national gas transmission

SIF Project Registration

Date of Submission

Mar 2022

Project Reference Number

10020605

Project Registration

Project Title

HyNTS Deblending

Project Reference Number

10020605

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

£148,141.00

Project Summary

This project aims to provide an offline demonstration of gas separation or 'deblending' technology on a gas network scale. Previous NIA projects have proven deblending technology could be utilised to support a gas network applications, however, current solutions are large industrial facilities that you would not want to build for a potentially transient application. This programme of work looks to develop a smaller scale skid mounted solution for the National Transmission System (NTS) that can be deployed to customers, providing the blend of gas needed on the point of extraction from the NTS.

The project will review the opportunity to demonstrate skid mounted deblending technologies at our FutureGrid facility and leverage Phase 1 of FutureGrid which will have built a hydrogen ready test facility which gas separation assets can be connected to. In Alpha and Beta we will work with a chosen original equipment manufacturers (OEMs) to facilitate designing, building and testing a demonstration; in collaboration with a mobility infrastructure providers who are looking to build refuelling facilities across the UK.

This project directly addresses all of the scope challenges under the Zero Emissions Transport Theme as demonstrating gas separation, compression and purification technology will increase the locations for hydrogen refuelling across the country and remove the reliance on local production of hydrogen for the transport sector. Refuelling from the transmission system is also a viable option for hydrogen in the heavy haulage, trains, buses and shipping sectors due to the higher demands.

The partners chosen for this SIF application each offer a unique aspect to the overall picture of gas separation, compression, purification, refuelling and use. Element Energy have been selected due to their extensive hydrogen capabilities and work in the deblending sector. HyET are a specialist company focusing on new technology which not only compresses hydrogen but also purifies it in the same process which we hope could reduce overall costs. Element 2 will offer insight into the refuelling infrastructure sector. Jaguar Land Rover will provide a end user perspective and requirements for the final gas output.

Scenarios for gas separation are:

- The customer is interested in extracting the hydrogen, purifying it and offering it to the transport sector.

- The offtake customer cannot accept any increase in hydrogen as they are not ready to transition.
- The offtake customer requires a very precise blend of hydrogen and natural gas and will be sensitive to fluctuations.

VIDEO - https://www.youtube.com/watch?v=XsC58xoLAWQ&list=PLrMOhOrmeR6ktSag0RbT7zPNVn0p1P2f6&index=26

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Problem Being Solved

The hydrogen strategy released by the UK government in August 2021 stated that in order to support the net zero targets of 2050, by 2030 there is an ambition to produce 5GWs of low carbon hydrogen. This ambition to provide low carbon hydrogen as a part of a suite of net zero energy sources provides clear guidance to the UK gas networks to progress our hydrogen transportation capability. The national transmission system (NTS) provides a supply of gas to 40 power stations, large industrial users and gas distribution networks from natural gas terminals situated on the coast. The NTS provides a resilient supply of natural gas today and aims to provide the same capability for hydrogen, especially in light of the variability in green hydrogen production.

In the transition to Net Zero by 2050 we are looking at utilising the current high pressure NTS to provide hydrogen as a net zero alternative to natural gas to our consumers. The first step of this will be to provide a hydrogen backbone (Project Union) that links industrial clusters to terminals improving the resilience of hydrogen supply. In developing this backbone we could provide transportation applications hydrogen directly from gas network assets earlier than previously expected.

In transport applications fuel cells are sensitive to impurities in the hydrogen fuel utilised, this could be a limitation to using gas transported through the gas networks. Deblending followed by electrochemical compression could resolve this for the transport sector enabling the use of gas network hydrogen for transport applications.

In some areas of the country there are limited parallel feeders which could cause a constraint when looking at running a hydrogen and methane gas network in the transitional period. In this case an alternative to building new pipelines is to blend natural gas and hydrogen into the feeders and utilising deblending systems to provide the correct blend to the consumers who may have varying needs along a particular feeder.

Another constraint to the hydrogen transition is where customers cannot accept an increase in hydrogen at the point when we wish to begin injecting hydrogen into the NTS. Deblending could also prevent hydrogen entering sensitive consumers and/or provide very precise blends of hydrogen to those whom may be sensitive to fluctuations.

In this project we will consider the wider impact of deblending but focus on the transportation application, comparing the cost of other hydrogen fuelling systems against deblending.

Project Approaches And Desired Outcomes

The Big Idea

Gas separation technology is an established industry today with many processing plants around the world in operation and being designed. Separation can be for a variety of reasons and each scenario is unique for the requirements of the businesses that need them. These processing plants are however a significant size and are built in one location, both factors which do not help if the technology is to be used at hydrogen refuelling stations across the country or to help with transmission offtakes transitioning to net zero.

The proposed idea is to work with industry experts, OEMs and subject matter experts to fully design, build and test, mobile, small scale gas separation plants which can be transported across the country helping to transition transmission offtakes and in doing so offer a route to purified hydrogen for the transport sector. In the future we envisage a network of these skid mounted modules around the country separating the blended gas in the transmission network. This will either protect sensitive customers whilst they transition to net zero fuels or with additional modules such as purification and compression, offer a feed of hydrogen ready for the transport purposes. On the latter, being able to refuel hydrogen vehicles straight from the national transmission network (NTS) will remove the reliance on local production of hydrogen and in areas of high demand and low production offer a secure supply.

In the future we envisage hydrogen refuelling stations near the NTS helping to support the network of local refuelling stations, working towards promoting the adoption of greener transport by making hydrogen transport a viable option to chose for the consumer. Refuelling from the NTS will also help to promote hydrogen usage in the heavy haulage, trains, buses and shipping sectors as the higher pressures and large quantities transported by the transmission network could supply that demand.

As previously mentioned gas separation, compression and purification are all established industries however they have not all been brought together in a skid mounted, mobile module which takes up as small a footprint as possible. These factors are key for their use at refuelling stations and at NTS offtakes around the network. It is proposed that generated IP will be shared amongst funded partners on the project.

Innovation Justification

Previous work looking at the opportunity of deblending successfully proved that gas separation technology could be used on a gas network and the pressure drop between transmission and distribution could be used to 'power' the process. It also summarised the different technologies such as pressure swing adsorption (PSA), membranes and cryogenic separation, highlighting the different positives and negatives for the technology. Ongoing work to develop an understanding of our sensitive customers and assets that may require gas separation and development of the market framework required for commercial arrangements has indicated transport as an opportunity area for deblending. Enabling gas separation from the gas network could enable transport consumers to access a wider refuelling network in an accelerated timeline to that of additional infrastructure investment and construction for electrolyser driven refuelling stations.

Whilst the concept of gas separation, compression and purification is not innovate in its separate parts it has not yet been been attempted on a gas network scale, using the pressure drop between the tiers to 'power' the process. Additionally the technology is currently very large scale and permanent and it is the ambition of this project to discover whether it would be possible to build and operate, mobile, skid mounted smaller modules that could be moved around the country where needed or built near the transmission network to offer hydrogen refuelling capabilities for the emerging transport market.

Internationally, National Grid have been involved in the H2GAR (Gas Asset Readiness) group with the other European Transmission System Owners (TSOs), one of the working groups is leading on gas separation for sensitive customers. Within this group shared challenges have been discussed and projects highlighted to others. Outside of Europe, National Grid have also had separate virtual meetings with SNAM in Italy, Fluxys in Belgium and APA in Australia on gas separation and in each case the challenges and opportunities are the same for the TSOs.

Until the evidence has been provided that the gas network can accept hydrogen, natural gas will continue to be the transported fuel within the network and so any research into hydrogen will need funding outside business-as-usual routes. SIF offers a unique opportunity to understand the feasibility, design, build and test innovative gas separation technology to help protect sensitive customers and/or offer a route to purified hydrogen for the transport sector.

Project Plans And Milestones

Project Plan And Milestones

Overall accountability of the project will lies with National Grid Gas (NGG) with responsibility for each of the work packages given to the project partners. The project will be manged through several work packages (WP) enabling elements to be run in parallel as appropriate and allowing us to make the most of the 2 month discovery period. Each project meeting will be run at one of the project partners facilities to improve collaboration and understanding of each others capability.

WP1 - Project Management Element Energy
Manages the project activities and reporting requirements to ensure the progression of the activity through the 2 month period and developing the planned approach for future phases.

WP2 - Business Case & Requirements Document Element Energy
Develops a detailed understanding of the market, technologies and requirements for the system to enable the detailed design to commence in the Alpha phase. This WP will pull all the information derived through the project together to determine feasibility of demonstration through the SIF process and at what location this should be undertaken.

WP3 - Deblending Technology Development Element Energy
Deep dives the technical options and produces a concept selection matrices that will enable us to identify the optimum technical partners for the Alpha detailed design phase of the project. It also considers the technical capability in a number of scenarios developed in WP2.

WP4 - Deblended Gas to Refuel HyET
Develops the requirements and understanding of the systems that come after the gas separation stage to enable the gas to be provided to the refuelling system purified and compressed to the required standards.

WP5 - Refuelling System Element 2
Provides an insight into the vehicles fuelling system requirements and enables us to ensure our technology development can provide a solution to meet our customer demands.

WP6 - Build Commission & Test NGG
Determines the optimum method for demonstration of the deblending technology

There are no significant risks for the delivery of the Discovery project, however, looking ahead the most significant risk is that the technology cannot be designed and built to be mobile and sufficiently small scale so it could be used at Transmission offtakes or at hydrogen refuelling stations. To mitigate this risk we are looking to work with the OEMs of gas separation technology as soon as possible to understand the nature of the challenge and highlight issues as early as possible.

Route To Market

In the Beta phase of this project we will be aiming to create a fully functional demonstrator of deblending, purification and hydrogen refuelling at our FutureGrid hydrogen test facility on the DNV Spadeadam site. This demonstration will show how the deblending technology can extract various blends of gas from the national transmission system and using a skid mounted mobile system, reducing the size of the current solutions that are available in todays market. Whilst also demonstrating how this deblended gas can be compressed, purified and provided to refuelling systems and end users. This demonstration is likely to complete in 2025 with our hydrogen backbone work commencing construction at around the same time period. It is important this technology is ready to be deployed on the national transmission system (NTS) when it begins its conversion to reduce overall cost and enable all consumers to join the transition.

Once the technology has been proven at the required scale then hydrogen refuelling stations can start to be built attached to the transmission network. In much the same way as a customer would connect to our network today to take natural gas off they could apply to separate the blended gas, compress and purify the hydrogen to feed into a fuel station. Additionally this technology could be placed near to transport hubs such as HGV, trains, buses or shipping to help fuel the demand for hydrogen vehicles in that area.

Once demonstrated, procurement strategies could be agreed on which would allow customers to buy the modules they require, allowing them to be brought to site and connected; gas separation, compression, purification and fuelling pumps.

For sensitive transmission offtakes who only require separation, the required modules would be brought to site to ensure they have no

hydrogen in their supply or that the blends are kept very consistent for their processes.

Internationally we have already had good conversations with SNAM in Italy, Fluxys in Belgium and APA in Australia who are interested in the technology and what it could offer. Significantly if the modules are mobile then there is the option that they can be moved not only around the UK but internationally as well. This concept benefits from the fact that gas separation, compression and purification from the transmission network in the UK is largely the same as it is across the world and so technology developed here could be of interest globally.

Costs

Total Project Costs

148141

SIF Funding

148141

This project has been approved by a senior member of staff

☑ Yes