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

Nov 2019

Project Reference Number

NIA_NGGT0158

Project Registration

Project Title

Combined CP and Pressure Remote Monitoring Phase II

Project Reference Number

NIA_NGGT0158

Project Licensee(s)

National Gas Transmission PLC

Project Start

November 2019

Project Duration

1 year and 5 months

Nominated Project Contact(s)

Peter Martin

Project Budget

£450,916.00

Summary

Remotely monitor CP and nitrogen levels.

Preceding Projects

NIA_NGGT0108 - Combined CP and P remote monitor

Third Party Collaborators

Des19ncor Limited

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Combined CP and Pressure remote monitor NIA Project (NGGT0108) phase 1 concluded in January 2019, with the development of Smart Pipeline Remote Terminal (SPIRET) units. It is recognised that within the RIIO T2 period that the 2g/3g wireless GSM data Networks are due to be switched off Nationally as telecommunications companies focus on 4g/5g roll out.

At this time existing CP and other remote integrity monitoring devices using 2g/3g technology will become obsolete and ineffective. Presently National Grid have in the region of 1600+ remote CP devices and 50+ pressure logging devices which are not compatible with 4g/5g communications protocol.

As part of the Phase 1 SPIRET development this need was recognised and the SPIRET remote monitoring unit was designed in such a manner as to allow it to be replaced as (Long term Evolution LTE) LTE/5G technologies emerge, thus building in an element of future

proofing. The unit has also been designed to be able to fulfil a number of functions which are currently discharged by individual bespoke remote monitoring devices in a single platform to simplify communications and software compatibility. The unit has also been designed so that it is fully compatible with the existing hardware plug connections at remote monitoring locations including test post facilities and transformer rectifier installations. This ensures minimal disruption when the 2g/3g network coverage is switched off.

The existing remote monitoring devices used on the Network has been incorporated within the Phase 1 design, so that batteries can be swapped by the operator using readily available rechargeable cells instead of specialised cells. The specialised cells require that the remote monitoring units are removed and returned to the manufacturer at considerable cost.

By enabling the batteries to be replaced in field and can be aligned with other activities where operatives are visiting or passing the installations locations as opposed to having to undertake a bespoke visit or visits.

The initial trial units were developed and underwent extensive laboratory testing to evaluate component durability and basic hardware/software configurations. The design options with respect to energy budgets and installation logistics were defined and the initial set of trial units (beta) were manufactured.

The SPIRET unit has the potential to be a viable solution for remote monitoring of CP performance. However, further work is required to verify the solution. This will be carried out by conducting live field test to ensure Cathodic Protection (CP) and pressure (P) is being monitored and the appropriate data is being received.

Method(s)

The project will be broken down into 8 work packages:
WP1 Required update to SPIRET software

- Introduce Blue tooth connectivity for local display
- Enable flexible logging for fast and slow sensor readings
- Develop GPS location data and enable local storage for test reporting
- Develop SPIRIT interface to create flexibility
- Introduce algorithms for alarms via email

WP2 Mobilisation Field Trial Project

- Secure additional software engineering resources and part time Project Management.
- Re-energise the data portal to be used for data transfer.
- Check connectivity still exists and restore / resolve if not.
- Risk analysis work.
- Restore cloud data services for des19ncor server connection.
- Identify and provision nitrogen connection test points.
- Secure Web-API interface software.
- Build outline project plans and governance

WP3 Initiation

- Provision and Integration testing of software.
- Provision and Integration testing of hardware.
- Provision and Integration testing of sensor hook up.
- Test the portal and data validation sub routines, conduct load test and data base background support.
- Define housing for CP & P interface, with Solar and Spiret unit.
- Turn on and test cloud and data connectivity services.
- Support NG pre surveys for trial sites.
- Define solar power aims.
- Secure and provision data contracts.
- Project management and governance plus progress updates.

WP4a Installation

- Create training support material for installation and server teams.
- One unit to be installed in a CP test post and TR installation (use one of the locations near to the trial sites) to prove that it is also compatible with any future swap out of the current units Hold training day for installation crew and server support.
- Onsite & telephone support.
- Software, server and connectivity support.

- Project management and governance.

WP4b Support and Monitoring

- Support trial systems.
- Maintain software, portal and data connections.
- Respond to issues encountered, debug, software upgrades, visits, telephone support.
- Project management and governance.
- Capture and initial analysis of results.

WP5 Project meetings and Govenance
WP6 Results and final report
WP7 Solar Panel, design, development build and test

- Solar option design
- Solar option development
- Solar option manufacture
- Solar option test

WP8 SPIRET Hook-up box, design development and pilot production batch.

- SPIRET Hook-up box design and specification work
- SPIRET Hook-up box development
- SPIRET Hook-up box manufacture (& materials)
- SPIRET Hook-up box test install

Change Control August 2020
Mott McDonald must be included within this project in order for them to carry out a revision to the design of Nitrogen Sleeve Cabinet (T/PM/G/19) paperwork , so it can be appraised and approved before the new SPIRET units can be fitted.

Scope

Nitrogen sleeves are used to provide additional protection to critical sections of pipework, for example road crossings, bridges and motorway junctions etc.

Sleeves are often located in remote locations and are often difficult to get to. There are circa 1200 sleeves on the National Transmission System (NTS). A nitrogen sleeve comprises a sealed and welded steel shell around the pipeline that is pressurised with nitrogen to provide an inert atmosphere against corrosion on the inside of the shell. Cathodic Protection (CP) is also applied to the sleeve to protect it against external corrosion.

The integrity of the nitrogen sleeve can degrade overtime through inadequate application of effective CP current to the carrier. Similarly, the integrity of the pipeline within carrier sleeve can be compromised as a result of leakage of nitrogen from the sleeve.

Failure to maintain an inert atmosphere within the sleeve will lead to internal corrosion of the carrier sleeve and external corrosion of the pipeline eventually culminating in a loss of containment at sensitive or high-risk locations. Where an inert atmosphere is not maintained within the sleeve effective application of CP current to its outer surface cannot protect the pipeline within the sleeve as it is electrically shielded and is not within a conductive electrolyte.

National Grid and accepted industry practice and policy is therefore to monitor the pressure of nitrogen and monitor the voltage of the CP to ensure the shell and pipeline are protected from corrosion.

Currently Cathodic Protection (CP) and pressure (P) are measured by separate sensor units that require separate installations, separate maintenance regimes, separate batteries or power supply connections and separate communication systems where they are remotely monitored.

Objective(s)

To complete a live field trial and prove the successful operational use of the SPIRET units.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

SPIRET beta units must operate and report back as per the software and without fault.

The units must operate and report back as per the software and without fault. It must be possible to change the settings with the web interface and the response to this should be as per the specification. The control and calibration on site must be within +/- 1% of the Full Scale Span (FFS) (where the FFS is 300p.s.i) of that measured on site. Units must remain operational throughout the trial, battery swap out and fuse replacements must be completed during calibration checks on 2 of the units to provide evidence that the system works and does not cause the monitor to fault or otherwise go out of specification. Accuracy of internal barometer and GPS position shall be compared with a NG portable control unit. The barometer will operate to within +/-1 KPA or 10 millibars and the GPS will be accurate to within 10 metres dependent on current resolution.

Project Partners and External Funding

Des19ncor Ltd
No external funding

Potential for New Learning

The integration of the pressure and CP voltage sensing into a single standalone unit for deployment at Nitrogen Sleeves. Also includes solar power to extend battery life, the introduction of 4G communications via modular communications circuits which are ready for 5G, so future proofing the device.

Scale of Project

Field based trial in a working environment.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Trial based work on the NTS.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£450,916

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)

Savings will be derived from a mix of capex, opex and one-off savings.

Firstly, a reduction in capital costs (capex) by being able to install one unit instead of two separate units at each Nitrogen Sleeve site assessed to require measurement of both CP and Pressure. Using existing products from the marketplace:

Capital cost (purchase and installation) of a standalone CP sensor unit is estimated as £2000
Capital cost (purchase and installation) of a standalone pressure sensor unit is estimated as £2050
Capital cost (purchase and installation) of £2500 per combined unit, the saving is £1550 per nitrogen sleeve.

Secondly, by a reduction in maintenance and asset management costs (opex) by having one unit instead of two to maintain, and by providing improved visibility of asset condition through remote condition monitoring removing the requirement for periodic site visits to record data and a high number of repeat visits for leak detection, trending and repair monitoring, also resulting in a reduction of CO2 emissions and reducing employees' exposure to risk.

Lifetime (10yr) opex cost for a standalone CP sensor unit is estimated as £1500
Lifetime (10yr) opex cost for a standalone pressure sensor unit is estimated as £1500
Lifetime (10yr) opex cost for a combined unit is estimated as £1500, the saving is £1500 per sleeve over 10yrs.

Thirdly, by a reduction of database data correlation costs for the whole population of nitrogen sleeves by integrating correlation into the solution through installation of shared remote reporting with implied shared ID. An additional data alignment project (including a KPI build) would be required to capture the data from separate remote monitoring sensors as a one-off opex cost of £125,000 to provide integrated reporting, and is therefore avoided by undertaking this project and roll out of the solution.

The cost of installation and operation for 10 years by the existing method is therefore:

CP capex + Pressure capex + CP opex + Pressure opex
£2000 + £2000 + £1500 + £1500 = £7050 per nitrogen sleeve

The cost of installation and operation for 10 years by the innovative method is therefore:

CP & Pressure capex + CP & Pressure opex
£2500 + £1500 = £4000 per nitrogen sleeve

The cost saving per sleeve is therefore £7050-£4000 = £3050 saving per sleeve

Assuming application to 310 of the 1249 nitrogen sleeves, the maximum saving for installation and 10 years of operation is estimated at 310 x 3050 + £125k one off saving (against existing alternative) - £30k national database go-live cost approx = £1M maximum saving against an existing method cost of £2.3M (310 x £7050 + £125k).

An additional £ 85k per annum of efficiency savings is achievable by remotely monitoring N2 sleeves rather than manually monitoring them.

The obsolescence of the existing remote monitoring only devices due to the phased removal of 2g and 3g. The SPIRET solution enables a direct plug and play replacement to be deployed in the field using the existing architecture and reducing the install costs further circa £1200 per unit

Please provide a calculation of the expected benefits the Solution

See above

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

Other Network Licensees have a significant number of nitrogen sleeves at which the solution would also be applicable.

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

A low maintenance combined CP and pressure remote monitoring solution for 310 nitrogen sleeves within a National Grid Gas Transmission roll-out is estimated to have capital and operational costs (10 years' operation) of 310 x (£2500 capex + £1500 opex) + £30k national database go-live cost = £1.2M total cost.

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

n/a

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

Development of a combined solution aims to lower manufacturing and maintenance costs, make installation and maintenance easier and improve the integrity and frequency of the data collected. The combined CP and P sensor also offers the opportunity to replace the old sensor units on purely CP monitored sites where these are coming to their end of life.

☑ 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.

There is no known and proven low maintenance combined CP and pressure remote monitoring for nitrogen sleeves currently on the market.

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

The innovation within the project is the integration of the pressure and CP voltage sensing into a single standalone unit for deployment at Nitrogen Sleeves and will use 4G communication via modular communications circuits which are ready for 5G. This has not been tried before as the current devices are not combined and only use 2G and 3G communication.

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 as business as usual as combined CP and P sensor unit for Nitrogen Sleeves remote monitoring has not been tested in the gas industry, therefore National Grid needs to conduct a trial to prove that the units are monitoring levels accurately.

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

The risks based around the combined unit are: Software development, coding and testing. Measurement and Data communication Processing (MP, DP) vs optimised low battery and solar consumption Algorithm development to assist and enhance the monitoring of pipeline voltages and pressure (built-in intelligence). Hardware design, ruggedness Reliable mechanical connection to different pipework. Accurate testing. By trialing this solution National Grid can make informed decision regarding the monitoring of CP.

This project has been approved by a senior member of staff

☑ Yes