

NIA Project Registration and PEA Document

Date of Submission

Nov 2013

Project Reference Number

NIA_NGGT0038

Project Registration

Project Title

Novel vibration measurement technologies

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Project Licensee(s)

National Gas Transmission PLC

Project Start

December 2013

Project Duration

1 year and 5 months

Nominated Project Contact(s)

Stephen Walton

Project Budget

£110,000.00

Summary

Vibration of instrument stabbings and other pipework at National Grid's compressor stations and terminals has previously given rise to fatigue failures, and a programme of work has been undertaken to modify pipework identified as being at risk. As part of this work, pipework vibration monitoring at compressor stations and terminals has been used to assess the risk of fatigue failure following any incidents, and as part of a screening exercise.

Recent developments in sensor technologies may offer an improvement in these monitoring activities, enabling an understanding of the dynamic behaviour of pipework to be gained more quickly, in greater detail, and with a lower cost for installation and decommissioning, and for sites with high levels of electromagnetic interference such as the newer electric drive compressors. It may also be possible to make more immediate use of the results of this analysis, possibly assessing the condition of assets during operation to identify potential problems.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Vibration of instrument stabbings and other pipework at National Grid's compressor stations and terminals has previously given rise to fatigue failures. Monitoring and assessment of asset integrity is necessary to reduce the risk of vibration-related pipework failures, and to avoid the associated hazards and costs.

Method(s)

The proposed Method has two key elements:

Laboratory demonstration of new sensors and system architectures:

Tests for four technologies will be carried out as follows:

- A. Fibre Bragg Grating (FBG) Sensors – FBG sensors are optical strain sensors which use fibre optics to transmit information. Because they do not use electrical wires they are completely immune to magnetic interference and are intrinsically safe.
- B. Wireless USB – Wireless technology would significantly reduce the set-up time required to install vibration sensors on site.
- C. Ethernet Based System from National Instruments – This technology would reduce the number of cables required on site which would reduce the set-up time required.
- D. (MSR 165) Miniature Data Logger – This is a small, self powered recording device that has an in-built accelerometer. It can be attached to a structure and left to record data for up to 6 months. Although a miniature data logger cannot replace long term monitoring hardware, it may be a cost-effective solution for vibration logging in some applications and could prove useful in initial site surveys.

Field demonstration of selected technologies at an electric drive compressor station:

Following on from the findings of the tasks outlined above, demonstration of the most promising technologies will be carried out by deploying them for a short field trial at a National Grid compressor station. This is likely to be a site with electric drive compressors, in order to demonstrate the immunity to electromagnetic interference relative to conventional instrumentation.

During the technology testing phase of this project it was ascertained that an extended and modified field trial demonstration is required for the Wireless USB and Ethernet Based System, impacting the overall project budget. In addition, issues encountered with hardware provided on loan from the manufacturer, has meant a delay in project completion.

Scope

Vibration of instrument stabbings and other pipework at National Grid's compressor stations and terminals has previously given rise to fatigue failures, and a programme of work has been undertaken to modify pipework identified as being at risk. As part of this work, pipework vibration monitoring at compressor stations and terminals has been used to assess the risk of fatigue failure following any incidents, and as part of a screening exercise.

Recent developments in sensor technologies may offer an improvement in these monitoring activities, enabling an understanding of the dynamic behaviour of pipework to be gained more quickly, in greater detail, and with a lower cost for installation and decommissioning, and for sites with high levels of electromagnetic interference such as the newer electric drive compressors. It may also be possible to make more immediate use of the results of this analysis, possibly assessing the condition of assets during operation to identify potential problems.

Objective(s)

The desired result would see demonstration, through laboratory and field trials, of the capabilities of novel vibration measurement sensors and systems, which could be deployed for assessing the risk of vibration-related fatigue failure of process pipework, specifically for sites with high levels of electromagnetic interference such as the newer electric drive compressors.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Successful field trials prove the performance of one or more of the various sensor systems such that the product can be rolled out across the National Transmission system sites.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

Demonstration of the sensors will be carried out by deploying them for a short field trial at a National Grid compressor station. It is necessary to determine the performance of the sensors in a field environment.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

Trials will be undertaken in a laboratory environment (Loughborough) and on a UK compressor site.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£110,000

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)

Vibration of instrument stabbings and other pipework at National Grid's compressor stations and terminals has previously given rise to fatigue failures. Savings are estimated to be in the region of £80k per site if an incident is avoided through implementation of vibration sensor technology. Whilst five key sites have already experienced fatigue failures, the potential problem of fatigue failure has been identified at 60 locations.

Please provide a calculation of the expected benefits the Solution

Historically, the failure of compressor discharge process/impulse pipework, caused by high dynamic stresses, has cost in the region of £100,000 (including materials, manpower and nitrogen purging) per incident. Such failures can lead to large releases of natural gas into the environment as well as being a safety concern to operational staff, and such failures can be classed as RIDDOR-reportable.

The method cost of implementation is estimated at £20k per site.

Therefore expected benefits are in the region of £80k per site if an incident is avoided.

There is also a high risk of a loss of network flexibility with compressor units on outage. At critical sites this could run to many hundreds of thousands of pounds.

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

National Grid gas transmission has a network of 24 compressor stations where this technology can be applied to assess the risk of vibration related fatigue failure. These methods could also be utilised on pressure reduction stations across the UK where vibration problems may occur.

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

The costs associated with deployment of the technologies investigated will be dependent on those selected for further demonstration. This might range from £5k for a single self-contained vibration data logger, to an estimated £100k for a multi-channel fibre-optic strain sensor system. These systems could be re-used on different sites as and when monitoring is required, thereby enabling cost sharing to be achieved.

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

n/a

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

This project is aligned to Optimising Asset Management under the Reliability theme

- 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