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

Dec 2023

Project Reference Number

NIA_NGT0227

Project Registration

Project Title

Hydrogen Impact on NTS Valves & Maintenance

Project Reference Number

NIA_NGT0227

Project Licensee(s)

National Gas Transmission PLC

Project Start

December 2023

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Kousseyla Hamadi, box.GT.innovation@nationalgas.com

Project Budget

£765,462.00

Summary

Valves are an essential part of a functioning NTS and are installed throughout the system to enable effective isolation of sections of the network, limit gas loss in an emergency, manage flow direction, facilitate maintenance, repair, modification, testing and commissioning to enable safe and effective start-up and shutdown.

Valves on our network vary in Original Equipment Manufacturer (OEM), age and size and although some are to be incorporated into our FutureGrid facility for testing, three-piece bodied isolation valves are unable to be tested for hydrogen service.

This project will understand the impact of hydrogen on three-piece bodied valves performance and materials, while also considering the repurposing vs refurbishment CBA when compared to replacing all valves with new for hydrogen service.

Preceding Projects

NIA_NGT0211 - Impact of Hydrogen on NTS actuators

Third Party Collaborators

SCORE Group

Mackenzie Transport Services Ltd

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

There is a need to understand the impact of hydrogen on valve performance and internal components materials e.g. sealants for the repurposing NTS safety case evidence to HSE.

At FutureGRID we are testing various types of valves including flow control, slam shut and all -welded solation valves. However, we are not investigating the hydrogen impact on three-piece bolted body isolation valves which could be refurbished and reutilised on the NTS without scraping.

Approx 8000 three-piece bodied type isolation valve are operational on the NTS, 24% of isolation valves on the NTS. We have yet to map this specific valve type for valve manufacturer, age and size to identify opportunities for repurposing and refurbishment.

Internal databases have extensive data gaps in relation to granular valve data that need to be identified. However, to do a full NTS valve analysis on > 33,000 assets would be too labour intensive. This will need to be explored via a phased approach following on from this project. Hence, why this project focuses on only three-piece bodied valve types that are eligible for refurbishment.

Method(s)

The project will include an assessment of the impact of hydrogen on three-piece bodied isolation valves and OEMs on the NTS with hydrogen service to include the equipment performance and material impact.

The project will result in a technical report summarising the work undertaken and the outputs including business case and cost benefit analysis.

Measurement Quality Statement

The measurement approach used to meet Data Quality objectives will be through the identification of high calibre project partners who are experts in their given field. The methodology used in this project will be subject to our supplier's own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

Data Quality Statement (DQS)

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document and NGT internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Scope

The project is split into six work packages detailed below:

WP 1 - Functional Requirements
5 months

Develop the baseline information for valve repurposing and refurbishment. Determine test plans and understand the key standards to be followed. Benchmark against other network approaches.

WP 2 – Testing & Validation
4 months

Develop an inspection and test plan for approval by NGT. Undertake testing on a typical ball valve firstly in natural gas and again in hydrogen 100% or a suitable test gas. Soak testing for valve elastomers.

WP 3 – Refurbishment Demonstration

4 months

Following a test on a ball valve in up to 100% helium. Strip and inspect the valve and provide a technical condition assessment report. Review and identify any components that may require replacement to re-configure the valve ready for Hydrogen service. Re-test the reconfigured valve to validate that an old valve can be re-configured and overhauled for Hydrogen service.

WP 4 – Standards, Procedures & Policies Review

6 months

Develop associated processes, standards, policies and procedures to enable roll out of the options created in this project.

WP 5 – Commercial Review

5 months

Understand CBA for refurbishment vs new replacement and supply chain assessment

WP6 Reporting

1 month

A technical report will be produced detailing the work carried out in the project, including a technical summary of the findings and cost benefit analysis. This will also include the ENA Closure Report.

Objective(s)

· Understand valve sealing elastomer degradation with hydrogen

· Understand valve sealing capabilities for natural gas v hydrogen

· Ball valve cavity venting blowdown tests to understand flow rates and noise (Note- NGT are developing a tool to quantify leak rates in methane and could be tested as part of this project in Hydrogen)

· Understand other valve materials (springs, mechanical joints) properties to exposure with hydrogen

· Mitigation of leaking strategies for 3-piece bodied / non-welded valves

· Identify maintenance procedures needing updated for hydrogen service of ball valves

· Understand costs associated with new replacement vs repurposing of NTS three-piece bodied ball valves including carbon savings and sourcing strategies.

· Understand condition of internal components with hydrogen and hydrogen service capability via modifications

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a

bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations. This is because it is a transmission project.

Success Criteria

The following key criteria need to be met for the project to be considered successful:

- Objectives met to time, quality and cost.
- Successful and cost-effective demonstration of three-piece bodied valve refurbishment process
- Project findings inform the HyNTS safety case to provide evidence to HSE.

Project Partners and External Funding

Lead Network: National Gas Transmission plc

Supplier: SCORE

Sub-contractor: Element Materials

External costs: £ 566,820

Internal Costs: £ 188,940

Total: £ 755,760

Potential for New Learning

The project will provide the parties with an understanding of the impact of hydrogen on valve types and OEMs, the costs associated with refurbishment and repurposing of valves for hydrogen service, supply chain assessment, refurbishment modifications required for hydrogen, carbon savings with refurbishment vs replacement of valves, procedures, policies and standards for valves for hydrogen service.

The findings from the project will be uploaded to the ENA Smarter Networks portal and will be shared via National Gas innovation social media.

Scale of Project

The project will predominantly involve desktop research for WP1, WP4, WP5 & WP6. Decommissioned three-piece bolted isolation valves will be tested in WP2 to assess impact of hydrogen on materials and equipment performance. WP3 will demonstrate refurbishment for hydrogen service on another decommissioned three-piece bolted valves. Three-piece bolted isolation valves can be connected/disconnected to the network, making them viable for refurbishment unlike all welded construction valves.

The NTS has around 33,347 isolation valves on the network which need to be assessed to determine the scale of impact and CBA. Of which, ~8000 (24%) are eligible for refurbishment. This project will provide a process solution and develop a standard around refurbishment that will have sustainable cost and carbon savings if technically feasible.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

United Kingdom, Warwick.

Revenue Allowed for the RIIO Settlement

None – hydrogen focused innovation project.

Indicative Total NIA Project Expenditure

External costs: £ 566,820

Internal Costs: £ 188,940

Total: £ 755,760

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 provide insight into how hydrogen in the NTS will impact an NTS valve type and OEMs with a focus on three-piece bodied isolation valves, as they have the potential to be refurbished. To repurpose our NTS to a HyNTS we must develop a standard and procedures for hydrogen service with valves, this is currently in development with the supplier as part of the committee developing it, known as API/6Z. It is widely assumed hydrogen will be an energy vector of the future energy system transition, similar to natural gas transmission today, hydrogen should be transmitted in the future NTS to enable the transition.

To define, repurposing is modifying the valve to change / upgrade the specification (i.e. change of seal type / material, replacement of hard parts in alternative materials, weld build-ups / overlays, etc.), whereas a refurbishment would be maintaining the original valve specification but repairing / replacing parts with like-for-like (a general service / overhaul).

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

Although this project does not directly affect vulnerable consumers the energy transition may and as such, we must consider the effect of the work we are doing through the NIA funding. The National Transmission System (NTS) is a key UK infrastructure for the transport of Gas to consumers, including those considered vulnerable. In a scenario where hydrogen replaces methane as a household heat source, it is essential the vulnerable are not excluded by virtue of fuel inaccessibility. In cases where vulnerable consumers already utilise gas it is likely that in a net zero future the optimum option is to provide a consistent energy solution. The transition to hydrogen within the NTS provides continuity of access to the vulnerable of hydrogen as a replacement to methane, with ongoing benefits of efficiency and economy of scale within a closely regulated environment. Ensuring robust NTS assets and consistent hydrogen production options will support the transition of the NTS to hydrogen which in turn supports the availability of gas to the vulnerable.

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)

N/A

Please provide a calculation of the expected benefits the Solution

Value tracking

	Data Point	Data Point Definition
Maturity	TRL2-3	The project will focus on commercially available or emerging technologies
Opportunity	100% of single asset class	The project can be applied to all three-piece bodied isolation valves units ~8000 (24%) on the NTS.
Deployment costs	-	Deployment costs are not known at the start of the project but will be

		defined throughout the project.
Innovation cost	£ 755,760	The cost includes desktop-based work and site visits.
Financial Saving	-	Any financial savings are not known at the start of the project. Savings may be realised if CBA shows value for money on refurbishment.
Safety	-	Understand the impact of hydrogen on valve performance and impact on internal materials e.g. sealants for the repurposing of NTS safety case evidence to HSE.
Environment	-	Perform carbon footprint assessment on repurposing of a valve vs. procurement of new (consider steel production, machining, and transport) using Carbon Intensity Tool (CIT) / Score tool.
Compliance	Support compliance	/
Skills & Competencies	Individuals	The project will inform individuals who are directly involved.
Future proof	Supports business strategy	The project will help enable hydrogen in the NTS and support the energy transition.

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

The findings on hydrogen impact on materials and equipment performance from the project could be applied to all valves on the network. All valve types and OEMs will be mapped as part of the project across the NTS. However, the refurbishment demonstration will only be completed on three-piece bolted isolation valves. The NTS has 33,347 of which the majority are assumed to be three-piece bolted.

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

At the start of the project the roll out costs are not known. The business case and cost benefit analysis of three-piece bolted valves is a deliverable of the project, therefore roll out costs will be known at the end of the 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

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

This project focuses on valves which may impact gas distribution networks. However, the project learnings will inform National Gas Transmission's HyNTS safety case for hydrogen transmission for HSE evidence.

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.

There will be no duplication of activities done as part of this program. This project will address a gap in National Gas' ongoing innovation work looking at repurposing valve assets for hydrogen service.

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

The project will determine the impact of hydrogen on existing NTS valves, which has not been investigated previously.

An investigation and mapping exercise of valve type, age and manufacturer will be done to determine suitability and impact of repurposing for hydrogen service. It is essential to inform hydrogen safety case and will provide evidence to develop emerging hydrogen standard for valves.

This work is a counterfactual to the ongoing work looking into repurposing gas turbine systems. Electric drive systems could provide

an opportunity to manage variable hydrogen blend compression and reduce emissions from gas turbines whilst they are still utilising natural gas or natural gas blended with hydrogen from the NTS as a fuel gas.

Relevant Foreground IPR

This project will not result in any new Foreground IPR.

Data Access Details

Details on how network or consumption data arising in the course of an NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Gas can be found in our publicly available "Data sharing policy relating to NIA projects" at www.nationalgas.com/gasinnovation. National Gas data access is managed IAW provisions under 2.15-2.18 for the current NIA Governance Document.

National Gas already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGT internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to our supplier's own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

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

Hydrogen is not currently present in the NTS and therefore current valves have not been approved or potentially not capable for hydrogen service. Hydrogen is being directed as a future energy solution but RIIO-2 business funding does not allow the development of hydrogen ready solutions and therefore this project cannot be undertaken as part of BAU activities.

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 impact of hydrogen on NTS valves has not previously been investigated, therefore early-stage research and assessments will carry additional exposure to risk. The NIA funding reduces this exposure to risk. FutureGrid testing will cover some valve testing and provide leak rate data with hydrogen but not enough to give a conclusive outcome on all valves.

This project has been approved by a senior member of staff

☑ Yes