

## NIA Project Registration and PEA Document

### Date of Submission

Nov 2020

### Project Reference Number

NIA\_CAD0065

## Project Registration

### Project Title

I-0337 HyNet Operation and Control

### Project Reference Number

NIA\_CAD0065

### Project Licensee(s)

Cadent

### Project Start

December 2020

### Project Duration

0 years and 4 months

### Nominated Project Contact(s)

Damien Hawke – Cadent Lee Davis – Genesis

### Project Budget

£49,323.44

## Summary

As part of the HyNet project the blue hydrogen will be distributed to predominately heavy industry using a purpose-built hydrogen pipeline. This hydrogen pipeline will connect blue hydrogen production with underground salt cavern storage and will also connect to heavy industry, power generation sites and transport hubs. The hydrogen pipeline will be the central component to enable widespread decarbonisation across a number of sectors in the North West of England and will provide the infrastructure to allow further carbon savings to happen in the near future.

### Nominated Contact Email Address(es)

Innovation@cadentgas.com

## Problem Being Solved

As a result of the UK Government's recently announced 10-Point Plan for a Green Industrial Revolution both hydrogen and CCUS are firmly identified as technology that needs to be delivered and deployed on a large scale. The plan points to the fact that the UK is aiming to develop 5GW of low carbon hydrogen production by 2030. Hubs where renewable energy, CCUS and hydrogen can congregate are known as industrial 'Superplaces'.

The North West of England, with its well developed and strategically aligned HyNet CCUS/Hydrogen project is undoubtedly defined as a 'SuperPlace'. There is already a large proliferation of renewable energy technology with offshore wind being the standard bearer but other technologies such as tidal barrages, wave technology and nuclear energy, particularly small modular reactors, also showing great promise. Whilst the final destination for energy resources in the North West is green and renewable to get there a need has been identified for the production of blue hydrogen with CCUS.

As part of the HyNet project the blue hydrogen will be distributed to predominately heavy industry using a purpose-built hydrogen pipeline. This hydrogen pipeline will connect blue hydrogen production with underground salt cavern storage and will also connect to heavy industry, power generation sites and transport hubs. The hydrogen pipeline will be the central component to enable widespread decarbonisation across a number of sectors in the North West of England and will provide the infrastructure to allow further carbon savings to happen in the near future.

With the hydrogen pipeline positioned in the very centre of the HyNet project it is imperative that the necessary control and operational philosophies are well understood to allow the pipeline to play the role required to enable widespread decarbonisation in the region. This project looks at this control and operational philosophies in further depth before the HyNet FEED starts in 2021.

## Method(s)

The methodology is to call on an experienced subcontractor to develop the Operating and Control Philosophy.

Work package 1 – Operating and Control Philosophy. Defining the operating and control philosophy to provide a preliminary understanding of those requirements. The Process Flow Diagram's currently being developed will be revised based on the resulting philosophy and provide a more advanced basis for the FEED work to commence.

The philosophy will be developed in consultation with the Cadent Network Design, Control Centre and HyNet project teams.

Work Package 2 – Coarse HAZOPs. The HAZOP will look specifically at interfaces of the hydrogen production plant (HPP) and the Hydrogen Storage Plant (HSP). The purpose will be to identify any hazards or design flaws at this early stage in the development of the design.

The Coarse HAZOPs will be developed in consultation with Cadent Engineering team and the HyNet Project team.

## Scope

The scope of this work is the preparation of an Operating and Control Philosophy document for the HyNet Pipeline Network and a Coarse HAZOP looking at the pipeline interface with the HPP and HSP. This document will supplement the work currently being undertaken in relation to this project (developing a FEED Basis of Design and FEED Scope of Work) and will form part of the ITT package for the FEED when it goes out to the market.

Subcontractor will attend (and chair, as appropriate) consultation meetings with Cadent Network Design, Control Centre and HyNet project teams. It is anticipated that this will be a series of meetings as clarity of the issues and understanding of stakeholder requirements develop.

The operating and control philosophy will include:

- Major control loops and valves required for the stable and safe operation of the pipeline network
- Operating philosophies, including (i) normal operation whilst filling H2 storage (ii) normal operation while providing H2 from storage (iii) shut-down philosophy (iv) start-up philosophy (v) ramp-up / slow-down
- A high-level description of the interaction between the hydrogen production plant, storage plant, network and users

Enhanced PFDs, being developed for the Coarse HAZOP, will be revised to reflect the operating & control philosophy requirements. The PFD detail will be commensurate with the maturity of the design at this stage.

## Objective(s)

The primary objectives of developing the operating and control philosophy are to (i) provide a firmer basis for the FEED and (ii) improve understanding of system design and operating considerations and interfaces.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

The success criteria for this piece of work can be summarised as follows:

- Create an Operating and Control Philosophy document that provides a preliminary agreement on how the hydrogen pipeline network will be operated thus:
- Allowing instrumentation and valving requirements to be defined and for those requirements to be reflected within enhanced PFDs;
- Providing a more advanced basis for the pipeline network FEED.
- Creating a Coarse HAZOP which will include:
- 'Enhanced' PFD (one at each of HPP and HSP locations)

A Terms of Reference (ToR), including preliminary details of the process description and operating philosophy

## 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, have a hydrogen production plant and a hydrogen storage element. This work will be applicable to other UK clusters such as Acorn, Teeside and Humberside.

## 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 - £40,000

Internal Cost - £9,323.44

Contingency - £0

Total Cost - £ 49,323.44

## Project Eligibility Assessment Part 1

There are slightly differing requirements for RII0-1 and RII0-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RII0-2 / RII0-1).

### 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 RII0-2 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 (RII0-1 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 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