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

May 2015

Project Reference Number

NIA_NGGT0063

Project Registration

Project Title

Investigation into Novel Robotics Locomotion Techniques

Project Reference Number

NIA_NGGT0063

Project Licensee(s)

National Gas Transmission PLC

Project Start

March 2015

Project Duration

3 years and 6 months

Nominated Project Contact(s)

Richard Waine, box.GT.innovation@nationalgrid.com

Project Budget

£141,000.00

Summary

National Grid Gas Transmission has identified the need to develop and demonstrate robotics technologies suitable for the inline inspection of buried pipework on AGIs. A NIC bid for 2014 has been submitted for a demonstration project in this area. The NIC bid is a medium risk project with a tight scope and making use of existing technologies, combined into a novel platform.

The work done under this studentship will push at the current technology boundary, is at a much lower technology readiness level, therefore higher risk. The work is specifically focused on the locomotive aspects of a robot solution given the requirement to traverse changes in diameter. Pipework on AGIs can vary from 8 to 48 inch and currently there is no single robot that could successful negotiate such an extreme change. Multiple robots and careful planning of entry and exit routes would be required. This work will research and develop new locomotion concepts to overcome this challenge.

Third Party Collaborators

University of Leeds

Engineering and Physical Sciences Research Council

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

National Grid Gas Transmission is moving away from predictive asset type modelling towards condition based monitoring of its critical assets. This is particularly important because these assets are ageing and many have already reached the end of their intended asset life.

There is currently no available technology which can in line inspect below ground pipework on at high pressure installations (AGIs). Pipework on AGIs can be operated pressures up to 100Barg, and site configurations involve complex geometries which are not possible to inspect using inline inspection tools, PIGs.

Current methods of inspection for below ground pipework on AGIs involve visual inspection via excavation which is both financially and environmentally expensive.

Method(s)

This project is an industry sponsored CASE studentship. The key deliverables include:

1. Background research into robotic locomotion techniques required to traverse complex ground pipework at high pressure installations considering:

a. The challenges of changes in pipe diameter

b. Intrinsic safety of devices in high pressure pipes

c. Operation at distance from entry point

d. Deployment techniques

2. Develop robotic locomotion concepts and perform computational kinematic and dynamic analysis to relate the concepts to the required performance set out in the specification.

3. Select appropriate concepts and develop designs to test the principles

4. Fabricate and assemble prototype robotic devices, and perform experiments to validate the performance in a simulated laboratory environment.

5. Refine the designs and develop a design for a prototype robotic solution

6. Perform an analysis of the feasibility of making the device intrinsically safe.

Scope

National Grid Gas Transmission has identified the need to develop and demonstrate robotics technologies suitable for the inline inspection of buried pipework on AGIs. A NIC bid for 2014 has been submitted for a demonstration project in this area. The NIC bid is a medium risk project with a tight scope and making use of existing technologies, combined into a novel platform.

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Objective(s)

To investigate robotic locomotion techniques suitable for high pressure gas installations.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Publication of a technical paper / thesis on the work with discussions on the findings, recommendations and suggestions for further work.

Project Partners and External Funding

Project Partner – **University of Leeds**

External Funding – **EPSRC**

Potential for New Learning

This work will generate new learning associated with novel techniques for robotics locomotion in extreme environments that will be of benefit to all gas transporters in UK and internationally.

The development of this technology offers the potential for new learning associated with the condition of the network assets. These aging installations would be assessed in a more comprehensive and intelligent way resulting in more appropriate decisions made on asset repair and replacement.

Scale of Project

This work is predominantly desk and laboratory based.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will take place at the University of Leeds premises with some work on National Grid Gas Transmission sites.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

NIA expenditure - £70.9k

Top up from EPSRC - £69.5k

Total Project - £140.4k

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)

Savings would be associated with reducing the number of robots required across the NTS and reduced requirements for robot launch and receiving facilities on a site if a greater proportion of pipework can be inspected by the one tool (~£1m)

Please provide a calculation of the expected benefits the Solution

N/A Research Project

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

The Method would be replicable on 200+ AGIs on the National Transmission System that are currently not inline inspected.

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

Roll out would involve the purchase of one or more robots, the cost of which is unknown 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):

☑ 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

The use of a robotics technology with capability to inspect pipework with large changes in diameter will give valuable asset health information on pipework that is not currently inline inspected to network licenses.

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 the strategic 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.

It has been established through technology watch that there is no suitable technology available for traversing complex pipework on high pressure installations, in particular negotiating large change in pipe diameter. If the NIC bid is successful this project will be closely aligned to the NIC project team.

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