure history) and for component in hydrogen (Load level; consequence level)

· Evaluate any components which contribute to asset assembly failure due to the material failing the secondary gas-facing criterion

♦ D0: Prioritised list of failed materials

♦ D1: overview of sensitivity study and effect of key variables on pass/fail criteria

WP2: Review of Materials literature and rating system

· Focus on materials scoring with a high degradation level, and identified in for example in Table 1 above. These are also listed under the 'red list' in the NIA 276 reports

· Re-visit the underlying data sources such as gas pressure, test conditions, etc and confirm initial materials rating assessment

· Limited literature search for newly arising data for susceptible network materials in representative hydrogen environments

· Discussion with network operators to better understand the use of trade-name sealants and their characterisation according to relevant standards

♦ D2: Update of materials degradation scoring if additional / new exists to enable this

WP3: Workshop on Loading and Consequence

· Better understand the loadings applied to different components within families of identified asset assemblies in conjunction with NGN

· Case studies on loading conditions across a range of components, also including a workshop with NGN

· Review the consequence classes and their appropriateness in a workshop environment with NGN

♦ D3: Update of loading conditions and consequence classes where the data permits this

WP4: Experience from other industries

· Identify other industries utilising materials in a gaseous hydrogen environment

· Establish contacts and question set

· Information from industry on experience of range of materials in hydrogen

WP5: Identification of improvements to method

· Improvements in the natural gas scoring

· Improvements in the hydrogen scoring

· Re-evaluate selected case studies from NGN set of assessments

WP6: Testing plan for susceptible materials

· Up to and including 2 bar

· Up to and including 7 bar

· Metals, polymers, elastomers

♦ D4: test plan

WP7: Final report

♦ D5: Summary report

The project is rated low in the common assessment framework detailed in the ENIP document after assessing the total project value, the progression through the TRL levels, the number of project delivery partners and the high level of data assumptions. No additional peer review is required for this project.

In terms of ensuring success, the deliverables from each work package will be reviewed by the steering board and technical experts from within NGN network, where relevant.

An interim report will be provided to the HSE, to ensure it meets their expectations and so that any feedback can be incorporated before project close. Data quality and measurement requirements will be adhered to inline with OFGEM requirements, RIIO2 NIA Governance requirements and those set out within the Energy Networks Innovation Process document.

Scope

- Review of NIA 276 output and identification of unsuitable materials.
- Review of material literature and assessment justifications, with comparison to 'real world' operational requirements.
- Develop recommendations for testing of materials and testing programme (Stage Gate)
- Propose a testing plan for materials to determine suitability of operation at:

o Up and including 2bar

o Up to and including 7bar

- Compile results and final reports, including risk mitigation appraisal and guidance for wider standards development (ie. IGEM)

Objective(s)

WP1: Review of NGN NIA 276 assessment outcomes

· Obtain individual assessments which failed the assessments from NGN

· Review inputs of each

· Assess materials rating for each component in the asset assembly which fails the assessment

· Collate an initial list of prioritised failed components and materials

· Sensitivity study for evaluation in natural gas (e.g. known and specific locations; location; failure history) and for component in hydrogen (Load level; consequence level)

· Evaluate any components which contribute to asset assembly failure due to the material failing the secondary gas-facing criterion

♦ D0: Prioritised list of failed materials

♦ D1: overview of sensitivity study and effect of key variables on pass/fail criteria

WP2: Review of Materials literature and rating system

· Focus on materials scoring with a high degradation level, and identified in for example in Table 1 above. These are also listed under the 'red list' in the NIA 276 reports

· Re-visit the underlying data sources such as gas pressure, test conditions, etc and confirm initial materials rating assessment

· Limited literature search for newly arising data for susceptible network materials in representative hydrogen environments

· Discussion with network operators to better understand the use of trade-name sealants and their characterisation according to relevant standards

♦ D2: Update of materials degradation scoring if additional / new exists to enable this

WP3: Workshop on Loading and Consequence

· Better understand the loadings applied to different components within families of identified asset assemblies in conjunction with NGN

· Case studies on loading conditions across a range of components, also including a workshop with NGN

· Review the consequence classes and their appropriateness in a workshop environment with NGN

♦ D3: Update of loading conditions and consequence classes where the data permits this

WP4: Experience from other industries

· Identify other industries utilising materials in a gaseous hydrogen environment

· Establish contacts and question set

· Information from industry on experience of range of materials in hydrogen

WP5: Identification of improvements to method

· Improvements in the natural gas scoring

· Improvements in the hydrogen scoring

· Re-evaluate selected case studies from NGN set of assessments

WP6: Testing plan for susceptible materials

· Up to and including 2 bar

· Up to and including 7 bar

· Metals, polymers, elastomers

♦ D4: test plan

WP7: Final report

♦ D5: Summary report

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The project will have a positive impact on customers in vulnerable situations by evaluating the suitability of components for distribution of Hydrogen within gas distribution networks. Key benefits for CIVS are outputs from the project confirming suitability of existing components and supporting decarbonisation of the energy networks.

Success Criteria

The project must further ascertain if the incompatible materials within network components are suitable or not for use with 100% hydrogen and make recommendations for further testing/research. The project will be measured successful if an analysis of the incompatible components is both verified and factored into a recommended testing plan.

Project Partners and External Funding

HSE SD – Project Delivery

Northern Gas Networks – Lead Network Partner

Cadent – Network Partner

SGN – Network Partner

WWU – Network Partner

Potential for New Learning

The learning developed will allow for further testing and assurances on material compatibility with 100% Hydrogen.

Scale of Project

This project inputs into the evidence base for future hydrogen trials which will provide critical information applicable to the entire UK gas system when considering conversion to 100% hydrogen incrementally over time.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

Desktop study. Outcomes replicable across all GB GDNs.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Total Project cost = £126,841.00 External Project Cost = £15,855.13 Internal Project Cost = £16,141.38 External Cost = £126,841.00 Cadent £63,420.50 NGN £15,855.13 WWU £16,133.00 SGN £31,710.25 Internal Cost = £16,141.38

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:

The project will further be understanding into material compatibility with 100% hydrogen, in addition to providing the networks with a testing programme to demonstrate evidence of this compatibility on components considered unsuitable.

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)

This project is one of a suite of projects to enable a conversion of the UK gas grid to hydrogen. Repurposing the UK gas networks with hydrogen to support the challenge of the climate change act has the potential to save £46 billion with minimal gas customer disruption verses alternative decarbonisation solutions.

Please provide a calculation of the expected benefits the Solution

N/A – Continued Research from NGN_NIA_276

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

The research and learning undertaken as part of the services testing is applicable to all GDNs within the UK as the networks have the same construct and design parameters and so will assist with future Hydrogen conversion projects.

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

N?A

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

Further investigation is required into the gas network components material compatibility with 100% hydrogen, reviewing the key functionality of critical components, the demands on the materials from which they are constructed and how hydrogen could affect these properties. This learning can be replicable to all Gas distribution networks.

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

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.

As this is following on from a previous project and discussed at various working groups, the project has ensured no other duplicate projects, in terms of scope & deliverables are underway or in planning.

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

There are similar projects in terms of methodology, assessing material compatibility and suitability with 100% Hydrogen at above 7 bar (LTS and NTS), for example work completed under the LTS Futures & FutureGrid programmes.

Additional Governance And Document Upload

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

The previous project built a brand-new assessment methodology to determine the suitability of asset assemblies with 100% Hydrogen. This project will review these assessments that took place, review the current literature and evidence built since phase 1 of the project. Further refining this unique methodology tool to ensure it is fit for use for further assessments and provide sound evidence towards the suitability of its use and determinations. Logic will be reassessed to ensure the tool's assumptions are up to date with current knowledge.

Relevant Foreground IPR

All IPR stays with GDN's and as such no change to exiting market arrangements, the project focussing on no regrets changes and the use of exiting processes / frameworks where possible in order to ensure that financial impacts on customers are kept to a minimum.

Data Access Details

For all data access requests, please follow the guidance set out in NorthernGas Networks Innovation Data Sharing Policy.
https://www.northerngasnetworks.co.uk/ngn-you/the-future/our-funding/

Innovation@northerngas.co.uk

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

This project is in the interests of UK Net Zero Strategy and is not specific to business-as-usual operations of the network with no allowance within regulatory business plans. Whilst the benefits are undeniable there is no guaranteed benefit back to gas customers without regulator and government support– projects associated with 100% hydrogen are at the cutting edge of gas network innovation.

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 project would only be undertaken with support from NIA funding, it is in the interests of gas customers, the regulator and the UK government and realization of any benefits are outside the control of the gas networks. There is no allowance in BAU business plans for this type of work and the commercial benefits and technical/operational risks associated with this type of 100% hydrogen projects are outside the traditional environment of any gas distribution network or its shareholders.

This project has been approved by a senior member of staff

☑ Yes