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NIA Project Registration and PEA Document

Date of Submission

Oct 2018

Project Reference Number

NIA_WWU_046

Project Registration

Project Title

Cryogenic Pipeline Cracking Technology

Project Reference Number

NIA_WWU_046

Project Licensee(s)

Wales & West Utilities

Project Start

October 2018

Project Duration

1 year and 11 months

Nominated Project Contact(s)

James Hatt. Vishal Dhanji.

Project Budget

£648,928.00

Summary

Presently, conventional gas main replacement technologies are designed to cut and break metallic pipes at ambient temperature. These technologies work well for inherently brittle materials such as cast iron (CI) and spun iron (SI), but are hindered by the ductile nature of DI and steel. DI and steel pipes are more difficult to remove and subsequently, based on current trends it is forecast that towards the latter stages of the mains replacement programme there will still be a substantial population of DI and steel pipelines requiring removal, which will pose a major challenge in terms of time and cost.

A possible solution is the development of cryogenic pipeline cracking technology that would facilitate faster rates of DI and steel pipe removal equivalent to that of CI and SI.

Nominated Contact Email Address(es)

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Problem Being Solved

Presently, conventional gas main replacement technologies are designed to cut and break metallic pipes at ambient temperature. These technologies work well for inherently brittle materials such as cast iron (CI) and spun iron (SI), but are hindered by the ductile nature of Ductile Iron (DI) and steel. DI and steel pipes are more difficult / time consuming and so more expensive to remove.

Based on current trends it is forecast that towards the latter stages of the Tier 1 Mains Replacement Programme (MRP) there will still be a substantial population of DI and steel mains requiring removal, which will pose a major challenge in terms of time and cost.

Current solutions to cut the mains are the Steve Vick Ductile Iron Window Cutter, Steve Vick Circumferential Cutter & the Kent Cutter. Compared with CI mains, it can take up to 65 minutes and 20 minutes longer for DI and steel mains connections and service connections respectively.

Method(s)

A possible solution is the development of cryogenic pipeline cracking technology that would facilitate faster rates of DI and steel pipe removal equivalent to that of CI and SI

DNV GL and Morrison Utility Services (MUS) propose to investigate whether DI and steel gas main materials could be embrittled by localised cryogenic freezing, inducing a ductile-brittle transition, increasing their propensity for cracking utilising either current or augmented conventional cracking equipment

A desktop calculation on the financial benefits of replacement efficiencies of DI, equivalent to CI and SI mains, estimates there would be a cost reduction for replacement of the remaining DI and steel population during the latter stages of GDPCR1. Increased efficiency would also drive a change in replacement strategy, with replacement schedules targeting all metallic mains in each locality enabling effective planning and use of resources, whilst also addressing the sector wide resource challenge.

Scope

The project will be stage-gated, with the scope of work for this project undertaken in three distinct phases.

Phase 1 (3.5 months)

Proof of Concept / Feasibility Assessment

The aim of Phase 1 is to demonstrate that cryogenic freezing can successfully embrittle DI and steel pipelines that are present in the gas distribution network.

The final deliverables from Phase 1 will be:

A report will be presented in the first instance with a full review of the test programme to ensure correct and consistent interpretation of results.

A final report will be presented with results, conclusions and recommendations for movement to Phase 2. Decision making will be aided by a traffic-light threat and risk matrix highlighting obstacles for Phase 2 that may need to be overcome to aid stakeholder decision process judgement as to whether the project should proceed.

The report will include real world financial benefits to ensure there are no blockers to the enablement of the technology and that the business case remains justified

Phase 2 (8 months)

Laboratory Prototype Design & Build

Having proven that the concept works and no show stoppers are envisaged, the aim of Phase 2 is to define working operating parameters and a working prototype

The final deliverables from Phase 2 will be:

Report with a full review of the test programme, results and conclusions.

Risks and challenges will be captured in a traffic light risk matrix and 'No Go' / 'Go' recommendations provided for Phase 3.

Phase 3 (3.5 months)

Field Trials

The aim of the field trials will be to assess the technology on a statistical range of pipe diameters under real world conditions in comparison to the incumbent technology.

The output of this stage will be a final report

Report with a full review of the test programme, results and conclusions.

2 x Working prototype units inclusive of risk analysis / method statement and COSHH assessment.

Objective(s)

To develop a new and novel approach to accelerate the replacement of ductile iron Tier 1 (DI) and steel gas mains.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

A successful project will deliver to both Cadent and WWU a full-scale working prototype where potential uncertainties and risks posed

by the technology have been assessed and managed through the development of a robust qualification strategy. This plan will evidence that the risks can be managed, or are negligible, giving assurance in the reliability, safety and commercial viability of the technology in respect to the operator, environment and pipeline asset

Project Partners and External Funding

Project partners: DNV GL, Morrison Utility Services and Steve Vick LTD
This project is wholly funded by the Network Innovation Allowance

Potential for New Learning

Throughout the project key challenges and risks posed by policy, operations and real world financial benefit will be investigated and analysed to ensure there are no blockers to the enablement of the technology and that the business case remains justified.

Scale of Project

We will develop 2 prototype models that will be trialled across the network area following the initial design and development stages and will include all modifications identified and agreed during the trial stage

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Trials will take place in both Wales & West Utilities and Cadent's network.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total Project cost is £648,928; with external costs: £486,697 and Internal costs: £162,231

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)

A desktop calculation on the financial benefits of replacement efficiencies of DI, equivalent to CI and SI mains, estimates there would be a cost reduction for replacement of the remaining DI and steel population during the latter stages of GDPCR1. Increased efficiency would also drive a change in replacement strategy, with replacement schedules targeting all metallics in each locality enabling effective planning and use of resources, whilst also addressing the sector wide resource challenge

Please provide a calculation of the expected benefits the Solution

Based on an example of 15,000 mains connections and 150,000 service connections for DI the below benefit can be realised:

Base Cost

Current minimum cut time per mains connection: 125 minutes

Current minimum cut time per service connection: 20 minutes

15,000 x 125 mins labour cost at £65 / hour = £ 2,031,250

150,000 x 20 mins labour cost at £65 / hour = £3,250,000

Method Cost

Estimated cut time per mains connection: 65 minutes

Estimated cut time per mains connection: 10 minutes

15,000 x 65 mins labour cost at £65 / hour = £ 1,056,250

150,000 x 10 mins labour cost at £65 / hour = £1,625,000

Base cost – method cost

£2,031,250 (base mains connection cost) + £3,250,000 (base service connection cost) = £5,281,250

£1,056,250 (method mains connection cost) + £1,625,000 (method service connection cost) = £2,681,250

£5,281,250 - £2,681,250 = £2,600,000

A saving of £2,600,000 for Ductile Iron connections over 12 years.

Steel pipes currently have a minimum cut time of 132 minutes and 30 minutes, it is hoped that the innovation could reduce these times to 90 minutes and 20 minutes. Based on 25,000 mains connections and 250,000 service connections and using the same logic as above this would see a saving of £3,845,833 over 12 years.

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

The use of the ductile iron cutting tool, on completion of development, can be re-created across any network whilst undertaking replacement activities on ductile iron mains.

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

We anticipate the costs will be predominantly through purchase of the equipment, maintenance of the equipment and training in its use.

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

All networks will encounter the need to replace ductile iron mains in the most efficient method which reduces impact to customers and offers them the best value for money. The learning generated and successful implementation of tooling could be used by all networks within their replacement programmes.

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.

No other similar project has been identified on the ENA portal.

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

A pipe embrittlement technique has never been investigated by any gas network in the UK, so it is a truly innovative approach to an issue faced by all GDN's. Cryogenic techniques have been used in the water industry for many years with great success. In the water industry they use the process to freeze the neck of a hydrant to create a plug of ice which in turns stops the flow of water, enabling work to be carried out above the ice and on the pipe. The use within the gas industry would be very different, using the technique to freeze a pipe so it can be cracked. The mains replacement program has been predominately in C/Sl, however this is shifting to D/ST and a new way of replacing these mains is needed.

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

There is uncertainty about how the pipes will react to this type of approach, which is a risk to Wales & West Utilities Ltd and Cadent

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

This project will investigate the feasibility of the technique, as well as testing the prototype in a real world environment. We cannot be certain if the pipes can withstand cryogenic cracking technology in a range of scenarios until the project has been completed. This trully innovative soloution can only be investigated with the support of NIA funding.

This project has been approved by a senior member of staff

Yes