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

Jun 2023

Project Reference Number

NIA_NGGT0193

Project Registration

Project Title

HyNTS 100% H2 Metering System

Project Reference Number

NIA_NGGT0193

Project Licensee(s)

National Gas Transmission PLC

Project Start

July 2023

Project Duration

1 year and 9 months

Nominated Project Contact(s)

Peter Martin, box.GT.innovation@nationalgas.com

Project Budget

£941,920.00

Summary

The outcome of this project will be the demonstration of a novel 100% hydrogen metering system that is currently in development. The meter will be tested alongside other metering technologies to validate its capability and accuracy. Metering of up to 30% hydrogen is possible with small changes to current systems but 100% hydrogen requires a new metering system. A test skid will be built to enable testing and to understand the accuracy of the novel flow metering technologies in Hydrogen at high pressure. Determining the changes that need to take place to continue maintaining an accurate energy balance for consumers in a net zero network.

Third Party Collaborators

DNV

Kelton Engineering Limited

SICK (UK) Ltd

Elster Metering Limited

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Traditionally, flow meter and gas analyser technology has been required to measure the flow and energy characteristics of purely Natural Gas in the National Transmission System. Introducing Hydrogen into the NTS will alter the physical characteristics of the gas being transported in our pipelines, therefore impacting the capability of measurement technology we use on today's network. For the

purposes of fiscal measurement, we are required to operate within specific tolerances of measurement uncertainty which will need to continue in a Hydrogen blended network.

Up to 30% Hydrogen is believed to be possible with small changes to the transducers in the current metering systems, however greater blends of hydrogen do not currently have a metering solution. A novel 100% meter has been developed by SICK which could provide a solution for 100% hydrogen and the early phase of Project Union which is looking to connect industrial clusters with a hydrogen backbone across the UK. Metering between 30-100% hydrogen requires further development and will not be considered within this project. The associated project test skid could enable future testing of any new developments for gas blend metering systems. Therefore, the test skid developed in this project could facilitate testing of different measurement technologies in Hydrogen blends, to ensure that the right assets are put in place on the network in the future to continue accurately measuring the flow and energy content of blended gases for consumers.

Method(s)

The project will enable the testing of a 100% hydrogen meter developed by SICK alongside other metering technologies to validate its capability and accuracy. In order to test the metering systems a test skid will be designed, manufactured and installed at the FutureGrid facility enabling a realistic test environment in comparison to that seen in the lab testing to date.

The project will be divided into 4 Phases:

Phase 1: Detailed feasibility & Design of Test Skid and Kiosk

Led by – Kelton Engineering and supported by all partners

This work package will investigate the metering system requirements for the demonstration activity. It will consider the variables between our current systems and the prototype and the potential testing regime requirements for our application demonstration. Consideration of the control systems both for the facility and the skid will be determined along with a full safety assessment. A feasibility assessment will be undertaken alongside the detailed engineering design of the new metering test skid and associated metering kiosk to be installed at the FutureGrid facility. The success of this work package is required to enable the next work package of construction and installation of the new metering skid and kiosk. All project partners are to collaborate on this phase to ensure a robust design for the testing phases.

Phase 2: Fabrication and Commissioning

Led by – Kelton Engineering

This work package describes the activities leading from the design work to the construction and offline commission of the skid system.

Phase 3: Installation and Testing

Led by - DNV

This work package describes the installation and calibration of assets, with test activities as part of Phase 1 at the FutureGrid Spadeadam site. This work package will be led by DNV and supported by relevant collaborating partners.

The testing plan will consist of:

· Testing plan designed to determine metering assets accuracy in Hydrogen flows. Looking at shifts between the relative performance of each metering compared to each other in the series.

- Review testing plan, extra testing may be possible if testing skid is commissioned ahead of schedule
- This new testing skid is ready for 100% H2 testing
- Checking flow computer flowrate calculations are correct.

Phase 4: Reporting

Led by – Kelton Engineering and supported by all partners

Phase 4 will deliver high quality, robust and relevant Technical Report and ENA Closure Reports to meet National Grid's requirements.

Measurement Quality Statement

The measurement approach used to meet Data Quality objectives will be through the identification of high calibre project partners whom are experts in their given field and the use of real data and materials from National Grid sites. In this instance the project will be a demonstration to inform new insights into the use of Metering systems with the ability to measure varying blends of hydrogen. The design and fabrications of the testing unit will adhere to Gas Transmission technical standards and the test procedures will determine the optimum Design of Experiments for the variables and systems in question.

Data Quality Statement

The project will be delivered under the NIA framework in line with OFGEM, ENA and NGGT internal policy.

Data produced as part of this project will 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.

Scope

The project scope enables the development and demonstration of a metering system that can be utilised on a 100% hydrogen network. The project will enable the deployment of 100% hydrogen into gas network NTS assets and is targeted to be implemented in the Project Union Hydrogen Backbone. At present there are no metering technologies approved for use on a hydrogen system, this project will demonstrate the capability of 100% hydrogen and provide a basis for further testing of other hydrogen/natural gas blends.

The measurement of gas is a key requirement for both monitoring our network systems but also for recording ingoing and outgoing gas and therefore enabling charging of the customers. Accuracy is important and each metering system is calibrated for the gas composition it is likely to see. In the net zero transition as gas composition changes the metering systems will need to be upgraded and replaced to enable these new blends to be measured as is done today with natural gas. Using ultrasonic systems similar to those seen on the network today will reduce the cost associated to the transition of these systems.

The key benefit of this system is the enablement of the measurement of hydrogen networks in the future, this is a required task but there are no systems on the market today to resolve this. The prototype system developed by SICK could provide a solution that is easy to roll out due to its similarities to those systems already in use.

The scope of work will include the following:

- Feasibility and technical assessment of 100% hydrogen metering systems
- Design, fabrication and installation of a new skid comprising of three meters: one turbine and two ultrasonic meters
- Design, fabrication and installation of a new metering kiosk comprising of flow computer racks and supervisory station

· Procurement of meters and flow computer(s) required

· Calibration of meters in series to enable testing of relative performance

· Configuration of flow computers

· Integration of skid and kiosk into FutureGrid site, with all required connections to support assets

· Testing regime demonstrating metering in 100% Hydrogen

Technical reports of design, fabrication and results of meter testing to be produced for sharing with wider energy industry for NIA requirements

Objective(s)

The following objectives will be sought through the project:

- Determine the optimum metering solution for ~100% hydrogen gas compositions

- To support the development of a 100% hydrogen metering system through application testing of a meter capable of measuring 100% Hydrogen alongside other metering technologies to assess its capability and accuracy

- To produce a technical report from the findings of all tests conducted during testing phase in this project, assessing the accuracy of the metering technology

To design and construct a metering skid and associated kiosk to enable application testing of the metering system, complete with metering assets

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 project will be deemed successful if:

· The project delivers objectives within time and cost parameters

· Study findings inform NTS Strategy for hydrogen metering

· A functioning test rig for metering devices, fitted to the FutureGrid Test facility, which enables repeatable assessment of hydrogen metering devices is created and validated

· The 100% SICK hydrogen meter is confirmed as suitable for use on the NTS in hydrogen applications at an appropriate cost to that seen for natural gas

Project Partners and External Funding

Gas Network – National Gas Transmission

Design & Fabrication - Kelton's Engineering

FutureGrid Facility Integration and Testing - DNV-GL

Ultrasonic Meter Supplier - SICK

Turbine Meter Supplier - Elster Honeywell

Potential for New Learning

The key output of this project is learning and knowledge in the differences in metering systems for hydrogen vs natural gas. The project

will demonstrate that a novel ultrasonic meter can provide accurate and validated meter data in an application setting. The development of the application test rig system will enable other meters in the future to be tested alongside validated systems proving their capability for use on the gas networks.

The learning from this project will add to the NTS Strategy on energy transition and inform the changes needed to ensure metering of a varying hydrogen gas blend. The output may also support and inform other gas networks. The data will be shared through the smarter network portal and provision made for other networks to utilise the metering application test system as appropriate.

Scale of Project

There is currently no method for metering 100% hydrogen networks, this is a requirement for the network to accept 100% hydrogen in the future. The Hydrogen backbone (Project Union) looks to provide gas to industrial clusters as early as 2026 through existing network assets. A solution is required for metering as these assets will need to be replaced in this transition and will need similar asset types and functionality to reduce the cost to the consumer of these changes.

This is a demonstration project, to be installed at the FutureGrid test facility. In order to reduce the cost of testing we are looking to align the system testing with the FutureGrid phase 1 test work and utilise the existing application demonstration site. This work will provide the required HSE safety evidence and a demonstration site is required to capture the required data.

Lab scale testing will not be able to demonstrate the full systems capability within our network and therefore an application-based scenario is required. Today there are no online network assets running with 100% hydrogen, therefore the only route is to utilise our offline application test facility.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

United Kingdom – Warwick and FutureGrid Facility (RAF Spadeadam)

Revenue Allowed for the RIIO Settlement

None – Hydrogen network focused project

Indicative Total NIA Project Expenditure

£927,431.74

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:

For the transition to hydrogen, the NTS will need to ensure hydrogen can be supplied to consumers reliably from producers. Metering is a key requirement for the gas networks and reliable, accurate data is required for any gas that is being transported. Up to 30% hydrogen can be accommodated with existing assets with a small change to the transducers of the ultrasonic meters. However, 100% hydrogen requires a novel ultrasonic solution not yet utilised on the networks. The project will provide the first step in determining the metering requirements for 100% hydrogen NTS supplier and determining whether the prototype system can be utilised at minimal cost in the transition.

After the initial testing period the testing rig can be reused for future test profiles with new devices as required.

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)

RIIO-1 Question N/A

Please provide a calculation of the expected benefits the Solution

Currently, gas networks are required to measure the volume and energy of gas flow within certain levels of accuracy (uncertainty) to ensure that, as network operators, there is a solid understanding of the energy balance in the UK and therefore consumers are billed accurately. Moving to a Hydrogen future, this level of accuracy will need to be maintained and measurement devices in use today on the network most likely will not be able to achieve this in Hydrogen or pure Hydrogen blends. The key benefits from this project are difficult to monetise at this time; however it will contribute to ensuring that on a Hydrogen network, we will have the right assets in place to enable accurate billing of consumers for their energy usage.

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

The project is focused on metering on the NTS, however the research and learning undertaken as part of this project is applicable to all GDNs within the UK as the networks will have the same gas composition and potential operational issues and so will assist with future Hydrogen conversion projects.

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

N/A – The Project does not intend to rollout anything, but knowledge and information generated through the lifecycle of the project. Consideration of the business case for the 100% hydrogen meter will be provided as part of the final report for 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 research and analysis undertaken in this project will be applicable to pipeline operators and will inform the strategy for hydrogen in the energy transition. Findings from the project will deliver new data for use to understand metering on gas networks of variable gas blends which can in-turn develop safe hydrogen standards and procedures.

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.

There will be no duplication of activities done as part of this project. The work undertaken by others has focused on metering device development. The project replicates the NTS network to test and understand these systems in operational settings. These efforts are to ensure the energy transition can be undertaken at as low a cost as possible to the consumer. The testing of the devices will be a bespoke regime unique to the conditions on the NTS.

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 100% Hydrogen Ultrasonic meter to be demonstrated and tested is a prototype system currently undertaken lab scale testing. The application testing of this system is the next stage in its development. There are no commercially available systems for 100% metering that could easily align to our current systems and capabilities. This system demonstration will enable us to verify the use of the 100% meter in our first application of hydrogen on the NTS network.

There is also a long-term benefit for future measurement innovation projects to be completed on the application rig at FutureGrid. This application rig is innovative in its own right because it is not possible to test Hydrogen-ready assets as part of business-as-usual activities on the National Transmission System. The FutureGrid facility is currently designed only to test existing assets from the network which limits the opportunity to test new meter systems which will be enabled by this project.

Relevant Foreground IPR

This project and the resultant outcomes/deliverables will conform to the default treatment of IPR as set out under the agreed NIA Governance (where the default requirements address two types of IPR: Background IPR and Foreground IPR).

The results of the tests will create knowledge around the capability of potential metering systems to support the NTS but will not create any new systems.

Data Access Details

Data for this project, and all other projects funded under the Network Innovation Allowance (NIA) funding scheme, can be found or requested in a number of ways:

· A request for information (RFI) via the Smarter Networks Portal at https://smarter.energynetworks.org. National Grid Gas Transmission regularly publishes much of the data arising from our innovation projects on the ENA portal, before submitting a RFI check this website.

· Via our managed mailbox box.GT.Innovation@nationalgrid.com. Further data can be shared upon request through the innovation mailbox. Each request will be assessed by the GT Innovation Team for its merits and viability.

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

Hydrogen metering devices have not yet been full developed nor tested to satisfaction on simulated operational network environments, therefore is a low TRL system with high levels of risk associated. There are also no NTS pipelines transporting hydrogen today that this work can be completed on. It is therefore relevant for NIA funding.

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

This approach is unknown and there are many routes that could be taken, there is a risk that without this work the different energy networks would spend time and money on carrying out the research and testing. The NIA funding reduces this risk and enables the feasibility of repurposing existing assets to be assessed.

This project has been approved by a senior member of staff

☑ Yes