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 2021

Project Reference Number

NIA2_SGN0001

Project Registration

Project Title

Grangemouth to Granton LTS Futures

Project Reference Number

NIA2_SGN0001

Project Licensee(s)

SGN

Project Start

September 2021

Project Duration

3 years and 1 month

Nominated Project Contact(s)

Nancy Thomson

Project Budget

£533,200.00

Summary

The UK government has committed to reducing greenhouse gas emissions to Net Zero by 2050. All future energy modelling identifies a role for hydrogen in providing decarbonised energy for heat, transport, industry and power generation. A key element of transition to hydrogen is to deliver compelling evidence for the enduring use of existing gas network assets in the form of a pathway to decarbonisation. This project seeks to undertake critical work to ensure completion of a live field trial in a statistically representative pipeline. The LTS programme seeks to develop a blueprint for repurposing of LTS pipelines for hydrogen transmission whenever, wherever. Project findings will be key to support the transition to 100% hydrogen.

Third Party Collaborators

DNV

Pipeline Integrity Engineers Ltd

Bell Ingram

Kiwa

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

In June 2019, the UK became the world's first major economy to legally commit to cutting greenhouse gas (GHG) emissions to net zero by 2050. The Scottish Government has committed to net zero GHG emissions by 2045. A major system transition away from natural gas is required for these ambitious targets to be met. It is widely recognised that repurposing of the gas network for hydrogen could offer a lower cost and lower disruption option for customers compared to other decarbonisation options such as electrification.

Decarbonisation of the gas network offers a credible least cost solution to support the transition to net zero.

It is necessary to understand compatibility across the spectrum of assets and operations, to what extent they can play a role in any system transformation and the cost. The Local Transmission System (LTS) is an essential network asset that delivers energy to towns and cities across GB. The processes, systems, facilities, technologies, assets, networks and services of the LTS are critical national infrastructure.

With system transformation of the network to 100% hydrogen, the 11,000km of LTS pipelines within GB are well placed to provide transportation routes for hydrogen to consumers. The LTS Futures programme will look to research, develop, test and evidence the compatibility of LTS infrastructure for hydrogen distribution, culminating in a first of a kind repurposing trial and demonstration for hydrogen. This project will look to identify the statistically representative nature of the pipeline earmarked for repurposing under the programme in addition to a number of other key learnings relating to the development of blue hydrogen at industrial cluster locations and connection to our existing LTS network. This will provide key learnings that feed into a blueprint methodology for repurposing and support transition of the GB LTS network to 100% hydrogen, enabling decarbonisation at scale.

Method(s)

The project will involve five main work streams including the following:

1. An evaluation into a number of options for hydrogen supply identifying associated engineering and civil costs to determine the optimal solution for the Grangemouth to Granton, live pipeline trial.
2. Development of a route map and methodology to detail how the existing GB LTS network can be repurposed for use with 100% hydrogen, and utilising a live demonstration project to repurpose the existing Grangemouth to Granton pipeline and associated installation, and additional testing in the HYNTS FutureGrid experimental research programme being progressed by National Grid at Spadeadam.
3. Illustrate the statistical representativeness of the Grangemouth to Granton pipeline and cost effectiveness of hydrogen conversion, complete severity analysis on the GB LTS pipeline materials, and produce a comprehensive testing approach for offsite testing of LTS assets..
4. Undertake land referencing activities for repurposing of the Granton to Grangemouth pipeline to 100% hydrogen.
5. Feeding from outputs of workstream 1 on potential options for hydrogen supply for the trial of the Granton to Grangemouth pipeline, one option is a pipeline from a Steam Methane Reformer (SMR) located in the Grangemouth industrial cluster. This investigate the feasibility of routing the 100% hydrogen pipeline from the refinery to gas network.

Work streams 4 and 5 have been recently developed following discussions and agreement with OFGEM to bring aspects of LTS Futures programme forward to keep momentum on the programme and the NZASP funding decision does not affect timelines.

Scope

The scope and objectives of the Project should be clearly defined including the net benefits for consumers (eg financial, environmental, etc). This section should also detail the financial benefits which would directly accrue to the GB Gas Transportation System and/or electricity transmission or distribution.

1. **Hydrogen Optioneering**
   - Initial discussions with SGN and Grangemouth refinery to set boundaries of the study and identify available options
   - CAPEX and OPEX of hydrogen options ranging from:
     - Routing of pipe within refinery (2inch and 18inch) from SMR production to Granton to Grangemouth pipeline.
     - Choice of pipeline material and operating pressure
     - Equipment required for injection from tube trailer
   - Functional specification of PRS
   - Odorization unit specification
   - Specification of purging systems from nitrogen to hydrogen
   - Commissioning plan
   - Decommissioning plan

- Liaison with SGN and review test programme
- Overall cost estimate

2. Repurposing Strategy
   - Develop technical strategy and the work programme and plan to deliver it
   - Define technical studies required including hydrogen release studies and equipment trials to establish scope of further works
   - Conduct parametric variable analysis of the UK LTS system, which enable understanding and demonstration of the applicability of the R&D programme to the whole LTS network.
   - Carry out Value for Money analysis to identify if repurposed pathway provides the best value for money for the whole system.
3. **G2G Statistical Representativeness**
   - Determine the statistical representativeness of the Granton to Gangemouth pipeline against the GB population of LTS infrastructure
   - Determine the cost effectiveness of hydrogen conversion of the LTS
   - Complete a severity investigation to ensure the worst case materials are covered for material testing allowing for prioritisation of material testing.
   - Gap analysis to confirm that the LTS Futures programme of testing covers all the evidence gaps but considers new evidence to be generated by the FutureGrid programme of work to avoid necessary duplication
   - Define a high-level approach for testing LTS assets alongside/between the existing H21 and FutureGrid projects a**t DNV Spadeadam**
4. **Land referencing for 100% hydrogen pipeline**
   - Land referencing to understand the effects on the landowners are along the 100% hydrogen Grangemouth to Granton pipeline and identify any previous interactions
5. **100% Hydrogen pipeline supply design**
   - Feasibility study to supply hydrogen from the refinery to gas networks, the project will:
     - complete of a utilities survey to understand any existing utilities lines that may cross the potential route of 100% hydrogen pipeline from the hydrogen supply (SMR) to the Grangemouth to Granton pipeline.
     - Desktop ground investigation to decide upon pipeline routing techniques (e.g. HDD or micro tunnelling) for the 100% hydrogen supply pipeline
     - A topographical survey will be completed for the 100% hydrogen supply pipeline
     - Geotechnical investigation will be completed for the 100% hydrogen supply pipeline
     - Internal camera inspection of Grangemouth pig trap to locate hydrogen supply tie in

Objective(s)

The objectives of the project are to undertake preparatory works for development of the live trial of the Grangemouth to Granton pipeline under the LTS Futures programme. The project will illustrate the pipelines statistically representative nature to GB LTS infrastructure, identify a clear strategy for the repurposing of LTS assets and identify the material testing strategy based on severity of the materials in the GB LTS pipelines. Potential routing and design of a hydrogen supply pipeline will also be completed post decision on the most cost-effective approach for hydrogen supply for the trial. All work programmes will be key in developing the live trial of the Grangemouth to Granton pipeline and will feed into the blueprint for repurposing.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Not applicable

Success Criteria

Success criteria of the project include:

- Final report including functional design of a connection to the Grangemouth to Granton pipeline including PRS, odorization and safety systems and including an operational concept to meet SGN’s testing and research requirements

- Defining of technical studies required including experimental hydrogen release studies and equipment trials to establish the scope of further work required
- Parametric variable analysis of the UK LTS system, which enables understanding and demonstration of the applicability of the R&D programme to the whole UK LTS network.
- Value For Money analysis to investigate whether the developed repurposing strategy will provide 'best' value for the whole system.
- Statistical representativeness and cost effectiveness of Grangemouth to Granton
- Material severity investigation to ensure blueprint covers all assets
- Spadeadam testing approach for off-site testing
- Evidence case for utilising existing LTS assets in transition to hydrogen
- Land referencing map for 100% hydrogen Grangemouth to Granton pipeline
- Hydrogen supply ground investigations completed for potential pipeline routing

Project Partners and External Funding

- DNV
- PIE
- Bell Ingram
- Kiwa
- SGN
- External NIA Funding

Potential for New Learning

Grangemouth to Granton LTS Futures project is critical to identify the overall economic viability case for the repurposing of UKs LTS infrastructure to 100% hydrogen based on its statistical representation and scalability based on the physical pipeline features that will be assessed as part of this project.

The project will aim to illustrate the cost effectiveness for hydrogen service compared to a number of different decarbonisation solutions including potential decommissioning of LTS assets for an electrified pathway or replacement with a new LTS pipeline system. Project learnings are key to SGN and other GDN's to illustrate the value for money for the customer by repurposing of LTS assets providing lowest cost to gas consumers as a Net Zero transitional option.

Further workstreams of the project aim to identify technical studies required including hydrogen release studies and equipment trials to establish scope of further works, critical to ensure knowledge gaps are minimised throughout the programme. Land referencing for the pipeline will also feed into requirements for LTS blueprint for repurposing, understanding the process and any challenges. Routing assessments for hydrogen supply through heavy industry sites will also be critical learning to gain from the project as clusters are earmarked as the first to transition to low carbon hydrogen. Understanding the processes and assessments required for pipeline routing from industrial sites for GDN's to then receive gas to the network is a key learning that can be utilised from the project. The project learning will be disseminated through various network collaboration channels and key project reporting outputs in conjunction with joint network collaboration events, SGN intend to fully share all project outputs as this is a critical national project to demonstrably show the UKS LTS pipelines are suitable for the transportation of hydrogen.

Scale of Project

The project outputs ensure that the Grangemouth to Granton pipeline is representative of GB LTS infrastructure. Therefore, developing the pipeline for live trial testing will ensure the maximum benefit, validating that the vast majority of LTS pipelines and assets on the GB network can be repurposed to 100% hydrogen. This provides the most economic viable relative to investment for the live trial. If the project were on a smaller scale, the key characteristics and features present on the Granton to Grangemouth pipeline that provide GB LTS representativeness would have to be found at other locations. Analysis of other mothballed pipelines in GB identified that none had the key representativeness of the Grangemouth to Granton pipeline which would mean a number of diversions of live pipelines would be required to provide the same representativeness. These diversions would be on a smaller scale, not include all key features and characteristics and have increased cost.

Technology Readiness at Start

Technology Readiness at End

TRL3 Proof of Concept	TRL4 Bench Scale Research

Geographical Area

The project will be desktop exercises however the work carried out will be applicable to the GB system transformation. The repurposing of Grangemouth to Granton pipeline will provide valuable and critical input into the development of the blueprint of how to repurpose LTS assets and the cost assessment. The hydrogen supply will be representative of how hydrogen will be entering the gas networks in the future and valuable learning can be shared with the industrial cluster projects.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

£533,200

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:

The development of the Grangemouth to Granton pipeline for live trial testing is a critical aspect of facilitating energy system transition through 100% hydrogen. As the Grangemouth to Granton pipeline provides a representative pipeline to GB LTS infrastructure, live trial of the asset with 100% hydrogen and subsequent production of a blueprint for repurposing of existing LTS pipelines and assets in addition to a robust cost assessment can be utilised by other gas network operators to undertake works to transition LTS pipelines to low carbon gas. This approach to energy transition will provide the most cost-effective solution for consumers and support UK's goals of net zero by 2050. Our current estimate is that if the LTS can be converted to transfer hydrogen then the cost of repurposing the LTS network will be between 15% and 30% of the costs of replacement, significantly reducing the costs of decarbonisation through the hydrogen pathway. The actual repurposing cost will be determined under the live trial and inform the system transformation. The results of the trial will also enable the development of the commercial, regulatory and safety models for future operations of hydrogen networks. Therefore, this project is critical to understand key aspects of the live trial, validate the pipelines representative nature and ensure that through development works that there is no delay to completion of the trial prior to key policy decisions on the future of domestic heat scheduled in 2025.

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

Not applicable

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)

Not applicable

Please provide a calculation of the expected benefits the Solution

Not applicable

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

LTS infrastructure will be critical in a network transition to 100% hydrogen to ensure security of supply for consumers. All GDN's have LTS infrastructure transporting natural gas into lower pressure distribution networks. Although the project focuses on development of the Grangemouth to Granton pipeline for live trial testing, outputs will feed into the blueprint for repurposing that can be applied to the vast majority of LTS pipelines and assets. Outputs of hydrogen optioneering and routing of hydrogen supply from industrial cluster locations to GDN tie in points can also be applied to other regions of the UK where GDN's are developing plans for energy transition through the construction of blue hydrogen reformation units on existing industrial cluster sites.

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

LTS infrastructure is fundamental to transferring hydrogen within a Local Distribution Zone (LDZ). Our current estimate is that if the LTS can be converted to transfer hydrogen then the cost of repurposing the LTS network will be between 15% and 30% of the costs of replacement, significantly reducing the costs of decarbonisation through the hydrogen pathway. Key learnings from the project will

identify the representative nature of the Granton to Grangemouth asset ensuring that repurposing of LTS learnings can be applied to the majority of GB LTS infrastructure.

The blueprint for repurposing will provide answer to what LTS assets can be repurposed, how they are repurposed and how estimate cost of repurposing. SGN have agreed with other GDNs that case studies of pipelines which are expected to see hydrogen deployment first will be undertaken.

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

Development of the Grangemouth to Granton pipeline for live trial testing is critical to ensure that the asset earmarked for testing provides a representative asset of GB LTS infrastructure. Using a representative pipeline for testing ensures development of a robust blueprint methodology for repurposing of the vast majority of GB's 11,000km LTS network. Ensuring the most optimal supply of hydrogen for the trial will also allow the project to undertake further studies on potential line pack capacity of LTS pipelines. Learnings of these studies will be critical for GDN's when understanding future storage requirements. Routing of hydrogen supply to the GDN tie in point from an industrial cluster site will also be critical learning that can be used by GDN's as plans develop for blue hydrogen production from industrial clusters.

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

Not applicable

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 scope has been reviewed against all existing projects and no areas of duplications have been identified.

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

There have been significant developments in positioning UK industrial clusters as the main driver for hydrogen production. The LTS forms critical national infrastructure in a future net zero system through transportation of hydrogen from industrial cluster locations to customers on the network. Assessing the viability of LTS infrastructure to be repurposed to 100% hydrogen is therefore of key importance.

The project aims to illustrate the representative nature of the Grangemouth to Granton pipeline to GB LTS infrastructure in addition to initial studies for the repurposing of the asset to 100% hydrogen. Currently up to 0.1% hydrogen by volume is allowed within GB LTS infrastructure. Transition to 100% hydrogen to support the decarbonisation of domestic heat is an innovative solution to ensure that we meet climate targets set out by UK Government.

Additional project workstreams also provide key innovative learning on the assessments, engagement and processes required to ensure safe distribution of hydrogen gas from an industrial cluster location to a site within the public domain, connecting to GDN LTS assets.

Relevant Foreground IPR

Not applicable

Data Access Details

Any consumer data gathered throughout this project will be anonymised and will be compliant with General Data ProtectionRegulations (GDPR) and the UK Data Protection Act. Any compliant data can be made available for review upon request.

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

This research forms part of SGN's pathway to decarbonisation to Net Zero through illustrating the viability of repurposing LTS infrastructure to 100% hydrogen. As such, it is not part of the usual activities of the business.

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 framework offers a robust, open framework to support this work and ensures the results are disseminated to all licenses. The repurposing of LTS infrastructure to 100% hydrogen at scale involves potentially significant technical risks. The project will look to develop the Grangemouth to Granton pipeline for live trial and hydrogen supply from refinery, with learnings that can feed into a blueprint for repurposing of LTS infrastructure.

This project has been approved by a senior member of staff

☑ Yes