national gas transmission

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

Jan 2014

Project Reference Number

NIA_NGGT0034

Project Registration

Project Title

External Contamination Detection & Measurement at Entry Points

Project Reference Number

NIA_NGGT0034

Project Licensee(s)

National Gas Transmission PLC

Project Start

January 2009

Project Duration

7 years and 1 month

Nominated Project Contact(s)

John Harris (box.GT.innovation@nationalgrid.com)

Project Budget

£1,350,000.00

Summary

Gas composition is currently monitored at entry points to the Gas Transmission System with “All-in-One” gas quality monitoring devices. These devices provide, and are primarily suitable for, monitoring energy content and combustion stability. In their current form, limitations exist in the detection of contaminants. For example, the devices were not historically designed to detect some of the expected potential contaminants.

The Gas Safety (Management) Regulations (GS(M)R) (1996) state that gas “…shall not contain solid or liquid material that may interfere with the integrity or operation of pipes or any gas appliance within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulations 1998 that a consumer could reasonably be expected to operate.”

National Grid network entry conditions go slightly further and state that gas “…shall not contain solid, liquid or gaseous material that may interfere…”. One of the reasons for this is that materials may be in vapour phase at the entry point, but if found in sufficient quantities may subsequently condense out to the liquid phase at within the downstream gas network due to changing pressure and temperature regimes.

Detection & quantification of contamination levels would enable National Grid to comply with the legal requirement of not transporting solids or liquids by either:

- Encouraging gas suppliers to improve their gas conditioning processes based on the evidence of detection
- Providing reliable and accurate information to facilitate the operational decision to shut down an offending incomer pipeline.

The development of a multi technique liquid or liquid bearing gas detection system would enhance National Grid’s enforcement of it’s GS(M)R obligations. The progamme aims to provide a series of operational options for the reliable detection of liquids within National Transmission System (NTS). The programme will develop and trail a prototype detection system based on commercially available technologies.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Gas Safety (Management) Regulations GS(M)R regulations state that the gas "…shall not contain solid or liquid material that may interfere with the integrity or operation of pipes or any gas appliance within the meaning of regulation 2(1) of the Gas Safety (Installation and Use) Regulations 1998 that a consumer could reasonably be expected to operate."

National Grid network entry conditions go slightly further and state that the gas "…shall not contain solid, liquid or gaseous material that may interfere…". One of the reasons for this is that materials may be in vapour phase at the entry point, but may subsequently condense out as liquid material at some point within the downstream gas network.

This project aims to provide guidance on the selection of detection & measurement equipment that could be installed at the entry points to the NTS. Gas composition is currently monitored at the entry points with "All-in- One" gas quality monitoring devices, but this is mainly provided to monitor energy content and combustion stability. In their current form, the devices have limitation in the detection of contaminants. For example, because of the high volumes of gas being transported in the NTS, it is conceivable that even small concentrations of contaminants can collect as significant volumes at points within the NTS. The devices are also simply not designed to detect some of the expected potential contaminants.

Method(s)

The programme will be progressive development and review of the current status of suitable detection technologies culminating in the development of a prototype system. The programme will cover:

- Establish historic and current position with respect to liquid delivery from entry points.
- Identify and review techniques or currently available instrumentation suitable for detecting and/or identifying liquid contaminants within the NTS.
- Liaison with suppliers and specification of candidate instrumentation.
- Conduct laboratory trials of individual instrument components.
- Develop scope of further work - sourcing costs, advance discussions with external supplies, project management & presentation of findings, purchase of equipment.
- Develop scope for conceptual design of measurement device and analyser system.
- Review pipeline interface, ATEX, PED issues.
- Instrument build and initial instrument testing.
- Build of laboratory test rig and prototype testing - followed by field trials.
  - Technical issues associated with external environmental factors interfering with the laser performance have resulted in the need for extended field trials.

Scope

Gas composition is currently monitored at entry points to the Gas Transmission System with "All-in-One" gas quality monitoring devices. These devices provide, and are primarily suitable for, monitoring energy content and combustion stability. In their current form, limitations exist in the detection of contaminants. For example, the devices were not historically designed to detect some of the expected potential contaminants.

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The development of a multi technique liquid or liquid bearing gas detection system would enhance National Grid's enforcement of it's GS(M)R obligations. The progamme aims to provide a series of operational options for the reliable detection of liquids within National Transmission System (NTS). The programme will develop and trail a prototype detection system based on commercially available technologies.

Objective(s)

This project aims to develop and trial a device, based on a review of available technology, that is suitable for the detection and quantitative measurement of liquid contamination at the entry points to the NTS gas transmission system.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The approach being taken is to consider using more than one detection method to give a greater chance of detecting liquid contamination.

For example, vertical ultrasonics will be assessed for detecting a level of liquid, horizontal ultrasonics will be assessed for detecting aerosol liquids, multi-FID will be used to detect liquid slugs, laser technology will be assessed for detecting particular molecules, irrespective of their phase, nitrogen purging of standard analysers will be assessed to see whether this improves their performance with liquid contamination.

This approach enables a range of composite detection systems to be configured for specific sites. This offers a wide range of installation options ensuring a wide range of gas quality detection capability.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The programme will develop liquid detection systems that can be utilised at UK gas entry points. The respective detection systems will depend on the results of the initial research phase of the project (performance of different combinations of detectors and evaluation of any particular known or expected problems at each entry point). Some entry points may benefit from pilot trials of detections systems. If these are successful they will be retained on the affected sites.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will deliver a solution potentially suitable for installation on a selected of entry points to the NTS.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

IFI - £1,208k
NIA - £ 142k

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)

The proposed detection systems would offer the following financial benefits:

Enduring Benefit

Liquid transfer also effects the operation of the NTS and results in increasing costs associated with maintenance and operation for example;

- Gas turbine engines have suffered from liquid contamination in the gas causes significant damage to the turbine blades this cost approx £0.75m to overhaul a Gas Generator.
- Significant costs of liquid removal and disposal during pigging operations and time staff time required to investigating and dealing with liquid contamination to metering installations, gas quality monitoring and other field measurement systems. Approximately £100K per year.
- Damage to dry gas compressor shaft seals at two compressor stations. The damage is caused by liquid contamination in the process gas. National Grid has incurred damage to dry gas compressor shaft seals at two compressor stations. The damage is caused by liquid contamination in the process gas. The cost of dry gas seal replacements over the last four years has been about £285k.

Single Event (Generic)

A single contamination resulted in compensation costs of £295k. Liquid identification at the entry points would enable National Grid to enforce the GS(M)R requirements for transportation of liquids and solids and enable the company to recharge any clean up costs to the site causing
the contamination.

Please provide a calculation of the expected benefits the Solution

Compressor Dry Seal Base Costs at sites of high contamination likelihood : £71,250/year
Implementation of gas entry detection systems.
Compressor Dry Seal Base Costs at sites of high contamination likelihood : £33,750/year
Annual Saving: £37,500, plus avoided costs as above.

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

It is anticipated that the successful development of a unit for the detection and identification of liquid would be fit for purpose across the Gas Transmission System.

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

The estimated cost of the future production unit is now £60k (Detection and Identification of Liquid) + £20-25k (Solid & Liquid Aerosol Detection) per installation.

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

This programme of work will provide the necessary learning and guidance around current technology to allow the development of a contamination detection and measurement device at an entry point to a Gas Transmission System.

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

Reliability: Successful implementation of the specific detection systems will enhance National Grid's response to gas quality excursions at entry points improving the overall control and management of gas quality of the NTS.

Safety: The proposed range of detection systems will improve National Grid's ability to manage their GS(M)R obligations.

☑ 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