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

Mar 2023

Project Reference Number

NIA2_SGN0034

Project Registration

Project Title

High Volume Gas Escapes Tool – update for hydrogen

Project Reference Number

NIA2_SGN0034

Project Licensee(s)

SGN

Project Start

March 2023

Project Duration

0 years and 3 months

Nominated Project Contact(s)

Johana Duran Santos

Project Budget

£14,930.00

Summary

The differences between natural gas and hydrogen, such as density and combustion characteristics, mean the dynamics of hydrogen in high-volume gas escapes needs to be analysed to ensure safe network interventions.

Nowadays, Gas Operatives utilise a tool named “High Volume Gas Escapes Tool” (HVGET) to predict indicative ignition distances associated with high-volume natural gas escapes. This project seeks to upgrade the methodology of the HVGET to make it suitable for hydrogen gas streams.

This project will provide Gas Operatives with an efficient tool to predict and identify distances of explosive atmospheres ensuring customer supply continuity and lessening the risk of explosion/injury to the public and operatives.

The upgraded methodology will be ready by Q2 2023.

Nominated Contact Email Address(es)

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Problem Being Solved

A fundamental requirement for the transport and distribution of gas is to ensure the safety of our consumers and operatives engaged in the construction, operation, maintenance, and repair of the network. Making sure our pipes deliver gas safely and reliably means that we need to upgrade or repair them at times.

The process of high-volume natural gas escapes is understood, with safe control of operations and procedures in place to carry out this process safely on natural gas networks across the UK. SGN responded to over 114,000 uncontrolled and 54,000 controlled gas escapes during the year ending 31 March 2022. Our engineers currently deal with high-volume gas escapes with suitable emergency response procedures and tools. The HVGET is one of them. This technology was developed in 2018/19 by DNV as an Excel-based

software tool for SGN to predict indicative ignition distances associated with high-volume natural gas escapes from distribution pipelines.

Notwithstanding, the transition from a fossil fuel-dependent network into a fully decarbonised, stable, and reliable energy system based on 100% hydrogen as H100 Fife project will require the development, update, and deployment of fitted tools and effective procedures applicable to the future network. There are significant differences between natural gas and hydrogen, particularly the very low density of hydrogen compared to natural gas and its ability to travel between 6% and 15% further than natural gas from below-ground release. All the above may imply that indicative ignition distances associated with high-volume hydrogen gas escapes could be significantly larger compared to natural gas. Considering this, the methodology of the HVGET needs to be uploaded to be capable to perform quantitative and qualitative risk assessments in the event of hydrogen escapes to reduce the likelihood of explosions and injuries to the public and operatives.

Method(s)

The project consists of a technical solution with the following milestones as outlined below:

Work-Package 1: Define requirements for hydrogen networks.

This work package will determine the scope and expected outcomes in the tool for hydrogen networks, identifying concerning areas, required inputs and needed information to develop the new model programme accordingly to upgrade the HVGET.

Work-Package 2: Development of the new model.

In this work package, an extensive review of theory, standards, practices and existing procedures will be carried out to ensure data and measurement quality. The work will then develop a methodology suitable for the hydrogen gas stream.

Work-Package 3: Reporting, dissemination of findings and project closure.

The upgraded methodology will be provided by DNV as an addendum to the original technical report. This final stage is to ensure that all management services including the final report are supplied as specified in NIA project deliverables.

Scope

The switch from natural gas to hydrogen will require a review of the end-to-end processes, including tools and procedures used to characterise and control high-volume gas escapes ensuring that current practices are fit for purpose with 100% hydrogen. Considering this, the methodology of the HVGET needs to be updated to perform quantitative and qualitative risk assessments of the hydrogen gas stream.

This technology, first developed in 2018/19 by DNV (then DNV GL), is an Excel-based tool for SGN to predict indicative ignition distances associated with high-volume gas escapes from gas distribution pipelines. The methodology for calculating the hazard distance was based on DNV's PERisk and FROST computer packages but the model is based on relatively rich natural gas.

The scope of the project includes the identification of required data to design the new methodology based on the new hydrogen network requirements, revision of the theory, standards and existing practices, calculation of the model suitable for 100% hydrogen, and update of the technical report.

Operating conditions and atmospheric conditions will be pre-defined in the model whilst input parameters comprised will be:

- Pipeline material
- Pipeline diameter
- Failure mode
- Pipeline pressure
- Ground conditions
- Wind conditions

The new methodology seeks to predict two hazard distances used to define three ignition zones named the "Red", "Amber", and

“Green” zones, which are displayed graphically in the model as a virtual map to help our engineers safely plan their activities and avoid damage while carrying out a range of work according to the established procedures.

The updated methodology of the HVGET will bring about a tool that might allow the users to select 100% Hydrogen as an input parameter. In addition, an update will be carried out on the base (natural gas) model to account for an improved understanding of below-ground releases. If a dual escape (a blend of hydrogen and natural gas) takes place the model will be run for both types of gas composition and the worst-case scenario will get set.

This proposal specifically aims to identify the new conditions to produce the procedures required to successfully respond to emergencies and lessen the risk of explosion/injury to the public and our operatives. As a result, it will support our operatives to make the workspace safer, reduce the emergency response time, and safely stop gas loss while allowing SGN to ensure the continuity of procedures and practices of emergency response in the event of gas escapes.

The updated methodology will allow an upgrade on the HVGET tool that will be beneficial for the H100 Fife project, which will become the first network worldwide that lays the foundations for switching carbon-emitting natural gas for a zero-carbon fuel while allowing three hundred residents to use 100% hydrogen for heating and cooking and pioneering the low-carbon economy. A key element of this project is to provide a highly reliable gas supply and to demonstrate the excellent performance of our emergency response service.

Objective(s)

The objective of this project is to update the methodology of an existing bundled software to get the option to select 100% Hydrogen as an input parameter and the mapping of the three ignition zones (Red, Amber and Green) pointing out hazard distances for high-volume gas escapes including the update of the technical report.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Customer protection relates to safety measures in the gas industry embracing safe operations, reliable infrastructure, adequate emergency procedures, and safe gas utilisation. For the H100 Fife project and future hydrogen networks, it is needed to update existing repairing gas escapes tools and procedures.

The methodology that will be developed as part of this project seeks to increase the prevention of and protection against explosions caused by high-volume gas escapes for the future hydrogen network. Once it is included in the excel-based tool, it might assist operatives to avoid the ignition of hazardous explosive atmospheres and hence, the mitigation of detrimental effects such as injuries and deaths. The paramount end is to keep workers and the public safe, especially vulnerable people.

Success Criteria

The success criteria for each work package are described below:

- **Work-Package 1:** The outcome of this work package (agreed scope and expectations from the tool for the H100 Fife and future hydrogen networks) will be reviewed and approved by SGN.
- **Work-Package 2:** In this work package, the developed bundled software tailored for 100% hydrogen and the mapping of the ignition distances will be reviewed and approved by SGN.
- **Work-Package 3:** The technical and final reports will be reviewed and approved by SGN.

Project Partners and External Funding

DNV will be the partner for this project.

Potential for New Learning

The project will provide key learning on the identification of ignition distances on high-volume gas escapes of hydrogen networks. It specifically aims to predict the explosive distances to safely carry out hydrogen piping repairs reducing the likelihood of an explosion, injuries to people and environmental damage.

Scale of Project

The HVGET, originally designed for rich natural gas, has proven to be a precise and consistent tool to predict hazard distances of explosive atmospheres. The software was developed as a desktop exercise based on natural gas theory, standards, and procedures.

The project considers three work packages where: the identification of the scope for the update will be determined according to hydrogen network requirements (work package 1); a thoughtful review of the theory, available standards and procedures for hydrogen will be carried out to produce a trustworthy methodology and the relevant model upgrade (work package 2); and the update of the

technical report and final report generation (work package 3). Like the aforesaid initial software, this project will be developed as a desktop exercise.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

Outputs of the project can be applied on a UK-wide scale for the transition of the network to hydrogen.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

£14,930

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:

A key aspect of the transport and distribution of gas is to ensure the safety of our consumers, the operatives, and the environment. Making sure our pipes deliver gas safely and reliably means that we need to upgrade or repair them at times. The method of piping repair is understood, with safe control of operations and procedures in place to carry out this process safely on natural gas networks across the UK. Our engineers currently deal with high-volume gas escapes with suitable emergency response procedures and tools. The High Volume Gas Escapes Tool is one of them and helps them to identify ignition distances when a high-volume gas escape occurs and reduce the risk of ignition. However, the transition towards 100% hydrogen networks will require the evaluation, update and even redesign of the end-to-end processes and tools.

The H100 Fife project aims to deliver 100% hydrogen to domestic customers for heating and cooking purposes. A key element of the H100 Fife project is to provide a highly reliable gas supply, demonstrate the excellent performance of our emergency response service when infrastructure has been compromised, and guarantee the continuity of the service while minimizing disruption.

The aim of this project is to provide a comprehensive methodology for understanding and characterising the dynamics of hydrogen in the event of high-volume gas escapes. It specifically aims to identify the new conditions to bring about the procedures required to successfully respond to emergencies and lessen the risk of explosion, injury to the public and operatives, and environmental damage.

The update in the methodology of the HVGET will bring about:

- Operatives will be able to identify ignition distances in high-volume gas escapes while performing repairs on the H100 Fife and future hydrogen networks.
- The well-known emergency procedures to control high-volume natural gas escapes could be tailored for hydrogen.
- Safe working conditions for our Gas Operatives.
- Reduction in the response time of piping repairs.
- Likelihood reduction in disruptions, risk of explosions, and injuries to the operatives and the public.

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 GDNs. All the Network Licenses are aiming to reduce carbon emissions through the transition to hydrogen. The project will provide a robust framework that DGNs can utilise to convert operating areas to hydrogen and ensure the security of supply to downstream users.

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 original HVGET provides detailed information regarding ignition distances associated with high-volume gas escapes in natural gas networks. This tool is a key aid when performing maintenance activities and must be updated to incorporate 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 original High Volume Gas Escapes Tool has not been updated to predict ignition distances associated with high-volume hydrogen gas escapes.

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

Gas distribution networks have yet no clear overview of the challenges when performing maintenance activities such as identification and control of high-volume gas escapes for the future hydrogen network. This project will offer the methodology to identify the hazard distances of explosive areas and once included in the final tool, it could help all GDNs to update current processes to make them suitable for hydrogen and ensure safe operation.

Relevant Foreground IPR

The project will be based on the original High Volume Gas Escapes Tool initially developed in 2018/2019 and DNV's PERisk and FROST computer packages.

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 that will be developed in this project is deemed a beneficial part of the 100% hydrogen trials process which is a key step towards the conversion of the existing gas network to 100% hydrogen. This 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 conversion of the GB gas network to 100% hydrogen is key 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