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 2016

Project Reference Number

NIA_NGGT0103

Project Registration

Project Title

Artificial Intelligence for Pipe Coating Inspection

Project Reference Number

NIA_NGGT0103

Project Licensee(s)

National Gas Transmission PLC

Project Start

November 2016

Project Duration

2 years and 5 months

Nominated Project Contact(s)

Richard Waine Specification and Standards Manager,
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Project Budget

£223,000.00

Summary

During the process of conducting a CM/4 inspection, technicians are required to undertake high volumes of visual inspections across the various asset types. Although comprehensive training and guidance is provided, the subjective nature of visual inspections inherently results in inconsistencies. When amplified across a high volume asset base these inconsistencies can impact the overarching view of asset health and planned investment to enable remediation works.

Third Party Collaborators

Premtech Ltd

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Across the National Transmission System (NTS) there are approximately 450 sites, which must have the condition of plant coatings, painting and cladding inspected and assessed. Coatings systems provide the primary method of protection against corrosion on above ground assets. Inspection of coatings systems is required to ensure National Grid has visibility of asset condition and to ensure the risk associated with loss of containment is managed to a minimum.

Inspections are currently carried out by technicians across the network this results in inconsistent categorization which leads to variable visibility of asset health condition. Inspections are carried out by qualified technicians at a frequency of anything between 1 month and 6 years depending upon the amount of risk associated with the coating system degradation and associated asset.

As key information that supports investment decisions across the coating systems used on the NTS, there is an opportunity to improve the data collection, condition categorization accuracy, maintenance strategies and subsequent investment efficiency through application of artificial intelligence.

Method(s)

Tractable holds patented machine learning technology that can be used to conduct visual inspections. The technology is applied in the automotive industry to assess insurance claims and predict optimal repair work. Visual inspection is common across the Gas Industry and within Gas Transmission one key process is specified in ' The Specification for The Assessment and Reporting of Plant Coatings, Painting & Cladding Inspections for National Transmission System Assets' (T/SP/CM/4). This project will assess the feasibility of the application of Artificial Intelligence technology to the process defined in CM/4 and will be divided into three phases:

Phase 1 - Equipment Type Classification:

The current method of CM/4 inspection results in the collection of a high volume of digital photographs (approx. 30,000). This library will be used to train the algorithm to identify the seven different types of asset assessed by CM/4:

1. General Paintwork and ancillary equipment
2. Risers
3. Flanges
4. Pipe Supports
5. Pit Wall transitions
6. Cladding/insulation
7. Ball Valve Sealant, body vent and drain lines

The deliverable for this stage is the ability of the algorithm to categorize assets into the 7 sections detailed above to an 80% accuracy level. It should be noted that algorithm performance improves as the quantity of data provided increased and the learning increases.

Phase 2 – Corrosion Level Categorization:

The CM/4 process categorizes each of the seven asset types by risk associated to integrity. The algorithm will be provided with photographs and training from trained technicians and engineers to support enable it to categorize assets.

The deliverable for phase two is the ability for the algorithm to carry out categorization of corrosion levels to an accuracy of 80%.

Phase 3 – App Development, Field Testing and NG Acceptance:

The focus of this phase is the transition of the algorithm from use in a development environment to a point of readiness for deployment to business as usual.

This phase will deliver and App for use in iOS that provides an interface for users in the field to take photos, organize photos, conduct assessments and develop a report which is provided to engineers in an e-mail format.

The current scope and funding will be evaluated at the end of phase 2 in order to assess whether the phase 3 scope, as currently scoped out, is appropriately scaled for field testing and business acceptance. The level of risk and uncertainty in developing the technique means it is possible additional time and funding will be required to achieve successful completion of phase 3.

Sept 17: Change Control

During the course of the project it was found that many of the existing CM/4 inspection photographs (approximately 30,000) could not be used for training as they did not meet the necessary AI photographic specifications. Photographs of approximately 15,000 defects are now required to train the algorithm to categorise corrosion levels to a desired accuracy level of 80%. A photograph collection and categorisation exercise will ensure the photographs meet AI specifications and will enable the algorithm to successfully determine corrosion levels.

June 2018: Change Control

The photograph collection exercise experienced delays due to issues accessing sites; all agreed sites have now been photographed. The delay has impacted the timeline of the remaining project activities; categorization of the photographs by subject matter experts and development of the online interface.

Scope

During the process of conducting a CM/4 inspection, technicians are required to undertake high volumes of visual inspections across the various asset types. Although comprehensive training and guidance is provided, the subjective nature of visual inspections inherently results in inconsistencies. When amplified across a high volume asset base these inconsistencies can impact the overarching view of asset health and planned investment to enable remediation works.

Objective(s)

Improve quality and consistency of asset condition assessment data associated with the CM/4 process, enabling improved asset maintenance choices and investment decision making.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria is based on the successful completion of the three deliverables detailed above: equipment classification, corrosion level classification and field testing to the business accepted standard.

Project Partners and External Funding

Project Partners – **Tractable and Premtech**

External Funding – **(nil)**

Potential for New Learning

In addition, this project will enable an increase in knowledge of the interaction between the business and artificial intelligence algorithm development. The application of the this technology to visual tasks, if successfully, is applicable to a number of processes across the Gas Transmission business.

Scale of Project

Phase 1 & 2 of this project will be desk based. Phase 3 will work to deliver the technology to the field environment.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

On NGGT and Tractable premises including across a number of NGGT operational sites

Revenue Allowed for the RIIO Settlement

Nil

Indicative Total NIA Project Expenditure

£223,000

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)

As a conservative estimate, reducing expenditure by 10% on above ground coating maintenance activities would result savings over £1m RIIO T1 and RII T2 periods.

Please provide a calculation of the expected benefits the Solution

Current activities on CM/4 have been relatively conservative over recent years, with associated spend on above ground coatings in the region of £1m per year. However a new process introduced in Q1 of 2016 will lead to significantly increased effort in this area. There are a number of pertinent areas where savings could be realised between the current process and the comparative solution under a machine learning scenario. The key areas of cost impact are:

Operative competence level - This currently requires an operative to have detailed understanding of site and completion of a suite of training packages. Application of Tractable presents the opportunity to reduce this to ½ day course to use the application.

Work Execution – Operatives are currently required to conduct a full site survey including detailed notes, access (e.g. scaffolding) and photos and report writing. Application of Tractable will facilitate the use of drones, remote access, Geotagged data, automated report production and evaluation

Audit – This is currently based on feedback to the individual, checking of local reports and possible retraining/mentoring. Tractable will enable feedback to the centralised algorithm having a global and immediate impact.

Accuracy – Reporting is subject to variability by individual interpretation. Tractable introduces the opportunity to minimise variability across the 7 assets assessed.

Policy updates – Implementation of the 2016 policy update, including workshops, material, training etc. is approximately 500 man days. With Tractable this is currently unknown but there is potentially the opportunity to achieve a significant reduction.

Scaleability – The approach used with CM/4 is common across other inspection activities and visual evaluation techniques. If proven this technology could be scaled across these activities driving similar benefits across these asset types.

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

The method will be replicable across businesses applying the CM/4 process. The 7 asset categories included in the project are applicable across all GB networks.

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

Costs will be focused on the differences of corrosion categorization across different network operators and construction of user interfaces and long term back office arrangements to suit. These will be further understood in stage two of the project.

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 demonstrate how corrosion assessment across the 7 categories can be improved upon in terms on accuracy and consistency.This learning will be useful to any pipeline operator with corrosion assessment policies.

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.

Initial investigation has shown that this technique has not been carried out in the UK Gas industry.

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