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

Oct 2015

Project Reference Number

NIA_NGN_076

Project Registration

Project Title

Gas Infrastructure Serviceability Performance Assessment

Project Reference Number

NIA_NGN_076

Project Licensee(s)

Northern Gas Networks

Project Start

October 2015

Project Duration

0 years and 11 months

Nominated Project Contact(s)

Dale Carter - DCarter@northerngas.co.uk

Project Budget

£68,731.00

Summary

- Infrastructure Data Cleansing

Cleansing and rationalisation of pipe and failure datasets

Sorting by material and diameter (rationalisation), attributing failures to pipes. Sense-checking.

- Environmental Data preparation

The following environmental datasets will be sourced and prepared.

Soils, Hydrology, Ground movement potential models (clay, sand, silt, peat), Soil corrosivity, etc

Weather - MORECS – Soil Moisture Deficit, Temperature, Rainfall, Days Air Frost. These raw data will be used, as well as some new, derived values (accumulated temperature below x degrees, delta SMD etc) which we will create:

- Intersection of pipes and failures datasets with spatio-temporal environmental data, (above)
- Modelling of number of pipe failures.
- Development of reporting graphs, maps and tables. In consultation with NGN develop a suite of reporting outputs inform decision making.

In brief, our modelling strategy is likely to involve fitting generalised linear models (specifically, Poisson regression) to the number of bursts for each week in each pipe-material-diameter-soil combination in each MORECS square. The length of pipework within that class will be used as an offset in the model, which can therefore be thought of as a model for the average *rate* of bursts in a unit length of pipe. We will divide possible explanatory factors and conditions (for example: shrink-swell potential, temperature, SMD) into groups, within which we will seek the best possible member of that group. For instance, when considering accumulated temperature below a certain threshold over a given preceding number of days, we will compare models that include a number of different thresholds, and

number of different antecedent periods. Assuming a global optimum is

- desired, we will consider all possible combinations of explanatory variables from each group. Model choice will be made on the basis of Akaike's Information Criterion (AIC).

This should provide NGN with a set of predicted and observed number of leaks / bursts per month from which we can test the suitability of the models to possibly identify more local areas which need pipe replacement prioritisation. (This prioritisation itself would lie outside the scope of this project.)

Third Party Collaborators

Cranfield University

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

NGN's current pipe selection processes are predominately retrospective looking at historical failure events to drive future pipe replacement. This project will try to predict future pipe failures based on weather, soil & temperature forecasts allowing NGN to select pipes for replacement in advance of failure.

Buried infrastructure is susceptible to changes in the environment. Both the soil and the weather contribute to the expected rate of failure of pipes of different materials and diameters. NGN would like to better understand how the changing environment affects the number of leaking pipes in their infrastructure. Furthermore, NGN would like to be able to identify which pipe should be prioritised for replacement.

Method(s)

Working with Cranfield University, the project will have 3 stages (the project can be stopped at the end of any stage should results prove inconclusive):

Initial Investigation:

Initial investigation on NGN data in light of the environmental parameters to build confidence that this investigation has a high chance of success.

Work Package 1 – Exploratory data analysis

This stage will explore the key relationships between the data and the rate of pipe failure per km in different soil types or under different environmental conditions.

Work Package 2 - Modelling and reporting:

These model should give a set of predicted and observed numbers of leaks per period.

Scope

- Infrastructure Data Cleansing

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Objective(s)

By the end of this project we hope to have proven models that, by the addition of weather / temperature variables, give robust data to better inform NGN's iron pipe replacement programme.

The models will be for different pipe materials and diameters, which predict the number of leaks / failures that should be expected each month, based on the soil in which they are buried and the observed weather

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- Identified what soil attributes affect the rate of pipe failure
- Identified what climatic attributes affect the rate of pipe failure
- Identified what infrastructure attributes affect the rate of pipe failure
- Modelled the rate of failure (with good predictive success)

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The proof of concept is to be done within NGN geographical area using historical data initially and the future data. All data sets on temperature & rainfall to facilitate this study will be provided by the Met Office.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

NGN Network

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Total External: £51,600

Total Internal: £17,131

Total Project Costs: £68,731

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 creation of a consistent model for predicting potential future pipe failures will be used as another "tool" in the pipe selection process. There is the potential that this model will help NGN continue to reduce, and at a faster rate, its numbers of pipe failures with an associated impact on operating costs.

Please provide a calculation of the expected benefits the Solution

N/A

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

The project hopes to prove that there is a correlation between the environmental & physical constraints on the pipe to the rate of failure. NGN believe this is fully replicable across all GDN's and will share the results of our development with them.

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

The report will be specific to NGN geographical location. The costs to roll out across the other GDN's will be in line with those incurred by NGN under this development project. Circa £50k per GDN.

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

☐ 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

Should the project prove to be successful, all GDN;'s could adopt the methodology.

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