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NIA Project Registration and PEA Document

Date of Submission

Apr 2024

Project Reference Number

NIA2_SGN0055

Project Registration

Project Title

Consequence Assessment of Internal Domestic Pipework Depressurisation

Project Reference Number

NIA2_SGN0055

Project Licensee(s)

SGN

Project Start

April 2024

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Houra Mozaffar

Project Budget

£89,100.00

Summary

This project aims to assess the depressurisation of domestic pipework and entrainment of oxygen into the pipework after depressurisation. By undertaking the experimental work we aim to understand this depressurisation rate during the process, and at what stage and up to what extent the oxygen ingress may occur in the pipe.

In addition to the test work, the project will present potential mitigations to prevent health and safety risks to the end user and safe methods/procedures to reinstate gas in the pipework after such depressurisation. It also investigates whether and how to disable a gas appliance and/or the gas supply after the supply has been shut off.

Third Party Collaborators

Kiwa

Nominated Contact Email Address(es)

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Problem Being Solved

There are instances where the domestic gas supply is isolated. An example of this is when a prepaid meter runs out of credit and automatically turns off the gas supply by closing an internal valve. If any appliances are running at this time, they will react to low gas pressure. If the occupant is away, it is likely that only the boiler would be running periodically. If a prepayment meter activates in this scenario, the boiler is expected to continue operation until it registers the low gas pressure, likely around 17 mbar. At this point, the boiler will stop operating and isolate its gas supply. As the resident is away, there are no other uses of gas in the property e.g. cooking, therefore once the boiler gas valve is closed, the full gas system within the property is isolated between the meter and the appliances (boiler/cooker).

After the gas is isolated (as described in the example above but other scenarios possible) it is highly likely that the pipework will slowly depressurise over time. However, it is unknown how long this depressurisation period may be. If the pipework reaches atmospheric pressure, or even during the depressurization, there is potential for oxygen ingress into the pipework forming a flammable mixture inside the installation. If not mitigated this phenomenon could become a health and safety consideration at the time of reinstating hydrogen to the pipework and re-igniting the appliances.

Method(s)

To investigate this evidence gap an experimental programme has been designed using a pressure monitoring rig. The test work requires testing over extended periods of time as the investigation tries to answer with what rate and to what extent does diffusive mixing of hydrogen and oxygen occur in domestic size pipework.

In addition to the test it is aimed to present methods to reinstate gas in the pipework after depressurisation and/or to disable a gas appliance and/or the gas supply after the supply shut off period to avoid any potential risk to the end user.

Tasks within this project will be:

- Design and build of rig
- Undertake test work
- suggest potential mitigation techniques for this risk
- Report writing.

Scope

To help assess the depressurisation of domestic pipework and entrainment of oxygen into the pipework after depressurization, the following scope of work has been proposed:

1. To establish a baseline and determine the potential pressure drop and rate of this drop in a typical isolated domestic system, an initial test with minimal joints and no unusual fittings will be carried out (no oxygen sensors included). This will determine the status quo and any repeat tests can be compared to these initial results.
2. Following the pressure only test, oxygen sensors will be added to the pipework and a comparison of the pressure drop with the additional joints will be made. This allows for any artificial effect of the sensors (expected to be minimal) to be identified and investigated.
3. A series of tests will then be carried out (in agreement with SGN) to investigate the phenomena of depressurisation and oxygen ingress under different scenarios.

the following test programme is suggested, which will be discussed at regular intervals with SGN to ensure it still meets all requirements:

- Test 1 – Establishing the baseline. Extended pressure measurement with no oxygen sensors (to simulate a domestic pipework as would be found in a property) for a repurposed and a new Press-fit system.
- Test 2 – Extended pressure measurement with oxygen sensors for a repurposed and a new Press-fit system.
- Test 3 (optional dependent on findings in test 2) – Extended pressure measurement with oxygen sensors for a repurposed and a new Press-fit system, artificially reducing the pressure in the pipework to atmospheric and allowing oxygen ingress (through natural means) for the duration of the test period.
- Test 4 – Extended pressure measurement with a small (but known) defect/hole included in the system, using a repurposed and/or a new Press-fit system (tbc based on results of test 2).

Time for one additional test has also been incorporated, which will allow for further test work of discovered concerns and/or requests from SGN based on findings of performed tests.

Alongside the proposed test work it is aimed to present potential mitigations for this health and safety consideration and suitable methods to reinstate gas in the pipework after depressurisation and/or to disable a gas appliance and/or the gas supply after the supply shut off period. It is important to note that oxygen ingress into the pipework could lead to a flammable gas in the installation hence one main risk when relighting the appliance with an air/hydrogen mix could be potential of light back from the appliance. Hence,

offering solution to prevent this risk is also another important aspect covered as part of this scope of work.

Objective(s)

This project aims to assess the depressurisation of domestic pipework and entrainment of oxygen into the pipework after depressurization. By undertaking the experimental work we aim to understand this depressurisation rate during the process, and at what stage and up to what extent the oxygen ingress may occur in the pipe.

The project will also present potential mitigations and methods /procedures to reinstate gas in the pipework after such depressurisation. It also investigates whether and how to disable a gas appliance and/or the gas supply after the supply has been shut off.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Safety of the H100 Neighbourhood trial, which is highly dependent on the findings and recommendations of this project are a priority for the go ahead of such projects. Hence, understanding this risk and finding ways to mitigate it in customer properties, will ensure the safety of the users which can allow this trial to go ahead. The H100 Trial can produce vital evidence for the roll out of hydrogen across the UK hence replacing NG with a green and potentially cheaper source of energy for all consumers including vulnerable customers.

Success Criteria

The success criteria for the project are the delivery of the following:

- Design and safe execution of a test programme to understand depressurisation rate during the test period, and at what stage and up to what extent the oxygen ingress may occur in the pipe.
- Delivery of mitigation techniques for prevention or decreasing the likelihood of this phenomena in addition to offering safe methods for reinstating gas into the pipework and preventing any potential light back or damage to the appliances which can all be a health and safety considerations.

Project Partners and External Funding

While this project is led by SGN and is mainly funded through SGN and NIA, it is a collaborative work between all GDNs. All partners will share their relevant information to fill the gaps and assist with the effective delivery of the work. Furthermore, findings of this work can form the basis of other projects which may evaluate the issue further and beyond H100 requirements.

Potential for New Learning

The main learning from this work is to understand the depressurisation of domestic pipework, the rate of this process, and at what stage and up to what extent oxygen ingress into the pipework may occur.

Furthermore, this work will present potential mitigations to minimize this phenomenon and methods /procedures to safely reinstate gas in the pipework after such depressurisation.

Scale of Project

While one of the primary aim of this project is to tackle this issue for H100 Neighbourhood trial, understanding the phenomenon and finding necessary techniques for addressing it, is an essential requirement for enabling the safe use of hydrogen in customer properties in any future trial and for the roll-out of hydrogen across GB.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project aims to fulfil the whole of GB.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

Direct Project Cost: £89,100

Total Uplifted Cost: £118,770

Recoverable through NIA: £106,894

SGN Internal Net Cash Flow: £11,877

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:

This project is a vital enabler to the H100 Neighbourhood trial, which can considerably facilitate the energy system transition.

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

This project is vital for the safe delivery and use of gas in domestic properties therefore can benefit all customers including those in vulnerable situations.

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)

N/A

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 method offered in this project will be used as the basis of the procedure in H100 which will be the first 100% Hydrogen trial. Following the success of H100 this method can be replicated across all relevant properties in GB at the time of roll-out of 100% hydrogen.

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

Not Applicable

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

While SGN is leading this project for resolving this issue for H100, the insights gained from this project, form the basis of future relevant project and can benefit any network planning to transition its end user connections to operate on 100% hydrogen.

Knowledge gained from this work will be shared in meetings with representatives from all GDNs, while also being available to all relevant stakeholders through the ENA Smarter Networks Portal at <https://smarter.energynetworks.org/>.

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

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.

Due to the immediate need for the H100 Fife Neighbourhood Trial, SGN are leading on finding a solution to the newly emerged risk. Findings of this work will be shared with other GDNs which can be used as the basis of further investigations which may be required for other purposes following this work. The project has been discussed with the other networks showing what the immediate requirements are for H100 and all findings will be shared with all GDNs and key stakeholders to avoid duplication in any future project.

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

This project is a crucial facilitator for the innovative H100 Fife Neighbourhood trial project, and the consequences and mitigations for the depressurization of domestic hydrogen pipework and oxygen entrainment following that has not previously been investigated.

Relevant Foreground IPR

Not Applicable

Data Access Details

All the information and knowledge gained will be shared with other GDNs. Also, the information will be available to all relevant stakeholders to review through the ENA Smarter Networks Portal at <https://smarter.energynetworks.org/>.

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

This work is deemed an essential part of the H100 Neighbourhood Trial which is a key step towards conversion of the existing gas network to 100% hydrogen which is yet not a business-as-usual activity for SGN or any other GDN.

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 is a robust, open framework which can support the work and ensure the results which play an essential part on the roll-out of Hydrogen, are fully circulated to all licenses. The conversion of the GB gas network to 100% hydrogen is a key step on the road to net zero.

This project has been approved by a senior member of staff

Yes