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

Jul 2023

Project Reference Number

NIA_NGT0217

Project Registration

Project Title

Hydrogen Repurposing Process for the NTS

Project Reference Number

NIA_NGT0217

Project Licensee(s)

National Gas Transmission PLC

Project Start

July 2023

Project Duration

2 years and 9 months

Nominated Project Contact(s)

Steve Johnstone, box.GT.innovation@nationalgas.com

Project Budget

£1,016,132.00

Summary

The project described in this PEA covers the development of a new repurposing process for NTS assets to transport hydrogen. The approach for repurposing the National Gas Transmission System (NTS) to transport hydrogen will need an innovative approach to meet the timelines for the net zero transition. There have been several projects undertaken to date to determine the interactions of hydrogen with the network assets, we are looking to determine if these activities are providing all the relevant data and evidence required for our network to transition.

Preceding Projects

NIA_SGN0165 - HyTechnical – Literature, science review and subsequent revision technical standards for hydrogen pipelines

Third Party Collaborators

Pipeline Integrity Engineers Ltd

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

The National Gas Transmission System (NTS) is to be repurposed to transport hydrogen instead of natural gas. This activity supports the UK ambition of Net Zero by 2050 and commences through the Hydrogen Backbone project – Project Union. Project Union commenced Pre-FEED as of April 2023 and is due to commence construction in 2026. The FEED activities that will require this new process, will commence from April 2024 and therefore the timeline for this project is aligned to this project.

The NTS currently transports natural gas and is looking to migrate to net zero fuels through to 2050. Project Union, our hydrogen backbone, converts ~2000 km of NTS pipeline through 2026-2035. Alongside this, blending into the remainder or the network is to be considered up to approximately 20% hydrogen. We must have robust processes and standards to enable the repurposing of our assets.

National Gas have undertaken a review of their standards and safety case through the FutureGrid Phase 1 project and continue to develop this as part of Project Union. This work has highlighted over 100 standards that require update and review. A focus for us is in the development of a new process for repurposing our network assets to transport hydrogen. The current uprating processes will be considered as a baseline for this work but have several challenges in direct application. We may still need to uprate network assets with both natural gas and hydrogen mediums therefore consideration of the approach to the TR7 and TR8 standards is required and will be considered by this workstream to support the work undertaken as part of Project Union.

T/SP/TR/7 is NGT's specification for Transmission System Uprating of above 7 bar steel gas transmission pipelines, including all associated fittings and AGIs. This specification addresses the technical assessments which are required to demonstrate that it is safe and acceptable to uprate, and the means of addressing non-compliances.

In order to develop a new process for re-purposing the Transmission System to Hydrogen, we are intending on using the methodologies and assessment criteria set out in TR/7 to formulate a new process to support the re-purposing of an existing natural gas system to Hydrogen.

In addition, NGT also have an accompanying Management procedure (T/PM/TR/8) for the management of Transmission System uprating projects. This procedure describes the necessary project control and administration requirements, including details of responsibilities, required formal acceptances and key work items for a project to consider the uprating of a part of the National Gas Transmission System. This too, will be reviewed and used as a 'blueprint' to formulate a new Management Procedure to support the re-purposing of an existing natural gas system to Hydrogen.

Whilst TR7 provides robust uprating evidence, the process can be resource heavy and lengthy to complete. The timelines to transition to hydrogen are ambitious and considerations through this activity must be made in streamlining the process and activities. Enabling novel approaches to deliver the repurposing of a pipeline asset and linking with digital systems should be considered throughout this project.

We have identified PIE (Pipeline Integrity Engineers) as a key partner in the development of this new standard due to their previous involvement in the creation of the existing TR7 standard and their activities in supporting the development of the TD1 supplement for hydrogen.

The initial activities in 2023 will be to take learning from Project Unions review of our current processes and standards and develop our understanding of global approaches to provide a new re-purposing draft version that can be trialed through the 2024 Project Union FEED study and revalidated through 2025-2026.

Method(s)

Phase 1 – Process Review & Impact Assessment

July 2023 – September 2023

This phase of work reviews global approaches to repurposing processes and considers how to enable a new hydrogen repurposing

process that is easy to use and provides relevant evidence to the HSE. This phase identifies any novel methodologies for repurposing that could accelerate the deployment of the new standard process in the future. In addition to this we will be required to review alignment with IGEM TD/1 Supp2 and ASME B31.12 as well as reviews of existing repurposing guidelines (e,g. DNVs whitepaper, EPRG whitepaper, NZTC paper)

Phase 2 – Gap & Evidence Requirements

September 2023 – December 2023

This phase takes the outputs from phase 1 and considers any additional work required in order to develop a new process for repurposing to hydrogen. The phase will also consider novel approaches to deploying the standard and review interactions with our digital systems.

Phase 3 – Process for Repurposing of Assets to Hydrogen Drafted

October 2023 – March 2024

Phase 3 produces a first draft of the new process to enable use as part of the FEED for Project Union and East Coast Hydrogen. Training will be provided to the deployment team to ensure understanding of the approach.

Phase 4 – Process Trial & Document Update

October 2023 – March 2025

This phase utilises the updated process to provide the evidence to repurpose a selected area of the network – likely to be the east coast hydrogen region. The PIE team will be required to support the deployment of the standard through the trial period.

Phase 5 – Revalidation of Gas Transmission Network and Analysis of Future Scenarios

March 2024 – March 2026

System Revalidation of design life considering the proposed future use scenarios and its impact on the new pipeline re-purposing standard approach – learning to be integrated into phase 4 activities.

Phase 6 - Standards & Reporting

January 2026 – March 2026

This phase produces the final reports required for the innovation funding – technical report and closure report.

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 initial activities in 2023 will be to take learning from Project Unions review of our current processes and standards and develop our understanding of global approaches to provide a draft version that can be trialed through the 2024 Project Union FEED study and revalidated through 2025-2026. The outcome will be a new robust process for repurposing high pressure NTS assets and associated digital systems to enable an accelerated safe transition of the network.

The financial benefits of repurposing vs replacing the gas network for hydrogen are in development through the Project UNION programme but are considered to be significant. This financial benefit will be updated through the project period in progress and closure reports. This project will enable those assets to be repurposed robustly, without such an approach for each pipeline section, data and evidence could be missed that could lead to safety and commercial implications. In the case that the NTS assets have no methodology for repurposing the stranded asset cost for the network could be around £6.5b.

Objective(s)

- Development of a new optimum solution for a hydrogen repurposing approach
- Determine gaps and evidence required for deployment
- Produce a new draft Hydrogen Repurposing process and procedure
- Trial the new process in a real-life deployment

Provide in-depth reporting for future understanding

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 successful output from this project will be in the delivery of the new repurposing approach and associated process to enable repurposing of the NTS assets safely and efficiently. Success will be measured through the programme of work against the project deliverables in each phase and associated acceptance criteria.

Project Partners and External Funding

PIE

Oakham Hydrogen Limited

Global stakeholders to provide insight into their approach and processes (TSOs include APA, H2GAR working group etc..)

Potential for New Learning

The approach for repurposing high-pressure pipelines could be utilised across the globe and in this we will be preventing duplication through engagement with other relevant global stakeholders. The learning created in this project will also be disseminated to other UK networks whom may be considering higher pressures for future applications. Consideration of projects such as LTS Futures and GDN Hydrogen development projects (H21, H100 etc…) will be taken to ensure that the outcome of this project provides insight to all UK

applications.

Scale of Project

The scale of the project is sufficient to deliver the novel process and methodology alongside the trial and revalidation. The trial and revalidation could be considered separate phases of work but have been sanctioned at the start of this programme of work to provide consistency and efficiency savings in this workstream. Whilst the project could be completed in several stages the costs and timeline associated would be unlikely to decrease and would most likely increase due to ancillary sanction administration requirements. The project tasks are unlikely to change as the project is progressed.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Newcastle Upon Tyne

Warwick

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£1,016,132

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:

This piece of work will support the energy transition through enabling the long-term transportation of hydrogen through the NTS pipeline network. The process by which the network provides evidence and data associated with its capability to be repurposed is vital to ensuring a robust and safe outcome. The outputs from this project will help educate, inform and drive the journey towards adopting hydrogen within the UK gas network, which will in turn help contribute towards the UK's target of net-zero emissions by 2050.

The outcome of this project will be utilised to drive the transition of the network elements for both 100% hydrogen and blends. In the case this new process is not developed, the robust delivery of evidence and associated data sets for the network transition cannot be assured.

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)

N/A

Please provide a calculation of the expected benefits the Solution

The following provides details on the benefits proposed for this project, the first phase of this activity is research and will move into development and demonstration through the project period. We will update the benefits as we progress through the programme of work.

Value topic - Data Point - Data Point Definition

Maturity – TRL 2 - The maturity of the existing TR7 uprating process is advanced, consideration for how hydrogen impacts this new process has not been made and therefore the TRL is low at the start of this project but should rapidly increase.

Opportunity – 100% of multiple asset classes - All assets will be considered for repurposing

Deployment costs – TBC - Significant cost in deploying the standard across the whole network however cost for deploying the new process and standard as business as usual

Innovation cost – TBC - Cost associated to the NIA project and deploying the outcome as business as usual

Financial Saving – TBC - Cost saving through preventing new build and preventing stranded assets (£6.5b)

Safety – 100% - Without this new process and approach we cannot guarantee the correct actions have been taken to ensure the repurposing of the assets has been done safely

Environment – TBC - The transition of the gas users in the UK to utilising Hydrogen provides a massive CO2 saving alongside the environmental benefits associated to reducing the requirement for new build.

Compliance – Ensures Compliance - Compliance will be insured through the delivery of this new robust process and approach

Skills & Competencies – Departmental - The process and repurposing delivery teams will be required to utilise this new tool, skills and competencies will need to be developed across these departments.

Future proof – Must have for the business strategy - this new process will be required in the transition of the UK NTS network and therefore is a must have for the net zero approach

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

The outcome of the project could be utilised for any pipeline above 7 bar that requires repurposing or uprating in a hydrogen environment. It could also be utilised by other networks across the globe, consideration for this in publication at the close of the project should be considered.

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

There should only be costs associated to the work of deploying the new process on each network asset, this will vary dependent of the pipeline length, complexity and age. Further work to determine this will be undertaken through 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

The outcome of the project could be utilised for any pipeline above 7 bar that requires repurposing or uprating in a hydrogen environment. It could also be utilised by other networks across the globe, consideration for this in publication at the close of the project

should be considered.

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.

The EIM GIGG forums have been notified of the activity and benchmarking of other network approaches undertaken. If in the period of the project further work is undertaken by other networks this will be incorporated and the project funding reviewed.

Project Union is currently undertaking activities as part of Pre-FEED on understanding our standards, policies and procedures and determining the route to updating these for hydrogen. This project will not duplicate any of these activities but support in developing a new process for hydrogen repurposing.

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

There is no current process or procedure for assuring the robust repurposing of natural gas pipelines to hydrogen. The project will pull together information from across multiple projects and determine an optimised approach. This project is innovative as it will be a first of its kind and is looking at deploying hydrogen which is currently not a gas transported in the UK networks.

Relevant Foreground IPR

The project will produce foreground IPR in the form of the repurposing standard with will be owned and manged by National Gas and disseminated as appropriate to relevant parties.

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

National Gas are currently not licensed to transport hydrogen and therefore cannot support this activity as BAU.

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

National Gas are currently not licensed to transport hydrogen, NIA funding enables innovative approaches to be developed for future deployment. This project has a clear opportunity to demonstrate and deploy a vital solution for the UK gas networks.

This project has been approved by a senior member of staff

☑ Yes