SIF Discovery Round 2 Project Registration

Date of Submission

Apr 2023

Project Reference Number

10052119

Project Registration

Project Title

Distribution Network Information Modelling (DNIM)

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10052119

Project Licensee(s)

SGN

Project Start

Apr 2023

Project Duration

2 Months

Nominated Project Contact(s)

stuart.sherlock@sgn.co.uk

Project Budget

£15,234.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£1.00

Strategy Theme

Data and digitalisation

Challenge Area

Improving energy system resilience and robustness

Lead Sector

Gas Distribution

Other Related Sectors

Funding Licensees

Lead Funding Licensee

SGN - Southern England (inc South London)

Collaborating Networks

SGN

Technology Areas

Digital Network

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Meeting the SIF challenge: This project meets all 4 of the aims of improving energy system resilience and robustness category by:

1. By accurately mapping our network, DNIM will enable future challenges and risks to be identified in a quick and cost effective manner. This will help create a more resilient network that can adapt to the energy transition.
2. Technology developed under the DNIM platform includes Artificial Intelligence and Machine Learning as well as robotic automation hardware. These technologies offer significant opportunities to facilitate hydrogen and heat energy system configurations for example.
3. Improving our operational activities as we transition to net-zero whilst reducing impact to customers. With DNIM surveying the network autonomously without excavations, the system offers the gas networks a chance to improve resilience and robustness for a future green gas scenario in a sustainable and relatively clean manner.
4. Overall strengthens our operation activities by having a better understanding of our assets and their precise locations. With this knowledge and the data collected, condition of the energy system and how those changes with future energy system configurations will be able to be analysed and evaluated.

SGN: SGN is one of the largest utility companies, distributing natural and green gas safely and reliably through our 74,000km of pipes to 5.9 million homes and businesses across Scotland and southern England. We are committed to exceeding the expectations of our stakeholders by delivering value for money and exceptional customer service as well as providing a safe, secure and sustainable future for our network.

SGN are the lead participant in this project and will provide clear direction and insight to the project partners. SGN will also provide insight and expertise from a gas distribution network perspective for the project, ensuring alignment to the challenge area and realisation of benefits to be captured.

ULC Technologies: ULC Technologies has over 20 years of experience developing robotic solutions and deploying them as services using their field teams. ULC's team includes engineers (mechanical, electrical, software, robotics), research scientists, and technicians. This enables ULC to tackle highly complex and multi-functional problems with innovative solutions. These solutions may then be driven deployed in-house using ULC's extensive field teams which has had success deploying robots in the UK and the US for over two decades.

Project Description

Over the next decade UK's gas networks face one of their greatest challenges yet -- transitioning away from using fossil fuels to zero-carbon alternatives like hydrogen and biomethane.

Current gas pipe records are an amalgamation of analogue information collected using the mapping datum of the time, from around 1880 onwards. Before introduction of hydrogen to the existing network, SGN needs to accurately locate and inspect buried gas infrastructure to ensure that their 74,000km of pipelines are resilient and robust to the change at that zero carbon alternatives can be distributed safely to 5.9 million customers. There is currently no viable method of collecting this data on either a time or cost basis that would allow transition.

This project looks to design, build, shop test and field trial a novel autonomous robotic system known as DNIM (Distribution Network Information Modelling) that can traverse within SGNs natural gas infrastructure and accurately map the network. This system will obtain data which shall enable it to categorise features and anomalies inside the pipe using machine learning. This data will be archived and integrated into mapping software and will provide an overall assessment of the natural gas infrastructure in a safe and cost-effective way. This data will also support UK's gas networks in developing an economic case for a hydrogen-powered future.

Additionally, by digitising the network using data from inside the pipe, in conjunction with machine learning-based feature identification, GDNs will be able to identify any high-risk features (plugs, fittings etc.) that may require replacement ahead of hydrogen deployment and currently don't show in existing records.

This project marks a vital step to strengthen the UKs gas networks robustness that will enable the transportation of zero carbon gases such as hydrogen in a cost-effective manner to the energy consumer.

Third Party Collaborators

ULC

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Project Description And Benefits

Applicants Location (not scored)

Southern Gas Networks

St Lawrence House, Station Approach, Horley, England, RH6 9HJ

ULC Technologies LLC

UK -- Unit 656, River Gardens, North Feltham Trading Estate, TW14 0RD

US -- 88 Arkay Drive, Hauppauge, NY 11788

Project Short Description (not scored)

DNIM aims to support the energy transition with the development of a cost effective and non-disruptive robotic system that will internally map and analyse the entire gas distribution network in a cost-effective manner.

Video description

https://youtu.be/FOye9cioyVY

Innovation justification

In August of 2021, the UK unveiled an aggressive strategic energy policy to transition to a world-leading hydrogen-based economy. These policies set out to reach Net Zero by 2050. For gas utilities, this policy represented a powerful shift from methane to hydrogen-based energy ecosystems that have introduced a variety of questions related to cost-effectiveness, safety, and risk mitigation.

Prior to the transition, gas utilities will be tasked with demonstrating the economic benefits of utilising existing network infrastructure with hydrogen compared to laying new, electrical-based heating infrastructure. Conversely, safety questions may arise in large part due to the heightened dangers of gaseous hydrogen compared to that of methane.

To support this transition, every portion of the gas network supply chain will require assessment and potential modification, ranging from network infrastructure to consumer appliances. To safely introduce hydrogen into the UK's gas networks, network operators will require extensive locating and mapping operations to mitigate risk to consumers. This analysis will define as-built network infrastructure prior to injection of hydrogen and allow gas utilities to ensure consumers are safely equipped to support hydrogen in their homes. In certain cases, consumers may be stealing gas which may introduce high-risk uncertainties to gas utility operators. As a result, mapping these networks has become a crucial step towards the transition.

Previously, ULC & SGN had completed an early-stage R&D project where a conceptual pipe mapping method was investigated which has been defined as DNIM. DNIM is a proposed tetherless robotic system to perform the network mapping from inside the pipe. When combining advanced mapping techniques in conjunction with machine learning-based feature detection, gas utilities may identify and quantify the cost of repair and/or remediation of high-risk network features (joints, plugs, etc.) in their network. In addition, these outputs have the potential to enable digitisation of networks through Building Information Modelling style models.

DNIM will be the first tetherless robot of its kind and as a result, introduces many new challenges and benefits. Due to the innovative approach, this style project would normally have a risk profile that is too high for BAU or other funding methods. In addition, if the project were funded under BAU or other methods, it would take significantly longer, and the solutions would arrive too late to enable effective transition to net zero. DNIM's aligns with the transformational challenge areas set forth by SIF whilst aligning with regulatory goals for Net Zero.

Benefits Part 1

Financial - future reductions in the cost of operating the network
New to market – products, processes, and services

Benefits Part 2

DNIM will deliver value directly to gas networks customers by reducing transporter accountable theft of gas as well as decreasing the

costs for customer connections. Furthermore, DNIM will offer future savings to the consumers by enabling superior energy models. This would reduce needless spend to upgrade the network for future energy scenarios.

Having a fully digitalised record of the network would allow customer enquiries for new connections or alterations to be delivered through the use of smart engineering and commercial models, reducing SGN's cost to serve, creating savings for the customer. In this way customers can quickly assess options for siting their plant and equipment where the cost of connection to the gas network may be an important commercial consideration. From a GDN's perspective the solution would encourage best use of available capacity and minimise or avert potentially expensive reinforcement costs that are borne by all users of the system.

Furthermore, theft of gas which is absorbed by the consumer would be minimised resulting in 26.72 GWh less energy stolen.

This cost evaluation will be validated in more detail as the project technology development evolves and we fully understand the capabilities of such a system. This evaluation may include but not be limited to a desktop cost and timeline comparison to map a regional network location using multiple traditional techniques.

As the projects develop through the phases, metrics shall be put in place to continue to assess the DNIM solutions effectiveness and benefits so that it can be continuously improved if required.

Project Plans And Milestones

Project Plan and Milestones

WP1: Business Engagement Workshop (All project team)

The outputs of our previous DNIM work will allow us to gather further information from the business and better understand the tangible and intangible benefits of this technology against tradition.

WP2: Alpha Planning (All project team)

Using the information within WP1 we will be looking to prepare a roadmap for the future technology development of DNIM.

Deliverables & Success Criteria:

- Report quantifying the problem and benefits through business engagement.
- Roadmap for the development of the DNIM platform for Alpha and Beta.

Risks/Constraints

- Technical / Managerial: There is a risk that uptake in engagement via internal workshops is not possible. Mitigation will be ensured through existing Innovation channels that will help with the review on ongoing discussions. This will be further mitigated through effective project management by an experienced team.
- Political / Policy: The benefits of this project will be linked to industries challenge to safely deliver net-zero. This will be regularly checked to ensure benefits are measured.
- Regulatory / Commercial: There are no immediate regulatory risks associated with the delivery of this project. Learning may however feed into regulation and policy making.
- Commercial: There is a small risk that the work costs exceed the budget. If this is the case, the additions will be contributed by project partners.

Regulatory Barriers (not scored)

At present SGN and the project team, are confident the proposed concept would not provoke any regulatory barriers that could affect or hinder delivery of either the Alpha or Beta phases.

As the utility industry aims to build a shared net-zero future by accelerating decarbonised energy solutions and minimising our environmental impact, we aim to revolutionise our network records by developing the DNIM platform. This aims to ensure safety in our network with the introduction of Network Hydrogenisation.

The project team will also be working closely with internal stakeholders including Operations, Network Planning and Policy, to help consider any policy and procedural impact. As the project develops through the different phases, we will give consideration to a suitable accredited Technical Consultant to help add further industry understanding.

Commercials

Route To Market

Regular engagement with business stakeholders is key to ensure a successful adoption within the business. The project team will achieve this by holding regular workshops throughout the project during Discovery, Alpha and Beta phases. This proactive approach will be coupled with regular assessments of the benefits.

The dedicated SGN Innovation Project Manager will be responsible for the implementation of DNIM and will be supported by the Innovation PMO. SGNs Innovation team are well established through experiences from other funding routes such as NIA and NIC and have developed a good working relationship with key business areas to ensure successful implementation. We also have a capable and broad knowledge of SGNs business activities, as well as the wider energy network industry in the UK.

Learnings will be applied to other licensees through providing regular project updates, generally expected to occur upon completion of key tasks, along with the production of a final reports for sharing with the wider licensee.

The adoption of any project learnings will be supported by maintaining effective levels of communication with relevant stakeholders and interested parties through regular update and showcase meetings/forums. These forums will gauge what each stakeholder group/team might specifically want to take opportunity from, in terms of the learnings delivered by the project.

For DNIM, the target customer segment would be UK-based gas utilities. In addition, this will support the greater adoption of the technology as the customers will not require expertise in robotics field deployments. Similar to ULC's existing structure, DNIM may potentially be provided via a service-based offering.

DNIM will provide access to both mapping results and ML-processed feature detection. Unlike traditional technologies, this provides both mapping results, and links to network features of interest. The latter feature will enable gas utilities to develop economic assessments of their network as they establish the business case for infusing hydrogen into existing networks.

Funding for DNIM will be pursued through SIF from the Discovery phase through the Beta phase.

Intellectual property rights (not scored)

For SIF projects, each Project Partner shall own all Foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation. The exact allocation of Foreground IPR ownership will be determined during the contractual negotiations with the Project Partners on the agreement for the project.

We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done will be subject to contractual negotiations with the Project Partners on the agreement for the project.

Costs and value for money

Over the last 18 months SGN and our project partner have completed an initial phase of works through two alternative funding routes; Network Innovation Allowance (NIA) and Transport for London (TfL). If this project is approved, the outputs of this work shall benefit this SIF project and the wider gas industry networks.

The goal for this stage of the project if awarded through SIF is to advance the benefit realisation and carry out engagement with key stakeholders to inform the Alpha and Beta development phases. This effort of works will not bare any costs to SIF in the discovery phase.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

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DNIM_Discovery_Show and Tell_6-12-23_v2.pptx

This project has been approved by a senior member of staff

☑ Yes