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

Oct 2016

Project Reference Number

NIA_NGGD0086

Project Registration

Project Title

I0071 H2 Clusters

Project Reference Number

NIA_NGGD0086

Project Licensee(s)

Cadent

Project Start

November 2016

Project Duration

0 years and 9 months

Nominated Project Contact(s)

NGGDx – Andy Lewis Progressive Energy – Peter Whitton

Project Budget

£178,900.00

Summary

The work programme will focus on the definition of a hydrogen supply system to supply converted gas distribution networks, basing the supply system on Humberside and Merseyside. The work will build on the Leeds City Gate work, utilising the cost data and approach where possible. The work will consider the synergies and interactions between the base SMR production and the needs and opportunities provided by industry in these clusters, the availability of hydrogen storage in the locality to manage daily and inter-seasonal fluctuations in demand, and will outline the shape of the CCS infrastructure required for the hydrogen supply system. The aim will be to define a system of a scale to supply Leeds or a city of similar size together with any local use in the region of the cluster itself.

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The H21 City Gate project has shown that the use of hydrogen in place of natural gas in principle offers a potential route to widespread decarbonisation of low pressure gas distribution networks.

The core requirement is to supply low carbon hydrogen in bulk, matching production to distribution network demand at an affordable cost.

The H21 study concluded that to supply hydrogen in bulk it is best produced by reforming natural gas fitted with Carbon Capture and Storage (CCS) and that extensive hydrogen storage in salt formations is needed to manage inter-seasonal and daily fluctuations in network demand.

It is concluded that the Steam Methane reformers (SMRs) with associated CO2 capture should be located near to CCS infrastructure

and notes that candidate locations for this are Teesside, Humberside, Merseyside and Grangemouth. Two of these, Humberside and Merseyside, are within the NGGD area and are also industrial centres with significant populations.

Both the Humber and Mersey clusters are close to salt deposits which are suitable for both daily and some inter-seasonal storage of hydrogen. New large scale gas CCGT power stations widely recognised as being important anchor projects for any CCS infrastructure, have been consented in both cluster areas, confirming that they are both strong candidates as locations for the first CCS clusters. Government policy on CCS is under review but it is noteworthy that both cluster areas have a strong technical case for hosting the first CCS network. Demonstration of the business case for a hydrogen supply system at either location would strengthen the CCS business case, and as CCS is essential for deployment of hydrogen on the network enhance the prospect for the hydrogen conversion initiative

Additionally existing and planned power generation facilities are located in both areas and, as some gas turbines can operate on hydrogen and/or natural gas hydrogen mixtures, this in principle offers the opportunity for management of the hydrogen distribution network demand by adjusting the hydrogen/gas mixture used to fuel these stations. The stations also provide an additional base load hydrogen demand which may help reduce costs improving the business case.

Method(s)

The work proposed here will provide a techno economic study assessing the relative importance of the elements outlined in the schematic above in creating a practical, cost effective hydrogen scheme

The work will focus on defining a low carbon hydrogen supply systems at Humberside and Merseyside and will be based on a system scale sufficient to supply a large city. The work will also consider the opportunity for a delivery plan which starts from a smaller but complete project involving domestic, industrial users, hydrogen production and CCS.

The study will consider the opportunity to supply low carbon hydrogen for heat in specific industries and the opportunities for network demand management using industrial or existing power generation plant.

The study will also scope the practicality of CCS infrastructure for a standalone project not predicated on major infrastructure created as part of a major power generation scheme, given the uncertainty in current policy

The programme will involve strong interactions with industrial and other stakeholders on Humberside and Merseyside

Scope

The work programme will focus on the definition of a hydrogen supply system to supply converted gas distribution networks, basing the supply system on Humberside and Merseyside. The work will build on the Leeds City Gate work, utilising the cost data and approach where possible. The work will consider the synergies and interactions between the base SMR production and the needs and opportunities provided by industry in these clusters, the availability of hydrogen storage in the locality to manage daily and inter-seasonal fluctuations in demand, and will outline the shape of the CCS infrastructure required for the hydrogen supply system. The aim will be to define a system of a scale to supply Leeds or a city of similar size together with any local use in the region of the cluster itself.

The work packages are:

1. Identify options for hydrogen supply and use from Humberside industry (including refineries, steel production and chemical industries), and from power generation. This includes hydrogen substitution for natural gas for process heat generation Estimate demand profile and fluctuations in seasonal and daily timeframes. Quantify the carbon benefits to the industries involved.

2. Identify option for hydrogen supply and use from Merseyside industry and power eg Ineos chlor-alkali plant. Estimate demand profile and fluctuations in seasonal and daily timeframes. Quantify the carbon benefits to the industries involved.

3. Assess the feasibility of converting the heat supply at an industrial plant from gas to hydrogen or hydrogen/gas mixtures. Gas fired steam raising boilers are a common source of heat in industry, as well as direct fired burners and process use of gas. The feasibility of conversion will be explored. The feasibility of changing the hydrogen/gas balance in fuel supplied for heat to help manage demand fluctuations in the wider network will also be considered.

4. Assess the feasibility of converting gas turbines to operate on hydrogen/natural mixtures and evaluate its potential to support the management of demand fluctuations.

5. Assemble a possible plant configuration at Humberside which meets the requirement for deliverable, cost effective supply of decarbonised hydrogen to the wider gas distribution network, including expected plant costs. The plant involved to include:

a. Hydrogen Generation from SMRs

b. Incorporation of other hydrogen sources if available

c. Supply of hydrogen to specified local industries, providing increased base supply and/or allowing swing to enable the hydrogen generation units to operate closer to base load

d. Supply of hydrogen for power generation on Humberside

e. Hydrogen storage availability in local salt caverns

f. A suitable CO2 Transport and storage infrastructure configuration for CO2 captured from the SMRs and other plant associated with the configuration

6. Assemble a possible plant configuration at Merseyside which meets the requirement for deliverable, cost effective supply of decarbonised hydrogen to the wider gas distribution network, including expected plant costs. The plant involved to include:

a. Hydrogen Generation from SMRs

b. Incorporation of other hydrogen sources if available

c. Supply of hydrogen to specified local industries, providing increased base supply and/or allowing swing to enable the hydrogen generation units to operate closer to base load

d. Supply of hydrogen for power generation on Merseyside

e. Hydrogen storage availability in local salt caverns

f. A suitable CO2 Transport and storage infrastructure configuration for CO2 captured from the SMRs and other plant associated with the configuration

7. Develop a financial model to provide the levelised cost of hydrogen from the Humber and Mersey clusters and consider its sensitivity to variations in scale and key variables.

8. Consider the steps to deliver a cost effective hydrogen supply system in the Humber and Mersey clusters and the deployment uncertainties and risks. Outline next steps to advance towards a first deliverable proposition.

9. Project management and stakeholder interactions (including BEIS, H21 team if formed, Humberside and Merseyside LEPs)

Objective(s)

Identify synergies between the cluster SMR facilities designed to supply hydrogen to the gas network and local manufacturing industry, power generation and the required CCS infrastructure at the two clusters

Determine the potential market for hydrogen in manufacturing industry and power generation and consider the role this may have in managing seasonal and daily demand fluctuations. Give guidance on its potential as an emissions reduction approach for industry.

Provide guidance on the most cost effective configuration for low carbon hydrogen related facilities at both clusters, recognising technical, commercial, market and financing issues.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Techno economic feasibility of configuring industry within Humberside and Merseyside to produce and use hydrogen.

Understand the levelised cost of using hydrogen within these industrial clusters and understand any barriers that may exist to development.

Advise next steps and conduct stakeholder engagement to inform government decision making.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This will be an entirely desk top study which will concentrate on the regions of Humberside and Merseyside region and the large scale industrial processes which happen in these regions.

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

Humberside and Merseyside, in the North of England

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Internal - £59,633.33

External - £178,900

Project Value Claimable under NIA (90% of total cost) - £214,680

Total Costs: £ 238,680

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)

This project will not decarbonise the Merseyside and Humberside regions in itself but will inform the technical and economic feasibility of displacing natural gas with methane in these areas.

Please provide a calculation of the expected benefits the Solution

N/A

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

N/A

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

This project will be the first time that demand, storage and generation of hydrogen has been looked at to decarbonise the industrial centres of Humberside and Merseyside.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

The need to decarbonise the gas grid and specifically the heat sector to allow the UK to meet its obligations under the 5th Carbon budget to reduce CO2 emissions by 57% by 2030 and then an 80% reduction in CO2 emissions in 2050 compared to 1990 levels

☑ 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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes