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

NIA_CAD0096

Project Registration

Project Title

Great Britain Hydrogen Distribution QRA

Project Reference Number

NIA_CAD0096

Project Licensee(s)

Cadent

Project Start

October 2023

Project Duration

0 years and 9 months

Nominated Project Contact(s)

George Brookfield

Project Budget

£356,025.00

Summary

This project will produce the Quantitative Risk Assessment (QRA) to cover hydrogen distribution and use across Great Britain. This work builds on DNV's previous work as part of the H21 project, where the risk across Great Britain was quantified for hydrogen use in houses. It also makes use of work carried out by DNV as part of the End Use Safety Evidence (EUSE) programme, to investigate the risks posed by leaks in different locations within a house, and within small non-domestic buildings. In particular, the CONIFER risk assessment package will be used in this QRA.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The development of hydrogen distribution QRAs has been to support the various hydrogen projects and the comprehensive formal assessment (CFA) the HSE will be making on the safety evidence for hydrogen transportation in the GB network. Although there has been multiple successfully delivered QRAs to date, it has been identified that there are still evidence gaps within the QRA work. This NIA project will allow the networks to address the remaining gaps in time for the CFA submission deadline of September 2024.

Method(s)

It is proposed that this project will build upon the previous similar projects and iterations of the QRA and so utilise the same CONIFER model, developed by DNV.

The project will cover the following areas:

- Updates to the CONIFER model, following HSE comments on the QRA work undertaken for H21 and Multiple QRA's
- All necessary sensitivity analysis.
- Updates to the CONIFER model to address latest industry and evidence findings.
- Review of wider gas industry projects and their findings.
- Modelling of non-domestic buildings and Complex Distribution Systems (CDS) (such as Schools and Hospitals)
- Updated risk calculations
- Analysis of risk mitigation

This will include the following deliverables:

- HSE ERG reviews and comments tracking spreadsheet
- Two risk prediction outputs (one preliminary result part way through the project, and second iteration at the end of the project).
- Formal report on the updates made to the CONIFER model
- Formal report on the outputs of the QRA and its results

Continued communication with critical project partners plus HSE and DESNZ representatives.

Scope

This project covers the Great Britain natural gas distribution system up to but excluding LTS. Typically, a distribution system would be limited to the natural gas distribution network down to the ECV, but this project will make use of the work carried out by DNV, as part of the End User Safety Evidence (EUSE) programme, and also include downstream of the ECV. This means governors on the distribution network, distribution mains (up to 7 barg operating pressure), services to end users, and end user installations (meters, pipework inside buildings and appliances), are in scope.

Mains and services owned by the Independent Gas Transporters (IGTs) will be included in the assessment if sufficient information can be supplied to the project. Though it is anticipated that any outputs will have some application across the board, subject to a review of applicability of assumptions used by the project.

Objective(s)

1. Review of historical data, from DNV's incident investigation team and from the Gas Distribution Networks (GDNs), if available. This output will:

• Help define any differences in methodology between gas leaks in typical houses and in other types of buildings.

• Improve the representation of Great Britain (which is currently based on a detailed analysis of information provided by Northern Gas Networks, but 'scaled up' to Great Britain using high level data of pipe lengths and numbers of customers etc.).

• Improve the robustness of failure frequencies and hole size distributions applied downstream of the ECV.

2. Improve the model for unconfined hydrogen explosions outdoors, if further experimental data becomes available.

3. Include diffusion effects in the gas accumulation modelling within buildings.

4. Review the modelling of gas accumulation in large rooms. This includes open plan houses and rooms in non-domestic buildings, which often have larger floor areas but only slightly higher ceilings, which changes the aspect ratio of the room.

5. Review the behaviour of people in large buildings. This includes the ability to detect gas, reporting of the presence of gas, and subsequent response such as evacuation and closing the Emergency Control Valve.

6. Review and incorporate outputs from all relevant gas industry research projects, and update CONIFER, where necessary.

7. Undertake work required to model larger and more complex buildings. In particular, the numbers and types of these buildings will need to be determined, and a process developed to quantify the associated risks across Great Britain. In addition, sites such as schools and hospitals often include multiple buildings that need to be included in the risk calculations. (Note: The detailed analysis of domestic Multi-Occupancy Buildings (MOBs) is not included in this scope of this contract).

8. Risk predictions will be carried out for two cases,

• A natural gas distribution network base case, and,

• A hydrogen distribution network as it is expected to be in 2032, but without additional risk mitigation measures beyond those already in place. This will include changes that will be made before that time regardless of conversion to hydrogen, such as planned metallic mains replacement. It will also include changes that must be made in order to operate a hydrogen network, such as increased operating pressures and the replacement of end user appliances.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project will deliver an appraisal of the societal risk of converting the UK Gas Network over to hydrogen. This will help facilitate a ministerial decision on a future net-zero domestic heating solution that could benefit vulnerable customers in the coming years.

Success Criteria

A successful project will have addressed all outstanding gaps within the GB-wide QRA exercise, and will have provided the HSE with enough data required to complete the Comprehensive Formal Assessment

(CFA). The conclusion report and findings will sufficiently support the HSEs CFA requirements in conjunction with the other Network Safety and Impacts (NS&I) and End-User Safety Evidence (EUSE) projects. This in-turn will enable the UK government to make an informed policy decision on the viability of utilising hydrogen as a heating fuel, transported using repurposed natural gas networks in Great Britain, replacing the natural gas we use today.

Project Partners and External Funding

This project will see the collaborative working of 7 of the 8 Great Britain GDNs; Cadent Gas, NGN, and SGN. The delivery partner will be DNV, who have developed and adapted their CONIFER model to meet the needs of hydrogen distribution QRAs.

Potential for New Learning

The project will build upon the findings from H21 Phase 2 QRA and other GB related QRAs completed to date (such as the Whitby and Redcar Hydrogen Trial QRAs). This piece of work will consolidate the findings from all related work that has been previously delivered to ultimately inform industry and government on the safety requirements of hydrogen network. The project will create insights in the areas of Societal risk and Individual Risk, allowing for the advancement of several areas of work including:

- Study of safety mitigations
- Operational requirements and viability
- Public engagement and communication

The current project learning dissemination methods will continue throughout this project, including but not limited to:

- Written publications to project partners and wider industrial subject matter experts

Seminars and webinars, when appropriate.

Scale of Project

The scale of the project is defined by the areas of outstanding analysis required to allow the HSE to deliver the CFA. The GDNs, along with the delivery partner, have undertaken a detailed appraisal of areas that need further analysis through the QRA. The areas have been identified, assessed and then taken forward under this scope.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The scope and scale of the project cover all of Great Britain.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

The current proposed quotation for the required deliverables is £320,400.00 plus an additional £35,625.00 of contingency should it be required (£356,025.00 total).

The contingency is required should the project need to respond to mid-project developments outside the immediate projects scope, e.g. findings from the SGN MOBs QRA or the various EUSE projects which may result in the GB QRA requiring modifications.

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 project is required to demonstrate that a hydrogen distribution network and user cases can be implemented and operated to acceptable limits of safety.

Without such modelling, the implications of safety to society and individuals is not fully understood. This work is a requirement of energy system transition.

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

N/A

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

N/A

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

The applicability of the outputs from this project run Great Britain wide.

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

This project is to model the safety implications of transitioning to hydrogen. Although cost, deliverability, business appetite to effort, and perceived customer appetite for safety tolerances is considered, the exact costs associated with the application of the findings from this project will need to be determined separately.

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

All GDNs (and potentially IGTs, subject to applicability of findings) operating within Great Britain will be able to utilise the findings from this project to help guide their development to transitioning their businesses.

Fundamentally the project will help provide content for the HSE to carry out their CFA on behalf of the government and DESNZ.

Any and all learning from this project will help prepare the GB gas networks to transition to low carbon alternatives.

The specific findings that are linked to the tangibly benefits to Great Britain are around the ways in which we achieve safety criteria in line with GB standards and the publics expectations. Earlier iterations of the Hydrogen Distribution QRA have shown where additional safety mitigations are required when operating a hydrogen network as opposed to a natural gas network. As well as supporting a government decision, this type of information now can also assist GDNs prepare strategies and plans for conversion and operation in the future, with no bias towards who or where.

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.

The current project learning dissemination methods will continue throughout this project, including but not limited to:

- Written publications to project partners and wider industrial subject matter experts,

Seminars and webinars, when appropriate.

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

The constrained IPR arrangement is limited to the CONIFER risk calculation model, which is the IP of DNV.

The DNV CONIFER model is an industry recognised model for the determination of risk for gas pipelines and networks, a tool developed and owned by DNV. This tool is not unique to this project and will not be one of the disseminated deliverables. The outputs of it, however, will be.

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

The project will contribute to the advancement and betterment of the CONIFER model, ensuring future applications of the model will prove more reliable and accurate than the iteration before. The development of the model itself generates a great deal of know-how for the industry, which can then be utilised for the benefit of customers and their value for money by ensuring we continually improve our

network infrastructure and services we provide.

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 is the next iteration and so is not repeating anything gone before (unless deliberately revalidating the past results). It will be done with appropriate levels of transparency to ensure concurrent projects scopes to not cause rise to duplication of effort. Which, given the project partners and industries awareness of this piece of work, is manageable.

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

N/A

Additional Governance And Document Upload

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

This project represents the next iteration, addressing new concepts which are being identified by industry. It is the amalgamation of several pieces of knowledge and project outcomes that we are yet to have seen or attempted in Great Britain.

Relevant Foreground IPR

The foreground IPR will be limited to the results and findings of the QRA model, plus any additional knowledge/IP gained as a result of carrying out said QRA.

The modelling and software tool (CONIFER) itself, constituting the background IPR and foreground IPR modifications as a result of this project, are not going to be supplied as a product of this project.

Data Access Details

The data regarding the scope of the evidence being gathered will be captured.

Data for this project will be found or requested via the 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 piece of works primary focus is to deliver results to feed into the HSE's CFA to help determine the viability and opportunity of repurposing the GB gas distribution networks to hydrogen. The primary benefactors are the GB government and the GB citizens.

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

NIA represents the requirement to do this piece of work collaboratively. We are required to show that hydrogen gas can be safely distributed and used throughout Great Britain.

As such, funding this type of work needs to be done to the maximise it's dissemination and minimise the burden on any singular population of energy consumers.

This project has been approved by a senior member of staff

☑ Yes