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

Oct 2023

Project Reference Number

NIA2_SGN0043

Project Registration

Project Title

Hydrogen MOBs QRA and Testing Phase 3

Project Reference Number

NIA2_SGN0043

Project Licensee(s)

SGN

Project Start

October 2023

Project Duration

0 years and 9 months

Nominated Project Contact(s)

David Raymond

Project Budget

£833,955.00

Summary

There is a requirement for gas distribution network (GDN) operators to understand the cost, safety, and practicality of converting network pipelines from natural gas to hydrogen in Multi-Occupancy Buildings (MOBs). This phase of the project will carry out a Quantitative Risk Assessment (QRA) of domestic MOBs detailing the steps needed to convert a range of different MOB types as well as testing to fill evidence gaps required for the QRA. This will act as part of Phase 3 in the ongoing project to investigate the conversion of MOBs from natural gas to hydrogen use.

Preceding Projects

NIA2_SGN0023 - Hydrogen MOBS Data Analysis Phase 1

Third Party Collaborators

ROSEN

DNV

ICS Consulting Ltd

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Most of the research focus on hydrogen to date has targeted on smaller, simpler end user systems (e.g., simple one and two storey dwellings) but there is a need to understand hydrogen as applied to Multi Occupancy Buildings (MOBs). MOBs connected to natural

gas represent a significant portion of domestic dwellings (a proportion of which are classed as vulnerable customers) and non-domestic buildings. It has been estimated that flatted properties make up 21% of the UK's domestic heat load. GDNs need to fully consider these properties and make an assessment for likely conversion opportunities.

To understand conversion opportunities, a Quantified Risk Assessment for hydrogen MOBs conversion is required to compare the safety and practicality of converting MOBs from natural gas to hydrogen. This will require testing to fill evidence gaps identified from Phase 2 of the MOBs project and will provide the basis for recommendations for an interim standard for MOBs conversion to hydrogen in Phase 4.

Method(s)

This phase of the project will solve the problem detailed above by:

1. Expanding the functionality of DNV's existing CONIFER model from houses and small blocks of flats to all domestic MOB types.

Risk predictions will be made for input into the Great Britain Quantified Risk Assessment (QRA) and to allow the major risk contributors to be identified. This initial set of risk estimates could be quite high level and include relatively simple assumptions in places, in order to produce preliminary results quickly. DNV has already produced two models for risks posed by natural gas infrastructure in high rise buildings (one fully predictive, another giving relative risks for different configurations) and features of these models will be incorporated into CONIFER as appropriate.

A methodology workshop will be completed where all relevant stakeholders will agree the approach to modelling MOBs. This will ensure that the approach will deliver the required outputs, but also highlight any additional information that would improve the modelling.

2. Building site surveys

Surveys will be carried out for a sample of buildings (up to 25 in total) of various age and construction methods to:

a. Identify issues specific to building types/architectures and gas installations that could affect a conversion to hydrogen and

b. Collect data that will feed into the development of the QRA, the analysis of network capacity, the assessment of ventilation of enclosures, ducts and dwellings, and the assessment of fittings present in gas installations in MOBs.

3. Testing to fill MOBs evidence gaps

Evidential work will be completed to fill the evidence gaps identified in the Document Landscape Review completed in Phase 2 of the MOBs project. Testing will fill evidence gaps in:

- Network Pipeline Capacity
- Ventilation of enclosures, ducts and dwellings
- Assessment of fittings
- Influence of hydrogen on network installation and maintenance activities
- Combined effects of hydrogen and thermal loading on material integrity
- Electrical safety
- Fire protection measures
- Commissioning and decommissioning

4. MOB data enhancement

As recommended in the Asset Portfolio Characterisation Report in Phase 2 of the MOBs project, an enhancement of the MOBs data will be completed. This will be done through the purchase of commercial datasets and further analysis of available data. This will support the modelling of the QRA. MOB attributes that will be acquired as part of this data enhancement include:

· Premise Age.

· Premise Use.

· Premise Type.

· Premise Floor count

· Premise height.

· Basement.

· Listed Grade.

· Wall type.

· Substructure type

5. Developing a Quantified Risk Assessment (QRA) of MOBs

This will be done by improving the modelling relevant to major risk contributors and will take account of any information that becomes available through testing completed as part of this project or other industry projects.

The assessment will include MOBs receiving typical natural gas and 100% hydrogen, to allow a direct comparison between the risks posed by the two gases.

Risk mitigation measures will be investigated for the hydrogen case. The purpose of this will be to determine the levels of risk reduction achieved based on the current assumptions of effectiveness for each measure. This phase of the project will not recommend any particular measure or combination of measures, although these results can contribute to that decision.

The QRA will differentiate between different building configurations, likely based on factors such as

· Building type (number of storeys, number of individual flats, presence or absence of basement etc.)

· Gas supply (type of main and service to the building)

· Gas infrastructure configuration (gas to an 'energy centre' that supplies heat to the whole building, or gas supplies to each flat, the location of riser etc.)

Scope

The Quantified Risk Assessment (QRA) will apply to all MOBs in the UK. For this project a MOB is defined as a building that contains three or more domestic dwellings and/or commercial units with one or more meter points within the building. The QRA will include network pipelines and pipework downstream of the ECV.

Objective(s)

· Develop a Quantified Risk Assessment (QRA) model for 100% hydrogen to compare against natural gas

· Enhance MOB data through commercial datasets

· Carry out building site surveys for a sample of buildings (up to 25 in total) of various age and construction methods to:

a. Identify issues specific to building types/architectures and gas installations that could affect a conversion to hydrogen and

b. Collect data that will feed into the development of the QRA, the analysis of network capacity, the assessment of ventilation of

enclosures, ducts and dwellings, and the assessment of fittings present in gas installations in MOBs.

· Investigate whether the diameter of existing risers and laterals is adequate to supply the energy required with hydrogen.

· Investigate the effects of an increased flow rate, velocity, or increased pressure (pipe integrity), should it be required to meet the demand without increasing the diameter of risers and laterals. This will consider the effect of altitude on hydrogen riser systems, the pressure drops from existing fittings and additional safety devices installed (e.g. excess flow valves) and the minimum pressure required to ensure safe operation of hydrogen appliances.

· Determine ventilation requirements for meters, risers and laterals inside buildings.

· Investigate the feasibility of adding ventilation to buildings which will need to be positioned so as not to compromise fire safety if located in a fire compartment.

· Determine ventilation requirements for typical meter banks and energy centres with hydrogen and how they compare with ventilation requirements for natural gas.

· Investigate the feasibility of adding ventilation to existing enclosures

· Determine ventilation requirements for typical ducts with hydrogen and how they compare with ventilation requirements for natural gas

· Investigate the feasibility of adding ventilation to existing ducts.

· Confirm compatibility and functionality of materials and fittings typically used in MOBs with hydrogen.

· Assess the feasibility of continuing to use the current jointing and repair systems for riser networks if they are repurposed to carry hydrogen

· Investigate the effect of hydrogen on material integrity when steel pipe and fittings are subject to thermal loading.

· Confirm whether the material, diameter and height limits for approved jointing methods remain acceptable with hydrogen

· Confirm whether the minimum allowable wall thickness remains adequate with hydrogen

· Confirm whether the standards to which the electrical equipment has been specified related to natural gas or any flammable gases and whether they are affected by the fact hydrogen is a gas group IIC?

· Investigate whether the currently required separation distance between natural gas pipes/meter and electrical equipment remains the same with hydrogen.

· Check the applicability of the maximum permitted leakage rate of pipework components following a fire test with hydrogen.

· Confirm the applicability of the test temperature of 650°C (currently specified in BS EN 1775 and which corresponds to the self-ignition temperature of a natural gas / air mixture) with hydrogen auto-ignition temperature.

· Update IGEM work to incorporate latest findings from ongoing work for 100% hydrogen (including test duration, equipment accuracy and allowable leak criteria).

· Confirm whether the existing procedure for the direct purging and indirect purging of network pipelines and laterals in MOBs currently used with natural gas are suitable with hydrogen.

· Investigate whether hydrogen would affect the potential noise, smell and flammability that may be generated from a purge operation in MOBs.

· Identify the risks associated with venting hydrogen including the likelihood and consequence of ignition during purge operation of network pipelines and laterals in MOBs compared to natural gas.

· Identify variables which will allow the grouping of MOBs; variables will include both building characteristics (type, architecture, age and height) and gas installations (external vs internal risers and laterals, above vs below ground entry into the building, meter bank, energy centre and gas usage)

· Determine for each group risk profile, feasibility and costs of conversion.

· Consider the safety of hydrogen in MOBs vs alternatives and provide overall recommendations for the suitability of hydrogen versus alternatives with potential split between different categories of buildings

· Identify subsets of MOBs which are unsuitable for hydrogen conversion, or which do not easily fit into generic assessments.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

MOBs connected to natural gas represent a significant percentage of domestic dwellings (a proportion of which are classed as vulnerable customers) and non-domestic buildings. To understand conversion opportunities, GDNs must complete a Quantified Risk Assessment (QRA) to identify safety impacts compared to natural gas.

Success Criteria

Deliverables for the following topics are given below:

Data Enhancement

· Enhanced MOBs data dashboard

Development of Quantified Risk Assessment (QRA)

· Phase 1 – Interim report summarising the outcome of the workshop and review of the evidence supporting the methodology used for the development of the QRA.

· Phase 2 – Final report including review of the results of the QRA testing on a sample of building types.

Building Surveys

· A survey proforma detailing the data required.

· Building matrix to demonstrate that the buildings selected for the surveys cover the variables considered

· A technical report summarising the data collected by the surveys.

Network Pipeline Capacity

· Final report detailing results from analyses.

Ventilation

· Final technical report will also include the review and assessment of the applicability of the NIA-WWU_2_12 ventilation within building work to MOBs.

Material and fittings

· Final report including results from the assessment of assemblies using H21 method and recommendations based on mitigations from HSE report.

Influence of hydrogen on network installation and maintenance activities

· Pre-test set-up.

· Final report summarising results from testing.

Combined effect of hydrogen and thermal loading on material integrity

· Technical report summarising materials properties for materials considered, stress results for all load cases considered and combined effect of 100% hydrogen and thermal loading on material integrity.

Electrical safety

· Technical report detailing the review and assessment of the applicability NIA_WWU_2_13 EUSE Hazardous areas within buildings and NGNG_NIA_346 ATEX Equipment & SR25 Modification Assessment projects to MOBs with a particular focus on the suitability of the currently specified distances between gas and electrical installations with hydrogen.

Fire protection measures

· Technical report summarising assessment of applicability of maximum permitted leakage rate following a fire with hydrogen.

Pressure testing

· Technical report confirming applicability of test pressures and maximum permitted leakage rate with hydrogen in MOBs.

Commissioning & Decommissioning

· Review and comment on Steer Energy's 'Purging MOBs' project, with outcome to be included in the final WP3 report.

Final Work Pack 3 Report

· Final report detailing key differences between MOBs with their associated risk profile, feasibility and cost of conversion, along with any groups of MOBs identified as being unsuitable for hydrogen conversion or which do not fit into generic assessments.

Project Partners and External Funding

- ROSEN (UK)
- DNV Services UK
- ICS Consulting

Potential for New Learning

The project will produce a Quantified Risk Assessment (QRA) for hydrogen in MOBs to compare against a natural gas base case. The QRA will be essential to help GDNs understand conversion opportunities in MOBs. New learning will be posted on the ENA Smarter Networks portal.

Scale of Project

This will be a desktop study, with regular engagement between SGN and the project partners. This is a Quantified Risk Assessment covering MOBs across Great Britain prior to the follow on engineering and technical assessment of potential physical conversion changes required (at scale) for MOBs, against a defined population delivered from this work.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The output of this project will be a Quantitative Risk Assessment (QRA) covering MOBs across all GDN areas in Great Britain.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

SGN External - £833,955.00

SGN Internal - £277,985.00

Total - £1,111,940.00

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:

To understand conversion opportunities, GDNs must be able to compare safety of converting MOBs to hydrogen compared to natural gas. This will require a Quantified Risk Assessment (QRA) of MOBs to identify conversion opportunities. The project will produce a QRA applicable to all MOBs across GDNs in Great Britain.

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

Not applicable at this stage.

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)

Not applicable

Please provide a calculation of the expected benefits the Solution

Not applicable

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

The output of this project will be a Quantified Risk Assessment applicable to all MOBs across GDN areas in Great Britain.

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

Not applicable at this stage

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 output of this project will be a Quantified Risk Assessment applicable to all MOBs across GDN areas in GB.

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

Not applicable

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 project has been reviewed against other projects with collaboration and regular engagement between all GB Gas Networks.

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

This project feeds into the similar Cadent led ‘GB QRA’ project to provide a QRA that covers all of GB

Additional Governance And Document Upload

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

The output of this project will be Quantified Risk Assessment of all MOBs across GDN areas in GB in preparation for conversion of gas networks to hydrogen

Relevant Foreground IPR

Not applicable

Data Access Details

Any consumer data gathered throughout this project will be anonymised and will be compliant with General Data Protection Regulations (GDPR) and the UK Data Protection Act. Any compliant data can be made available for review upon request.

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

The project is carrying out research and development on an emerging technology. This technology is at a low technology readiness level and as such it is not part of the usual activities of the business.

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

The NIA framework offers a robust, open framework to support this work and ensures the results are disseminated to all licenses. The project will produce a Quantified Risk Assessment to enable an understanding of conversion opportunities in MOBs.

This project has been approved by a senior member of staff

- [x] Yes