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

May 2019

Project Reference Number

NIA_CAD0039

Project Registration

Project Title

Long Term Asset Reliability Study for Hydrogen Blended Gas

Project Reference Number

NIA_CAD0039

Project Licensee(s)

Cadent

Project Start

May 2019

Project Duration

1 year and 11 months

Nominated Project Contact(s)

Cadent Innovation Team

Project Budget

£186,000.00

Summary

The real-world long-term reliability of network and domestic assets when distributing, or fuelled by, hydrogen blended natural gas, cannot easily be explored in a short-term laboratory experiments. This project is therefore needed to design and install equipment to operate on a network operating with blended gas, which will allow long-term reliability to be explored in both a domestic and network context.

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The role of hydrogen blended natural gas up to 20 vol% is likely to form a foundational step in decarbonising the gas network and provide a pathway to deeper carbon savings to ensure regulated UK emissions reduction targets are achieved. The scientific and exploratory work undertaken as part of HyDeploy demonstrated that the assets due to be exposed to a blend gas containing up to 20 vol% hydrogen will not experience a reduction in performance or increase in operational risk over the course of the 10-month trial. To enable wider adoption and acceptance of hydrogen blended gases, longer term asset reliability evidence is required, as any incremental implications due to potential degradation mechanisms promoted by blended gas will require pro-active mitigation via OEM engagement.

Alongside OEM and consumer acceptance of hydrogen blended natural gas, operational robustness must be evidenced across all likely network operational modes to provide GDNs with confidence that the integrity of network assets will not be compromised due to hydrogen blending. This confidence gaining exercise will have to be set with the context of real-world operations to ensure operational variables associated with actual operations are accounted for.

Method(s)

The real-world long-term reliability of network and domestic assets when distributing, or fuelled by, hydrogen blended natural gas, cannot easily be explored in a short-term laboratory experiments. This project is therefore needed to design and install equipment to operate on a network operating with blended gas, which will allow long-term reliability to be explored in both a domestic and network context.

The proposed methodology for domestic asset works is as follows:
1. Engage with boiler OEMs through collaboration with HHIC to identify components of interest,
2. Develop a technical specification for domestic boiler installation,
3. Baseline performance of boilers and undergo audit testing,
4. Install domestic boilers in a commercial boiler house to operate on an accelerated duty mode,
5. Return boilers to OEMs to repeat performance and integrity testing,
6. Aggregate performance information and disseminate findings to stimulate the market.

This work will have assessed the performance and long-term integrity of domestic boiler components to facilitate product development programmes and ensure any long-term effects are understood, quantified and if necessary mitigated.

The proposed methodology for network asset works is as follows:
1. Engage with gas detection manufactures to undertaken technical options for monitoring,
2. Design and install an online compositional measurements on representative network pipework,
3. Vary operating conditions with blended gas from full flow to stagnant gas and monitor fuel composition.

This work will have provided the evidence base to inform operational network models of any expected operational changes due to the introduction of hydrogen blended gas, across the spectrum of operational conditions expected of a gas network.

Scope

It is predicted that in the future hydrogen blended natural gas will be commonplace for gas network operators and downstream consumers. Therefore, it is critical that confidence can be gained across the full supply chain of stakeholders from OEMs to networks to consumers, that assets are fit for purpose in the long-term when exposed to hydrogen blended natural gas.

The scope of the domestic boiler element of the project will cover:
• A review of domestic boiler internals in collaboration with OEMs and facilitated by HHIC to identify specific components of interest within boilers where the introduction of hydrogen blended natural gas could impact long-term performance.
• Development of a testing specification to allow representative domestic boilers to undergo accelerated testing under real-world conditions.
• Development of a rigorous testing specification to baseline boiler performance and component integrity prior to undergoing accelerated testing, to be repeated following the testing to provide evidence for analysis.
• Anonymise performance information across boilers, aggregate information and disseminate to domestic boiler industry to highlight any areas of concern for which product development will be required.

The scope of the network asset element of the project will cover:
• Development of real time monitoring specification on network pipe.
• Development of operating mode testing regime to simulate the range of likely flow conditions network pipelines undergo.
• Analysis of relationship between flow conditions and pipeline composition over full range of expected operating modes.
• Review of network integrity models to ensure any dependency between flow condition and pipeline composition is incorporated to allow proactive management.

Objective(s)

This work will culminate in the development of dissemination material to inform boiler OEMs and in development of network model to be ‘blend ready’.

The work will seek to:
• Inform the domestic boiler supply chain of focus areas to facilitate widespread adoption of hydrogen blending,
• Stimulate the boiler market to drive innovation,
• Inform network models of any expected ‘blending effects’ to ensure they are fit-for-purpose.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project can be summarised as follows:
• Safe execution of testing programme,
• Development of robust testing criteria to allow accurate assessment of project focus areas,
• Stimulation of domestic boiler market to promote collaboration and innovation to the benefit of future consumers,
• Ensuring network models are fit-for-purpose and have incorporated any potential compositional effects due to the introduction of blended gas

Project Partners and External Funding

Cadent and Keele University

Potential for New Learning

Presently evidence has been gathered to allow the short-term (<1 year) assessments of domestic boiler performance to be made, which has demonstrated no increase in operational risk resulting from the introduction of hydrogen blended gas. This evidence base must be extended to long-term assessments, in collaboration with domestic boiler OEMs, to ensure consumer products are fit-for-purpose. Alongside this, evidence has been gathered as to the expected composition of idealised gas. This evidence base must be extended to incorporate real-world conditions across the breadth of standard flow conditions networks operate in.

This project will draw upon knowledge from domestic boiler OEMs, gas industry experts and trade bodies to provide a springboard for innovation through collaboration and ultimately stimulate markets to the long-term benefit of consumers. Alongside this, this project will allow an in-depth and rigorous review of network models to be undertaken to ensure network operators can accurately and robustly predict performance under a blended gas operation.

Scale of Project

The budget requested will enable equipment to be safely designed, installed, operated and decommissioned to enable rigorous evidence to be collected. A collaborative approach will be taken with all OEMs and equipment suppliers to minimise cost to the project, such as leasing equipment for the experiment duration instead of purchasing, and requesting equipment to issued free-of-charge where available. A reduced budget will limit the ability to conduct experimentation of sufficient quality to inform both networks and industry, and could ultimately lead to repeated works to develop the necessary evidence base.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Not applicable

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

Total Cost - £186,000

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:

n/a

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)

If a hydrogen blend can be injected into the network at 20% volume this could generate 6TWhr per annum of low carbon heat and save the consumer £8 billion per annum compared to the equivalent heat from air source heat pumps. The quantity of low carbon heat provided by blended hydrogen is potentially greater than the Renewable Heat Incentive (RHI) has delivered to date.

The principal benefits of this project are to ensure domestic gas boilers are fit-for-purpose in the long-term and ensure network forecasting remains robust and accurate following hydrogen blending.

Please provide a calculation of the expected benefits the Solution

There is no direct cost saving as a result of this project as the project is a demonstration. The project is designed to provide the necessary evidence required to ensure long-term performance of consumer appliances and network models.

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

Network model learnings could be rolled out across all gas network operators and boiler performance learnings would be of benefit to the approximately 25 million consumers who utilise a gas boiler to heat their homes.

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

The purpose of hydrogen blending is to deliver carbon savings without requiring modification to either consumer or network assets. This project seeks to establish further basis for this. In terms of the wider costs of adoption (hydrogen production etc.), these have been factored into the £8billion savings identified above.

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

It is envisaged that in the near future gas networks will be distributing hydrogen blends of up to 20 vol% in their respective networks, therefore the learning from this project could have a direct impact to all network operators with regards to network models and operational forecasting.

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

This project will provide a crucial element of the necessary evidence base to facilitate hydrogen blending roll out and ensure the interests of consumers are protected and accounted for within the deployment of hydrogen blended natural gas.

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

This work forms part of the evidence base required to enable a blend of hydrogen across the gas distribution systems. Blended Hydrogen will be practically demonstrated for the first time since town gas via the HyDeploy project. This project therefore leads to no duplication.

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

It is extending the current evidence base to ensure domestic and network assets are fit-for-purpose for future deployment of hydrogen blends, therefore this information has not been a necessity until now.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

Hydrogen blends are not currently considered BAU for networks, therefore cannot be funded as a BAU 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

There are challenges in gaining the necessary evidence that current asset bases will be robust as the nature of gas changes, therefore innovation funding is required to explore these questions to ensure any necessary measures can be taken in a pro-active and managed manner.

This project has been approved by a senior member of staff

☑ Yes