

SIF Project Registration

Date of Submission

Mar 2022

Project Reference Number

10020622

Project Registration

Project Title

HyNTS Pipeline DataSet

Project Reference Number

10020622

Project Licensee(s)

National Gas Transmission PLC

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

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Project Budget

£95,571.00

Project Summary

Based on the opportunity described under Q2, there is a need to understand particular properties of each individual pipe joint within "target" pipelines, i.e. those pipeline segments which National Grid wish to repurpose for hydrogen transportation. The following Work Packages (WP) are envisaged during the three project phases:

Discovery

- WP1. This WP will establish the level and quality of relevant data/information that National Grid already holds, and the determination of key gaps in the data.
- WP2. To establish the ability of currently available ILI tools to obtain the data identified in (i) above.
- WP3. To define the requirements for a data management system to store, align and visualize the data required for integrity assessment and the required links for dissemination/sharing of agreed datasets to facilitate asset management activities.
- WP4. To outline a methodology that will permit National Grid and Cadent to rank the suitability of all their individual pipeline segments for potential repurposing to hydrogen.

Building on a successful Discovery phase, the key objectives of the "alpha Phase" project would be:

- WP1. Having identified gaps in the data requirements, the next step would be to determine how the necessary data can be acquired.
- WP2. Having identified the current status of ILI tool technology, this phase seeks to trial novel technologies and conduct preliminary studies to determine the feasibility of conducting "live" inspections. The use of data analytics/artificial intelligence for predicting possible anomaly populations will also be investigated.
- WP3. A specification will be developed and agreed between the project partners for the capture of the required datasets and a prototype data management system will be developed.
- WP4. A detailed suitability for conversion ranking protocol will be developed and applied to the entire NTS.

Building on a successful alpha phase, the key objectives of the "beta Phase" project would be:

- WP1. Conduct baseline ILI runs and produce associated ILI reports to acquire the data identified in the Discovery and alpha phases.
- WP2. Conduct studies and integrity assessments to determine any requirements for the safe repurposing of target pipelines and define the requirements for future integrity management under hydrogen operation.
- Upload the generated ILI datasets into the Data Management tool and transfer the agreed datasets to the National Grid "data lake".

An appropriate level of Project Management will be provided to plan and coordinate activities and collate/disseminate information between the project partners.

VIDEO - <https://www.youtube.com/watch?v=QFkFQX-oHxg&list=PLrMOhOrmeR6ktSag0RbT7zPNVn0p1P2f6&index=23>

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Problem Being Solved

Hydrogen will play a significant role in the energy transition required to meet net zero emissions targets by 2050. To safely transport hydrogen from production facilities to end users, the options are new builds or repurposing of existing national and local gas transmission networks (NTS and LTS) for hydrogen operation. For economic reasons alone, it is clearly desirable to repurpose existing pipelines - indeed, it is anticipated that up to 80% of the existing system could be repurposed. However, the NTS and LTS systems were designed and built to transport an essentially inert gas -- methane. Hydrogen, however, is known to be deleterious in relation firstly to its potential degradation of material properties, and secondly its effect on pre-existing anomalies. Consequently, before repurposing any pipelines to hydrogen, there is a requirement for the gas networks to have improved understanding of their pipeline assets with emphasis on the determination of material type and possible crack-like anomaly populations. In addition, detailed integrity assessments will be required to determine their suitability and to identify any remedial actions that must be performed before repurposing can be safely undertaken.

Given the length of individual pipeline segments (typically 40 miles), in-field examination is unfeasible. The overall aim of this project is therefore to define and gather the data necessary to conduct the integrity assessments required to facilitate safe repurposing of pipelines from natural gas to hydrogen operation. It is anticipated that data gathering will include running non-destructive examination (NDE) devices (i.e. in-line inspection -- ILI -- tools, or "pigs") in "target" pipelines to obtain the necessary information. Such inspections will gather huge amounts of data and therefore another goal of the project will be to develop a Data Management system to store, align and visualize data from these inspections, together with other relevant asset data. The system will be set up so that relevant data sets can be transferred to National Grid in a format suitable for further integrity management/data analytics studies.

In response to Question 3 below, the Project Partners summarize the Work Packages (WPs) which they intend to conduct during the Discovery, alpha and beta phases to provide overall context to the bid. The Discovery phase essentially looks to answer the question, "Where are we now and what gaps in knowledge are there?", the alpha phase would then develop a plan to fill the gaps and the beta phase would then execute the plan.

Project Approaches And Desired Outcomes

The Big Idea

A major challenge for National Grid is to obtain information about the current condition of each individual pipe joint within their target pipelines, with respect to repurposing for hydrogen transportation. It is envisaged that the types of information required will relate to material properties (in particular, pipe strength determination) and possible crack-like anomaly populations. There are technologies available to generate such datasets, but they have never been run before in National Grid pipelines and based on current knowledge, they have never been run in hydrogen pipelines anywhere in the world. Indeed, it is believed that very few ILI tools of any description have been run in hydrogen anywhere in the world. If the project progresses through the different phases from Discovery to beta, then NG will have gathered the required data to undertake the necessary integrity assessments to determine the suitability of pipelines for repurposing and identify any remedial actions that must be performed prior to repurposing.

ROSEN as a proposed partner to National Grid has ILI as its core business. As such, ROSEN responds to market demand by developing new sensor and communication technologies as part of its own research program - whilst such developments are outside the scope of the proposed Strategic Innovation project and ROSEN would retain any IP rights, any such developments would be considered for trial within the project.

Finally, the use of data analytics/artificial intelligence is just beginning to develop as a complementary pipeline integrity tool to predict populations of possible anomaly types, and the use of data analytics as proposed within the alpha phase of the project is novel.

The OFGEM document OFG 1161, "OFGEM Innovation Vision 2021-2025" outlines four key themes. Under the "Low Carbon Infrastructure", Gas and Hydrogen, it is stated that innovations which target "to ensure that hydrogen can be transported safely on the network" are of interest. The proposed project strikes right at the heart of this goal in that it will directly impact network safety and operability. Furthermore, the proposed project deals specifically with points 7. and 9. of Innovation Challenge 2: Data and Digitalisation, since a data management platform will provide pertinent data directly to transmission and distribution companies, which will directly relate to the integrity, safety and operability of both the National Transmission Systems and Local Transmission Systems.

Innovation Justification

As a service provider to customers around the globe, ROSEN is very familiar with providing consultancy services relating to asset integrity management, including change of service, pipeline uprating, etc. ROSEN has worked on projects with both National Grid and the third proposed partner, Cadent, in providing both ILI and integrity-related services. We are experienced in working for industry groups such as the European Pipeline Research Group (EPRG), IGEM and the Energy Institute where the views of multiple stakeholders need to be considered. We are also accustomed to working with customers in helping them present cases to pipeline Regulatory bodies, and we therefore believe that there is a good fit for this proposed project with National Grid and Cadent. An example of such a project is a recently conducted worldwide review into the effects of hydrogen service on the integrity of pipelines for the European Pipeline Research Group. This work was requested by the EPRG because existing integrity assessment models for different anomaly types have all been calibrated for essentially inert products such as methane, but do not take account of the potentially deleterious effects of a gas like hydrogen. Experience from this project will help in defining the data requirements for repurposing integrity assessments.

The truly innovative nature of the project lies in the response provided to Question 4, i.e. that the types of work envisaged culminating in the beta phase have never been performed before within National Grid or the gas distribution companies. For that reason, the project is most definitely not "business as usual" but as explained in our response to Question 8, we believe that if the project is successful, then the methodologies/technologies developed can in time become part of "business as usual" as part of ongoing asset integrity management for the future hydrogen pipeline networks that will need to be operated by National Grid and the Gas Distribution Networks as an integral part of the energy transition leading to Net Zero.

Project Plans And Milestones

Project Plan And Milestones

The Project plan and risk matrix are provided as Appendices.

The plan follows the four (4) Discovery Phase Work Packages (WP), all of which are desktop reviews of the current status of information held within the gas transmission and distribution networks.

- WP1. This will establish the level and quality of relevant data/information that National Grid Gas (NGG) already holds, and the determination of key gaps in the data.
- WP2. To establish the ability of currently available In-Line Inspection tools to obtain the data identified in WP1.
- WP3. To define the requirements for a data management system to store, align and visualize the data required for integrity assessment and the required links for dissemination/sharing of agreed datasets to facilitate asset management activities.
- WP4. To outline a methodology that will permit NGG and Cadent to rank the suitability of all their individual pipeline segments for potential repurposing to hydrogen.

The bulk of the reviews will be conducted by ROSEN UK, who will liaise with NGG and Cadent to ascertain those data currently held by the organisations with respect to the integrity management of pipelines transporting high pressure hydrogen. Key personnel to conduct the work should our application be successful have already been identified. Given the resources at ROSEN's disposal, then other members of the organisation can step in.

In view of the short overall timescale for the Discovery Phase (2 months), and the number of tasks that will be conducted in parallel, the project will have a single milestone. Milestone #1: Delivery of final project report covering Work Packages WP1-WP4 at the end of week 9.

With respect to risks to the project, key staff have already been identified and the technical scopes of work are also identified and agreed. Knowing that the project would be conducted over a fixed two month period allows the key staff members to be "ring fenced" for that time. Liaison staff within NGG and Cadent will need to be identified, but provided ROSEN are given access to the existing data sources within NGG and Cadent, then ROSEN can be almost self-sufficient. Finally, since the study is primarily desktop-based and there is no dependency on third parties outside NGG, Cadent and ROSEN. The project fully under the partner control and there should therefore be no issue with meeting objectives within the stipulated timescale.

Route To Market

The Discovery Phase will provide an understanding of the feasibility of assessing our pipelines state both prior to injection and throughout its lifetime. This will include a review of the pipeline inspection gauge technologies available today, data analytics potential to improve data insights and a review of alternative technologies that could assist in pipeline assessment. This feasibility study will direct the Alpha phase which will detail two assessments one on a methane live pipeline and another on a hydrogen offline facility to demonstrate our capability to understand the pipeline state in the two scenarios in the Beta SIF phase. In the discovery phase we will develop the functional requirements needed, reviewing the difference in defect allowance for methane and hydrogen pipelines. A study that Rosen has recently undertaken for the European Pipeline Research Group (EPRG)

If the outcome of the project up to and including the proposed beta phase is successful, then a framework will exist to allow the developed methodologies to be applied to other National Grid pipelines and those of the Gas Distribution Networks. The methodology / technologies will become part of a pipeline operator's standard toolbox for maintaining pipeline integrity whilst operating with a "new" product, namely high-pressure hydrogen and will therefore become "business as usual".

If the system is proven on the National Grid national transmission systems (NTS) / gas distribution local transmission system (LTS) networks, then the methodology / technologies can be offered commercially to other gas pipeline networks worldwide who are looking to repurpose parts of their systems from methane to hydrogen.

Costs

Total Project Costs

95571

SIF Funding

95571

This project has been approved by a senior member of staff

Yes