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

Dec 2014

Project Reference Number

NIA_NGGD0049

Project Registration

Project Title

Pressure to Gas (Phase 2)

Project Reference Number

NIA_NGGD0049

Project Licensee(s)

Cadent

Project Start

December 2014

Project Duration

0 years and 5 months

Nominated Project Contact(s)

Robert Cairns – Project Delivery Specialist, Tony Nixon – Business Sponsor

Project Budget

£99,733.00

Summary

The proposal is to replace the existing pressure reduction equipment with an integrated energy recovery and hydrogen electrolysis equipment package. The hydrogen gas will be generated from the power generated and immediately injected into the gas grid. The main elements to this technology are:

- Pre-heat (if required)
- Turbo expanders
- Hydrogen electrolysis
- Gas analysis and injection

The feasibility report delivered by AMEC in June 2014 has shown that this technology is technically possible and early indications are that it is commercially viable. On this basis, National Grid Gas Distribution wishes to proceed with funding a development. There are several funding mechanisms that can be drawn upon and each of these will require commercial justification. Therefore, there is a need for a well thought out and solid business case to be developed so that National Grid can make an informed decision.

To increase the accuracy of the estimated costs, there will be a need to develop the ‘scheme of arrangement’ for the proposed installations. From these engineering drawings quoted costs can be obtained.

Equally the other non-financial benefits need also to be fully understood and this will need further investigation.

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The UK gas industry is presently wasting significant amounts of potential energy during pressure reduction. Recovering this energy has been looked at in the past and there have been barriers to its adoption.

Natural gas in the UK is inputted at high pressure into the National Transmission System (NTS) with the aid of compressors. It is then transported to major consumers and Local Distribution Zones (LDZs). Typically the gas passes through three pressure tiers, high, medium, and low pressure before it reduces from 60-80 bar down to household mbar pressure. It is estimated that within the grid, there are many MW of accessible mechanical energy from gas expansion. This energy is mainly lost at Pressure Reducing Stations and there is a potential for the energy to be recovered using turbines which generate electricity. This process has been established for many years; however, one of the remaining challenges is the effective utilisation of the electricity generated.

Method(s)

ITM Power has developed a new concept that looks to overcome some of the barriers based on new high efficiency electrolysers. The concept is that the energy from the pressure reduction process is converted to electricity and immediately converted to hydrogen gas for reinjection into the gas grid. This is an elegant and self-contained solution, which could potentially be used in any gas network provided certain controls are in place.

The proposed system is potentially a very efficient method with green credentials. The developed levels of injected hydrogen are relatively small considering the high gas flows and thought not to present a significant gas quality issue with the correct controls in place. All the component technologies required to build a Pressure-to-Gas plant are mature and therefore the combined technical risk is low.

The feasibility report delivered by AMEC in June 2014 has shown that this technology is technically possible and early indications are that it is commercially viable. On this basis, National Grid Gas Distribution wishes to proceed with further funding a development which will result in field trials at three sites.

This proposal is for AMEC to develop a business case in conjunction with ITM Power. The main deliverables are to provide National Grid with the appropriate information cost, benefit, implementation opportunities and recommendations to form the decision of three field trials that would be either NIA/NIC fundable projects.

- Formulate a business case to support a NIA/NIC field trial.
- It will quantify the size of the opportunity and rough idea of a roll out plan
- Show the financial return with a confidence of +/- 15%
- It will identify other non-financial benefits
- Describe how National Grid would manage any risks raised

Make clear recommendations

Scope

The proposal is to replace the existing pressure reduction equipment with an integrated energy recovery and hydrogen electrolysis equipment package. The hydrogen gas will be generated from the power generated and immediately injected into the gas grid. The main elements to this technology are:

- Pre-heat (if required)
- Turbo expanders
- Hydrogen electrolysis
- Gas analysis and injection

The feasibility report delivered by AMEC in June 2014 has shown that this technology is technically possible and early indications are that it is commercially viable. On this basis, National Grid Gas Distribution wishes to proceed with funding a development. There are several funding mechanisms that can be drawn upon and each of these will require commercial justification. Therefore, there is a need for a well thought out and solid business case to be developed so that National Grid can make an informed decision.

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Objective(s)

This proof of concept will be divided into two main work streams.

Technology review

The objective of this work package is to understand what information is already available, how mature the technology is (TRL level) and to get an approximate feel for the cost of the equipment.

Commercial and financial review

The objective of this work package is to understand, given the costs and technical risks, how attractive is this technology, will the regulator support its introduction and what ownership models will work best for the network.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success of the initial feasibility study has acted as a precursor to prove the ability for demonstration projects in the UK and potentially the programmed rollout of many such installations once the project is proven successful.

To allow this decision to be made, Amec will produce a report which will highlight;

- Recommendation of sites appropriate sites where technology may be applied
- Breakdown of costs to install equipment and maintain
- The derived benefits, financial and non-financial

A decision can then be made as to whether a field trial would be beneficial and highlight the possibility of success into a programmed roll out.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

If successful this will be a precursor to a next stage including demonstration and field trial of the technology.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

AMEC and ITM offices - Midlands

Revenue Allowed for the RIIO Settlement

No Revenue Allowed for in the RIIO Settlement

Indicative Total NIA Project Expenditure

£68,000 external cost

£6,800 contingency

£24,933 internal costs

£99,733 Total NIA Project Expenditure

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)

If this project is successful and gas quality regulations changes are successfully put in place, energy from the pressure reduction process could potentially be converted to electricity and immediately converted to hydrogen gas for reinjection into the gas grid.

This would result in potential significant carbon reduction and environmental savings associated with the reuse of energy, as well as efficiency savings. This technology could be successfully implemented across all networks to the benefit of all customers.

The introduction of this technology, if successfully implemented has the potential to provide financial benefits. However, at present this is a research project and it is not possible to determine the exact cost savings associated with this type of technology.

Project Benefits Rating 9 / 25

Please provide a calculation of the expected benefits the Solution

Not required (research only)

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

This method would be replicable across the whole of GB where proof of concept is required for use of the Pressure-to-Gas technological concept on the gas distribution network.

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

As this is a proof of concept only, costs of full roll out of the Pressure-to-Gas technology are unknown at this time and will be determined as a result of this work.

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

Learning will be published in the form of an output report to describe the technological, commercial and financial feasibility of use of the Pressure-To-Gas technological concept for use on the distribution network.

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.

n/a

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