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

Aug 2022

Project Reference Number

NIA_CAD0082

Project Registration

Project Title

Use of Automatic Isolation Valve (AIV) Systems with Hydrogen – AIVs in LP and MP Services

Project Reference Number

NIA_CAD0082

Project Licensee(s)

Cadent

Project Start

August 2022

Project Duration

1 year and 8 months

Nominated Project Contact(s)

David Jones

Project Budget

£375,000.00

Summary

This project will gather safety evidence to support the delivery of a Village Trial of hydrogen gas supply. While the Village Trial is the principal focus of this study, the works will provide output to investigate and confirm the suitability of using an AIV system. This is not just the valves themselves, but the hydrogen monitoring sensors and how the system interacts as a whole, to protect a hydrogen trial commercial installation between 67-100 kW. The project will also consider larger low pressure and medium pressure applications and provide evidence that the use of an AIV system is an appropriate mitigation strategy for commercial applications at any scale.

Third Party Collaborators

Kiwa

Steer Energy

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The Prime Minister's Ten Point Plan for a Green Industrial Revolution set out the government's intent to explore the option of hydrogen to be used within the current gas network infrastructure. It specifically mentioned that a Hydrogen Village Trial should be underway no later than 2025 to enable an important policy decision to be made in 2026 on the options for heating homes in a net zero future.

End User Safety Evidence group (EUSE) is a group within the End User sub programme of the BEIS Hydrogen Grid R&D Programme. EUSE will facilitate the gathering of safety evidence downstream of the emergency control valve (ECV) to support delivery of the Village Trial.

Previous work has recommended that AIVs are installed in commercial installations between 67 and 100kW, or with a peak demand above 20m3/h. Below this value, excess flow valves (EFVs) greatly reduce risk, however, above 20m3/h the effect of such an EFV is reduced therefore AIVs are required.

The work will address the following questions (evidence gaps):

(i) Is the use of an AIV an appropriate mitigation strategy for commercial premises?

(ii) How does the use of an AIV change and/or influence the associated risk assessment/safety case?

(iii) The interaction between an AIV with SR25/UP16 for hydrogen needs to be understood.

(iv) Are the appropriate detectors available? Where should hydrogen detection sensors be located?

(v) Complete a high-level assessment of suitability of AIV components for use with hydrogen taking into account:

a. Functional performance

b. Possible degradation

(vi) Understand impact and/or influence of hydrogen AIBV requirement(s) on new/emerging Standards, Codes etc.

There is no reason why (once proven) such AIV systems should not be widely adopted to effectively permit the use of hydrogen at any commercial scale, for example stand-alone or building integrated boiler houses, gas fired ‘sheds’, laboratories, educational, catering establishments and light industry.

This project is one of the GDNs collaborative projects, led by Cadent, undertaken as part of the End User Safety Evidence working group.

Method(s)

This project is a mixture of understanding current evidence, identifying additional research to fill evidence gaps, and then using existing and new evidence to specify, design, and develop a product that delivers the safety function required by the evidence.

The project will use the following methods to answer the evidence lines:

Base Line Report/Literature Review: The initial phase will involve a review of scoping work carried out by SGN and with reference to AIVs in IGEM/UP/2 which needs extended to include hydrogen.

Production of Tender Documents: Based on initial review a draft specification will be used to seek potential suppliers to demonstrate three competitive AIV systems suitable for commercial and industrial gas users.

Installation and Demonstration: The main aim of the project will be to demonstrate three complex AIV installations, including the relative position of hydrogen sensors and other critical system interfaces. Must be able to demonstrate the full functionality of the off systems with hydrogen, including advanced interlocking with extraction systems and combustion devices as necessary.

Risk Assessment Impact: Consolidate the evidence and include in the safety case to provide further clarification of risk mitigation potential for AIVs for any/all commercial buildings included in the trial safety case. It will be important to identify the limitations of operation in commercial environments, including boundary conditions for the safe use of AIVs.

Support for Modification of IGEM/UP/2: Considering the learnings from the work, provision of guidance to IGEM on the use of AIV

systems to reduce the risk of hydrogen use in commercial and industrial premises is required.

Project delivery will be supported by hiring professional organisations to support Cadent on the project. Much of the work will involve physical testing in a laboratory environment so it is important that any organisation involved has the test facilities to fulfil the project requirements.

Scope

This project is undertaken in 5 work packages, which are:

Work Package 1: This first phase will involve looking at all the possible requirements that an AIV will have to meet in hydrogen service. These will be determined through discussions with HSE, consideration to required tightness, impact of building use etc. and a market survey/literature review of available products on the market.

Once all requirements have been identified, a draft technical specification for AIV system functionality will be produced and used as the basis to invite OEMs to put forward equipment to be used in the later testing phase. The specification will cover both gas system proving and shutdown in the event of gas detection or other hazardous occurrences in a building.

This draft technical specification, along with the literature review and procedure for detector siting, should be shared with the GDNs, ENA and key stakeholder groups.

Work Package 2: Once the literature review/market analysis and draft specification have been completed in Work Package 1, Work Package 2 involves taking 3 of the preferred suppliers, scored against a clear selection criterion, and placing orders for equipment that best match the technical specification. It is likely that a gap will exist between what is available on the market and the technical specification. In this event, 'weighting factors' will be added to the selection criteria, informed by the activities of Work Package 1, to ensure that an objective way of selecting suppliers is presented.

A note of caution is that, due to the nascent nature of the hydrogen market, suppliers may need pro-active encouragement from both Cadent and contractors to submit tenders. Input from GDNs, ENA and key stakeholder groups will help to ease this task, demonstrating the scale of the commitment to the work.

Work Package 3: In Work Package 3, thorough development and testing will take place on the preferred suppliers' equipment. It is anticipated that some suppliers may be using existing natural gas qualified products, so further development or test work may be required for some to use with hydrogen. Minor development may be required for specific application requirements; however, it is believed that the real challenge will be for system integration of components from different OEMs.

Stage 2 of the Village Trial concludes at the end of March. An interim report will be shared with HSE/BEIS ahead of this to describe the build and delivery phase to date, including longevity data. If any of the systems are available "off-the-shelf", every endeavour will be made to include test data in this interim report, ensuring HSE/BEIS have a more substantial bank of evidence to inform their Stage 3 decision.

As this Work Package is likely to extend beyond the March deadline, the report will be updated and re-issued at the end of the build phase.

Work Package 4: This work package focuses in on the delivery of three sets of equipment with appropriate validation documentation. The test programme will have been designed to address all possible evidence questions, mimicking real situations using suitable

hardware with detectors placed in an environment where hydrogen concentration can be accurately controlled. Correct functioning of the AIV and interlocks with ventilation systems will be proved along with other evidence questions. It could be envisaged that further testing could be recommended out with this project – GDNs, HSE and key stakeholder groups will assess whether this is a requirement to enable a Village Trial, or whether this can be managed as a risk at this stage.

Wherever possible, testing and certification to standards harmonised under or aligned with the Gas Appliance Regulation should be preferred as the level of rigour in these standards is perhaps greatest. Due consideration to the relevant standards will be made during the literature review and referenced in the technical specification from Work Package 1.

The key deliverable from this Work Package will be a report informing of the three systems' performance in the test programme, an assessment of the System Integrity Level (SIL) rating of the systems, a comparison between them and commentary on longevity evidence supplied by the OEMs.

Work Package 5: The overall aim of this project will be to have proved that an AIV system is a suitable mitigation strategy for commercial and industrial premises. This is seen as especially important as excess flow valves (EFVs) may not be suitable for larger commercial and industrial applications.

This work package is dedicated to compiling all evidence gathered in previous work packages to produce an overall report on the suitability of Automatic Isolation Valve systems for hydrogen use in commercial installations where peak demand is above 20m3/h or 67kW. This will be shared with GDNs, key stakeholders, and the HSE Energy Review Groups who will advise whether evidence gathered in this project is sufficient to support the 'Build and Prepare' stage of the Village Trial.

Objective(s)

The objectives of the project are as follows:

- Provide evidence that an AIV system is a suitable mitigation strategy for commercial premises
- Define the threshold valve tightness/leak rate of AIVs in hydrogen service.
- Determine the optimum AIV system design according to specific building use – consideration given to where hydrogen detection sensors should be located.

Update IGEM/UP/2 Standard to include proven hydrogen AIV systems.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project focuses on the provision of additional gas safety measures in commercial settings and as such consumers in vulnerable situations are highly unlikely to be impacted by the work undertaken.

Success Criteria

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

- Provision of evidence that an AIV system is a suitable mitigation strategy for commercial premises.

Delivery of three sets of equipment and appropriate validation documentation to allow roll out in a live Hydrogen Village Trial.

Project Partners and External Funding

Cadent, WWU,NGN,SGN

Potential for New Learning

So far, it has been recommended that AIVs are installed in commercial installations with a peak demand above 20m3/h or 67kW. AIV systems are already used in natural gas service and so this project is expected to provide learning on the suitability of AIVs for use in hydrogen service, as well as the availability of suitable equipment to enable these “hydrogen-safe” AIVs.

Learning will be disseminated to GDNs, HSE and key stakeholders through a series of interim reports, culminating in a final report summarising all learning at the end of the project.

Scale of Project

The use of AIV systems with hydrogen will be considered as part of the Village Hydrogen Trials potentially located in the North West and North East of England.

The project is required to cover a key evidence gap that must be covered ahead of any potential Hydrogen Village Trial. The Village Trial itself is required to inform a UK government policy decision on hydrogen for home heating in 2026.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Desktop based project with physical testing taking place at the location of the technical organisation hired to lead the work.

Revenue Allowed for the RIIO Settlement

Not applicable to this R&D project.

Indicative Total NIA Project Expenditure

The project is broken down into an agreed fixed cost, plus the purchase price of the systems from OEMs. The agreed fixed cost for the project is £217.7k, with £20k budgeted for each of the 3 systems, plus contingency costs.

This gives a Total NIA Expenditure to reclaim of £300000.00

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 Hydrogen Village, which has a considerable benefit in facilitating the 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

Not applicable (this is a research project)

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

The intention is for this project to be relevant and therefore replicable to hydrogen trials of any size.

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

N/A

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 learning can be used by any network that intends to do a hydrogen village trial or built upon by any network that intends to do any subsequent trials.

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.

SGN are carrying out an early conceptual investigation of an existing natural gas unit which is classed as proof of concept and early “learning by doing”. This work and the learnings from it will be reviewed as part of the literature review to ensure this project only acts to build on any previous work.

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

This project seeks to extend on the early work carried out by SGN, building on their early learnings to deliver sophisticated AIV systems that can be installed in commercial premises as part of a Hydrogen Village Trial.

Additional Governance And Document Upload

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

This project is a vital enabler for the Hydrogen Village trials which is a highly innovative programme that has not been replicated anywhere else in the world to date. This project has been initiated as part of the collaborative projects agreed by BEIS and HSE ahead of the trial commencing.

Relevant Foreground IPR

All relevant foreground IP created as part of the project will follow NIA governance.

Data Access Details

Current expectation is that all data used in this project will be sourced from published documentation, the test cases will be available upon request.

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

· A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. Cadent already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.

· Via our Innovation website at https://cadentgas.com/future-of-gas

· Via our managed mailbox futureofgas@cadent.com

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

The hydrogen village projects and any of the associated enabling projects, cannot be considered as BAU due to their first of a kind nature and risks which go beyond BAU.

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

This project has inherent risks due to its first of a kind nature so it is right it should be supported using NIA funding.

This project looks to uncover commercial, technical, operational and regulatory considerations when determining the suitability of Automatic Isolation Valve Systems in commercial hydrogen installations.

This project has been approved by a senior member of staff

☑ Yes