SIF Project Registration

Date of Submission

Mar 2022

Project Reference Number

10022352

Project Registration

Project Title

Hydrogen Metering

Project Reference Number

10022352

Project Licensee(s)

National Gas Transmission PLC

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

Peter Martin - peter.martin@nationalgrid.com

Project Budget

£86,378.00

Project Summary

The project will test the feasibility, design and ultimately build metering installations attached to the hydrogen test facilities at Spadeadam(Futuregrid/H21) and will replicate metering systems across the whole gas transportation system through to industrial metering installations. The facility will;

- Provide valuable data on the compatibility of existing metering installations and ancillary equipment under hydrogen
- Support determination of repurposing costs
- Answer gas equation fundamentals
- Be a test facility for new innovative technology

This will provide consumers and networks assurance that data critical to their businesses will be accurate, supporting the transition to net zero at the lowest cost to society.

This project will bring together a number of industry experts:

National Grid Gas; Metering, with an extensive background and experience in metering across a large number of industrial users, for design, build and operation, will lead on the project working closely with representatives from

Gas Transmission, including John Wilson, Gas Metering manager -- who brings a wealth of metering knowledge from the last 30 years and was involved in the original metering requirements for the gas industry. Both will provide repurposed assets where appropriate for the build of the test facility.

Northern Gas Networks will provide key stakeholder requirements of metering needs from a distribution perspective as well as specification requirements for tying into the H21 facility.

DNV as an independent technical specialist and who oversee the Spadeadam site will bring expertise across a wide range of areas

including, safety assessments, feasibility studies, build, design etc and will provide strong support across all stages of the project.

IGEM will provide expertise in industry standards that all the networks and wider equipment providers use to ensure safety and performance of assets, including metering installations. These standards will be assessed and tested through the project, enabling specification and standards to be amended to ensure hydrogen compatibility.

Each partner has been selected as they have a deep understanding of metering processes across the whole gas transportation chain as well as the capability to support feasibility, design, build and operate requirements.

This facility will specifically look at metering applications used by UK network operators and critical industrial and commercial users in a way that combines end consumer and network requirements and which utilises the considerable metering expertise from the partners above. This will support delivery of the next generation of user driven digital products, services and processes spanning transmission and distribution.

VIDEO : https://www.youtube.com/watch?v=slkav6q_Xik&list=PLrMOhOrmeR6ktSag0RbT7zPNVn0p1P2f6&index=25

Third Party Collaborators

DNV

Institution of Gas Engineers and Managers

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

What is the problem that you are trying to solve?

A key part of the evidence for transitioning the gas network to hydrogen is to ensure that metering and ancillary assets (e.g. regulators etc) across the gas system can safely and accurately measure the energy, flow and volume of hydrogen transported to end consumers.

This will provide a fair and accurate hydrogen/gas transportation system which will provide vital assurance on fiscal accuracy for industrial users and network operators alike, supporting consumer uptake and our net zero future.

Metering in the Networks

Both the National Transmission System (NTS) and the Gas Distribution Networks (GDNs) rely on accurate metering under a range of operational conditions to measure the energy that enters/exits their networks. This is critical for accurate billing and physical network management. The metering that exists today is varied across the networks and uses a wide range of technologies for their applications which are built upon metering fundamentals derived for natural gas, under GS(M)R.

Hydrogen and hydrogen blends are likely to test the suitability of those assumptions as well as the suitability of the various metering technologies employed today.

Metering to the Consumer

In the UK there are c890k industrial and commercial metering installations that provide vital last mile services, connecting consumers to the UK gas networks. Usage in this context represents 17% of UK carbon emissions. These installations meter gas to high levels of accuracy whilst also delivering the required pressure and temperature for consumers. Large variances in technologies are used to meter gas usage and factors such as the complexity of installations, pressure, size, and consumer requirements will need assessment under hydrogen to support a gas grid transition.

The Opportunity

There is an opportunity to close a gap in the current hydrogen trials to; test the feasibility, design, build, commission and operate transmission, distribution and industrial metering installations with hydrogen under real world operational conditions at the Futuregrid and H21 facility at Spadeadam. This will provide vital cost and safety data on metering assets and ancillary equipment under hydrogen scenarios. This future metering facility will provide cost data on the repurposing of existing network and last mile metering for hydrogen in a whole system context and will test new technology to enable new innovate digital technologies.

This will answer a key part of the evidence to demonstrate hydrogen is safe and cost effective for use in the existing gas system and that hydrogen can be metered accurately and robustly.

Project Approaches And Desired Outcomes

The Big Idea

To enable the successful decarbonisation of the gas grid, networks and metering providers must be able to safely and accurately measure the flow, volume and energy of hydrogen transported in order to give large end consumers the confidence to transition away from natural gas.

Supplementing the Futuregrid and H21 facilities at Spadeadam we propose to build a set of metering installations that will replicate network and industrial operational conditions.

This future metering facility will offtake hydrogen from the futuregrid facility at transmission pressures, which will then feed a transmission metering test installation. The pressure will then be reduced and feed into a number of downstream metering installations, replicating distribution network and industrial metering systems. Installations will be made of refurbished transmission, distribution and industrial metering assets, including ancillary equipment such as regulators and instrumentation etc. It will also enable the testing of new products which can be assessed for hydrogen compatibility and performance supporting new digital technologies.

The proposed facility would check meter performance both in series and parallel configurations providing the opportunity for in-depth testing of metering fundamentals on hydrogen, answering important questions on how gas networks and last mile connections would operate.

The installations beyond the transmission metering facility will contain three levels of smaller metering units of different pressure levels -- High Pressure (\>7bar), Intermediate Pressure (2-7bar), Medium pressure (75mbar -- 2 bar), Low Pressure (<75mbar). These installations will test different metering types and equipment, therefore ensuring that testing of equipment at all gas system pressures and meter types is undertaken to provide evidence for to support transition.

Installations will be tested on various blends of hydrogen/natural gas (2%/20%), as well as full hydrogen (100%)

The build and test of the facilities under hydrogen will discover:

- Fundamentals of metering equations, e.g. compressibility factors and relative errors (for accuracy suitability)
- Compatibility of materials used in metering installations (meters and regulators etc)
- Accuracy and performance of types and variants of metering and associated equipment for example: Turbine, Ultrasonic, Rotary and Diaphragm, regulators, instrumentation etc
- Proposed new meter types such as Thermal mass flow, Nuclear Magnetic Resonance etc Associated equipment e.g. pressure reduction equipment, instrumentation
- Assessment of key legislative safety requirements e.g. DSEAR etc
- Assessment of key industry standards and suitability with Hydrogen

An initial feasibility study in the discovery phase will confirm the costs, suitability of existing assets and supply chain readiness for the build of this facility.

Innovation Justification

A large number of projects at various stages are proposed or underway with much of the focus rightly on the safety and compatibility of assets under hydrogen in the current gas transportation system.

There is a gap in looking at specific metering fundamentals under the hydrogen scenario projects, especially given the large number of technology types and variations of meters across the gas network. National Grid Gas, NGM and GT have a high number of variants of meters across their asset portfolio as do Northern Gas Networks, this is likely to be replicated across the other GDNs.

Then first page of the attached appendix provides a summary of the projects funded by government and led by networks. While some studies have looked at the safety of metering assets, none have looked at the fundamentals of metering in operational conditions or provide a facility for the wider assessment of metering variants and new technology for consumer and network benefits. From a cost perspective it is not realistic to expect that the current industry data can provide the level of granularity required to provide assessment of costs and risk for the repurposing of assets.

The second page gives visual examples of some of the types of meters, assets and installations Future Metering would look to test and/or replicate in it's facility. As the visuals demonstrate, some of the installations have a reasonable level of complexity and with that,

the need to ensure these are tested and validated under hydrogen conditions. Future Metering has the potential to answer a huge range of questions associated with the wide variance of metering technology and ancillary equipment in hydrogen, this is necessary to support a gas grid transition at the lowest cost to the consumer.

Project Plans And Milestones

Project Plan And Milestones

Phase 1 - Discovery Phase -- March 2022 -- April 2022.

This phase will focus on engaging stakeholders and gathering user requirements, assessing assets for repurposing and the supply chain and industry standards and then deriving the functional specification and producing a feasibility study which will output options, costs and risks for the eventual build of the facility and subsequent testing of the assets.

This phase will be set into 4 areas:

1. Start-up and Stakeholder Engagement - Led by NGG - GT/NGM
   This phase will design the data requirements and then engage with all stakeholders across the gas transportation value chain, transmission through to consumers and industry regulators. These will include; industrial user, network operators, regulators (Ofgem/BEIS), energy suppliers etc.
2. Manufacturer/Supply Chain Engagement - led by NGG - GT/NGM
   This stage will engage with meter and equipment manufacturers who operate within the scope of this project. NGM will run a Request for Information (RFI) to gather data for the assessment of manufacturers of hydrogen compatible metering equipment that can be used to create a series of new installations, with the potential to test new technology. This phase will output information for the assessment of costs and equipment available.
3. Information Gathering and Risk Assessment Stage -- GT/NGM/DNV/IGEM
   This phase will perform risk assessments against industry and legislative requirements using the known effects and properties of hydrogen against the requirements in those standards. This will derive constraints and risks for the feasibility study to look at potential solutions and updates to standards. Key engagement will also be held with the Future Grid and H21 projects at the Spadeadam site for technical information.
4. Technical Study and report development - DNV - GT/IGEM/NGM
   This phase will be led by DNV and will review all the information to provide options for further design, project risks, costs, testing considerations and output objectives against which the overall project can deliver. This report will be submitted to enable consideration of the next phases of the project.

At this stage key risks identified are documented in the attached risk assessment

Further Stages:

Alpha

This will be the detailed design phase, again engaging with key stakeholders and networks as well as choosing an option and providing detailed requirements for the procurement and build of the facility.

Beta

Will contain the procurement, build and test of assets which will then be tested on the various hydrogen blends.

Route To Market

The project will involve close collaboration with stakeholders across the whole gas transportation and metering value chain to ensure that solutions chosen and built are either existing assets or new assets that are, or close to being market ready (we may test prototypes/samples if appropriate) and will meet all the existing certification requirements where appropriate.

Through IGEM, an integral partner in this project, feasibility studies and eventual build and test data will feed into gas industry standard development. These standards will then be available to the whole gas industry and will provide valuable guidance for use by any organisation wishing to provide or operate hydrogen metering installations.

This approach will ensure that the learning, knowledge, information and expertise gained from this project is embedded into the wider gas and metering markets that will;

- Support competition
- Provide comfort to industrial users on the maturity of hydrogen metering and the wider market
- Enable smaller energy and metering equipment providers to participate in hydrogen meter markets without the need to do expensive testing

New technology and products will be tested as appropriate and information fed back to manufacturers for inclusion in future product

amendments which will be released to wider markets. This will facilitate new digital innovations but will, importantly, maintain the suitability and safety of products to be used under hydrogen scenarios on the gas grid.

Costs

Total Project Costs

86378

SIF Funding

86378

This project has been approved by a senior member of staff

☑ Yes