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

Nov 2021

Project Reference Number

NIA_NGGT0181

Project Registration

Project Title

HyDew

Project Reference Number

NIA_NGGT0181

Project Licensee(s)

National Gas Transmission PLC

Project Start

November 2021

Project Duration

0 years and 5 months

Nominated Project Contact(s)

David Hardman, Box.GT.Innovation@nationalgrid.com

Project Budget

£33,859.00

Summary

This desktop study looks at the theoretical impact of hydrogen blends in conventional gas mixtures on hydrocarbon dewpoint and water dewpoint (HCDP/WDP).

HCDP/WDP tell us when liquid drop out will occur. There is a requirement to monitor this under Gas Safety (Management) Regulations (GSMR) as the liquids can cause damage to National Transmission System (NTS) assets and downstream customers equipment e.g. Power Station turbines or Distribution Networks.

HCDP/WDP is currently calculated by using a calculation which is not designed to include hydrogen mixes.

The Distribution Networks do not check for HCDP/WDP as National Grid Gas Transmission (NGGT) check at the entry point to the NTS only. The Distribution Networks therefore assume the gas is safe to transport and use as NGGT have checked it.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

To determine the temperature at which a natural gas mixture will produce a liquid, the commonly adopted methods are direct measurement through the use of a chilled mirror or indirect using a calculation on the gas composition measurement by a gas chromatograph. For pipeline operators it is essential to avoid liquid formation as this can impact on the operation and give rise to

potentially hazardous situations.

Natural gas is a complex mixture of many chemical species, and the hydrocarbon dewpoint is highly sensitive to the composition, particularly to the number of components with six or more carbon atoms.

The addition of hydrogen to the natural gas mix will impact on the gas composition overall and this will change the dewpoint.

For the indirect method, the thermophysical properties of the components are considered and the interaction of these is contained within the “Equation of State” (EoS) used in the calculation. The EoS that are traditionally used in the gas industry have been demonstrated to provide good accurate estimates of the dewpoint, but few have considered significant fractions of hydrogen (say up to 20% by volume), and as such the suitability requires investigation and validation. For the gas chromatographic analysis, the ISO 23874 (Gas chromatographic requirements for hydrocarbon dew point calculation) is the method adopted for complex hydrocarbon mixtures but this does not include hydrogen.

If we are to add hydrogen blends, then we need to understand what that does to the formation of liquids in pipeline.

Method(s)

The research will be completed in phases of which this is the first phase and is strictly limited to a desktop exercise. We shall review any existing literature and available Equations of State to understand the potential error of measurement by introducing hydrogen blends.

Future phases will investigate any changes required and implementing lab trials as proof of concept, if that is deemed necessary by the desktop review.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGGT / NGET internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to our supplier’s own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

Scope

A two part project is proposed and the first phase includes:

1. Desk-top review of impact of hydrogen on calculated hydrocarbon and water dewpoints.

a. Review of published data – use the GERG work as a starting point.

b. Investigate the different EoS (GERG 2008, RKS, LRS, Peng Robinson and other options)

c. Theoretical mixture analysis and also “real” gases – including links to ISO 23874 (Gas chromatographic requirements for hydrocarbon dew point calculation).

d. Intercomparison of the calculated values focusing on error analysis and deviations with a view to developing a sensitivity analysis of the calculated dewpoints as a function of the EoS used

e. Evaluation of the potential deviations and errors that may result for existing EoS options for natural gas if the method id changed to accommodate the presence of hydrogen

2. Report

The report will comprise:

· Results on impact of different EoS on wide range of gas mixtures from different entry points and with different hydrogen content

· Endorsement of EoS for hydrogen blends

· Overall estimate of uncertainties and errors

· Proposed next steps required to address the conclusions of part 1.

The work is required to allow compliance with Gas Safety (Management) Regulations 1996 should we use the existing National Transmission System as the entry point for hydrogen blends. Specifically, Schedule 3, Regulation 8, Part 1 which states that HCDP and WDP: 'shall be at such levels that they do not interfere dewpoint with the integrity or operation of pipes or any gas appliance which a consumer could reasonably be expected to operate'.

Objective(s)

The objective of this project is to complete a desktop review on the impact of hydrogen blends on hydrocarbon and water dewpoint.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This is a RIIO2 project but does not impact vulnerable consumers any differently from non-vulnerable customers.

Success Criteria

- Understand the limitation of the current method of calculation HCDP/WDP for future hydrogen blends.
- Ability to scope follow on work as necessary.

Project Partners and External Funding

DNV have been selected as the preferred partner due to the extensive experience in this area. The software currently used is a licensed product supplied by DNV.

Potential for New Learning

Understand the limitation of the current method of calculation HCDP/WDP for future hydrogen blends. This will be articulated in a project report to be made available via the NIA portal.

Scale of Project

The ultimate scale of this project will be large as it will impact all gases entering the Transmission system which contain hydrogen blends. However, due to the uncertainty around this future market we have chosen to take a phased approach and start by completing a desktop study. This scope of works is already minimal and therefore a 'smaller scale' project is not feasible.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

Not applicable – desktop study only

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£33859

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 vital to the energy transition and needs to be completed so we can understand the safety impacts with regards to hydrocarbon dewpoint and water dewpoint (HCDP/WDP) when transporting hydrogen blends in the National Transmission System (NTS).

How the Project has potential to benefit consumer in vulnerable situations:

This project benefits vulnerable and non-vulnerable consumers equally.

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

This is a research project and therefore not applicable. If this work is not completed, then we will not be able to comply with our safety case with respect to GSMR monitoring. We will not know the properties of the gas we were transporting.

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

The current method is used on circa 37 sample points at entry locations around the National Transmission System. The number of locations the new solution will be used will vary and increase in scale as more hydrogen blend entry points are brought on line.

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

This cannot be estimated at this at this time as the first phase of the project (this NIA) will need to completed first.

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

☐ 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 Distribution Networks do not check for HCDP/WDP as National Grid Gas Transmission (NGGT) check at the entry point to the NTS only. The Distribution Networks therefore assume the gas is safe to transport and use as NGGT have checked it.

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.

The calculations for hydrocarbon dewpoint and water dewpoint (HCDP and WDP) have not required a change as the natural gas composition has not changed. It is only now that hydrogen is being considered that the calculations will need to be revisited. National Grid Gas Transmission is responsible for carrying out these calculations and so there is no risk of duplicated efforts from the gas distribution networks.

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

Not applicable

Additional Governance And Document Upload

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

Transmission and Distribution companies within Great Britain have not investigated the impact of hydrogen blends on hydrocarbon dewpoint and water dewpoint (HCDP and WDP) before.

Relevant Foreground IPR

Foreground IPR for this project will be the closeout report.

Data Access Details

Details on how network or consumption data arising in the course of a NIC or NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Grid can be found in our publicly available “Data sharing

policy relating to NIC/NIA projects" at www.nationalgrid.com/gasinnovation

National Grid already publishes much of the data arising from our NIC/NIA projects at www.smarternetworks.org . You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

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

There is no requirement for this research to facilitate the business as usual transportation and distribution of natural gas.

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 NIA process offers a route to complete research into the affect of hydrogen on how NGGT transports natural gas today, the risk to the project is that hydrogen is not utilised and therefore the current calculations for hydrocarbon dewpoint and water dewpoint (HCDP and WDP) will remain. The output is of interest to multiple parties including Distribution Networks and gas terminals so the NIA is a great way to share this information.

This project has been approved by a senior member of staff

☑ Yes