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

Sep 2015

Project Reference Number

NIA_UKPN0009

Project Registration

Project Title

Composite Shell Joint Retrofit Trial

Project Reference Number

NIA_UKPN0009

Project Licensee(s)

UK Power Networks

Project Start

September 2015

Project Duration

1 year and 9 months

Nominated Project Contact(s)

Lynne McDonald

Project Budget

£186,000.00

Summary

The project will research the existing market, design, develop, trial and validate a safe, affordable LV branch (T) joint repair solution.

i) Literature Review

The literature review will involve researching the current market locally and internationally to determine what products exist on the market that could be either adopted directly or amended to suit our requirements. Speaking with jointing contractors and UK Power Networks Field Engineers, it is understood that no products as proposed exist anywhere in the UK.

ii) Development and Design

Design and development of a trial run of plastic shells will involve producing a casting model based on LV branch (T) joints which have been replaced. This will be done in conjunction with a molding company and our jointing partners.

iii) Manufacture Trial Run

An initial trial run of five plastic shells will be developed to aid in the off-network testing (summarised in iv below) following which a further manufacture run of 100 are proposed to be rolled out into the on-network trial (summarised in v below).

iv) Off Network Tests

The first run of shells will be utilised in off-network tests. The off-network trials are proposed to test and refine the design prior to a full 100 shell manufacture trial run.

v) On Network Tests

The on network trial will involve installing approximately 80 shells on defective LV joints as identified during the Cable Pit inspection process. The exact number cannot be confirmed at this stage as each location has not yet been enabled to confirm that a shell can be fitted.

vi) Monitor

The repairs will be logged on UK Power Networks' asset management system. Details will be added against the assets as the repairs are completed. It is also proposed to circulate a directive to all network engineers that the future replacement of any repaired joints will need to be communicated to the project team so that an assessment can be made on the cause of the fault and whether the repair was a contributing factor. It is proposed that a forensic examination of failed joints be carried out on all failed joints to determine the cause of the failure.

vii) Review

Review of the trial will rely on a qualitative analysis as a suitable control group cannot be assigned. Comparing the failure rates of non-defect T-Joints with defective ones would be an unrealistic comparison as would comparing defective joints against one another.

viii) Product Development

Building on vii above, product development will involve liaison with the existing UK Power Networks incumbent shell supplier and developing an approved kit and installation procedure. It is likely that this stage will involve an additional round of design amendments to suit the production process.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

UK Power Networks is 3 years into an industry-leading potential 8 year project to inspect and mitigate all cable pit assets across London Power Networks area. As part of this ongoing work an increasing number of defective joints are being discovered and further afield, this is a global problem. Traditionally, defective low voltage (LV) joints are removed and replaced as live working, requiring excavation work and jointing or as they fault. The reactive approach can lead to Customer Minutes Lost and Customer Interruptions or as the cover can occasionally be ejected potentially causing a safety risk to members of the public.

This project aims to develop a safe, cost effective alternative to removal and replacement of defective LV joints, lowering the unit cost per repair and allowing for more repairs to be carried out under the same budgetary constraints. The project aims to innovate an existing jointing technique which involves encapsulation of joints in resin-filled plastic shells. Where traditionally this approach is only adopted on new joints, the project proposes to adapt this technique to repair existing, defective LV branch (T) joints.

Method(s)

The proposed methodology to develop an alternative, innovative repair solution is summarised as follows:

- Research the current market to confirm that no superior, alternative repair solutions exist
- Design and develop a plastic shell suitable to encompass the majority of defective LV branch (T) joints likely to be encountered on the network
- Engage a molding specialist to manufacture a trial run of 100 plastic shells based on the developed design
- Off-network test of the developed shell and resin. This will involve implementing approx. 20 of the plastic shells to a previously removed T-Joint, pressure and water bath testing the specimen as well as allowing us to cut the shell to examine how the repair would bond in the field
- On-network test of approximately 80 plastic shells in the field in a range of locations and situations to ensure that they are applicable in practice
- Monitoring of the installed repairs over a 12 month period concentrating on whether the joints remain in service
- Review the results of the trial
- Develop the test specimen into a viable repair product to be rolled out as a reliable, safe and affordable option to repair defective LV branch (T) Joints

Scope

The project will research the existing market, design, develop, trial and validate a safe, affordable LV branch (T) joint repair solution.

i) Literature Review

The literature review will involve researching the current market locally and internationally to determine what products exist on the market that could be either adopted directly or amended to suit our requirements. Speaking with jointing contractors and UK Power Networks Field Engineers, it is understood that no products as proposed exist anywhere in the UK.

ii) Development and Design

Design and development of a trial run of plastic shells will involve producing a casting model based on LV branch (T) joints which have been replaced. This will be done in conjunction with a molding company and our jointing partners.

The compatibility of the polyurethane resin (JEM Resin) with bitumen compound will be explored at this stage. It is proposed to contact existing resin/shell producers to gain an understanding of the limitations of the resin and carry out trials where required.

iii) Manufacture Trial Run

An initial trial run of five plastic shells will be developed to aid in the off-network testing (summarised in iv below) following which a further manufacture run of 100 are proposed to be rolled out into the on-network trial (summarised in v below).

The manufacture of the shells will be in conjunction with a UK Power Networks approved joint molding company. An initial scoping exercise has already been carried out which yielded two prototype shells.

The trial run of shells will be developed with reference to the UK Power Networks approved jointing manual utilising all approved 'off the shelf' components. The shell will be constructed of approved cross linked polyethylene plastic as is currently adopted with approved straight joint shells.

The shells are proposed to be filled with UK Power Networks' approved JEM Resin.

iv) Off Network Tests

The first run of shells will be utilised in off-network tests. The off-network trials are proposed to test and refine the design prior to a full 100 shell manufacture trial run.

The off network tests will involve fitting the shells to previously removed joints, installing moisture stops and filling the shells with resin. The shell will then be submersed in a water bath for a minimum of 24 hours. The joint will then be cut in three locations so that the quality of the bond between the resin and old shell can be examined. The shells water tightness will also be examined at this stage.

Key areas for the cuts will be:

- Through each of the plumbs to ensure the resin has migrated to the extremities of the shell
- Perpendicular to the cable crutch
- Parallel to the cable crutch

v) On Network Tests

The on network trial will involve installing approximately 80 shells on defective LV joints as identified during the Cable Pit inspection process. The exact number cannot be confirmed at this stage as each location has not yet been enabled to confirm that a shell can be fitted.

The joints will be installed under the supervision of an Approved Person (AP) in accordance with the UK Power Networks approved LV jointing manual.

vi) Monitor

The repairs will be logged on UK Power Networks' asset management system. Details will be added against the assets as the repairs are completed. It is also proposed to circulate a directive to all network engineers that the future replacement of any repaired joints will need to be communicated to the project team so that an assessment can be made on the cause of the fault and whether the repair was a contributing factor. It is proposed that a forensic examination of failed joints be carried out on all failed joints to determine the cause of the failure.

The on network monitoring will run for approximately 12 months to determine whether the repair measure exacerbates failure of the joints.

vii) Review

Review of the trial will rely on a qualitative analysis as a suitable control group cannot be assigned. Comparing the failure rates of non-defect T-Joints with defective ones would be an unrealistic comparison as would comparing defective joints against one another.

The outcome of the review will be to determine whether the proposed repair method is a suitable safe, efficient, cost effective repair system. The decision to develop the trial into a viable product to roll out to the greater network will be assessed at this stage.

viii) Product Development

Building on vii above, product development will involve liaison with the existing UK Power Networks incumbent shell supplier and developing an approved kit and installation procedure. It is likely that this stage will involve an additional round of design amendments to suit the production process.

Existing practice in the industry is that joint repair/installation jobs involve fully equipped kits which include everything required to carry out the job including water stops, earth straps etc. The outcome of this stage will be to develop a similar product for the repair of LV branch (T) -Joints.

Objective(s)

This project aims to develop a safe, cost effective alternative to removal and replacement of defective LV branch (T) joints, lowering the unit cost per repair and allowing for more repairs to be carried out under the same budgetary constraints.

The proposal aims to innovate an existing jointing technique which involves encapsulation of joints in resin filled plastic shells. Where traditionally this approach is only adopted on new joints, the project proposes to adapt this technique to repair existing, defective joints.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be deemed a success if:

- We can prove retro fitting existing LV branch (T)-Joint and encasing it in resin is a suitable repair option to avoid water ingress into the crutch of a damaged joint (see iv above in method)
- Field trials of the installed repair do not lead to any faults of the damaged joints
- A safe, effective, cost efficient repair kit can be developed and implemented across the network on to all future faulty –LV branch (T) Joints.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

Approximately 80 T-joint shells will be installed as part of the network trial and the learning from the project will be shared with other UK DNOs.

Technology Readiness at Start

TRL7 Inactive Commissioning

Technology Readiness at End

TRL9 Operations

Geographical Area

The network trial will be located in the London Power Networks region initially, but rolled out to other networks on successful completion.

Revenue Allowed for the RIIO Settlement

In the UK Power Networks business plan for ED1 there is already money set aside for the repairs of joints. This is not separately

defined, but included in category Emergency Asset Repair - LV service fault repairs Underground.

Indicative Total NIA Project Expenditure

£186,000 is the total expenditure which we expect will be incurred during the duration of the project.

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 the project is successful an estimated 118 faults will be repaired annually by this method resulting in an annual saving of £135,700.

Please provide a calculation of the expected benefits the Solution

Base Cost: £200,000

Based on conventional LV Joint Repair at 80 locations at a cost of £2,500 per joint.

Method Cost: £108,000

Cost of deploying the joint shell solution that is planned to be at a lower cost to current technique by £1,150. Therefore based on joint shell solution at 80 locations at a cost of £1,350 per joint.

Benefits: £92,000

The cost saving of deploying a lower cost technique to joint repair where it is £1,150 cheaper per joint.

Financial Benefits: £184,000

(Base Cost – (Method Cost – Benefits)

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

Based on the estimated number of faults repairable using the joint shell technique in SPN and EPN, there will be approximately 200 sites annually where this technique is employable across the other DNOs across GB.

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

This technique uses existing jointing skills meaning that roll-out costs should be minimal, requiring only familiarisation training and manual updates. Once the joint shell materials are commercially available, it is not envisaged that there will be any additional

significant costs to roll-out the method across other DNOs as it is believed it will be at a reduced cost to current techniques.

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 project will be applicable to all Low Voltage underground networks.

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.

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