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 2020

Project Reference Number

NIA_NGGT0160

Project Registration

Project Title

Geopolymer Injection for Ground Stabilisation and the re-levelling of buried assets

Project Reference Number

NIA_NGGT0160

Project Licensee(s)

National Gas Transmission PLC

Project Start

July 2020

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Paul Ogden

Project Budget

£445,505.00

Summary

A resin is injected into the ground to re-level and stabilise the ground under gas pipes. This novel technique can be used at Kings Lynn site and potential save in the region on £20/£30m.

Third Party Collaborators

Geobear Infrastructure Ltd

Premtech Ltd

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Settlement of buried assets is a significant problem being experienced across the NTS, differential settlement causing potential overstress on the pipework due to ground subsidence. The range of remediation measures is currently very limited, disruptive, expensive and typically involving major excavation and new construction. The potential for settlement and/or subsidence to cause stresses in pipework and fittings at above ground installations can lead to structural failure. This is an important area to look for new innovative solutions.

The project will assess the potential application for geopolymer resin injection to stabilise the ground underneath gas pipework and adjust asset levels to eliminate differential stress situations. This will demonstrate the ability of the technology to remediate settlement of ground hence resolving and removing the potential for further stress exceptions with the ultimate risk of pipework failure.

Method(s)

There are two stages to the project:

Stage 1 – Technology Review and trial Design
1.1 Understanding of technology and limitations
A review of the geopolymer resin injection technology and applicability to National Grid's buried assets in general. Comparison with alternative solutions.
Deliverable: Technology Review Report

1.2 Trial Site Selection
Identification of potential trial sites, representative of the typical issues being faced in aging gas assets, on which the technology can be trialled.
Deliverable: Trial Site selection report.

1.3 Data Collection – Collect all data required to develop design
Carry out surveys and data collection e.g. visual surveys, laser scan survey and trial hole surveys. Collate into as built drawings/3D models. Level monitoring facilities will be installed whilst trial holes are open.
Deliverable: Survey results.

1.4 Trial site design – Develop a proposal for trial application
Development of a scope, design, method and success criteria for the application of geo polymers on the trial site to demonstrate that geo polymers can stabilise ground and lift pipework in a controlled and predictable manner as proven by stress analysis.
Deliverable: Trial site solution proposal.

1.5 Challenge and Review of Solution
Identification of relevant National Grid standards. Review how the Geobear technology and methods align with National Grid standards and procedures. Identify gaps and challenges.
Deliverable: HAZCON report, Challenge and Review Meeting Minutes.

1.6 Risk Assessment - Carry Out Risk Assessment of Proposed Solution
Identification and quantification of all risk associated with the application of the Geobear technology on National Grid assets on both the trial site and taking in to consideration live pipework for potential future applications. This will be a continuous process and include monthly risk register reviews.
Deliverable: Risk Assessment and risk register.

Stage 2: On Site Trial and Closeout

2.1 Trial Mobilisation
Provision of safety passport training for Geobear site operatives, site inductions, site welfare facilities, installation of demarcation fencing around trial site area. Commencement of level monitoring.

2.2 Trial site Demonstration
To ensure the technology can be demonstrated in a representative but safe environment this package will demonstrate the processes of injecting geo polymer to stabilise and lift redundant buried pipework within the trial site.
Deliverable: Trial application findings report

2.3 Closeout Report and Carbon Cost Comparison
Closeout report to be developed to include lessons learnt, best practices, and results of the monitoring. This report shall also include a carbon cost comparison between the geopolymer technology achieved solution and the comparative traditional solutions such as piled foundations and underpinning.
Draft geopolymer injection specification adoption document for application of the technology on live pipework.
Deliverable: Project Close Out Report

Scope

To demonstrate the applicability of the geo-polymer injection technique as an innovative solution for stabilising ground under assets. The scope will review the technology detailing the potential applications which may have relevance to National Grid. A trial design proposal will be developed to establish that geo polymers can stabilise ground and lift pipework in a controlled and predictable manner as proven by stress analysis. A field trial will be conducted to demonstrate position monitoring of pipework and ground level during the application of the geopolymer. The process and the movement response at the ground surface will be monitored in real time, which allows for immediate tailoring of the injection process to the response of the ground surface.

Stage and outcome reports will be provided as deliverables, as defined in the 'methods' section above.

Objective(s)

1. Assess suitability of geopolymer injection technology for ground improvement and ground stabilisation on and around high-pressure gas pipework within National Grid operational sites.
2. Assess the sustainability of product and its carbon footprint benefits when compared to concrete foundation replacement options.
3. Conduct trial on decommissioned pipework to demonstrate ground stabilisation and pipework releveling techniques.
4. Facilitate adoption of geopolymer injection technology in the gas transmission / distribution industry as business as usual.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Confirmation that the geo-polymer injection technique is practical, as a permanent mitigation of ground settlement and associated effects on buried pipeline assets.

Project Partners and External Funding

Premtech and Geobear

Potential for New Learning

To test the effectiveness of new ground stabilisation technology with an aim to improve the ground under various gas assets from the effects of potential settlement and subsidence. This technique can be used across the pipeline industry.

Scale of Project

Demonstration trials on a redundant pipeline applicability across the entire NTS where settlement is experienced.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

National Grid above ground installation or compressor site for demonstration trials, but ultimate applicability nationally and potentially internationally within the pipeline industry.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£445,505.00

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)

Due to the UK wide applicability and the known and future number of settlement issues, it has the potential to save £664,500p.a. over a 10-year period for one site.

Please provide a calculation of the expected benefits the Solution

A financial and environment benefit is a key outcome from the project.

Base Cost
The current remediation to repair the ground under assets by replacing like for like plinths of varying sizes:
2000 x 2000x 700 cost £2924.50, 15000 x 1000 x 400 cost 630.30, 500x500x350 cost £183.00 and
1450 x 850 x 450 cost 798.60

38 plinths size 2000 x 2000 x 700
Internal costs 17985.76
Suppliers cost 53,722.40
Suppliers materials 39422.50
Environmental impact = 0.5t per plinth
Total £111,130.60

31 plinths costs 1500x1000x400
Internal costs 3162.24
Suppliers cost 9445.4
Suppliers materials 6931.20
Environmental impact = 0.11t per plinth
Total £19538.90

5 plinths costs 500x500x350
Internal costs 148.12
Suppliers cost 442.40
Suppliers materials 324.70
Environmental impact = 0.02t per plinth
Total £915.20

31 plinths costs 1450 x 850 x 450
Internal costs 4006.64

Suppliers cost 11967.60
Suppliers materials 8782.10
Environmental impact = 0.09t per plinth
Total £24756.30
Based on one site = £180,450.00

Method
By using this geo polymers to stabilize the ground will cost £114,000.00
The use of the technique would typically avoid the use of concrete for new slabs and thereby make a significant carbon saving.

Total saving for one site £66,450.00

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

The technique would be 100% replicable for ground conditions across the UK where settlement is being experienced.

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

This would depend on the scale of the problem and size of area but is always likely to be a minimum of 50% of the cost of using traditional methods.

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

A key outcome will be the development of relevant specifications and operational methodology to support and control the use of the technique within the industry.

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

To prove the applicability of geo-polymer injection as a new technique to stabilize and re level pipework and buried assets which have experienced settlement or have the potential to experience settlement and as a result mitigate the risk of structural failure due to subsidence.

☑ 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.

This solution to inject geo-polymer into the ground and re-level the surfaces has never been trial led on pipework infrastructure.

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

Ground stabilisation (or soil stabilisation) is the process of making changes to the soil to improve its ability to bear weight and to increase its properties. This creates a more reliable basis for building and construction works and can remedy existing issues with earth and subsoils that are causing problems. The technique has been used under properties, roads, railways, airports and ports but has never been tried on pipework infrastructure.

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

The project will not be funded as part of business as usual as the technique has not been tested in the Gas industry. National Grid therefore needs to test that the technique is a practical and safe for use on buried gas assets.

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

As this technique has never been used within the Gas industry, it is unknown whether the solution is viable to re-level the ground under assets.

This project has been approved by a senior member of staff

☑ Yes