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

Mar 2018

Project Reference Number

NIA_SGN0120

Project Registration

Project Title

Universal Temperature Controller using Artificial Intelligence

Project Reference Number

NIA_SGN0120

Project Licensee(s)

SGN

Project Start

March 2018

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Keith Ellison, Innovation Project Manager

Project Budget

£57,700.00

Summary

This project aims to assess the potential application of a universal controller based on Artifical Intelligence (AI) to act as an intermediary between a traditional station exit temperature signal and an installed preheat asset.

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Problem Being Solved

Findings from NIA project “NIA_SGN0106 Strategic Pipeline Heat Study” identified an opportunity to improve heat efficiency on pressure reducing sites. The Heat Study project highlights overheating on sites and the opportunity to develop a ‘smart’ system to better control the efficiency of the heater systems.
The majority of the PRSs within SGN have preheating. Having inefficient systems results in call outs which could be reduced if the heaters were able to anticipate load fluctuation. As well as this, inefficient systems can result in higher energy consumption due to higher fuel use and over-delivery of heat.

Method(s)

This project will review the feasibility of a universal preheat controller to act as an intermediary between a traditional station exit temperature signal and an installed preheat asset. The controller will be programmed to learn and anticipate site specific dynamics through a desktop exercise learning stage using historical site operating data.
The desktop exercise will explore patterns of energy usage and to identify predictable and unpredictable patterns using historic site operation data. This data will be used to identify process optimisation opportunities, bottlenecks and act as a training tool for an Artificial Intelligence (AI) based learning and control algorithm.
In parallel a hardware specification of a universal controller which meet safe operating requirements, supporting processing needs of the AI software and offer potential for retrofits across existing network preheat assets.

Scope

This project aims to assess the potential application of a universal controller based on AI to act as an intermediary between a

traditional station exit temperature signal and an installed preheat asset.
By using AI combined with historical data, it is hoped that it will be possible to recognise patterns and learn to predict upcoming events such as variations in demand, and impact of environmental variables such as temperature and humidity.

Objective(s)

This project will include:
Teaching the AI controller:

- Select a sample of 3 sites with different operating characteristics.
- Use data mining techniques to identify process bottlenecks, energy saving opportunities and process variability issues.
- Train the AI to assess performance with the minimum number of inputs for maximum potential application (Inlet Pressure, Outlet Pressure, Station Outlet Temperature, Historic Weather).
- Development of a virtual system expert to advise on “optimal operation” to help guide process performance from past operating data.
- Optimise computation for data efficiency.
- Assess reliability and robustness for suitability on critical infrastructure.

Hardware Specification:

- Determine computation requirement (Central Processing Unit (CPU)/ Graphic Processing Unit (GPU).
- Develop physical specifications (considering any restrictions).
- Input / Output specifications and protocols.
- Review SGN specific requirements / Applicable standards.
- Determine power requirements.
- Review connectivity (Global System for Mobile Communications (GSM)/ Wi-Fi etc.).
- Determine appropriate security & cyber-security protocols.
- Remote update and control.

Implementation:

- Development of a project implementation roadmap for site integration.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following success criteria for the project are:

- Nomination of 3 site visits to understand the telemetry and control system.
- Progress report including description of limitations of existing control systems, proof of concept results including energy savings opportunities, potential reductions in call-outs and other system bottlenecks for 3 sites.
- Deliver final NIA Report which will include Hardware Specifications and an Implementation Roadmap (development and trial) for Site Integration.
- Workshop to present results and next steps.

Project Partners and External Funding

ProHeat.

Potential for New Learning

The project is expected to provide all Gas Distribution Networks (GDNs) with further understanding of how to better control the efficiency of the preheaters.
The outputs of the project will be detailed in a final project report which will be available to other Network Licensees once published on the Smarter Networks Portal.

Scale of Project

This project will determine the feasibility and benefits of using AI for preheating control. All GDNs across GB use preheating and there is a desire to make the systems more efficient.

Technology Readiness at Start

Technology Readiness at End

TRL2 Invention and Research	TRL3 Proof of Concept

Geographical Area

This is a desk top exercise involving 3 site visits to determine the feasibility and benefits of using AI for preheating control. This project will look at the most challenging preheating systems with regards to control to allow understanding on the feasibility.

Revenue Allowed for the RIIO Settlement

During RIIO-GD1 it is estimated SGN will spend approximately £2.6m on call outs. As this project is the development phase to raise the TRL, the full potential savings that could be achieved under RIIO-GD1 will be determined upon completion of this stage.

Indicative Total NIA Project Expenditure

The total expenditure is £57,700, 90% (£51,930) of which will be recovered via the NIA funding mechanism in line with the funding conditions.

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:

n/a

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

n/a

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)

It is expected that if successful this project could allow Network Licensees to operate preheaters more efficiently, helping to reduce energy consumption. This would also create an opportunity to make cost savings on unnecessary call outs.

Please provide a calculation of the expected benefits the Solution

N/A – this is a research project.

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

The potential outcome of this project is applicable across GDNs. All the GDNs will have preheating on some of their PRSs and will want to run them more efficicently and reduce carbon emissions.
SGN and ProHeat aim to determine if AI is feasible for controlling preheating and improving efficiency. The results will be detailed in a final report, which will be made available for the other Network licensees.

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

There are no costs associated with sharing the conclusion and recommendations of this study with the other Network Licensees, which will be the first step to roll across GB.
The very low TRL means it is not possible to estimate the cost of deployment at this stage.

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):

- [x] 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

☐ 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

The learning from this project will benefit Network Licensees as it will provide them a better understanding of how a more efficient method of controlling preheaters can help reduce:

- Reduce call outs;
- Minimising temperature fluctuations;
- Predict loads before they occur, ensuring sufficient energy is available; and,
- Improve system performance, resulting in gas savings and ultimately reduce carbon emissions.

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

N/A

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

A review has been made of all Network Licensees and no other similar projects have been identified.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

n/a

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

n/a

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes