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NIA Project Registration and PEA Document

Date of Submission

Nov 2024

Project Reference Number

NIA_NGT0246

Project Registration

Project Title

Multi-Gas Detection: Phase 2

Project Reference Number

NIA_NGT0246

Project Licensee(s)

National Gas Transmission PLC

Project Start

October 2024

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Doug Millington-Smith,
box.GT.innovation@nationalgas.com

Project Budget

£165,543.00

Summary

Following on from project NIA_NGGT0195 – Multi-gas Detection, Phase 2 expands on the project findings in both the methane and hydrogen emissions monitoring space, as well as generating new innovations in the field of hydrogen detection, leaving National Gas Transmission well-poised to deploy long-term pilot projects based on the results in RIIO-3.

This project involves surveying the current state of the art of methane and hydrogen emission monitoring solutions, further development of methane and hydrogen detection, localisation and quantification performance of the Nevada Nano sensors at Bacton Terminal and HyNTS FutureGrid, and measuring relative performance of personal hydrogen monitors for deployment on a hydrogen-based National Transmission System (NTS). The project develops and demonstrates systems relevant to both our applications today and the net zero future.

Preceding Projects

NIA_NGGT0195 - Multi Gas Detection

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

1. The performance of the existing Nevada Nano sensors for methane monitoring can be measured in terms of value – gas saved as a result of detected leaks being repaired ahead of when a walkover survey would have found them.

However, the Nevada Nano sensors were initially deployed because they were marketed to be sensitive to both methane and hydrogen, rather than because they represented the state of the art in monitoring methane alone. It has been shown by previous studies that the performance monitoring hydrogen emissions is not conclusively proven.

2. The calculation of value added by the Nevada Nano sensors at Bacton, in terms of savings due to emissions fixed earlier than would otherwise be detected, has not been comprehensively assessed.

3. At present, no realistic alternative to the Nevada Nano sensors for hydrogen emissions monitoring is available to the market. The continued deployment of the sensors at HyNTS FutureGrid, which comes at no further rental cost due to the unproven nature of the sensors for hydrogen monitoring, can enable Nevada Nano to build on the promising but inconclusive results generated during Phase 1 by further refining the detection, localisation and quantification algorithms. It can also provide a test bed similar to the deployment at Bacton Terminal for methane.

4. Hydrogen has a considerably wider explosive range than methane, and a marginally lower flammability limit. With the high freedom of hydrogen relative to methane possibly leading to fugitive weeps and seeps of gas from even well-sealed infrastructure, the risk of higher concentrations of ambient hydrogen remains high.

Personal hydrogen monitors worn by staff at HyNTS FutureGrid have not been assessed for suitability against other models for wider deployment when the hydrogen national transmission system comes online. No project in the public domain has yet exploring the performance, functionality and reliability of personal hydrogen monitors in realistic environmental conditions, and their suitability for deployment on a hydrogen-based National transmission system to protect site workers.

Method(s)

Work Package 1: Calculation of natural gas value saved by Nevada Nano multi-gas sensors at Bacton Terminal

Led by National Gas Transmission

Using records of repairs carried out on the Bacton site resulting from leaks identified by the Nevada Nano sensors, timed against the next scheduled traditional walkover study of the area in question, the value of gas saved by the sensor deployment at Bacton can be calculated.

Use the value of the gas saved in each area of the site to resolve the performance of the Nevada Nano sensors in the spatial- and time-based domains.

The calculations using the historical data can be applied to the remainder of the Bacton deployment in WP2, utilising the ongoing reports to extend the calculations of savings.

Work Package 2: Continued deployment of Nevada Nano multi-gas sensors at HyNTS FutureGrid

Led by National Gas Transmission

The FutureGrid Site consists of decommissioned assets from across the Network, installed above ground in a test loop for hydrogen. Through the test period the facility will run with 2%, 10%, 20% and 100% Hydrogen/Natural Gas blends. The Nevada Nano sensors

were deployed on the active part of the site and monitored hydrogen emissions from the blends as they were produced by the loop.

While the results of the hydrogen monitoring operation were promising, the hydrogen detection, localisation and quantification performance of the Nevada Nano sensors remains unproven, both practically and statistically. Nevada nano report that the new iteration of the sensors (as well as enhanced battery life and near-zero maintenance requirements) should improve the detection and localisation algorithms, to the point that they can add value to a hydrogen transmission system in terms of gas savings through leak detection. However, there is no evidence to support either the validity of this claim, nor that of the performance.

The continued deployment at FutureGrid, in which similar blends of hydrogen and methane will be deployed in the loop, will assess this claim. At this stage of the development, Nevada Nano are crucially lacking hydrogen test data, and ruing the sensors at FutureGrid, even if none of the detected leaks are acted upon, will provide tens of thousands of additional data points with which to refine and improve the detection and quantification algorithms.

A major factor of this improvement lies in automatic speciation between methane and hydrogen, which is currently not offered, but which Nevada Nano report is possible. As the only facility in the UK currently circulating blends of methane and hydrogen through a facility-scale gas circuit, deploying the sensors at FutureGrid is essential to demonstrating this functionality.

The performance of the Nevada Nano sensors in detecting, localising and quantifying emissions of methane alone is being demonstrated at Bacton, and this will continue, to both enable Nevada Nano to further refine the detection, localisation and quantification of real-world methane emissions, and to aid the calculation of value added through gas emission savings in WP1.

Work Package 3: Continuous market survey for new hydrogen monitoring solutions and realistic assessment of any that are presented for suitability

Led by National Gas Transmission

The market for continuous and survey-based methane techniques continues to evolve in real-time, and in order to accurately develop a roadmap for future methane emissions monitoring, it remains necessary to keep well-appraised of developments in the market. The project will ensure that NGT remain fully informed of the cutting edge of methane emissions monitoring technology, and have a good idea of where the market will trend in the future.

At present, no other site-based continuous hydrogen monitoring solutions are presented to the market for consideration. This may change during RIIO-2 and the project will be diligent in its search to provide competitive comparison with the NN devices, helping NGT to remain as well-informed about their options for hydrogen emissions monitoring in RIIO-2 as they are for methane.

The project will be funded by Network Innovation Allowance and therefore we are required to demonstrate the innovative nature of the technologies we are looking to deploy. This work package will provide key cutting-edge understanding of the market surrounding hydrogen and methane emissions monitoring, providing a detailed review of the detection landscape for the two gases, and the relative merits of the Nevada Nano system vs other technologies on the marketplace.

Work Package 4: Comprehensive Assessment of Commercially Available Personal Hydrogen Monitors

Led by National Physical Laboratory

Personal hydrogen monitors worn by staff at FutureGrid have not been assessed for suitability against other models for wider deployment when the hydrogen national transmission system comes online. All of the monitors on the market will conform to basic safety requirements and will be IP-rated to allow outdoor use, but there is no information on how their accuracy varies across different environmental conditions such as temperature, relative humidity, or the presence of wind or precipitation. They also display varying windows of concentration detection, some of which do not reach the LEL of hydrogen. It is unclear how they perform when confronted with concentrations of hydrogen outside of their measurement range. No project on the ENA portal exists exploring the relative performance, functionality and reliability of personal hydrogen monitors, and their suitability for deployment on a hydrogen national transmission system to protect site workers.

A comprehensive study will be carried out on the range of personal hydrogen monitors on the market, assessing their detection capability, resilience, integration with other personal sensors, value, robustness, and other metrics to be decided. NPL have been approached to carry out the work, due to their long history of market leading metrology, and the availability of suitable environmental chambers and controlled release facilities.

Work Package 5: Standards and Reporting

Led by National Gas Transmission

Deliver high quality, robust and relevant Technical Report and ENA Closure Reports to meet NIA and National Gas Transmission's requirements.

Measurement Quality Statement

The measurement approach used to meet Data Quality objectives will be through the identification of high calibre project partners who are experts in their given field. 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.

Data Quality Statement (DQS)

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document and NGT 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.

Scope

The scope of this project will encompass improvements to the detection, localisation, quantification of, and protection from, two hazardous, polluting gases representing the present and future of the National transmission system. If successful, this project will provide a clear roadmap indicating which system should be used in long-term pilot deployments of continuous methane emissions monitoring, assess the readiness of systems to continuously monitor hydrogen emissions, and promote the safety of workers on the future hydrogen-based transmission and distribution systems, reducing safety risk associated with gas escapes for both hydrogen and methane networks, supporting a network in transition through to hydrogen.

The scope of work contained in this project includes:

· Comprehensive calculation of financial savings made on the network as a direct result of methane emissions being detected and repaired sooner than they would in the absence of the Nevada nano sensors.

· Comprehensive assessment of the methane emissions monitoring market with a focus on competitive solutions to the Nevada Nano sensors.

· Comprehensive assessment of the hydrogen emissions monitoring market with a focus on competitive solutions to the Nevada Nano sensors.

· Development of sensor technology to ensure capability in hydrogen and hydrogen blends

· Comprehensive assessment of the relative suitability of commercially available personal hydrogen monitors for safety critical deployment on a hydrogen-based national transmission system.

Objective(s)

The project has several different motives, and will consequently generate several different deliverable objectives. The goal of Phase 2 of the multi-gas detection project is to complete RIIO-2 with:

1. Building on previous work in this area (including third-party studies), a comprehensive assessment of the state of the art of hydrogen and methane emissions monitoring techniques (including those of Nevada Nano).

2. A market assessment of continuous and survey-based hydrogen and methane monitoring solutions.

3. A comprehensive yet flexible road map for the deployment of methane and hydrogen monitoring solutions at National Gas Transmission installations in RIIO-3.

4. An independently verified assessment of the viability of personal hydrogen monitors for deployed personnel on the hydrogen-based national transmission system.

5. An improvement of the continuous hydrogen detection, localisation and quantification protocols in collaboration with Nevada Nano.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations. This is because it is a transmission project.

Success Criteria

The project shall be deemed successful if it:

· Clarifies the direction for the future of continuous methane and hydrogen emissions monitoring on the national transmission system.

· Demonstrates an improvement in the performance of the Nevada Nano sensors to be able to detect, localise and quantify emissions of hydrogen and hydrogen blends at FutureGrid.

Demonstrates the most suitable personal hydrogen monitor for safety-critical deployment on a hydrogen-based National transmission system.

Project Partners and External Funding

- Multi Gas Sensor Supplier – Nevada Nano
- FutureGrid Facility Testing – DNV-GL
- Contract Testing House – National Physical Laboratory

Potential for New Learning

We hope to prove an integrated approach can support the natural gas network through to a 100% hydrogen network, by detecting, locating and quantifying fugitive emissions or gas leaks on sites. Using a single system as a benchmark, we will learn how accurately the system is able to pick up on fugitive emissions of a comprehensive range of blends of natural gas and hydrogen; success would mean that National Gas Transmission would have clear direction on the monitoring systems that could be used through the transition to net zero. We need to understand the relative ease of implementing the solutions, how they could be maintained, as well as how the data collected could be utilised. We will learn which of the several commercially available personal hydrogen monitors is the most suitable model for long-term deployment as a safety critical item of personal protective equipment.

The learnings from this project shall be shared through the smarter network portal, as well as through direct engagement with any other gas networks that could benefit from the results.

Scale of Project

To obtain a suite of solutions for the majority of potential gas scenarios for the National transmission system at present and in the future, we must demonstrate the system against natural gas, as well as differing hydrogen blends, which is why we have chosen to demonstrate at both the Bacton Terminal site and FutureGrid facility. Currently there is no other online high pressure test facility with hydrogen capabilities in the UK. We shall be making use of existing trials in varying blends to make efficient use of investment in other projects. Bacton provides the opportunity to monitor emissions of a complex site on the National transmission system. Completing this exercise on a smaller scale, for example solely in a lab, would not provide nearly as much benefit, as we need to test these systems in open conditions where external factors such as the weather can affect gas releases.

There is a wide selection of personal hydrogen monitors on the market, all of which suggest they are suitable as safety critical PPE and have various certifications to prove it. However, there is a difference between conforming to a minimum standard, and proving the best in class. Testing as many personal monitors as possible against each other provides a definitive assessment of the best in class model, which would not be possible if only a subsection of the widely available monitors were assessed. Using a contract testing house makes the assessment unbiased and objective with respect to National Gas, which may not be the case if the assessment were performed in house.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

United Kingdom – Warwick, Bacton Terminal and FutureGrid Facility (RAF Spadeadam)

Revenue Allowed for the RIIO Settlement

None – all funds will be consumed within RIIO-2.

Indicative Total NIA Project Expenditure

External Costs: £109,157.36

Internal Costs: £36,385.79

Contingency – including personal hydrogen monitors cost - £20,000

Total: £165,543.15

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:

From both an environmental and commercial standpoint, it could prove a suite of gas sensing systems can support the current natural gas network through to a 100% hydrogen network, by detecting, locating and quantifying fugitive emissions or leaks of both natural gas and hydrogen on sites. There is a need right now to be able to monitor fugitive emissions from our natural gas network, however we will also need a system that can continue to do so as we move towards blends of hydrogen and then pure hydrogen.

From a personal safety standpoint, it could verify the best in class in personal hydrogen monitoring ready for widespread deployment on a hydrogen-blended and then pure hydrogen based national transmission system. Operator safety is of paramount importance in the delivery of the energy network of the future, and the choice of which PPE to use should represent the greatest value added towards this goal.

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)

N/A

Please provide a calculation of the expected benefits the Solution

It is difficult to quantify the benefits for this project, as they shall be of an environmental and safety kind. Through continuous monitoring of natural gas, whether that is natural gas as we use today or blended with hydrogen, we would be able to target and hope to reduce fugitive emissions from our networks to reduce the negative impact of greenhouse gases on the environment. A successful detection system will also provide a warning system for flammable atmospheres of gas leaks, helping to manage safety risks.

Value Tracking
Data Point
Data Point Definition
Maturity
TRL 3-8
Some of the existing sensors in the study are at TRL 3-4
Opportunity
100% / multiple asset class
The project can be applied to:

- Pipeline
- Branched pipework
- Stub/dead end pipework
- Above ground installations (AGIs)

Deployment Costs

Deployment costs are zero, as the equipment to be deployed already has been in previous projects
Innovation Costs
£165,543.15
The cost includes all installation, testing and sensor costs.
Financial Savings – Project

Exact financial savings not known at this phase, to be calculated as part of the project.
Safety
Earlier leak detection
Reduction in emissions facilitates the ability to operate the NTS within GS(M)R guidelines
Environment
Emissions reduction calculation
Reduction in greenhouse gas emissions, particularly methane emissions, will have a marked, immediate impact on climate change and facility National gas Transmission and the UK's Net-Zero ambitions
Compliance
Support compliance
Review guidelines, procedures
Skills & Competencies
Group

Future Proof
Indicated on the business strategy

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

Most aspects of the project are focused on gas detection and quantification on the National transmission system of now and the future. However, the research and learning undertaken as part of this project is applicable to all GDNs within the UK, as the networks will have the same gas composition and potential emissions/leak issues and so will assist with future hydrogen conversion projects.

The findings of the suitability assessment of the personal hydrogen monitors will be of use and value to every operator and industry in the UK and beyond who intends to work with pressurised hydrogen at risk of leaking.

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

N/A – The Project does not intend to rollout anything, but knowledge and information generated through the lifecycle of the project. Consideration of the business case for utilising the gas detection system beyond the project shall form part of the final report.

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 research and analysis undertaken in this project will be applicable to all pipeline operators and will inform the strategy for hydrogen in the energy transition. Findings from the project will demonstrate the use of new sensor technologies on gas networks of variable gas blends which can in-turn develop safe hydrogen standards and procedures.

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 project will not seek to carry out competitive testing of methane emissions monitoring solutions, as these would represent a duplication of previous work. Instead, it will undertake to remain informed of the state of the art of methane emissions monitoring technology to provide a clear roadmap for potential competitive testing of new technologies against the incumbent technology in the future. As the market continues to evolve, every study finds and assesses new technology in the monitoring space.

No previous project has been undertaken to competitively assess the suitability of continuous hydrogen monitoring solutions for deployment on hydrogen-blend and pure hydrogen-based infrastructure.

No previous project has been undertaken to competitively assess the best in class of commercially available personal hydrogen monitors, instead relying on supplier certification to make safety-critical decisions.

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 constantly-evolving emissions monitoring landscape has carried out some competitive comparison of methane monitoring systems in sealed conditions, but no such competition has been carried out on a live site. In contrast, no such competition has taken place among hydrogen monitoring solutions at all, despite the need to move to blended hydrogen, and subsequently pure hydrogen, in gas networks in order to achieve Net Zero and beyond.

It is not clear why a comprehensive assessment of the suitability of personal hydrogen monitors has not been undertaken and published, but the benefits of such an independent assessment are significant, and represent an innovative approach to the decision-making process in personal safety of hydrogen operatives.

Relevant Foreground IPR

This project and the resultant outcomes/deliverables will conform to the default treatment of IPR as set out under the agreed NIA Governance (where the default requirements address two types of IPR: Background IPR and Foreground IPR).

Data Access Details

Details on how network or consumption data arising in the course of an NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Gas can be found in our publicly available “Data sharing policy relating to NIA projects” at www.nationalgas.com/gasinnovation. National Gas data access is managed IAW provisions under 2.15-2.18 for the current NIA Governance Document.

National Gas already publishes much of the data arising from our 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.

Data for this project, and all other projects funded under the Network Innovation Allowance (NIA) funding scheme, can be found or requested via our managed mailbox box.GT.Innovation@nationalgas.com. Further data can be shared upon request through the innovation mailbox. Each request will be assessed by the GT Innovation Team for its merits and viability.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGT 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.

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

activities

Continuous monitoring of fugitive emissions of both natural gas and hydrogen does not constitute business as usual for National Gas. Regulation does not mandate continuous monitoring for emissions, though it is strongly anticipated that it will in the future. Funding the development of solutions under NIA ensures that the network is fit for both the near and further future of the national transmission system, and guards against the risk of rash and rushed decision-making if the development of these solutions is only undertaken as part of business as usual practices when it becomes business-as-usual to carry them out.

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 work in the project is of value and use across energy networks and the wider industry. If the work was not undertaken with the support of NIA, it would risk multiple duplications of work as each operator carries out their own surveys of the best in class solutions for continuous natural gas monitoring, continuous hydrogen monitoring, and personal hydrogen monitoring.

This project has been approved by a senior member of staff

☑ Yes