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 2024

Project Reference Number

NIA2_SGN0060

Project Registration

Project Title

H100 Interference Damage Management Project

Project Reference Number

NIA2_SGN0060

Project Licensee(s)

SGN

Project Start

September 2024

Project Duration

0 years and 5 months

Nominated Project Contact(s)

Joseph Abazeri

Project Budget

£171,291.00

Summary

This project is a safety-critical H100 Fife Distribution Network Project to train H100 Fife personnel and demonstrate safe interference damage management in gas mains up to 250mm Polyethylene (PE) in diameter for the H100 Fife Distribution network building on previous work developed under the Hypurge project. The Hypurge project focused on planned commissioning and decommissioning purging operations and recommended direct purging for airtight systems up to 90mm in diameter. However, approximately 40% of the H100 distribution Network has pipe diameters above 90mm, and the conclusions of Hypurge cannot be applied to systems where airtightness has been lost, and oxygen ingression is predominant, as experienced during pipeline interference damage without further research.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

The H100 Fife Distribution network is constructed with newly laid PE pipes, featuring sectorisation valves at the start and end of each street and additional key valves at strategic locations. In the event of a Public-reported event (PRE) or loss of containment on the H100 network, the SGN response team will close the sectorisation valves and purge the affected section of the network before and after conducting replacement or repair works.

Existing research on hydrogen purging, conducted through various industry projects like HyPurge, has focused on planned commissioning and decommissioning for 100% hydrogen, 20% blends, and both direct and indirect purging methods. This research indicates that direct hydrogen purging is generally more efficient than natural gas purges for pipework up to 90 mm in diameter,

provided the system is airtight and resources are readily available.

However, in the case of unplanned events such as external interference, spontaneous pipework or joint failure, water ingress, or other mechanical damages, significant differences arise when:

- A leak or damage location allows hydrogen to escape and air to enter the pipeline.
- A flammable hydrogen-air mixture can form inside and outside the pipeline around the damage/leak location.
- Leaks can occur at any time, and a specialist team with the required equipment for indirect purging might not be immediately available.

Approximately 60% of the H100 Fife distribution network consists of pipes with diameters of 90 mm or below, leaving about 40% (approximately 3 km) with diameters of 125 mm, 180 mm, or 250 mm. The recommendations from the HyPurge project do not cover this 40%. Moreover, practical aspects of purging, such as tooling (including purge stacks, block and bleed vent lines, and purge vents) and processes, need to be validated and approved for field use, and H100 Fife operatives must be trained in Hydrogen purging operations.

Therefore, it is essential to obtain assistance from DNV to demonstrate safe Interference damage management in gas mains up to 250 mm PE low pressure (LP) (75mbar) for the H100 Fife distribution network.

Method(s)

The project will use a combination of technical methods to develop a procedure for safely purging hydrogen pipelines in case of damage or leaks. The methods include:

Phase 1:

Review and Analysis:

- Review Existing Procedures: Analyse existing SGN procedures for natural gas purging and emergency response to understand current best practices.
- Review Existing Knowledge/Models: Examine existing purging knowledge and natural gas and hydrogen models to leverage applicable insights.

Scenario Definition and Analysis:

- Define Credible Leak Scenarios: Identify plausible damage leak cases, including external interference damage and spontaneous pipework/joint failure, with or without water ingress.
- Predict Outcomes: Use existing knowledge and experimental data to predict flammable mixture formation around the damage/leak point before and during the purging operation.

Calculation and Modelling:

- Perform Calculations: Conduct calculations for various scenarios, considering pipe size, leak size, pipe lengths, and leak locations to assess the impact and requirements for safe purging.

Workshops and Documentation:

- Kick-off Workshop: Hold an online meeting to discuss and finalise assumptions and approaches.
- Assumptions Document: Produce a document capturing the outcomes and assumptions agreed upon during the workshop.

Reporting and Validation:

- Develop Preliminary Procedure: Use the reviewed procedures, defined scenarios, and calculation results to draft a preliminary procedure or update existing procedures for hydrogen pipeline purging.
- Define Experimental Data Needs: Identify and recommend experimental data necessary to validate the proposed procedure.
- Report Production: Compile a comprehensive report detailing input data, methodology, results, and conclusions, with revisions based on feedback from SGN.

Phase 2:

Review and Analysis:

- Existing Procedures Review: Analyse SGN's current procedures for indirect purging techniques and compare them with direct purging risks.

Training Development:

- Course Design: Develop a training program for SGN operatives on indirect purging techniques, focusing on the use of hydrogen in preparation for the H100 Fife project.
- Assumptions and Caveats: Base the initial concept on existing assumptions and current knowledge, recognising that some aspects are still to be formalised.

Training Scope:

- Onsite Training: Conduct classroom and practical training sessions at DNV Spadeadam, focusing on indirect purging of gas pipes (32mm to 250mm in diameter).
- Hydrogen Purging Sequences: Train operatives on the sequences of purging – Air → Natural Gas → H2 for commissioning and H2 → N2 → Air for decommissioning.

Utilisation of Existing Infrastructure:

- H21 Microgrid: Use the DNV/H21 Microgrid to provide a realistic training environment with PE pipework and pre-installed rider points.
- HyStreet Facility: Enable training that simulates real-world conditions, including purging operations relative to buildings, plants, and equipment.

Training Execution:

- Classroom Training (Day 1): Cover the theory and core properties of hydrogen, purging techniques, and the history and reasons for procedural changes.
- Practical Demonstrations (Days 2-3): Perform methodical demonstrations and hands-on training on the microgrid, including multiple purging scenarios and repeat procedures as requested by SGN.
- Knowledge Checks: Develop and administer knowledge checks to ensure understanding and competence, followed by issuing certificates of completion.

Scope

Phase 1

The following activities shall be undertaken to complete the work scope:

- Review the existing natural gas purging and emergency response procedure(s) to develop a new emergency response procedure for hydrogen.
- Kick-off workshop
- Assumptions document produced, capturing the workshop outcome.
- Review existing purging knowledge/models for natural gas and hydrogen.
- Perform calculations for various scenarios covering agreed pipe size, leak size, pipe lengths, and leak locations).
- Reporting on methodology and results, including defining next steps.

Phase 2

The following activities shall be undertaken to complete the work scope:

- Develop Non-routine operating procedures (NRO) for Commissioning, Decommissioning and Recommissioning operations based on the updated SGN and Industry Distribution and Emergency Bridging Documents for Hydrogen for the proposed training scenarios up to 250mm PE.
- Provide training courses for H100 Fife Personnel for indirect hydrogen purging (Classroom and field work) of gas pipes up to 250mm in diameter using the H21 Microgrid.

Objective(s)

The aims and objectives of this project are to:

Phase 1:

- Review any SGN procedure that exists for the equivalent natural gas case.
- Define the range of credible damage leak cases.
- Use the existing knowledge and experimental data to predict the outcome of each scenario.
- Update the SGN and Industry Distribution and Emergency Bridging Documents, which will then be used to produce an emergency purging procedure.
- Reporting of findings.

Phase 2:

- Training of H100 Fife delegates in indirect Purging for 100 Hydrogen Systems utilising the DNV Spadeadam Microgrid.
- Develop Non-routine operating procedures (NRO) for Commissioning, Decommissioning and Recommissioning operations to be used as part of the training activities.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations.

Success Criteria

The outcomes of the project will be considered successful if they can:

Phase 1:

- Conduct a comprehensive review of all SGN and Industry procedures for the equivalent natural gas scenarios.
- Define the range of credible damage leak cases.
- Use the existing knowledge and experimental data to predict the outcome of each scenario and perform calculations for various scenarios covering agreed pipe size, leak size, pipe lengths, and leak locations)
- Report findings.

Phase 2:

- Train H100 Fife delegates in indirect Purging for 100 Hydrogen Systems utilising the DNV Spadeadam Microgrid.
- Develop non-routine operating procedures (NRO) for commissioning, decommissioning, and recommissioning operations as part of the training activities.

Project Partners and External Funding

DNV will be the supplier for this project.

The project is fully funded via NIA.

Potential for New Learning

This project seeks to comprehensively analyse the disparities between the purging procedures delineated in SGN and Industry Distribution and Emergency Bridging Documents and the specific purging procedures pertaining to hydrogen. Through meticulous comparison of empirical data, the intent is to inform and revise the standards set forth by SGN and the broader industry concerning purging activities within the Hydrogen Distribution Network.

Scale of Project

This project is essential for effectively and safely managing interference damage on the H100 Fife Neighbourhood Distribution Network. Its results will be used to update the SGN and Industry Distribution and Emergency Bridging Documents for network operations and training. Additionally, this project will provide further evidence to help inform policy decisions regarding the adoption of hydrogen across the GB gas networks.

Technology Readiness at Start

TRL8 Active Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

The project will be delivered at the DNV Spadeadam site. Its outputs will represent the H100 Fife Neighbourhood project and the wider GB Network up to 250mm PE pipes.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

SGN External - £128,500

SGN Internal - £42,791

Total - £171,291

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 outputs of this project will provide a clearer understanding of management interference Damage in 100% Hydrogen Gas Network up to 250mm PE pipe network. The outcomes of the project will help to identify opportunities for updating SGN and Industry Distribution and Emergency Bridging Documents and allow the Gas networks to develop the low carbon gas network of the future safely and efficiently.

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 (this is a research paper)

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

The outcome of this project is relevant to GB Gas network from 32mm up to 250mm PE pipes.

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

Not Applicable

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

By identifying and confirming discrepancies in SGN and Industry Distribution and Emergency Bridging Documents, this project aims to provide network licensees across GB with an appropriate understanding of the safe management of interference damage in a switch to 100% Hydrogen. Findings from the project will be available to all relevant stakeholders through the ENA Smarter Networks Portal at https://smarter.energynetworks.org/

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.

This project is unique to the H100 Fife Neighbourhood project and aims to provide further evidence to support SGN operations on the H100 distribution network during emergencies and any future trials or wider rollout of hydrogen.

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

This project holds immense importance for the safety of the H100 Fife Neighbourhood Distribution Network operations. The H100 Fife Neighbourhood trials represent a highly innovative program that is unmatched in scale and replication worldwide.

Relevant Foreground IPR

Not Applicable

Data Access Details

Information relating to the project will be published on the ENA Smarter Networks Portal at https://smarter.energynetworks.org/

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

The methodology undertaken in this project is deemed beneficial for the network conversion to 100% hydrogen. This is not yet a business-as-usual activity for the GDNs.

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 conversion of the GB gas network to 100% hydrogen is essential to pave the road towards net zero. A reliable supply and the assurance of safe operations for workers and the public are crucial to supporting the hydrogen transition's viability. The NIA framework can support works that ensure results that play an essential part in the roll-out of hydrogen.

This project has been approved by a senior member of staff

☑ Yes