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NIA Project Registration and PEA Document

Date of Submission

Oct 2015

Project Reference Number

NIA_SGN0086

Project Registration

Project Title

Cured In-Place Pipe (CIPP) (Stage 3)

Project Reference Number

NIA_SGN0086

Project Licensee(s)

SGN

Project Start

October 2015

Project Duration

6 years and 7 months

Nominated Project Contact(s)

Oliver Machan, Innovation Project Manager

Project Budget

£1,521,181.00

Summary

Fully structural CIP liners side and end connections will be developed. Up to four solutions will be developed in total – 2 end fittings with appropriate PN16 flange and 2 side fittings between 2-6" to cover service and bagging-off applications. This will involve considerable collaboration with the supply chain to develop and test these new solutions. A parametric study of shrinkage of fully structural CIP liners will allow robust pressure testing procedures to be developed.

The majority of performance testing will be carried out in WRc's Engineering Testing Facilities. Field demonstrations will be managed by WRc using where possible the GDN field trial sites where CIP liners were installed within cast iron mains during the Stage 2 CIP project. Time and motion auditing of the complete CIP liner process will be undertaken for fully structural CIP liners. A delivery mechanism will be developed to allow rapid implementation of CIP liners upon completion of this project.

Nominated Contact Email Address(es)

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Problem Being Solved

The development of cured-in-place (CIP) liner technology for the repair and remediation of gas distribution pipelines up to 2 barg has progressed through two stages of development, initially as a GDN-sponsored IFI project, and since April 2013 as a NIA project. WRc has been the lead contractor for the project, drawing on and coordinating the support of a further 15 technology organisations spanning consultancies, test houses and the liner technology providers and installers. The project has been steered by a management group led by SGN and comprising representatives from the four network companies and WRc. Key achievements of Stages 1 and 2 are or will be:

Stage 1 (December 2011 to March 2013) – development and publication to the supply chain of a performance specification and

installation best practice guide for non, semi and fully structural CIP liners for deployment in GB gas distribution systems at pressures up to 2 barg (medium pressure system) and diameters up to 48 inches.

Stage 2 (April 2013 to March 2016) – preliminary worldwide screening and audit/testing of available technologies resulting in the selection of four CIP liner solutions for further detailed mechanical/physical life testing, together with a field trial on each of the four GDN networks. Also, delivery of a risk assessment framework for lined pipes as an aid to solution selection, and a contractor 'fit-for-purpose' certification scheme framework. These, and the results of the comprehensive test programme, will inform any modification of the performance specification and installation best practice documents generated at Stage 1. The project will essentially be complete by April 2015 and subsequently, once outstanding long-term test results become available those systems that are 'fit for purpose' will be determined. A process through which these and further systems can complete or seek certification will also be defined.

Development and testing of the CIP liner technology has revealed a development gap in the maintenance, flow-stopping and end connection systems. Currently no end or side connection fittings exist which are suitable for use on fully structural CIP liners i.e. they bond to the CIP liner and exploit the superior mechanical strength of the fully structural liner material. There is a need for these technologies to be developed and tested for gas applications, initially for systems at 2 barg but potentially at pressures up to 7 barg, to enable the roll-out of fully structural CIP technology across the GDN network and this forms the basis of Stage 3.

Method(s)

Phase 1 – Identifying potential solutions

- Task 1: Understanding the science of liner shrinkage and relaxation
- Task 2: Development of a pressure testing procedure for FS CIP liners
- Task 3: Performance Specification development for bonded main and side connections
- Task 4: Information gathering and promotion of project to supply chain and GDN operations teams
- Task 5: Open call for technology solutions
- Task 6: Assessment of potential technology solutions and decision on which to take forward

Phase 2 – Demonstration of fully structural technologies

- Task 7: Development of generic procedures for fully structural solutions
- Task 8: Development of fully structural bonded end and side connection systems
- Task 9: Manufacture of bonded end and side connections at WRc
- Task 10: Laboratory testing of fully structural bonded end and side connection systems
- Task 11: Field trials of fully structural bonded end and side connection systems
- Task 12: Commercial delivery model, implementation support and reporting

Scope

Fully structural CIP liners side and end connections will be developed. Up to four solutions will be developed in total – 2 end fittings with appropriate PN16 flange and 2 side fittings between 2-6" to cover service and bagging-off applications. This will involve considerable collaboration with the supply chain to develop and test these new solutions. A parametric study of shrinkage of fully structural CIP liners will allow robust pressure testing procedures to be developed.

The majority of performance testing will be carried out in WRc's Engineering Testing Facilities. Field demonstrations will be managed by WRc using where possible the GDN field trial sites where CIP liners were installed within cast iron mains during the Stage 2 CIP project. Time and motion auditing of the complete CIP liner process will be undertaken for fully structural CIP liners. A delivery mechanism will be developed to allow rapid implementation of CIP liners upon completion of this project.

Objective(s)

The objective of this work is to develop and commercialise a range of solutions for installation, maintenance and intervention operations for fully structural CIP liner systems. To do this the project will engage the supply chain in bringing forward designs and operating practice. This will ensure that at the end of the project the industry has a robust and complete CIP liner solution that is ready for implementation.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project would be considered a success if one bonded connection solution is deemed 'fit-for-purpose' for use. Two approved solutions would provide a competitive market.

Specific success criteria are:

- To understand and quantify the shrinkage behavior of fully structural CIP liners and so develop pressure testing procedures.
- To develop audited time and motion schedules for fully structural CIP liner processes.
- To develop a CIP liner delivery mechanism to enable the implementation of this technology upon the completion of the Stage 3 project.
- To demonstrate a range of fully bonded end and service connections for fully structural CIP liners up to 2 barg; and in so doing;
- Provide an option to widen the operating envelope of fully structural liner systems to 7 barg (intermediate) pressure. This option does not fall within the scope of this project but could be progressed separately should there be enough interest in the application.

Project Partners and External Funding

This project has been approved by the Gas Networks Collaboration Forum (GNCF) in March 2013 and is in collaboration with other GDN's. The project is being led by SGN and is managed by the WRc (Water Research Centre).

The GDN's participating in the project are:

- National Grid Gas Distribution
- SGN

Potential for New Learning

The deployment of CIP liner technology to the gas distribution network has the potential to contribute in the following applications:

- As a lower-cost, fully structural, replacement option across all pipe tiers.
- As a refurbishment option in Tier 2/3 to both reduce the residual risk and extend the useful life of the existing gas main.
- As a repair and risk management tool to address leakage and other operational problems with significant opex impact, predominantly in Tier 2/3.
- As a contributor to improved customer experience, reduced urban congestion and reduced environmental impact across the network.

The project will enable the GDNs to implement CIP liners across the network with confidence that the liner and connections are fit-for-purpose, having been fully assessed for gas applications under a rigorous programme of laboratory and site testing. The programme of work will bring the gas industry significant knowledge and experience on bonding thermosetting composite materials to form connections to pipe liners and systems.

Scale of Project

Fully structural CIP liners side and end connections will be developed. Up to four solutions will be developed in total – 2 end fittings with appropriate PN16 flange and 2 side fittings between 2-6" to cover service and bagging-off applications. This will involve considerable collaboration with the supply chain to develop and test these new solutions.

A parametric study of shrinkage of fully structural CIP liners will also allow robust pressure testing procedures to be developed. The majority of performance testing will be carried out in WRc's Engineering Testing Facilities. Field demonstrations will be managed by WRc using where possible the GDN field trial sites where CIP liners were installed within cast iron mains during the Stage 2 CIP project. Time and motion auditing of the complete CIP liner installation process will also be undertaken.

Upon completion of this project, a delivery mechanism will be developed to allow rapid implementation of CIP liners.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

WRc will conduct the majority of the testing in their own facilities. However, WRc will organise and manage two field trials of fully structural bonded end and side connection systems, working closely with the GDNs on the installation and subsequent monitoring. These trials will provide an opportunity to see the connection systems operating in real site conditions which will help identify if there

are any issues regarding the installation procedure and materials. The trials will install, in total, one of each of the 2 end connectors and one of each of the 2 side connections.

Revenue Allowed for the RIIO Settlement

There are no direct saving benefits anticipated.

Indicative Total NIA Project Expenditure

The total recoverable allowance will be 90% of the project costs shown below for each Licensee under the Network Innovation Allowance (NIA):

SGN - £507,060 Total Project expenditure

NGGD - £1,014,121 Total Project expenditure

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)

The gas distribution industry GB-wide has an opportunity to outperform current cost allowances for large diameter metallic mains replacement/repair by ca £19 m during the second half of the RIIO-GD1 period through CIP deployment, with a range of opportunity from £10 m to £29 m (undiscounted). Dialogue and confirmation with the supply chain is required to ensure their prices are on the right trajectory, having excluded GDN cost contributions to these. Further investment by the GDNs over the period 2015/16 to 2017/18 is justified to bring an integrated system of CIP liners and ancillary connection technologies to the market at TRL8, with a minimum benefit cost ratio of 10:1 on an undiscounted basis.

Please provide a calculation of the expected benefits the Solution

The following picture of the national abandonment workload for RIIO-GD1 and therefore the expected replacement volumes was determined:

- All Networks (Tier 2 & 3) = 1858km

Although unit cost allowances vary around the country owing to labour, efficiency and local conditions, the averaging process calculates the following allowances per metre:

- All Networks (Tier 2) = £365
- All Networks (Tier 3) = £962

There are varying views about the applicability of CIP ranging from 0% to 40% dependent on diameter class. These high/low estimates have been used by diameter class to calculate the likely annual work volumes of CIP deployment (assuming the remaining abandonment work load takes place on a pro-rata basis over the remaining period of RIIO-GD1).

- Tier 2 – Applicability of between 5.1% and 13.4% and therefore between 10.18km and 22.85km per year.
- Tier 3 – Applicability of between 12.3% and 20.1% and therefore between 8.04km and 14.60km per year.

Total applicable of between 18.21km and 37.45km per year.

Target price data relative to unit cost allowances have been used to infer the National picture. The network view supports a more ambitious price target for the lower diameter classes (owing to a range of competing solutions), and that in a mature competitive market price targets can be reduced relative to market entry conditions.

- Tier 2 – Target reduction of between 21.7% and 36.1% and therefore an inferred price (max) of £286 per metre and an inferred price (stretch) of £237 per metre.
- Tier 3 – Target reduction of between 21.7% and 31.7% and therefore an inferred price (max) of £754 per metre and an inferred price (stretch) of £657 per metre.

To bind the possible aggregate savings possible it is necessary to combine a view about the % applicability and calculated work volumes of CIP as a solution with a view about price. To do this the low applicability case has been combined with the max price case (low benefits case), and high applicability combined in the opposite way (high benefits case).

The following summarises these two combinations, accepting that a continuum of market pricing and applicability will be the norm and fall between these extremes.

All Networks:

- Tier 2 – Benefit case of between £0.92m and £3.31m per year.
- Tier 3 – Benefit case of between £1.49m and £3.89m per year.

This gives a total benefit case of between £2.41m and £7.20m per year.

As a final step in the benefits case it is instructive to calculate 4-year benefits that would arise following implementation of the fully-developed solution over the time period 2017/18 to 2020/21, i.e. during the second half of the regulatory period, at a mid-point of the two above limits.

All Networks – 2017/18 to 2020/21:

- Tier 2 – Midpoint benefit case of £8.46m
- Tier 3 – Midpoint benefit case of £10.76m

This gives a total midpoint benefit case of £19.22m over the remainder of the applicable regulatory period.

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

In summary the technology provides an opportunity for GDNs to outperform current cost allowances by ca £19.2m (and in the range £9.7m - £28.8m) deploying CIP solutions primarily in the diameter range 10 to 24", but significant value > 24". This is dependent on the supply chain being able to deliver solutions at the price point determined, to include all GDN ancillary costs of installation. All savings are on an undiscounted basis.

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

Each Network will either:

- Contract the work out to existing contract service providers or
- Train in house staff to implement the new system.

As a lower cost technique compared to current practice the work load will be included within existing replacement levels as per RIIO agreed service levels.

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

By undertaking this development work the gas industry as a whole can share the overall cost, knowledge, risk and subsequent benefit from development and testing.

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

n/a

- 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.

Up until Stage 3 (this stage) all GB Licensee holders were part of this project and the licensees that have decided not to continue through this final stage will not be developing anything similar or counter to the project.

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