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 2020

Project Reference Number

NIA_CAD0062

Project Registration

Project Title

I-0331 Optimising Distribution of Hydrogen Phase 2

Project Reference Number

NIA_CAD0062

Project Licensee(s)

Cadent

Project Start

August 2020

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Damien Hawke – Cadent, Mike Rice – Saith

Project Budget

£181,744.00

Summary

The UK relies predominantly on three energy vectors; electricity, gas and oil, for the decarbonisation of the power, heat and transport sectors. Progress is being made in reducing the carbon intensity of power generation but, as stressed by the Committee for Climate Change (CCC) in its 2018 review of the Government's Clean Growth Strategy, very little progress has been made in reducing the carbon intensity of heat or transport. Very deep emissions cuts are required across sectors with the urgency for progress made more acute by the decision to change the emissions reduction target from 80% to Net Zero by 2050 and for legislation has been passed in July 2019.

The body of work on the use of hydrogen for combustion and other applications is growing. It is clear that low carbon hydrogen may be able to substitute cost effectively for natural gas in several markets, including contributing to the provision of flexible power, high and low grade industrial heat, transport fuels and the reduction in emissions from consumers connected to the gas distribution network. Technical feasibility has been demonstrated in each of these markets

Beyond a small number of hydrogen pipeline systems connecting commercial users there is little experience of designing, creating, operating and then expanding a multi-user hydrogen distribution system. Such networks will initially be constructed at a relatively modest scale and will subsequently expand in terms of geography and in terms of consumer types. For example, the HyNet NW project plans to have a relatively contained network initially connecting a small number of industrial (and possibly small-scale power) users together with hydrogen injection into the LTS at a small number of points. The initial network will be extended in geographical extent and expanded incrementally to include further users with varying demand profiles, with hydrogen storage and other demand management approaches added to the system.

As anticipated by CCC, hydrogen networks will ultimately be created in several locations across the country and in different Network Operator regions, emanating from areas where low cost access to Carbon Capture Utilisation and Storage (CCuS) infrastructure is available. Creation of such networks is unique and there is very limited, if any, experience of the system design and issues involved in designing a multi-user hydrogen network for expansion or in operating the growing network.

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The UK relies predominantly on three energy vectors; electricity, gas and oil, for the decarbonisation of the power, heat and transport sectors. Progress is being made in reducing the carbon intensity of power generation but, as stressed by the Committee for Climate Change (CCC) in its 2018 review of the Government's Clean Growth Strategy, very little progress has been made in reducing the carbon intensity of heat or transport. Very deep emissions cuts are required across sectors with the urgency for progress made more acute by the decision to change the emissions reduction target from 80% to Net Zero by 2050 and for legislation has been passed in July 2019.

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Method(s)

The methodology is to call on experienced subcontractors and combine this with design experience of a Hynet multi-consumer hydrogen network. The work will focus on the issues associated with operating such multi-consumer hydrogen networks.

Work package 1 will be to review the existing Pre-FEED pipeline routes and HAGI locations, identifying areas of potential issues (ecological, engineering and consenting risks) and producing a list of critical areas to be visited during the vantage survey. These critical areas will be prioritised, and the reasons why recorded.

Work package 2 will be to carry out vantage point surveys visiting all critical areas identified in work package 1. This will enable an on the ground perspective to be taken, photos taken and any 'on the ground intelligence' on be collated and fed back to the project team for consideration.

Work Package 3 will be to carry out local authority searches on a 1km wide corridor centred on all routes identified. This will enable clearer detail on potential planning that may impact upon the pipeline. This will allow any obvious 'show-stoppers' to be identified or mitigated.

Work Package 4 will be to review HAGI locations and layouts with the information gathered in Stage 1, 2 & 3 and in accordance with IGEM/TD/13 & GD/SP/G/37. This will further prioritise where engineering design work needs to be concentrated. This will be critical to prioritise engineering detailed design during the FEED.

Work package 5 will be to review pipeline routes with the information gathered in stage 1, 2 & 3 and in accordance with IGEM/TD/1, GD/SP/TR/18, GD/SP/TR/21. Again, engineering priorities will be identified.

Work package 6 will be to produce a report & maps combining all the findings of the above work packages. These maps and reports will then be presented to the wider HyNet team and the information will be brought forward into the HyNet Front End Engineering Design (FEED) work package.

The Programme is scheduled to be completed in 8 months

Scope

The primary scope of this project will be to build on further detailed work which was produced during the initial I-0245 Optimising Distribution of Hydrogen NIA. Upon completion of the initial NIA it is clear that additional work needs to be completed, particularly with regards to options for the hydrogen pipeline. This project looks to fulfil the following scope.

- Desktop review of existing Pre-FEED phase 2 routes
- Identify additional routes for the hydrogen pipeline with 1 Km corridors and build upon potential corridors outlined in pre-FEED.
- Identify optional routes outside the 1km corridor that have not been identified as the preferred route. Identify and note reasons behind preferred route selection
- Vantage point survey of proposed pipeline and hydrogen above ground installation (HAGI) locations

· Review of Pre-FEED route against Local Authority Searches

· Review of Pre-FEED report on HAGIs

· Basic G/37 layout of site specific HAGI to establish HAGI footprint and aid G/37 location study

· Review of proposed route to 'Level 1 Route Corridor Study' in accordance with IGEM/TD/1, GD/ST/TR/18 and GD/SP/TR/21

· Review of proposed HAGI in accordance with IGEM/TD/13 and GD/SP/G/37

· Produce a Feasibility Report complete with maps of the proposed pipeline routes

The scope of this work will be delivered by experienced individuals at Saith, who have been involved in the previous NIA so this knowledge can be brought forward and further developed. This also ensures that optimal value for money can be delivered and key delivery times are met.

Objective(s)

The overarching objective of this work is to build upon work already done in the initial NIA and look at further detailed route options (and the reason why routes have been selected or deselected), HAGI locations and how this relates to IGEM technical standards. To support this work there are a range of sub objectives which can be described below:

· A range of potential hydrogen pipeline options must be examined in detail and the reason why these pipelines routes have either been accepted or why certain routes have been not developed any further needs to be clear.

· The review of IGEM standards in relation to the development of a bespoke hydrogen pipeline.

· Review of HAGI locations and how this will impact upon the control of the network. This will aid further investigations which will be required in the FEED.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project can be summarised as follows:

· Development of a detailed feasibility report identifying all options and the preferred routes, including the reasons as to why this is preferred.

· Maps showing route corridors, constraints and possible options

· G/37 location report on HAGIs

· Proposed option risk register alongside a decision and assumption risk register.

All of this work will be completed by the end of the RIIO GD1 period and all works will be made available to the HyNet FEED team moving forward.

Project Partners and External Funding

This project will be funded via NIA

Potential for New Learning

This work builds further upon work produced in previous NIA projects, all the learning needed has been identified and will be new.

Scale of Project

This project will be focussed on the hydrogen pipeline that will be developed as part of the HyNet project. Although this will be specifically for the HyNet project there is no reason why this learning cannot be brought forward and applied to other hydrogen projects which are looking at networked hydrogen.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This study is focused on hydrogen pipeline infrastructure that can be replicated throughout the UK by all the Gas Distribution Networks

Revenue Allowed for the RIIO Settlement

Not Applicable

Indicative Total NIA Project Expenditure

External Cost - £147,390

Internal Cost - £34,354

Contingency - £ 0

Total Cost - £ 181,744

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:

n/a

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)

The potential benefits of this project remain the same as the previous phase. The HyDeploy project suggests that if a 20% H2 blend is rolled out throughout the UK this will enable 29TWh of low carbon heat to be injected onto the GB network and this has the potential to save the consumer £8Bn compared to other methods/routes to decarbonisation such as heat pumps. On a wider scale, the 2050 energy scenario report by KPMG, produced on behalf of the Network Licensees as part of (NIA_SGN_00064) Energy Map and Plan (2016) suggest the conversion of the gas network to hydrogen compared to electrification could save the consumer £7,000 to £9,500 each or £152bn to £214bn for GB.

The work will also guide the GD2 business plans for Cadent and other network licensees. This will reduce costs for all customers during GD2.

We would also expect the potential CO2 and air quality benefits from solving the problem to be significant. Such environmental and health benefits can be converted to financial benefits (using 'damage' costs).

Please provide a calculation of the expected benefits the Solution

N/A – this is a research project that will define a suitable approach to network operation and control, which can be replicated by other network licensees.

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

The method can be replicated at any locations in which low carbon hydrogen is available in bulk. In most cases, this will require access to carbon capture and storage (CCS) infrastructure (to capture and store the CO2 from hydrogen production from natural gas) and therefore the most appropriate areas are Teesside, Humberside South Wales and Eastern Scotland. Hydrogen clusters potentially similar to that proposed by Cadent in the form of HyNet are being developed in these areas. In such areas the method will guide GD2 business planning.

In the shorter-term, the method can also be applied as part of smaller demonstration projects.

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

The cost of rollout will be clearer once the research project concludes. This will also enable the decision to be made as to whether to pursue initial demonstration projects or not.

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

This project will further consider how gas distribution companies will design and control, through the use of HAGIs, hydrogen pipelines in the near future. It is very likely that all gas distribution companies will be required to design and operate both repurpose and newly build hydrogen pipelines in the coming years, with HyNet being the forerunner.

It is envisaged that the information generated from this project can be applied by any gas network as they look to plan their respective hydrogen pipelines. Similar considerations will have to be worked through and this work will act as an ideal precursor to this work.

The above will also guide GD2 business plans for Cadent and other network licensees

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

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

This is a FOAK project in respect of Network Licensees' consideration of operational routing and HAGI locations. This work has not been done elsewhere by GDNs and developing a hydrogen pipeline at the scale proposed by Cadent is unique.

Cadent has discussed the project with other Network Licensees and can confirm that there is no duplication with either other historic projects or those currently being considered.

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

The project will represent the first attempt by a network licensee to develop a purpose built hydrogen pipeline for a hydrogen distribution network involving a range of diverse consumers. Due to developments in the initial NIA on Optimising a hydrogen pipeline this new work is now required and has come into focus. To that end, this work has not been done elsewhere and is completely unique.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

This project will provide detailed option analysis and detailed design to enable the deployment of a new distribution network transporting a new low carbon gas, hydrogen. If achieved this will provide a quantum leap for the UK gas industry and thus cannot be regarded as business as usual.

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 project conforms to NIA requirements. Commercial risks to be overcome, which require NIA support include the current absence of a relevant support mechanism for CCS and hydrogen as a fuel. Mechanism is currently under consideration by Government, but in the meantime, any network licensee would struggle to justify investment of this nature. However, support in the short-term for this project under the NIA, will allow all licensees to manage commercial risk and then move quickly at the relevant time to deliver maximum benefits to customers in the form of lower costs of network deployment.

This project has been approved by a senior member of staff

☑ Yes