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# NIA Project Registration and PEA Document

### Date of Submission

Apr 2017

### Project Reference Number

NIA_NGN_207

## Project Registration

### Project Title

H21 –Domestic and Commercial Metering

### Project Reference Number

NIA_NGN_207

### Project Licensee(s)

Northern Gas Networks

### Project Start

April 2017

### Project Duration

2 years and 4 months

### Nominated Project Contact(s)

NGN Dan Sadler, NGGD Lorna Millington

### Project Budget

£360,000.00

### Summary

The project will evaluate the performance of commonly used meters and ancillary equipment outside of their design duty (i.e. operation on hydrogen). A testing programme will be developed to ensure that a representative cross section of UK meters and regulators are tested so as to provide sufficient safety and performance data to ascertain the suitability of the existing UK meter stock for operation on a hydrogen network.

It should be noted that this project will be scoped only to provide an initial indication of the safety and operational performance of the existing UK meter stock to operate on a hydrogen network. Dependent upon the results from the testing programme further projects may be required to fully assess what actions may be required to address any safety, technical and performance issues identified.

### Preceding Projects

NIA_NGN_210 - H21 - Keighley and Spadeadam designs

NIA_NGN_225 - H21 – Field Trials Design

### Third Party Collaborators

Kiwa

nDash

Wilcocks Consulting

Institution of Gas Engineers and Managers

Aqua Consultants

### Nominated Contact Email Address(es)

innovation@northerngas.co.uk

## Problem Being Solved

The H21 – Leeds City Gate Project assessed the feasibility of converting a major city's gas network from natural gas to hydrogen. The project demonstrated the feasibility of the hydrogen conversion concept, developed detailed cost estimates for the conversion of the Leeds area and an estimate of the costs for an incremental roll out of hydrogen conversion nationwide.

The H21 Leeds city gate project identified (Section 10) the next steps required to move this concept towards a policy decision through a series of strategic projects aimed at filling critical evidence gaps, this was referred to as the 'H21 roadmap'.

To execute this H21 roadmap will requirement a combination of large scale NIC type projects, a government led program of research and a suite of smaller NIA projects. These projects will ensure the UK gas networks will understand the impact of hydrogen conversion in four key areas:

1. Application and impact of new equipment within the network. This will ensure a future conversion to hydrogen comprises the optimised selection of assets utilising the best technologies from around the world in the interests of gas customers.
2. Transportation of a different form of gas, i.e. 100% hydrogen on existing licensee assets
3. Operation of the network and its configuration when transporting 100% hydrogen.
4. The commercial impact of a hydrogen conversion and the alterations required to current commercial practices across the gas industry e.g energy efficiency losses across hydrogen production assets, different leakage model impacts etc.

This work will support the requirement for government to make firm energy policy decisions by the early 2020s. Without this suite of projects the opportunity for 100% hydrogen to play a significant role in future decarbonisation pathways may not be realistically considered. This could have a significant impact on UK gas customers if alternative non-optimized policy decisions are subsequently put into force.

This NIA project will focus on section 4.3 and 4.4 of the H21 roadmap. This project will determine the suitability of existing domestic, commercial and smart meters, assessing their suitability for operation on a hydrogen network.

There are over 30 million domestic and commercial meters installed across the UK gas customers. Furthermore there are numerous meters installed on the below 7 bar network, providing flow information critical to the operations of the gas distribution networks. The H21 roadmap identified the following potential actions required for hydrogen conversion in respect of existing domestic, commercial and smart meters;

- Do Nothing – the meters still work within acceptable tolerance
- Develop a correction factor – for example, if the meters perform from an integrity point of view (safety) but has an error in terms of measurement, could a corrective factor be established for meters originally designed for methane but now operating on hydrogen.
- Partial upgrade alongside the smart metering rollout program
- Upgrade as part of the conversion process.

Each option could have a differing economic, logistical and technical impact on the hydrogen implementation strategy. Replacing the existing meter stock in the UK could add significant cost to the overall conversion programme and add major logistical challenges. It is imperative to understand which option(s) are technically feasible to ensure the optimum strategy is adopted. This will minimise the impact on UK gas customers whilst ensuring the gas networks and wider industry understand the full remit of what is involved in the conversion process.

To identify the optimum solution from the options listed above, we need to understand the safety and technical performance of the existing UK meter stock, to determine their suitability for operation on a hydrogen network. This project will test a representative cross section of domestic, commercial and smart meters to assess their safety and operational performance whilst operating on hydrogen as opposed to natural gas. The project will also test meter regulators and assess the potential and cost for installation of an excess flow valve as an additional safety feature.

The metering and control of hydrogen entering a property is a potential challenge in any hydrogen conversion programme. The project will provide answers to the following potential problems;

- Are existing gas meters gas tight for hydrogen especially plastic components or seals?
- How accurate are the different designs of existing gas meters with hydrogen?
- What are the implications of hydrogen on the ATEX specification of existing meters containing batteries, especially SMART meters?
- What is the performance of existing meter regulators with hydrogen, especially their propensity to weep when 'locked-up' and the size of their pressure balance orifices.

- What is the impact of hydrogen conversion on the below seven bar meter population within the UK gas networks
- Should the UK gas networks and/or smart metering programme consider the installation of excess control valves in GD2 business plans or alongside the smart metering programme respectively

## Method(s)

In executing the project it is important to fully engage with the metering operator and manufacturing community. The project will work closely with IGEM (Institute of Gas Engineers and Managers) and representatives from the UK gas metering community via the Association of Meter Operators to ensure the scope of the testing programme is sufficient to provide a viable representative cross section of the existing UK meter community and that the test results will be credible and fully validated in line with industry standards.

The project will consist of three phases;

**Phase 1 – A review of the worldwide hydrogen meter technologies and applications**

During phase one the project will undertake a review of the use of gas meters and meter regulators operating with Town Gas, natural gas, LPG, and hydrogen. This will include meters used in places like Hong Kong, Singapore, China and the established Japanese and Danish hydrogen networks as well as the UK. Additionally expertise will be sought from the existing metering operators who supply direct to the industrial hydrogen market. As the project will be testing meters outside the manufacturer's specification, a key element of this review will be to provide the base data for the risk assessments required for the testing programme.

This stage is essential as a pre-cursor to phase 2. This is because there are little or no small volumetric meters in manufacture or operation globally it is impossible to fully determine the methodology, calibration and verification required for the hydrogen meter testing programme without this initial comprehensive review.

**Phase 2 – Meter and regulator testing programme**

During phase two of the project we will develop and design a testing programme to provide an initial assessment of the suitability of the existing, UK domestic and commercial meter stock to operate on hydrogen. The testing methodology and testing rig design will be developed in collaboration with the Association of Meter Operators, using information and data gathered during phase 1 of the project. The meter testing programme will be developed to satisfy the key performance indicators, detailed in the Measurement Industrial directive 2014/32/EU. The scale of the testing programme will be developed to consist of a representative sample of the following meter types and regulators;

- U type meters
- E types meters
- Smart meters
- Rotary meters
- Regulators

The testing programme will be developed to assess the following;

- Safety Performance – Testing to ensure the meter and regulator are leak proof when operating on hydrogen
- Technical Performance – Testing to provide an initial assessment of the impact on meter and regulator components when operating on hydrogen
- Operational Performance – Testing to assess the measurement performance across the full operational flow ranges

The testing programme and will be carried out by a suitably qualified and accredited testing organisation to ensure that results from the testing programme can be validated. As the scope and methodology for the phase 2 testing programme cannot be fully defined we have made an allowance for the phase 2 works in the project budget, based on discussions with the meter operators and IGEM.

**Phase 3 – Collation of data and reporting**

During this phase of the project, results from the testing programme will be collated and a final report produced. The report will provide an initial assessment of the operational and safety performance of the meters, regulators and excess flow valves tested, providing recommendations on their suitability to operate on a hydrogen network. The report will also provide an initial indication of the commercial impacts for any corrective / recommended actions in a hydrogen conversion programme.

## Scope

The project will evaluate the performance of commonly used meters and ancillary equipment outside of their design duty (i.e. operation on hydrogen). A testing programme will be developed to ensure that a representative cross section of UK meters and regulators are

tested so as to provide sufficient safety and performance data to ascertain the suitability of the existing UK meter stock for operation on a hydrogen network.

It should be noted that this project will be scoped only to provide an initial indication of the safety and operational performance of the existing UK meter stock to operate on a hydrogen network. Dependent upon the results from the testing programme further projects may be required to fully assess what actions may be required to address any safety, technical and performance issues identified.

**Time extension to project**

**The project duration will need extending by 6 months to June 2019, this is due to additional time taken in Phase 1 and to tender and award the design package. The sanctioned value of the project will not change based on the current scope, however, further sanction may be pursued to fully test the safety, technical and performance of the full range of commercial and domestic meters.**

## Objective(s)

The key objectives of the project are to provide factual, evidence based data to initial assessment of the suitability of the existing, installed UK meter stock to help determine the technical and economic implications of converting the gas networks to hydrogen. Undertaking this project will answer the key questions of;

- Are existing domestic, commercial and network meters suitable for operation on hydrogen?
- If not, can a conversion factor/ correction be applied?
- Will industry need to develop a new range of meters suitable for installation on a hydrogen network?
- What will be the impact on the existing UK gas industries below seven bar meter stock
- What will be the commercial impact for any associated errors for GDN business plans i.e. energy reconciliation to the shippers and impact on the leakage model

Answering these key questions will inform the economic model for hydrogen conversion and UK wide deployment. Furthermore, the project outcomes could help inform strategies for industry actions if the existing UK meter stock is found unsuitable for operating on a hydrogen network.

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

n/a

## Success Criteria

The project should deliver the following results;

1. Development of an appropriate below seven bar meter testing methodology for meters operating on 100% hydrogen utilizing international best practice and expertise from the Association of Meter Operators.
2. An evidence based assessment of the operational performance of a representative cross section of existing UK domestic, commercial and network below seven bar meters operating on hydrogen
3. An evidence based assessment of the safety performance of a representative selection of UK domestic and commercial below seven bar meter regulators operating on hydrogen.
4. An assessment of the Impact on current regulatory practices such as energy reconciliation.
5. Provide the basis for considerations for gas industry GD2 business plan provisions and potential opportunities for the smart metering programme.

Provide base information for assessing the commercial impacts of metering in hydrogen conversion scenario modeling.

## Project Partners and External Funding

**External Costs**

This project is completely funded by NIA allowance

National Grid Gas Distribution

Kiwa Gastec – phase one study

Wilcocks Consulting (Jim Sibley) - Specialist metering support and international benchmarking / connections with IGEM and the Association of Meter Operators

Aqua Consultants - External project management and coordination

Testing Programme provider to be defined following completion of phase one

## Potential for New Learning

This project will provide definitive answers to the anticipated performance of the existing, installed UK meter stock and their suitability for operation on a future hydrogen network. It will provide invaluable information on the economics of converting the gas networks, and what actions may be required for the gas network operators and the metering community in moving towards converting the UK gas grid to hydrogen. Furthermore it will identify any actions which should be considered by both the regulator and GDNs in the GD2 price control as well as impact/opportunities for the smart metering programme.

## Scale of Project

The project will undertake a testing programme of meters and associated equipment that will provide a representative cross section of the existing domestic and commercial meters installed in networks across the UK.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

The project will be based out of the H21 project office in Leeds. The location for the meter testing will be decided once the testing programme has been fully developed and defined following completion of phase one of the project. The project will be applicable to a cross section of domestic, commercial and operational meters installed in all the UK gas distribution networks.

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

Max recoverable internal costs - £90k

NGN- £45k

NGGD - £45k

**External Costs- £270k**

Kiwa Gastec (phase one study) - £25k

Wilcocks Consulting (Jim Sibley) - £35k

Aqua Consultants - External project management and coordination - £60k

Testing Programme - £150k (allowance)

NGN - £135k

NGGD - £135k

**Total Project Expenditure – £360k**

# 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 is one of a suite of projects to enable a conversion of the UK gas grid to hydrogen. Repurposing the UK gas networks with hydrogen to support the challenge of the climate change act has the potential to save £100s billions with minimal gas customer disruption verses alternative decarbonisation solutions.

## Please provide a calculation of the expected benefits the Solution

Not required as this is a research project

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

The research undertaken by this project is applicable to all of the Network Licensees

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

This project will inform the economic models for hydrogen conversion scenarios

## 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 project will assess the suitability of existing meters and associated equipment, installed across all gas networks in the UK

### 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 project will build on the original work of the H21 Leeds City Gate project and provide valuable knowledge and learning to inform some of the next steps identified in the H21 road map.

### 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