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

Jul 2015

Project Reference Number

NIA_NGGT0077

Project Registration

Project Title

Cathodic Protection for Pipelines within a Tunnel

Project Reference Number

NIA_NGGT0077

Project Licensee(s)

National Gas Transmission PLC

Project Start

July 2015

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Paul Lee / Martin Hadfield

Project Budget

£32,000.00

Summary

National Grid Gas Transmission currently have a number of tunnels on their network, approximately 5 to 6 segmental lined tunnels & 100's pipe crossings in sleeve's. These are mostly in locations where the NTS Feeder main needs to cross a road, river, railway or challenging geography. CP is provided by Impressed Current and Sacrificial Anode techniques. This works to protect the pipeline by allowing current to flow through the pipeline / to and from the ground bed to ensure that material is not lost in corrosion products.

However NGGT are looking for a method that fine tunes these existing techniques to make them suitable for a flooded tunnel environment.

There are known and managed CP issues on recent tunnel projects further pointing out the need to look at specialist marine type applications where there is a flooded tunnel.

Known challenges surrounding the tunnel exit / entry points / bulk heads of the tunnel; the water chemistry if an impressed current system is used which is a vicious cycle over time; and the challenges in returning to rectify a CP defect.

By utilising Dr Pat Lydon, one of the few CP specialists in the UK who is registered to level 3 with The Institute Of Corrosion (ICORR), National Grid will have access to his vast experience with marine type applications where solutions are complex / novel and have potential to experience saline, brackish and freshwater tunnel fill types.

Third Party Collaborators

IACS Corrosion Engineering Limited

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

National Grid are looking for novel solutions for Cathodic protection (CP) of pipelines within a tunnel environment. Within the gas transmission business there is currently no standard or specification which covers the application of CP on a pipeline within a tunnel. NGGT currently have onshore specifications (ECP suite) for CP, but nothing for flooded tunnels specifically. There are individual conventional CP solutions available including Impressed Current and Sacrificial Anode types used by National Grid on projects including tunnels however it has been identified that past projects have not fully optimised these for the marine application.

Existing Tunnel examples:

- UKT – River Exe Feeder 20
- UKD – Harefield Southall, Warburton Tunnels (open air)

By providing a specific CP in a Tunnel specification with a marine approach / angle rather than utilise the traditional solutions mentioned in isolation NGGT could generate significant savings over the lifetime of the asset.

This is because there would be more confidence that the CP is performing to specification and to allow gas transmission operational staff to monitor its health remotely. On tunnels where no permanent access is required i.e. fit and forget, this is critical as the cost of temporary works to go back once installed (if there are complications) is costly.

Method(s)

The project will look to develop a CP Specification for a Tunnel Environment.

1. Firstly, consideration will be given to marine standards and specifications such as;

   BS EN ISO 15589-2 Petroleum, petrochemical and natural gas industries. Cathodic protection of pipeline transportation systems. (Offshore pipelines).

   BS EN 12473 - General principles of CP in seawater

2. Dr Pat Lydon will canvas worldwide experience on the methodologies available and assist in rationalising which of these are optimum for National Grid's applications.
3. Mid-point reviews with Dr Pat Lydon will occur where Martin Hadfield and Paul Lee (NGGT) will discuss progress on the work and to understand key developments.
4. Prior to final completion of the works (Development of the Spec guidance) Dr Lydon will present his findings to National Grid.

Finally NGGT will narrow down select their preferences from the valid techniques presented and look to incorporate into NG standards / specifications.

Scope

National Grid Gas Transmission currently have a number of tunnels on their network, approximately 5 to 6 segmental lined tunnels & 100's pipe crossings in sleeve's. These are mostly in locations where the NTS Feeder main needs to cross a road, river, railway or challenging geography. CP is provided by Impressed Current and Sacrificial Anode techniques. This works to protect the pipeline by allowing current to flow through the pipeline / to and from the ground bed to ensure that material is not lost in corrosion products.

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Objective(s)

To investigate options for CP of pipelines within a tunnel and develop a specification based on the most appropriate techniques. This will deliver reduced procurement and construction costs for tunnel CP systems, provide greater integrity for pipeline during its lifecycle and potentially reduce requirement to design.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. Market review of techniques and existing specifications.
2. Production of the specification for review and acceptance by the NGGT Cathodic Protection engineer.
3. Long term - incorporation into ECP/ suite of specifications and sanctioned as a live document via Gas Engineering Policy Implementation Group (GEPIG).

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This will be a desk based study, reviewing suitable techniques and the production of the specification. Review meetings will also take place.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will take place at NGGT offices in Warwick and those of the supplier, in Kent.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£32,000

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)

- Cost of conventional CP solution = Circa £825,000
- Cost of novel CP solution= Circa £560,000
- Difference: £265k through reduction in cable trays (100k), reduction in ground beds (35k), reduction in transformer rectifier kiosks (30k) and reduction in mixed metal oxide anodes (100k)

Please provide a calculation of the expected benefits the Solution

The project costs are £32k to complete study with an estimated £265k total saving per tunnel project. Therefore net saving £233k per pipeline in a tunnel.

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

The methodology would be applicable to both gas transmission and distribution tunneling projects. Number of flooded tunnels: estimated 2 per network, therefore approximately 10 overall.

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

Savings have been estimated by comparison with current tunnel projects. Costs of roll out would be lower than a conventional solution and will be looked at in more detail as and when the next tunnel project arises. It is difficult to forecast how many there will be and their year of design / construction.

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 project will deliver a novel approach to protecting pipelines within a flooded tunnel. The learning will be available to all network licensees who can choose to incorporate into their in house specifications.

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 is aligned to 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