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

Nov 2023

Project Reference Number

NIA2_SGN0041

Project Registration

Project Title

Hazardous Areas Impact Mitigation Phase 1

Project Reference Number

NIA2_SGN0041

Project Licensee(s)

SGN

Project Start

November 2023

Project Duration

0 years and 3 months

Nominated Project Contact(s)

Innes Maciver - innes.maciver@sgn.co.uk

Project Budget

£66,254.00

Summary

This is a follow-on project to the NGN-led project on SR/25 Modification Assessment (NGN_NIA_346). As part of that project, 15 existing pressure regulating installations (PRIs) were surveyed and their hazardous areas calculated using the new SR/25 hydrogen calculator and compared with natural gas results. In some cases, the increase in hazardous areas were large and would require additional mitigations prior to any hydrogen conversion of the gas network. The primary objective of this project will be to look at potential mitigations to reduce the impact of the increased hazardous areas. Initially this phase of the project will undertake measurements of gas releases from vent stack configurations under realistic conditions and compare the results with the outputs from NGN_NIA_346 and those presented in industry standards.

Third Party Collaborators

Steer Energy

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Differences in the flammability of hydrogen (e.g. flammable range, flame velocities and minimum ignition energy) mean that current operational practices will need reviewing. This includes how gas clouds from vents and purge stacks are managed, in particular the relevant hazardous area calculations. An updated version of IGEM/SR/25 calculator version 5.01 was developed for use with hydrogen and hydrogen/natural gas blends. This was then used to calculate the hazardous areas for the 15 sample sites from the NGN_NIA_346 project and the Zone 2 radius distances (Xr) and heights (Xh) calculated for natural gas and hydrogen showed a significant difference. The increase in the defined Zone 2 radius distances (Xr) with hydrogen in particular will pose challenges to some above ground installations (AGIs) where hazardous areas could extend beyond the site boundary.

Method(s)

Measuring the actual size of the vented gas cloud would be valuable to confirm the increase in size of the hazardous areas when converting to hydrogen. This will be done by using a set of masts arranged around a hydrogen source designed to simulate a gas release from a typical vent configuration. Hydrogen gas detectors will be fitted at various points along these masts to measure the drop off in concentration and thereby the limit of the flammable zone of the gas clouds. A scaled approach is proposed to limit the inventory of hydrogen required with the initial 4 flow rates tested from the IGEM/SR/25 hydrogen supplement Xr and Xh tables. The view will then be taken on potentially stepping up the magnitude of the releases and/or whether the results can effectively be extrapolated to those of the sample sites previously assessed.

Scope

The scope of work for the initial phase of the project is as follows:

WP1: Design and build of test rig

Two main systems are required for the test rig: a controlled gas release and a gas cloud measurement system.

Gas release equipment

The work pack will commence by testing the initial 4 tabulated releases from the IGEM/SR/25 hydrogen supplement data tables for Xr and Xh. This work can be carried out using existing equipment on site at Steer Energy using a maximum of two hydrogen cylinders connected in parallel to provide the required hydrogen flow.

The flow rates will be controlled up to 86 m3 h-1 using an Alicat flow controller. The flow controller will set the release rates to 0.0002, 0.0005, 0.001 and 0.002 kg s-1. Two sets of experiments will be carried out for each scenario:

- Measurement of the vertical concentration drop off to ½ quoted LFL, providing Xh information
- Measurement of the horizontal concentration drop off to ½ quoted LFL, providing Xr information

These vent tests can be repeated for ideal and non-ideal vents.

Gas concentration measurement equipment

The measurement system involves a range of up to 16 IIC ATEX rated VQ546, and VQ549 gas detection sensors mounted on moveable masts at different heights. The masts will be constructed such that they can be positioned to surround the vent point and measure the gas concentration drop off from the vent in a variety of atmospheric conditions both vertically and horizontally displaced from the leak or vent. The gas concentrations will be logged using a new 16 channel datalogger developed by Steer Energy and DefProc Engineering Ltd.

Decisions will be made to potentially reduce the height of the vent; a 3 m vent may require measurement masts up to 8 m. Therefore, dropping the overall length of the vent may be preferable if this has little impact on the shape of the gas release plume. The outcomes of this work pack will be:

- Functional test rig that simulates gas releases from a vent stack or other feature.
- A measurement system to map the change in gas concentration over distance, both vertically and horizontally.

WP2: Initial experimentation

The measurement study expects to measure, log, and map out gas releases from a range of gas concentrations, spanning 0.0002 to 0.002 kg s-1 with hydrogen. Parameters that can be varied during the experimental programme of work include:

- Flow rates – up to four flow rates are expected to be tested
- Vertical and horizontal releases for one or more of the test cases
- Changing the shape of the release nozzle for one or more of the test cases
- Comparative testing with methane for one or more of the test cases
- Ideal and non-ideal vents (as defined in IGEM/SR/25)

It will not be possible to create a full test matrix where every parameter is varied for every test case and the full list will be developed during the programme of work as determined by results. The costing for the proposal assumes up to 10 individual test cases will be measured and mapped out.

The output of this work pack will be mapped Xr and Xh for up to ten test cases of release where the limit for Xr and Xh are defined by a 2 % concentration of gas in air:

- Mapped out results of concentration drop off horizontally, giving Xr and specifically identifying the 2 % concentration value.
- Mapped out results of concentration drop off vertically, giving Xh and specifically identifying the 2 % concentration value.

There is also the potential for mapping out the limit of ignition by pilot light from some of the releases, dependent upon the individual leak rates.

WP3: Reporting and map way forward

Reporting will be in the form of a weekly or fortnightly update meeting to provide ongoing results and agree individual test cases. A final report will be provided for discussion and dissemination to the wider community. This report will be used to define the subsequent steps. Once the results are concluded discussions will be held with SGN to plan the route forward. This could involve comparing the measured results to the output of the zoning study carried out by NGN. The outcomes of this work pack will be:

- Weekly / fortnightly update meetings
- A final report of the results including comparisons with pertinent studies
- Identification of relevant literature from other industries and implications
- A plan for further work

Objective(s)

The main objectives of this project are to obtain accurate measurements for a selection of gas flow releases representing real world scenarios to enable a comparison to be made between the measured results, the zoning exercise undertaken by NGN and the data from the IGEM/SR/25 hydrogen supplement data tables. The project will also map a way forward for potential further impact mitigation with regards to the potential increase in hazardous areas with hydrogen.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Any conversion to hydrogen should be done with minimal impact both financially and technically to consumers, particularly vulnerable consumers. By assessing mitigations to potential increased hazardous areas then any upgrade costs would be kept to a minimum.

Success Criteria

The success criteria for each work pack is described below:

WP1: Functional test rig that simulates gas releases from a vent stack or other feature and a measurement system to map the change in gas concentration over distance, both vertically and horizontally.

WP2: Mapped out results of concentration drop off horizontally, giving Xr and specifically identifying the 2 % concentration value. Mapped out results of concentration drop off vertically, giving Xh and specifically identifying the 2 % concentration value.

WP3: Weekly / fortnightly update meetings. A final report of the results including comparisons with pertinent studies. Identification of relevant literature from other industries and implications, and a plan for further work.

Project Partners and External Funding

Steer Energy will be supplier for this project with Cadent and NGN being project partners.

Potential for New Learning

By undertaking measurements of real world scenarios and comparing the results with the zoning exercise undertaken by NGN and the data presented in industry publications, this project presents the opportunity to accurately define the hazardous areas for a series of releases and therefore potentially revise the existing standard should the results prove to be different from those previously presented.

Scale of Project

The project will initially undertake assessments at the lower end of the scale of IGEM/SR/25. The first 4 vent flow rates will be measured and then the potential to extrapolate these results will be investigated. The project will also identify potential follow-on work for future phases of hazardous areas impact mitigation.

Technology Readiness at Start

Technology Readiness at End

TRL3 Proof of Concept	TRL5 Pilot Scale

Geographical Area

The project outputs will be representative for the entire GB gas network

Revenue Allowed for the RIIO Settlement

Not applicable.

Indicative Total NIA Project Expenditure

SGN – External £24,700
SGN – Internal £8,225

Cadent – External £12,350
Cadent – Internal £4,167

NGN – External £12,350
NGN – Internal £4,462

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:

The outputs of the project will provide accurate measurements for a series of real world release scenarios and will help determine the level of mitigations required for hazardous areas to ensure compliance with industry standards. The project will also map the way forward for further impact assessment work on hazardous areas.

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

Not applicable.

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 potential outcome of this project is replicable across the GB network.

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

The real world measurements of hazardous areas will provide the gas network operators the opportunity to assess the impact of any changes in zoning with a conversion from natural gas to hydrogen.

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.

The project is follow-on work from a previous NIA project on hazardous area assessment and will involve collaboration from 3 of the GB gas networks (SGN, Cadent & NGN) with results being reported to all via the Network Safety and Impacts group.

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 project will undertake real world measurements of a series of gas releases from typical vent configurations and compare these with calculated results from previous studies and existing industry standards.

Relevant Foreground IPR

Not applicable.

Data Access Details

Information relating to the project will be published on 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

The methodology undertaken in this project is deemed a beneficial part of the network conversion to 100% hydrogen. This is not yet a

business-as-usual activity for the GDNs.

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 conversion of the GB gas network to 100% hydrogen is a key element on the road towards net zero. A reliable supply and the assurance of safe operations for workers and the public are crucial to support the viability of the hydrogen transition. The NIA framework can support works that ensure results that play an essential part in the roll-out of hydrogen.

This project has been approved by a senior member of staff

☑ Yes