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 2021

Project Reference Number

NGGTGN04

Project Registration

Project Title

HyNTS FutureGrid Phase 1 – Transmission Test Facility NIC

Project Reference Number

NGGTGN04

Project Licensee(s)

National Gas Transmission PLC

Project Start

April 2021

Project Duration

2 years and 9 months

Nominated Project Contact(s)

Tom Neal

Project Budget

£12,699,997.00

Summary

Hydrogen has the potential to play a role in the decarbonisation of heat, power, and industry. Repurposing the NTS will minimise disruption, and potentially cost, for customers and consumers when developing a hydrogen NTS.

The project will involve building a hydrogen test facility from a representative range of decommissioned NTS assets. Flows of hydrogen and natural gas blends (up to 100% hydrogen) will then be tested at NTS pressures, to better understand how hydrogen interacts with the assets. The data gathered will be used to assess the impact that a hydrogen conversion of NTS assets will have.

The project will build on existing work under the HyNTS programme and increase understanding of the characteristics of hydrogen in the NTS, demonstrating what is required for hydrogen to be safely transported within the high-pressure gas transmission system.

Preceding Projects

NIA_NGGT0166 - HyNTS Roadmap to FutureGrid

Third Party Collaborators

DNV

HSE Science Division

Fluxys

Durham University

University of Edinburgh

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

The NTS is a critical national infrastructure that transports natural gas, in bulk, away from the import terminals (such as St Fergus, Bacton, Isle of Grain and South Hook) to large-scale customers such as gas fired power stations and Gas Distribution Network (GDN) offtakes. The most efficient way to move any gas is at high pressure and in large diameter pipelines, using compressors at strategic locations to maintain the flows. There are directly connected customers, such as the industrial and power generation sectors, and customers connected to the GDNs further downstream. The NTS currently transports over 97% of the natural gas that flows through the GDNs, much of which is delivered to 23 million domestic consumers for heat1.

Research is urgently needed to address the UK net zero 'heat challenge' to establish whether, and how, the NTS could be converted to 100% hydrogen. This is on the critical path for a UK Government policy decision on the futures of both heat and the gas industry. The NTS is also vital for daily storage to maintain security of supply; the need for storage would increase as the energy content of hydrogen is approximately a third of that of natural gas2. In parallel to live hydrogen consumer trials proposed by the GDNs, work is also needed to establish whether the NTS could maintain current levels of safety and security of supply if it were converted to hydrogen. To address this challenge, NGGT set up the HyNTS programme of works to cover all hydrogen related projects for the NTS. The FutureGrid project falls within the HyNTS programme and has its own roadmap of three phases, the first of which forms the scope of this proposal. Phases 2 and 3 focus on key areas such as compression, deblending and in-line inspection and are detailed further in Section 3.3. The Hydrogen Programme Development Group (HPDG) set up by Business Energy and Industrial Strategy (BEIS) has identified potential end states for a decarbonised gas industry. The FutureGrid programme of work will provide the evidence for these and understand whether it is possible and safe to:

- Flow high-pressure hydrogen through existing NTS assets (pipelines, valves etc) - this forms the scope of this proposal
- Deblend hydrogen from natural gas during the system transition (outside scope of this proposal – to be developed in FutureGrid Phase 2)

We have undertaken several desktop studies through the HyNTS programme of work which have confirmed, in principal, the suitability of hydrogen in the NTS. However, there are gaps in knowledge that are fundamental to, and underpin, the safe and reliable operation of hydrogen conversion. The Health and Safety Executive – Science Division (HSE-SD) carried out an initial study and highlighted impacts such as leakage, venting and the effects of hydrogen on the mechanical properties of some NTS materials. The main outcome of the research was that physical testing is required on a variety of NTS assets to understand the risks and mitigations required before more advanced operational studies such as deblending can be undertaken.

In Europe, gas network transporters; GasUnie and SNAM have already trialled hydrogen injection into a section of pipeline to test the impact on some assets. NGGT has not been able to identify a similar suitable section of pipeline for testing as the NTS is highly interconnected. We would not be able to meet the need for flexibility in testing, trialling and developing a range of technologies alongside ensuring supply to our customers at this early stage. In the case of online testing (the day-to-day functioning NTS), there would be the risk of hydrogen penetrating into the downstream GDNs and being delivered to consumers in an uncontrolled manner. To add to this, our current Safety Case does not allow transportation of gases other than Methane and the Gas Safety (Management) Regulations 1996 clearly states that the limit for hydrogen is less than or equal to 0.2% molar. Both documents sit under the Gas Act 1986 and to allow transportation of the proposed hydrogen blends in methane at this stage, will be a direct breach of our Gas Transporters Licence. Therefore, an off-line test facility constructed from decommissioned NTS assets will be the safest, most time-effective and cost-efficient way to understand the risks and demonstrate the capabilities of the NTS.

The physical and chemical properties of hydrogen differ substantially from those of natural gas. We need to further investigate how these properties may affect the NTS pipelines, assets, materials, operational procedures and energy delivery. We need evidence from testing that demonstrates that a hydrogen NTS system can be operated safely with hydrogen and hydrogen blended with natural gas. Repurposing the NTS for hydrogen could be fundamental to the Great Britain (GB) Gas Networks' transition to 100% hydrogen4 and would reduce reliance on costly, localised production of hydrogen from natural gas reforming with carbon capture. There would be benefits in producing blue hydrogen5 at existing gas terminals, which are already industrial chemical processing sites. This would negate the need for a new on-shore carbon dioxide transmission system that connects smaller reforming plants with offshore carbon capture and storage. Additionally, it is widely believed that blue hydrogen is an interim measure that is likely be replaced by green hydrogen6 generated from renewables. A fully converted NTS would be ready to support that transition. Maintaining the connection between the NTS and the GDNs will also support security of supply to customers by connecting hydrogen producers and providing line pack and connections to hydrogen storage facilities.

Method(s)

This project is a Network Innvoation Competition (NIC) Project. The project proposal document details all key deliverables, objectives and outcomes (including covering this requirement) as per Ofgem's NIC Governance Document Version 3.1. The project proposal is available on the ENA portal under the the entry for the project 'NGGTGN04 - HyNTS FutureGrid Phase 1 – Transmission Test Facility'

Scope

This project is a Network Innvoation Competition (NIC) Project. The project proposal document details all key deliverables, objectives and outcomes (including covering this requirement) as per Ofgem's NIC Governance Document Version 3.1. The project proposal is available on the ENA portal under the the entry for the project 'NGGTGN04 - HyNTS FutureGrid Phase 1 – Transmission Test Facility'

Objective(s)

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Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

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Success Criteria

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Project Partners and External Funding

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Potential for New Learning

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Scale of Project

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Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

FutureGrid Phase 1 is being constructed at DNV's Test and Research Centre at RAF Spadeadam in Cumbria. This facility provides a unique facility where we can safely build and test an offline hydrogen test facility. This facility is representative of the National Transmission System (NTS) and as such the results, knowledge and learning are applicable to the whole UK NTS.

Revenue Allowed for the RIIO Settlement

0

Indicative Total NIA Project Expenditure

Total value of this NIC project is £12,699,997.

Details of the funding awarded, the contribution by NGGT and Northern Gas Networks along with a detailed project budget can be found in the Full Submission NIC Cost Table Spreadsheet also availble on the ENA portal under the the entry for the project 'NGGTGN04 - HyNTS FutureGrid Phase 1 – Transmission Test Facility'

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:

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

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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)

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Please provide a calculation of the expected benefits the Solution

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

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

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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

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

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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.

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

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Additional Governance And Document Upload

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

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Relevant Foreground IPR

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Data Access Details

Details on how network or consumption data arising in the course of a NIC or NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Grid can be found in our publicly available “Data sharing policy relating to NIC/NIA projects” at www.nationalgrid.com/gasinnovation

National Grid already publishes much of the data arising from our NIC/NIA projects at https://smarter.energynetworks.org

In addition to this, as part of the communication and engagement plan. National Grid has held webinars for the purpose of sharing knowledge throughout the duration of the project. We plan to continue these events at the project continues. There are also specific events planned for the completion of different blends of hydrogen. These webinars and events will be open to all interested parties.

National Grid has also set up a shared email box in which any queries about the project can be addressed. The email is: futuregrid@nationalgrid.com. The website www.nationalgrid.com/futuregrid also contains presentations, videos, files and images relevant to the project which can be accessed by interested parties

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

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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

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This project has been approved by a senior member of staff

☑ Yes