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 2022

Project Reference Number

NIA_NGGT0206

Project Registration

Project Title

FutureGrid Phase 1 – 5% Hydrogen Blend Test

Project Reference Number

NIA_NGGT0206

Project Licensee(s)

National Gas Transmission PLC

Project Start

December 2022

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Tom Neal, Box.GT.Innovation@nationalgrid.com

Project Budget

£344,469.00

Summary

With an emerging need for an evidence base specifically for 5% hydrogen blends in the NTS, this project links with the ongoing FutureGrid Phase 1 NIC project and plans for 1.5 months of testing on the FutureGrid Facility. The testing will be conducted between the 2% and 20% hydrogen tests planned and all tests, analysis and results gathering will replicate those planned for the hydrogen blend tests in the NIC project. The results and outputs of this project will be collated and analysed alongside the NIC outputs to provide a rich evidence base of hydrogen blends operating on the NTS from 2%, 5% and 20% hydrogen blends upto 100% hydrogen.

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Through collaborations with European partners the FutureGrid team have kept a watchful eye on policy developments in Europe which could impact the use of hydrogen on the continent and, by extension, the UK through our two gas interconnectors. In a recent policy paper draft the European Commission suggested that a readiness for the acceptance of 5% hydrogen by volume could be the first step for European transmission network operators in a transition to hydrogen. This would mean that gas entering the National Transmission System (NTS) through the interconnector could have up to 5% hydrogen blended with Natural Gas.

Current thinking is that 2% hydrogen blends are likely to be the first introduced to the NTS. However, there is a potential for some fluctuation in gas composition during the first few years of hydrogen blending on the network. This means gas could be above or below 2% hydrogen mixed with natural gas. By developing strong empirical evidence of network performance at 5% hydrogen blends, we reduce the risk of any unexpected problems from a spike in hydrogen concentration.

When combined, the potential European Legislation and the requirement for a clear evidence base of 5% hydrogen blend transportation in the NTS present a clear case to conduct a controlled demonstration of 5% hydrogen blends. We are currently underway with FutureGrid Phase 1 which is our ambitious programme to build an offline hydrogen test facility and test the effect of increasing concentrations of hydrogen up to 100%, to demonstrate the National Transmission System (NTS) can transport hydrogen.

Currently planned for testing in FutureGrid Phase 1 are 2% and 20% hydrogen blends and 100% hydrogen tests. The detailed evidence base required for the specific application of 5% hydrogen blends in the NTS could not be determined from the 2% and 20% hydrogen blend tests which are currently planned. There is a chance that asset issues could arise between the 2% and 20% tests with no way to determine the exact concentration of hydrogen point at which the assets encountered the issue.

Method(s)

The FutureGrid offline hydrogen test facility is currently planned to test 100% natural gas as part of the commissioning process before moving to the hydrogen test phase where 2%, 10% (to calibrate meters) and 20% hydrogen blends will be tested, followed by 100% hydrogen. Between each of the hydrogen blend tests we have included a GO/NO GO checkpoint. This checkpoint allows all project partners to ensure all tests for the particular blend have been completed and that there are no re-tests required before the facility is prepared for the next blend test. It is imperative we ensure all tests are completed including any re-tests as it will be costly and time consuming to revert the facility back to a lower hydrogen blend at a later date.

The first of the hydrogen blends tested in the Offline Hydrogen Test Facility will be 2% hydrogen with 98% natural gas. This blend of hydrogen is being tested to reflect the assumption that blends will be required to facilitate the transition of the NTS to hydrogen. It is anticipated that a large scale ramp up of hydrogen production will be required order to achieve higher blends of hydrogen in the early stages of blending into the NTS. No significant changes to operation are expected with a 2% hydrogen blend, with the expectation that most assets should function with little to no impact from the 2% hydrogen blend test.

The full set of results from the 2% hydrogen blend test will be captured in the detailed report produced by DNV which will form a chapter as part of the FutureGrid Closure Report. A brief ‘GO/NO GO Checkpoint’ report will be issued straight after the blend test with an initial set of observations alongside a confirmation of all relevant tests for this blend have been completed. This report will inform the decision for the GO/NO GO Checkpoint – 2% Hydrogen blend tests complete, no additional tests required.

The 5% hydrogen blend test as part of this NIA project will be conducted after the 2% hydrogen blend test, before the 10% meter calibration test. This is the most efficient and effective option, allowing for a small amount of gas to be vented in order to take the concentration of the facility from 2% to 5% hydrogen. Following the 5% hydrogen blend test conduced under this NIA, the FutureGrid Phase 1 test programme will continue with 10% (to calibrate meters) and 20% hydrogen blends will be tested, followed by 100% hydrogen.

For each blend test on the FutureGrid facility, a re-compression unit is used to generate gas flows around the facility. This unit has been designed specifically for the facility, to operate with natural gas and hydrogen at a wide range of flow rates and pressures to replicate the national transmission system. This allows us to simulate various flows across the facility that are representative of the NTS. We have a complete off take arrangement with metering which is how we bill the customer and pressure let down to make sure the end user gets billed correctly and the right supply pressure of gas. The FutureGrid facility also includes a block valve which simulates isolations that we would be required on the NTS. Various tests will be performed across the facility that are routinely carried out by technicians on the NTS.

Flow rates as per table below will be applied at all blends, starting at natural gas as a standard then moving up to 100% hydrogen. Key elements of testing we will be concentrating on vibration, noise and permeation across the facility. Through testing leak monitoring will be completed comparing to natural gas.

The maximum flow that the recompression unit can achieve when raising the pressure from 49 to 70 bar, the flows are:

- Flow 1 – 0.12mSCm/day
- Flow 2 – 0.24mSCm/day
- Flow 3 – 0.36mSCm/day
- Flow 4 – 0.36mSCm/day
- Flow 5 – 0.82mSCm/day
- Flow 6 – 1.28mSCm/day
- Flow 7 – 1.74mSCm/day

As for all hydrogen blends tested on the FutureGrid facility, the 5% hydrogen blend test will be conducted over 4 weeks, with time to prepare the tests and fill the facility before hand and time to analyse the results afterwards. As the 5% hydrogen blend test forms part of the wider FutureGrid Phase 1 testing programme, an initial set of observations will be reported as part of the NIA governance, with the full technical report and analysis provided at the NIC project closure. This allows these results to be adequately interrogated alongside the full set of hydrogen blend test results and a full set of observations and outcomes can be recorded.

The deliverables for this NIA have been integrated alongside the FutureGrid Phase 1 NIC delivery programme. They are:

· NIA Deliverable 1 - Test plan review and sign off – 12 December 2023 to 13 February 2023

· NIA Deliverable 2 – Asset preparation and 5% Hydrogen 95% natural gas fill of high pressure reservoir – 8 May 2023 to 25 May 2023

· NIA Deliverable 3 (also known as NIC Deliverable 3.2) - 5% hydrogen blend test on the facility – 26 May 2023 to 22 June 2023. GO/NO GO decision point for the test facility to progress to 10% meter validation test 23 – 26 June 2023.

· NIA Deliverable 4 - Data analysis and review for 2% and 5% hydrogen including report- 26 July 2023 to 27 September 2023

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 NGGT / NGET 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

Achieving the UK's Net Zero targets will require decarbonisation across the whole energy system. Sectors such as heat are difficult to decarbonise, and the importance of the NTS to the UK's current energy supply means we need to consider how to reliably and safely deliver low carbon energy to consumers. Existing research suggests hydrogen could be an alternative to natural gas, but there are several knowledge gaps that need addressing and a lack of physical trials.

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. Using a hydrogen test facility that remains separate from the NTS will allow for testing to be undertaken in a controlled environment, with no risk to the safety and reliability of the existing NTS. FutureGrid provides a significant opportunity to increase collaboration across the gas networks, help share learning and increase hydrogen knowledge within the gas industry.

FutureGrid Phase 1 is building a hydrogen test facility from a representative range of decommissioned NTS assets, with construction due to finish at the end of 2022. As we progress into 2023, flows of hydrogen and natural gas blends (up to 100% hydrogen) will 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.

Currently FutureGrid Phase 1 consist of hydrogen blend tests for 2%, 10% (to calibrate meters) and 20% hydrogen blends, followed by 100% hydrogen. The FutureGrid facility has been designed to allow for flexible testing as new technical challenges emerge. In a recent policy paper draft the European Commission suggested that a readiness for the acceptance of 5% hydrogen by volume could be the first step for European transmission network operators in a transition to hydrogen. This would mean that gas entering the National Transmission System (NTS) through the interconnector could have up to 5% hydrogen blended with Natural Gas.

This NIA responds to the emerging need for specific testing of a 5% hydrogen blend. Recognising that the data between 2% and 20% hydrogen blend tests would not adequately pinpoint the impacts that 5% hydrogen blends may have on operating the NTS, there is a knowledge gap that needs to be filled. The flexibility to respond to this emerging need offers significant efficiencies to the consumer, with the cost of adding this to the existing FutureGrid Phase 1 Test Programme less than one third compared to having to conduct the 5% hydrogen blend test as a standalone activity at a later date.

Objective(s)

To conduct a 5% hydrogen blend test after the 2% hydrogen blend test on the FutureGrid Phase 1 facility in Spadeadam, replicating the full set of testing across 7 flow rates that are planned for the other hydrogen blend tests to deliver an evidence base for 5% hydrogen blend in the NTS in the most cost efficient way.

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.

Repurposing the NTS will minimise disruption to customers in the road to net zero. This is reflected in the Future Energy Scenarios (FES) 202[1] report produced by National Grid ESO. The report shows that a large-scale adoption of hydrogen allows the UK to meet net zero by 2050 with the least disruption to consumer behaviour. Following the conversion of home boilers to hydrogen, consumers could continue to use gas in a very similar way to how they do now. This would remove the need to switch over to heat pumps, which have high upfront costs and would cause a lot of disruption in the process of installation. This also avoids creating a fuel poverty issue, where vulnerable customers could be left behind because they cannot afford to buy expensive heat pump technology. FutureGrid could also enable a future where consumers could have a choice of energy (gas or electricity), as customers do today. Re-purposing the NTS also ensures that the existing infrastructure that UK consumers have already paid for continues to be utilised and avoids significant costs from decommissioning the current NTS.

Success Criteria

The success of this project will be the completion of the 5% hydrogen blend test within the FutureGrid Phase 1 programme, delivering on time, to cost and completing all tests. The success criteria of the 5% hydrogen blend test include:

1. Asset condition checks completed prior to 5% blend test commencing
2. All 7 flow rates operated at 5% hydrogen blend
3. All tests completed successfully with a log of any events / activities noted during the facility operation
4. Identification of any additional further testing required if relevant
5. Initial observations and outputs for 5% hydrogen blend test– ready for the full report as part of the FutureGrid Phase 1 NIC at the end of 2023.
6. Completed GO/NO GO report to allow for the decision to be made to progress to the next phase of hydrogen blend tests.

Project Partners and External Funding

The project partners for this NIA project are the same as the FutureGrid Phase 1 NIC project. The partners include:

· DNV who are the main delivery partner, responsible for building the test facility and developing the comprehensive master test plan across the range of decommissioned assets. DNV are responsible for delivering the 5% hydrogen blend test and achieving the success criteria. DNV are the only partner being paid under this project.

· HSE Science Division (HSE SD) are supporting the development of the test facility and subsequent master test plan, providing technical assurance and validation across the project

· NGN are collaborating on the project to drive closer links with the H21 project, which is building a distribution test facility at DNV's Spadeadam Facility.

· Fluxys are the equivalent Gas Transmission Operator in Belgium and are contributing a substantial level of hydrogen research, to ensure a internationally collaborative approach.

· Durham University are sponsoring a secondment student to study the NTS asset gaps, focusing on the development skills and training courses along with Phase 2 & 3 of FutureGrid.

· Edinburgh University are supporting the trials and developing technical papers and research from the project to enable dissemination, linking the H100 activities and FutureGrid/H21 activity to prevent duplication.

Potential for New Learning

From the outset of FutureGrid, we have adopted a 'digital first' approach to engagement and dissemination, to be as open and inclusive as possible for stakeholders across the UK and provide collaborative opportunities internationally. We have challenged ourselves to bring FutureGrid to life for as many people as we can, whether that's through virtual sessions, walkthroughs, digital models, or on-site visits. This has proven very successful, even with the disruption caused by Covid-19 and its ongoing impact on the way everyone works. By maintaining our 'digital first' approach, we have ensured continued resilience for our engagement activities, knowledge dissemination, and collaboration. As our colleagues and stakeholders have navigated the new ways of working, we've been able to introduce more face-to-face engagement both on site and at events.

As set out in the NIC governance, we will produce an annual Project Progress Report to provide a formal update on project progress against its aims, objectives and success criteria. In addition to this requirement, our detailed communications plan sets out a series of interactive sessions, which will report progress more frequently throughout the project, aligning to key milestones as the project transitions through build, test and trial at 2%, 5%, 20% and 100% hydrogen concentrations.

The 5% hydrogen blend test will provide detailed results as to how our key NTS assets such as pipelines, valves, regulators and metering and telemetry equipment perform with hydrogen. We will produce an NIA closure report for the 5% hydrogen blend test with the initial project findings and the full detailed 5% hydrogen blend test report will be incorporated as part as part of the wider set of results for 2%, 20% and 100% hydrogen concentrations under the Future Grid Phase 1 NIC project. This report will consider the implications of all hydrogen blends tested on the operation of the NTS and also the requirements for further work in order to update the safety case and associated procedures.

Scale of Project

The project scale is dictated by the ongoing FutureGrid Phase 1 NIC project. The 5% hydrogen blend test is being conducted under this NIA alongside the 2%, 20% and 100% tests planned for the NIC. It is imperative that the test is the same scale and duration as the other tests so that we have a complete set of data that can be analysed against the other results without variations to the testing parameters.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The FutureGrid Hydrogen Test Facility has been constructed at DNV's test and research centre located within RAF Spadeadam. The 5% hydrogen blend test will be conducted on the FutureGrid facility during the full hydrogen test programme.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

External cost = £258,352 (DNV – Supplier)

Internal cost = £86,117.33

Total = £344,469.33

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:

There are over 280,000 km of transmission and distribution pipelines delivering gas to over 20 million customers (domestic and non-domestic) in GB. This includes heating 80% of homes, meeting over 40% of the UK's industrial energy demand and providing around 40% of the UK's electricity generation. Although the electricity network supplies a steady load of power, it cannot meet the seasonal or intraday demand for heat. Therefore, significant additional infrastructure would be required to replace the NTS, which already provides this resilience. The additional infrastructure would come at a financial cost to consumers and cause considerable disruption, this is expanded on further, below.

A social carbon price can be applied to CO2 emissions, which relates to society ultimately paying for emissions that cause climate change; NGGT currently sets this price at £69.3 per tonne CO2 equivalent. As stated earlier, the NTS emitted a total of over 2.5 MT CO2 in RIIO-1 via its compressors and venting, equating to a social carbon price of over £173m[1]. Enabling the NTS to transport up to 100% hydrogen could remove up to 100% of the social carbon price from this source. Acting now to introduce hydrogen into the NTS will minimise the social carbon cost from transporting gas through the NTS.

The National Infrastructure Commission's report finds that using hydrogen in hydrogen turbines can lower the cost of the electricity system by up to 30%. Since the NTS delivers gas to many power turbines, enabling hydrogen transmission can lower the cost of electricity for consumers in the future.

Repurposing the NTS will minimise disruption to customers in the road to net zero. This is reflected in the Future Energy Scenarios (FES) 2020[2] report produced by National Grid ESO. The report shows that a large-scale adoption of hydrogen allows the UK to meet net zero by 2050 with the least disruption to consumer behaviour. Following the conversion of home boilers to hydrogen, consumers could continue to use gas in a very similar way to how they do now. This would remove the need to switch over to heat pumps, which have high upfront costs and would cause a lot of disruption in the process of installation. This also avoids creating a fuel poverty issue, where vulnerable customers could be left behind because they cannot afford to buy expensive heat pump technology. FutureGrid could also enable a future where consumers could have a choice of energy (gas or electricity), as customers do today. Re-purposing the NTS also ensures that the existing infrastructure that UK consumers have already paid for continues to be utilised and avoids significant costs from decommissioning the current NTS.

[1] This figure is an underestimate, as the social carbon price is expected to rise in the future
[2] National Grid ESO – Future Energy Scenarios, 2020

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

Not applicable

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)

RIIO-1 question N/A

Please provide a calculation of the expected benefits the Solution

There are 2 key benefits unlocked by this project. The first is the benefit of conducting the 5% hydrogen blend test during the FutureGrid Phase 1 NIC test programme, compared to completing it separately. This delivers a clear cost saving in the short term. In addition there is the wider benefits case associated with the completion of the full FutureGrid Test Programme which is further unlocked by this project.

Cost savings from conducting the 5% hydrogen blend test now

£530k cost to carry out 5% blend test separately to the FutureGrid Test Programme under Phase 1

£xxx cost to carry out 5% blend test as part of the FutureGrid Test Programme under Phase 1

£xxx direct consumer saving, achieved once the 5% blend test is completed as part of the FutureGrid Test Programme under Phase 1

Unlocking the benefits associated with the FutureGrid Phase 1 Programme

The key financial benefits of the FutureGrid programme of works are the following:

- Method 1 – Creation of world leading Net Zero test facility as a focus for hydrogen testing: in order to gather the required understanding and knowledge of how a hydrogen NTS would operate, a number of the different types of assets and tests we would need to carry out could either all be completed separately or combined on a single test facility. This projected benefit would see £20.5m saved against the cost of conducting all eligible tests separately.

- Method 2 – Avoiding valve replacement as part of work to connect industrial clusters: currently the most likely scenario for hydrogen transition and adoption will be at industrial clusters. The NTS will be used to join several clusters together by 2040, the plans of which are being developed in detail under Project Union. To facilitate this, safety critical assets such as valves would all need to be replaced for hydrogen operation if they are not proven to be compatible to operate safely in hydrogen blends up to 100%. FutureGrid unlocks the opportunity to prove this compatibility, with projected benefits of avoiding a proportion of valve replacement being at least £46.5m.

FutureGrid also presents an opportunity to reduce carbon emissions, with a total of 81m tonnes of carbon emissions expected to be avoided:

· Unlocking the opportunity for the NTS to convert to 100% hydrogen by 2050: we have assumed a linear reduction in demand towards 2050 as previously quoted in the ENA Pathways Report reducing from 880 TWh in 2020 to 440 TWh in 2050. Assuming 440 TWh and a CO2 emissions per energy demand of 0.0549 kg/ft3 by converting the NTS to 100% hydrogen by 2050 we will reduce carbon emissions by 81 million tonnes CO2 e.

· Avoiding valve replacement as part of work to connect industrial clusters: removing the need for all valves to be replaced by proving their compatibility with hydrogen could see at 100,000 tonnes of CO2 e being saved based on an initial part of the NTS transitioning to hydrogen.

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

The FutrueGrid Phase 1 NIC project and specifically this 5% hydrogen blend test are seeking to demonstrate that NTS assets are able to operate with blends of hydrogen. Depending on the concentration of hydrogen, there is expected to be some level of intervention to calibrate assets, with the higher the concentration requiring more intervention. At 2% and 5% there is expected to be little impact to the NTS assets. However the challenges arise where connected customers may not be able to accept a hydrogen blend currently, or where there are certain assets requiring more difficult modiciations or upgrades. These outputs from the FutureGrid testing feed into the wider feasibility work Gas Transmission & Metering are conducting to understand the capability of the network and positive outcomes will bring the NTS one step closer to being able to accept hydrogen.

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

At present this cost is unclear as the outputs of work such as FutureGrid will determine the level of modiciations required to the network and specific assets in order to be able to accept hydrogen at varying blends. Until this work is completed and we can understand the level of work required, we cannot accurately outline the potential costs.

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

Evidence for the conversion of the NTS to hydrogen is on the critical path for UK Government policy decisions on the future of the gas

industry. Although laboratory-scale testing capability for hydrogen-materials interaction is being developed by several commercial and academic entities in the UK, the FutureGrid test facility is the only advanced full-scale offline test facility planned. The FutureGrid project provides a unique opportunity to accelerate knowledge on capabilities of the NTS and will:

· Provide certainty on the feasibility of repurposing the NTS to transport hydrogen

· Confirm that NTS operations can be undertaken safely with hydrogen

· Confirm that the societal and individual risks are comparable to those of natural gas by supplying new data for quantitative risk assessment (QRA)

· Provide a platform to engage with stakeholders, users and customers about the transition to hydrogen

· Evaluate and validate results to enable progression to FutureGrid Phase 2.

· Contribute to the development of technologies that help the UK meet Net Zero 2050

This is relevant to the UK gas networks as we work closely to understand how a hydrogen gas network of the future will operate. It provides key indications of where hydrogen supply and demand could be and the capabilities of the NTS to be transporting hydrogen which then in turn would be transported through the Gas Distribution Networks (GDNs) at offtake. In addition there are some parallels in technical impact of hydrogen to both the high pressure steel pipes in the NTS and the metallic pipes in the Local Transmission System (LTS) operated by the GDNs. For instance, the LTS Futures project operated by SGN has been able to set aside some potential work packages identified under the project as these are being covered under FutureGrid – so the outputs and data will feed directly from FutureGrid to LTS Futures, providing a more efficient and effective approach and reducing duplication of work.

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

RIIO-1 question 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.

We work closely with all UK gas networks, BEIS, Ofgem and the HSE looking at the whole UK picture for transitioning the gas network to hydrogen. Through various working groups we are tracking the outputs of all key hydrogen projects and pieces of work to understand how these fill the knowledge gaps and ensure that we are building a comprehensive evidence base for operating the whole UK gas network with hydrogen. These working groups ensure the most efficient and effective delivery of innovative projects and programmes, identifying any potential duplication so it can be avoided.

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

Not applicable.

Additional Governance And Document Upload

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

There is a clear and compelling need for an offline transmission test facility that provides this capability and helps quicken the deployment of online trials of hydrogen injection on the NTS. The transmission test facility must be able to replicate a range of conditions and be fully representative of existing assets to provide compelling results. The test conditions allow us to extrapolate data over a longer time period, so we can fully assess the longer-term impacts of transitioning the NTS to hydrogen. Achieving this will allow for the next stage of the transition to begin. It will allow us to identify opportunities for online test and trial facilities, while providing a

platform to develop larger-scale hydrogen transformation plans for the NTS. This meets the needs of our customers who also have ambitious plans to transition their operations to low-carbon gas alternatives, with hydrogen being a significant option.

The 5% hydrogen blend test is an additional test to the 2%, 20% and 100% hydrogen tests planned in the FutureGrid Phase 1 NIC project. The requirement for a controlled, safe and offline hydrogen test factility to be able to test the various blends of hydrogen is unique, with no facility existing today. This is the first test of hydrogen with high pressure gas transmission assets taken from the NTS. As a result there is a level of uncertainty and risk, which require to be tested at a safe and specialised facility (such as that of DNV's test and research centre in Spadeadam).

Relevant Foreground IPR

The Foreground IPR generated as part of the project will be the results and outputs of the testing at DNV's Spadeadam facility, with all data common to the operation of NTS assets across the UK. There is no opportunity to commercially exploit any IPR arising as result of the project. Consequently, we will make all results freely available in the public domain to facilitate and accelerate knowledge dissemination. Copyright will exist on reports and materials produced as part of the FutureGrid project.

Background IPR will exist within the equipment used to construct the FutureGrid Test Facility and will remain the property of the supplier(s) as part of the commercial product. Knowledge and experience from the DNV GL and HSE-SD from other NIA and NIC funded projects will constitute background IPR. It will be fed into FutureGrid and, according to the respective governance arrangements, will be freely available to be accessed by the FutureGrid project. There will also be background IPR in relation to the hydrogen research provided by Fluxys as part of their in-kind contribution to FutureGrid. Ownership of this background IPR will remain with Fluxys. Access to this information for the purpose of the project between the project partners will be granted and detailed in the formal collaboration agreement prior to the project starting. In addition, there will also be background IPR as an output from the Roadmap to FutureGrid NIA project, in the form of more detailed master testing plans and results from initial lab-based asset testing. This is owned solely by NGGT and we will make it freely available to the project and its partners.

The equipment that forms part of the FutureGrid project relates to the physical transmission test facility to be constructed at DNV GL's test facility at RAF Spadeadam. DNV GL's lease conditions stipulate a requirement for DNV GL to own the assets permanently situated on site. The assets used to construct this NTS test facility will be those planned for decommissioning from the NTS during the RIIO-2 period. To comply with the licence stipulations, ownership of the assets will be transferred to DNV GL. There will be an arrangement in place that provides control of access for the FutureGrid Test Facility by NGGT, to facilitate GDN and third-party access and testing with fair commercial terms. In addition, contribution in kind from DNV GL associated with site costs, maintenance and access is in place to reflect 'scrap' value of the assets under the ownership transfer.

Data Access Details

The Project partners will be able to access the data via a shared access platform. Relevant documentation which contains key learning will be shared within the various governance groups under the FutureGrid Phase 1 NIC project.

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

As with the hydrogen blends being tested under the FutureGrid Phase 1 NIC, the 5% hydrogen blend test is a unique test which is a first of it's kind operating NTS assets with hydrogen. This does not form part of business as usual activities, requiring the use of the FutureGrid offline high-pressure transmission test facility to safely and effectively test the operation of the assets and understand the impact that hydrogen has upon them. The construction and operation of this facility has been covered by the FutureGrid Phase 1 NIC due to the risky and uncertain nature of the testing and the early stage research and development it entails. The 5% blend test under this NIA project is and extension of the early stage research and development and as such does not constitute business as usual activity.

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

To date, no such facility similar the FutureGrid Phase 1 NIC facility has exisited within the UK. This is due to barriers such as technical complexities, scale and cost involved in creating such a facility, and coordinating an industry-wide approach to generating and disseminating the associated knowledge. There are complimentary regional schemes that seek to develop solutions for the transition to low carbon alternatives. However, none of these are focused on creating large-scale, high-pressure test facilities or focus on the direct impact on the NTS. Instead, they are focusing on end consumers, industry and early stage research and development into low carbon technologies.

The risks of operating the NTS with hydrogen mean an offline facility to safely test hydrogen with these assets in a controlled manner is imperative. This will allow us to understand how the assets behave with hydrogen and what modificiations may be required in order to operate the NTS with hydrogen blends. For both the hydrogen blends tested under FutureGrid Phase 1 NIC and the 5% hydrogen blend under this NIA project, there is a level of uncertainty as to how the assets will respond to hydrogen, especially as the concentrations of hydrogen increase. The level of technical and operational risk to the assets alone is significant but when the commercial risks and impacts are considered there is a complex set of risks which make this work clearly eligible to be funded under NIA.

This project has been approved by a senior member of staff

☑ Yes