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

Jun 2017

Project Reference Number

NIA_NGGT0109

Project Registration

Project Title

Epoxy Grout Investigation and Analysis

Project Reference Number

NIA_NGGT0109

Project Licensee(s)

National Gas Transmission PLC

Project Start

June 2017

Project Duration

0 years and 10 months

Nominated Project Contact(s)

Gordon Platts

Project Budget

£298,000.00

Summary

The most commonly epoxy grout used has a number of benefit's, but also a number of limitations. For example, it can only be applied between temperatures of 4°C and 15°C and an operational limit up to 50°C before the strength start to deteriorate, which can impact on how quickly this pipeline repair method can be deployed. It can also extend the time taken for installation.

Secondly, one consequence of using 3-part epoxy grouts is the filler powder which is not suitable for open site mixing in high wind condition. This has been considered to have a potential risk to the quality of the final mix as some of this filler may be lost in the wind. If any amount of filler is airborne and lost due to high wind then there is a potential risk on the integrity of the epoxy quality and strength. In addition, due to high risk of inhalation of airborne filler, facial masks have to be worn by the site operators.

The other technique is welding; welding is very time consuming and labour intensive process. Flow rates may need to be reduced for welding to take place. However, there is no guarantee that the welding will be carried out at the planned time because in some cases flow rates could not be reduced due to the demand required for customers.

Third Party Collaborators

DNV

Nominated Contact Email Address(es)

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Problem Being Solved

Currently, there are three methods to repair pipelines. Cut out and replace this is costly; Welding which is a higher risk operation as welding on to a live pipeline and epoxy grout. The epoxy grout currently used is a 3-part grout for pipeline repair and grouted tees for

both Transmission and Distribution networks. The epoxy is made up of 3 separate components i.e. resin, hardener and filler powder which are available in 4 different grades of epoxy grout which are selected depending on the ambient and pipeline design temperature. Each grade has a very narrow range of installation operating temperature. For many years the current supplier has been the sole supplier; however they have recently removed their subsea epoxy grout due to their perceived view on commercial risk. The onshore range of epoxy repair grouts are still being supplied however there is a potential risk to pipeline repairs and epoxy filled hot tap operations if the supplier makes the decision to stop supplying epoxy products.

Method(s)

The project looks to assess a new type of epoxy, potentially suitable for pipeline repairs and grouted tees.

The lab based qualification test program will look to qualify the new grout for both winter and summer grades.

The test apparatus shall be set up to establish key materials parameters suitable for National Grid pipeline operating conditions. They include installation properties such as pot life and curing rate at both ends of installation temperature for each grade. The programme includes assessing material physical properties in order to establish whether these two grades would meet National Grid's minimum specifications of materials properties such as adhesive, cohesive, tensile, concentric shear and compressive strengths.

The epoxy grout shall be capable of (or exceed) the following practical requirements:

- Cured epoxy grout shall be free of cracks in any longitudinal, circumferential or near circumferential planes.
- Each epoxy grout component may have contrasting colour from each other. (i.e. It has been proposed blue for winter grade and red for summer grade)
- The physical mechanical requirements of the epoxy grout should be or exceed the following on steel surface preparation equivalent to SSPC-SP10 (SSI-Sa2.5) for surface cleanliness with surface roughness above 30 micron.
- Mixed epoxy grout during its pot life cycle is pourable and pumpable @ 5°C for winter grade and 20°C for summer grade.
- Epoxy grout components should have a minimum shelf life of 12 months.
- Epoxy grout to be supplied in small containers suitable for manual handling purposes.
- Cured epoxy grout product is to be an inert material.

> Qualification testing shall be divided into two phases in order to establish short term performance and long term material ageing and strength degradations, if any.

Phase 1

This work scope includes assessment of short term physical properties such as cohesive, adhesive, compressive, concentric shear and tensile strengths of each grade of epoxy. This phase assesses key aspects of material strength profile during the curing period and other installation properties such as pot life and material shrinkage after curing.

Phase 2

This phase assesses long term degradation of epoxy grout using an elevated temperature methodology. All samples are mixed and cured at room temperature for at least 7 days before subjecting them to soaked temperature at the test periods.

Scope

The most commonly epoxy grout used has a number of benefit's, but also a number of limitations. For example, it can only be applied between temperatures of 4°C and 15°C and an operational limit up to 50°C before the strength start to deteriorate, which can impact on how quickly this pipeline repair method can be deployed. It can also extend the time taken for installation.

Secondly, one consequence of using 3-part epoxy grouts is the filler powder which is not suitable for open site mixing in high wind condition. This has been considered to have a potential risk to the quality of the final mix as some of this filler may be lost in the wind. If any amount of filler is airborne and lost due to high wind then there is a potential risk on the integrity of the epoxy quality and strength. In addition, due to high risk of inhalation of airborne filler, facial masks have to be worn by the site operators.

The other technique is welding; welding is very time consuming and labour intensive process. Flow rates may need to be reduced for welding to take place. However, there is no guarantee that the welding will be carried out at the planned time because in some cases flow rates could not be reduced due to the demand required for customers.

Objective(s)

To assess and qualify a new type of epoxy grout such that it is suitable for pipeline repair and epoxy tees.

In doing so the project looks to :

To reduce the number of different epoxy grades from 4 to 2.

Eliminate the risk of single source sole supplier

Reduce commercial and operation risks to the repair strategy

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

To assess the new grout by evaluating two grades in two different installation conditions and ensure that the product is suitable for pipeline repair.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project is laboratory based to demonstarte the required performance across the required range of temperatures

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

National Grid premises at Pipeline Maintenance Centre, Ambergate

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£298,000

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)

If all the repairs were carried out on 36x36 pipes the total potential savings would be £2,920,000. This is based on 80 repairs carried out in one year.

To eliminate a single point of failure, and safe guard a very effective and efficient technique for replacing pipelines it is vital that material are sourced from the competitive market to ensure the best price obtained for materials which in turn will benefit the consumers.

The technique will enable NGGT to competitively procure epoxy grout which will generate modest saving however in a wider context, qualification of a new supplier and new product will ensure the grouted tee technique can continue to be used effectively into the future. On one large project a grouted reinforced sleeve was used at a price six times cheaper than the alternative, so it is vital that any new materials that support the technique can be assessed.

There are a number of other considerations:

- Reinforcement sleeve technology now approved within TD/1 (report that validates the pipelines are safe to operate) so volume of epoxy likely to increase significantly over next few years
- Technology now being used outside of NG but installed by PMC group
- Potential Grouted Tee project at one of our South Wales sites will require increased design temperature which currently eliminates to use of current grades of epoxy, apart from HTD grade. HTD grade will require minimum curing temperature of 40 degrees.
- Significantly reduced environmental impact by removing powder element (i.e. two part epoxy)
- Significantly reduced special waste by eliminating solvent
- Simplifies the installation process
- Two part epoxy grout allows for use of automated mixing and pumping system will:
  - Eliminate to requirement of solvent
  - Significantly reduce the volume of epoxy waste

Please provide a calculation of the expected benefits the Solution

It is imperative that maintenance and repairs are carried out to ensure the integrity of the pipeline. The comparison shows the costs of welding verses cost of using epoxy.

Base cost - Welding

To repair a Tee fitting on 36 by 36 pipes using the weld process would take approximately 7 days. Before any welding is commenced a carbon content test will need to take place and the costs are as follows:

11 FTE's - £500 each per day = £5500 x 7 =£38500

Consumables = £ 5000

Total **£43500**

Flow rates will need to be reduced and depending on the location any power stations surrounding the area will need to be closed and which may incur a compensation costs which could run into millions.

Method cost - Epoxy grout

Repairing a pipe the same size using epoxy, there is no need to reduce the flow, therefore no impact on customers and reduction in manpower.

4 FTE's - £500 each per day = £2000 x 3 =£6000

Consumables = £1000

Total **£7000**

The difference between base cost £43500 and method cost £7000 multiplied by 80 (number of repair in one year) =£2,920,000

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

Epoxy technology is easily replicable and is likely to be used in the region of 60 to 80 times per year. This technology has the potential to be used in distribution networks.

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

On completion of the project NGGT will look to procure the grout at a market competitive rate, there would be no other additional rollout costs.

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 qualification process will enable any high pressure gas pipeline operator make use of this alternative 2 part grout solution.

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

The project is aligned to our reliability theme, reducing commercial and operation risks to the repair strategy.

☑ 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