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

Sep 2019

Project Reference Number

NIA_NGGT0155

Project Registration

Project Title

Hydrogen Injection into the NTS

Project Reference Number

NIA_NGGT0155

Project Licensee(s)

National Gas Transmission PLC

Project Start

September 2019

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Lloyd Mitchell – Asset Engineer

Project Budget

£180,000.00

Summary

The UK has committed to be net zero by 2050 and as a result National Grid Gas Transmission (NGGT) is committed to understand and trial the impact of hydrogen within the National Transmission System (NTS). The impact of natural gas is well understood, however there is little understanding of the impact of a natural gas blend with a significantly increased hydrogen content (up to 100%) on the assets we own and operate and the impact to our direct customers.
To date there has not been an investigation into a customer trial with hydrogen directly from the NTS.

Third Party Collaborators

DNV

Health & Safety Laboratory

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

The UK has committed to be net zero by 2050 and as a result National Grid Gas Transmission (NGGT) is committed to understand and trial the impact of hydrogen within the National Transmission System (NTS). The impact of natural gas is well understood, however there is little understanding of the impact of a natural gas blend with a significantly increased hydrogen content (up to 100%) on the assets we own and operate and the impact to our direct customers.

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Method(s)

Carry out a research project to understand the requirements for proving the NTS can transport a hydrogen blend, summarise a range of customers that could become part of the project and develop further to understand the tecno-economic challenges.

Working with DNV-GL and the Health & Safety Laboratory (HSL) we will build on the shared extensive knowledge, previous experience on hydrogen based projects at a distribution level and their understanding of the types of assets on the NTS. The work will be split into phases to allow for deliverables to be met at the required milestones.

The NIA project will be split into three separate phases. Initially the project team will be brought together to build on the output from previous work and support the National Grid hydrogen roadmap. This will ensure that all the completed work to date (both internally and externally) is reviewed and there is an understanding into what the gaps in knowledge are.

Phase 1 – NTS Safety Case for transporting hydrogen

- Gap analysis between the current natural gas safety case and a safety case which included significantly higher level of Hydrogen than today
- What would be required to prove the NTS can operate safely and effectively with hydrogen up to and including 100%,
- What assets on the NTS would need to be tested to prove this readiness,
- What operational practices would need to be modified for hydrogen transportation.

Phase 2 – Locations for NTS hydrogen transportation trial

- Liaise with all viable customer connection points to understand their willingness to be a part of a trial project, work with NG customer connection teams and look to promote the project at established forums.
- Understand the various options for hydrogen production and how they could be used on the project,
- Summarise all available options using a variety of metrics to allow National Grid to decide on what location to carry out a hydrogen blending project.

National Grid decision on preferred option – the available options will be presented to National Grid and a decision will be made on if to proceed and if so where the small-scale trial will be located. This will be based on the presented metrics and liaison with all the relevant customers and stakeholders that will be involved.

Phase 3 – High Level Design

- Based on the decision to proceed and the hydrogen roadmap then support will be required to develop the design further to help understand the below aspects of work:

1. Customer impact
2. The technical details of injection, transport and extraction
3. Impact to the NTS (pipelines and assets)
4. Risk / Safety
5. Legal & Regulatory
6. Commercial

Scope

NGGT has launched the HyNTS programme of hydrogen projects which currently comprises of 4 projects, two of which are collaborative with the distribution networks, one is a feasibility study across the NTS (completed) and the newest is an offline test flow loop looking at the impact to a commonly used pipeline grade on the NTS. Whilst these studies have been effective, there is currently nothing focusing on the direct impact of providing hydrogen to a transmission customer, encompassing all aspects of safety, operability and commerciality. Various innovation projects are underway regarding distribution level transportation of hydrogen to a customer including the Hy4Heat and HyDeploy projects. To date there have been no physical trials regarding a blend of hydrogen and natural gas relating to the Transmission network.

This project aims to build on the outputs from the Feasibility of Hydrogen on the NTS project (NIA_NGGT0139) and develop a hydrogen trial project on the transmission network. The output of the previous project was a recommendation to complete further research relating to specific engineering challenges and to those that increase the confidence in using hydrogen across the whole energy system.

The ambition is to supply a direct customer to the transmission network with up to 100% hydrogen (or a blended mix depending on the scenario).

Objective(s)

The objective of this project is to understand what will be required to physically trial injecting hydrogen into the National Transmission System and to summarise all the potential ways this could be completed, allowing a small-scale trial to be completed. A gap analysis of the current NGGT Safety Case will also be carried out to understand what evidence would be required to prove the safe transport of hydrogen within the NTS.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The successful outcomes of this project are:

- A gap analysis between the current safety case and one for transporting hydrogen through the NTS, highlighting everything that will need to be addressed if a trial is completed. HSL will also provide an independent review of the gap analysis produced by DNV-GL.
- A prioritised list of identified locations for the hydrogen trial presented with relevant metrics allowing National Grid to decide on whether to pursue a location in the form of a physical trial.
- A selected and engaged customer who is willing to take part in the hydrogen injection project with NGGT.

Project Partners and External Funding

Project Partner – DNV-GL and Health & Safety Laboratory (HSL)

External Funding – nil

Potential for New Learning

This project will develop the requirements for introducing hydrogen within the NTS and scope out a viable customer based on all possibilities.

Scale of Project

Localised – restricted to the defined area of interest between the National Transmission System and the chosen customer.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Unknown until conclusion of Phase 3 – UK based

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£180,000

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)

It is widely accepted that over the coming decades the GB heating system must move to a decarbonised method of energy supply to allow the UK to meet its climate targets. To do this economically all routes to decarbonisation must be evaluated to provide UK consumers the most cost effective solution.

The direct benefit of this feasibility study is to define the best location for a hydrogen trial which will be representative of the entire National Transmission System. In this way, maximum benefit can be driven from any physical trial that is carried out.

One report from KPMG suggested that decarbonisation through the electricity network could be up to three times more expensive than the evolution of the gas network, mainly through hydrogen, and therefore hydrogen could represent a saving of up to £200bn across the entire gas industry. This project will help to realise those savings through effective utilisation of existing gas infrastructure.

Please provide a calculation of the expected benefits the Solution

N/A - Research study

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

There are numerous research activities exploring the potential of provisioning hydrogen rich gases utilising gas distribution networks. The use of the NTS for large scale hydrogen transportation would considerably improve the effectiveness of the widespread utilisation of hydrogen within the UK.

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

This is a feasibility study and it is not possible to provide indicative implementation cost.

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 information gathered in this project could be used as lessons learnt for a large-scale hydrogen rollout across any part of the gas system.

Specific information on the impact of hydrogen on materials used within gas transmission infrastructure would also be valuable, for example many of the steels, polymers and elastomers would be common to gas transmission and distribution assets.

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

This project directly impacts on the 'Fit for the Future' and 'Ready for Decarbonisation' aspect of the Innovation Strategy being presented to Ofgem as part of the NGGT wider submission to Ofgem for RIIO 2. The internal and external net zero commitments highlight the need for a decarbonised future, this project and the proposed plan to trial hydrogen on the NTS with a direct customer of NGGT will show the commitment to realising this strategy.

☑ 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.

No other work has looked at how hydrogen will be transported through the Transmission Network, but also where a hydrogen trial on the NTS could be located. It should be noted that the project will utilise work carried out by the distribution network providers who have already begun trialing hydrogen in their networks, in order to share lessons learnt and challenges.

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

Hydrogen gas is seen as a potential alternative to methane gas, however technical and financial considerations need to be examined before hydrogen gas can be used widespread. Alongside this and in collaboration with NTS customers and stakeholders there is a requirement to understand exactly how a physical trial will be enacted on the transmission system.

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

The provision of hydrogen within the future energy mix is a complex issue requiring detailed analysis at both a transmission and distribution network level. The initial stages of this work at a transmission level sits outside the normal activities of the business and internally funding such necessary work would be challenging. Funding the work through the NIA framework ensures that the programme is provisioned appropriately and the results are made available to all stakeholders.

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 transportation of hydrogen with the NTS requires a detailed independent review to ensure that all the major technical, operational and safety challenges and risks have been considered. The completion of this study will help inform the ongoing research activities both at a gas transmission and distribution level. The NIA framework offers a robust, open framework to support this work and ensure the results are fully articulated to all stakeholders.

This project has been approved by a senior member of staff

☑ Yes