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

Sep 2022

Project Reference Number

NIA2_SGN0027

Project Registration

Project Title

Ignition Probability in Small Services

Project Reference Number

NIA2_SGN0027

Project Licensee(s)

SGN

Project Start

September 2022

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Max Koronka

Project Budget

£93,700.00

Summary

The ignition probability of hydrogen has already been assessed in the H100 Hydrogen Consequence project, Hy4Heat and H21 projects however these have generally been in hydrogen rich atmospheres with the risk being a vapour cloud deflagration or detonation and less so on spontaneous ignition of hydrogen leaks which represents a less significant risk.

The objective of this Project is to gain a better understanding of ignition sources and ignition probabilities to determine the potential for hydrogen gas leaks to ignite immediately or
spontaneously in buildings associated with small services (i.e.domestic and light commercial).

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

BEIS have identified several end-user safety evidence gaps that must be fulfilled prior to final approval of the Hydrogen Village Trial. One gap was the immediate or spontaneous ignition of hydrogen gas during a leakage event within a small service building.

The ignition probability of hydrogen gas has already been assessed in the H100 Hydrogen Consequences, Hy4Heat and H21 projects. However, these have generally been in hydrogen gas rich atmospheres which consider the more significant risks of vapour cloud deflagrations or detonations and less so on spontaneous ignition of hydrogen gas leaks which represents a less significant risk. Current hydrogen gas trials such as H100 Fife utilise highly conservative risk mitigation measures identified from Hy4Heat to reduce the risk of gas leaks and ignition to as low as reasonably practicable in both upstream and downstream settings (e.g. meter box located outdoors, use of EFVs, use of flame failure devices, etc). However, implementing these measures for larger scale trials (such as the Hydrogen Village Trial) becomes exponentially expensive and impractical. Therefore, a programme of work is required to

further investigate this risk and assess if the conservative mitigation measures can be optimised.

Method(s)

The project will consist of:

1. A literature review surveying the properties of hydrogen and methane followed by a review of the environment and equipment likely to be found in buildings associated with small services.

2. An experimental programme which will include a simulated representative environment ignition source and hydrogen gas leak.

3. A probability study on ignition potential based on findings from the literature review and experimental programme.

Scope

The work is split into five work packs and scheduled for seven months.

WP1 - Set up and Project management

This would comprise the project setup and running, communications, and update meetings.

WP2 - Literature review

The literature review comprises two parts: the properties of hydrogen and methane and the environment and equipment likely to be found in buildings associated with small services.

Review gas properties

This work examines recent and relevant projects relating to relative ignition in hydrogen and methane. It will also examine the differences between methane and hydrogen in ignition likelihood.

Sources of information could include but not be limited to:

- H21 reports
- BEIS reports
- HyDeploy reports
- General literature

Review service environment

The second part of the literature review will examine the service environment. It will explore questions such as where and how are services run? Where do they terminate? What equipment and potential ignition sources are adjacent to services? And then the environment inside the properties supplied by these services and similar questions asked, such as where and how are downstream pipes run? What equipment/appliances and potential ignition sources are adjacent to these pipes? The study will also include a review of incident records with natural gas to determine the most likely/relevant scenarios for this hazard.

This work will inform the experimental evidence gathering and the probability study.

WP3 - Evidence gathering

This work package will form an experimental programme of works which could include a simulated environment such as a leaking pipework located next to an ignition source (such as an electrical component from a meter box or an appliance). The work programme will comprise a range of tests to get additional evidence to fill gaps identified in the literature.

Gas detectors will be used to first map out the gas concentrations within the environment in real-time, building up a picture of how the hazard develops over time with small and large leaks. Once the development of gas concentrations is understood, ignition sources could be added to identify the consequences of ignitions for different concentrations.

The work will likely build upon work carried out by DNV as part of the Hy4Heat and H21 projects, which looked at the build-up of gas concentrations in meter boxes and properties during leakage events. That work used gas sampling from a small number of set locations to draw out samples of gas from the environment under test, which will have had an effect on the environment itself. The tests

proposed here will use multiple ATEX rated sensor heads in the test environment to map out the change in gas concentration in real time.

WP4 - Develop relative probabilities

This work package looks to take in theory from the literature search and results from the experimental programme and use that to feed into a hazard identification process to quantify the relative risks of ignition in methane or hydrogen.

The ignition probability is a complex calculation involving the likelihood of release of the potentially flammable liquid/gas, the probability over distance of the liquid/gas being dispersed within the Upper and Lower Flammability limits, the probability of exposure to a live ignition source, and the probability of ignition given that it is exposed to a live ignition source. This then needs to be evaluated at a system level, accounting for all potential scenarios (leak locations, ignition source types and locations, dispersion parameters, etc.).

The purpose of this work pack is to identify and review, via a desk-top study, the existing data sources for similar equipment, locations and sectors to identify relevant ignition source probabilities for equipment in normal operation and fault/failure mode by assessing relevant causes of ignition and ignition modes. These ignition causes could be intentional causes where equipment is expected to possess an ignition mode under normal operations (e.g. producing hot surfaces, mechanical impact and friction, electric discharges, or hot gaseous combustion products) within the area of potential flammability. In addition, the ignition causes may also be unintentional and result from failure modes resulting in any of these characteristics that would result in a potential to cause ignition.

It is proposed that following an indicative site or environment survey, a hazard identification process using a combination of HAZID and FMECA or FTA be carried out for the illustrative area of interest to identify all potential ignition sources and ignition modes, both discreet and continuous modes. The potential generic causes of ignition will be considered in the context of equipment and facilities identified in the area of concern from the illustrative site survey within the identified lower and upper flammability (and, if required, explosive) limits. The probabilities of each ignition mode will be estimated based on the best available data identified through the literature review.

WP5 - Reporting

Reporting will include monthly updates and a final project report. Presentation results will also be fed into the EUSE group and disseminated to the wider hydrogen audience if required.

Objective(s)

The objective of this work is to determine the probability of spontaneous hydrogen gas ignition in a small service building environment. The evidence produced in this project will feed directly into a QRA being developed for the Hydrogen Village Trial and possibly subsequent large-scale hydrogen heating programs.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The project is required to directly fill an end user safety evidence gap, identified by BEIS, prior to approval of the Hydrogen Village Trial. A successful Hydrogen Village Trial has the potential to impact the roll-out of hydrogen gas as a form of energy for heating to current natural gas consumers and even those currently not connected to the gas grid. With current net zero targets and the rising price of natural gas, the success of the Hydrogen Village Trial will not adversely affect vulnerable customers. Moreover, a successful Hydrogen Village Trial could benefit consumers by replacing Natural Gas with a green and potentially cheaper source of energy.

Success Criteria

Delivery of a final report to fulfil requirements set out in project scope the end of Q1 2023. Feedback all outcomes to the End User Safety Evidence Working Group to provide supporting information for Hydrogen Village Trial bids and subsequent hydrogen heating projects.

Project Partners and External Funding

While this project is led by SGN and is mainly funded through NIA, its progress and outcomes are to be shared between all GDNs.

Potential for New Learning

The ignition probability of hydrogen gas has already been assessed in the H100 Hydrogen Consequence, Hy4Heat and H21 projects. However, these have generally been in hydrogen gas rich atmospheres with the risk being a vapour cloud deflagration or detonation and less so on spontaneous ignition of hydrogen gas leaks which represents a less significant risk. The probability of immediate ignition of such leaks is the main learning outcome from this project. The project may also reduce the requirement for highly conservative risk mitigation measures identified from Hy4Heat (e.g. meter box located outdoors, use of EFVs, use of flame failure

devices, etc).

Scale of Project

Around 1000-2000 properties are required to take part in the Hydrogen Village Trial. Current hydrogen gas heating trials such as H100 Fife utilise the highly conservative risk mitigation measures identified from Hy4Heat to reduce the risk of gas leaks and ignition to as low as reasonably practicable in both upstream and downstream settings (e.g. meter box located outdoors, use of EFVs, use of flame failure devices, etc). However, implementing these measures for larger scale trials (such as the Hydrogen Village Trial) becomes exponentially expensive and impractical. Therefore, this programme of work is required to further investigate this risk and assess if the conservative mitigation measures can be optimised.

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project aims to fulfil the whole of GB.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

Recoverable through NIA (Innovation): £112,437

SGN Internal Net Cash Flow: £12,493

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 enhances the safety case for using hydrogen as an energy source within a domestic environment. The project directly fills a gap identified within the hydrogen heating end user case for safety and is required prior to beginning the Hydrogen Village Trial. Success of the Hydrogen Village Trial will be a determining factor in the UK government decision for the potential role out of hydrogen and decarbonising the gas network over the entire GB.

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

With current net zero targets and the rising NG prices, the success of the HVT could benefit vulnerable consumers by replacing NG with a green and potentially cheaper source of energy and even provide an opportunity for those currently not connected to the gas grid to join the network and benefit from this clean energy source.

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

To achieve the net zero targets set by the UK and Scottish governments by 2050 and 2045 respectively, there are many different routes that are currently being investigated. However, the Hydrogen Village Trial which this project supports, can form the evidence of converting the existing GB gas networks to 100% hydrogen. This conversion has the potential to save millions of pounds with minimal gas customer disruption versus alternative decarbonisation solutions.

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

If the Hydrogen Village Trial is proved to be a success for rolling out 100% H2 as the replacement for NG across 2000 properties, it can be replicated in the Town trial which is expected to cover 10,000 properties. Following the success of the town trial, roll-out of 100% H2 can be replicated across GB.

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

The cost for the Hydrogen Village Trial is not within the scope of this project. This project evaluates risk of ignition in specific scenarios.

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, this is a collaborative work between all GDNs with different GDNs showing their support through sharing their findings within the End User Safety Evidence Working Group. Moreover, SGN have created working groups with representatives from all GDNs to enhance collaboration and knowledge transfer as the projects unfolds. Findings from the project will be 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

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

All the information and knowledge gained will be shared with other GDNs through End User Safety Evidence working group weekly meetings. Also, the information will be available to all relevant stakeholders to review through the ENA Smarter Networks Portal at https://smarter.energynetworks.org/.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

SGN were nominated by BEIS and Ofgem, as part of the HVT to lead this project by doing both the research and covering the funds required. £112,437 of the budget is recoverable through NIA but the remaining £12,493 is the SGN net cash flow for this project.

Please justify why the proposed IPR arrangements provide value for money for customers.

There are a number of collaborative projects that are contributing to the Hydrogen Village Trial. The understanding between the GDNs running these projects is that the lead GDN is responsible for the funding of that project. The ENA is monitoring the spend across all of these projects so that the overall costs is distributed across the GDNs according to the normal license split (i.e. the 4:2:1:1 split). Through this model all GDNs can benefit from each other's findings and help one another in the development and success of different trials which will in turn determine the future of using Hydrogen and hence the future of all gas networks.

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.

SGN have been nominated by BEIS and Ofgem, for undertaking this project and details of the project has been discussed with the other networks to ensure there is no duplication of work. The findings from the project will be shared with all key stakeholders.

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

The ignition probability of hydrogen gas has already been assessed in the H100 Hydrogen Consequence, Hy4Heat and H21 projects. However, these have generally been in hydrogen gas rich atmospheres with the risk being a vapour cloud deflagration or detonation and less so on spontaneous ignition of hydrogen gas leaks which represents a less significant risk. The project may reduce the requirement for highly conservative risk mitigation measures identified from Hy4Heat (e.g. meter box located outdoors, use of EFVs, use of flame failure devices, etc).

Relevant Foreground IPR

Some of the initial information used in this project will come from Hy4Heat program, H100 project, H21 project, BEIS reports and other relevant literature. All sources are publicly available and can be used by others without any IPR limitation. The project is not expected to generate any IPR.

Data Access Details

Information relating to the project will be published on the ENA Smarter Networks Portal at https://smarter.energynetworks.org/. Regular updates will be delivered to the End User Safety Evidence Working Group during weekly meetings. Such updates will feed into the Hydrogen Village Working Trial Group.

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 100% hydrogen trials process 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