NIA Project Registration and PEA Document

Date of Submission

Nov 2019

Project Reference Number

NIA_NGTO041

Project Registration

Project Title

Big Data Analytics for Cable Systems

Project Reference Number

NIA_NGTO041

Project Licensee(s)

National Grid Electricity Transmission

Project Start

December 2019

Project Duration

1 year and 8 months

Nominated Project Contact(s)

Oliver Cwikowski

Project Budget

£405,000.00

Summary

One of a Network owner's main priorities is maintaining its assets in a cost-effective way. National Grid Electricity Transmission own and maintain over 1,400km of underground cables, which reflects roughly 15% of its transmission system.

This project will investigate whether any relationships exist between asset condition and a range of operational and environmental data sets; proving insight into factors which can influence our condition assessments. This knowledge will allow NGET to quantify and mitigate the risk posed by different design, operational and environmental factors, with the aim of improving our management of cable systems.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

One of the major challenges facing underground transmission is how to collect condition data. Many of the existing tools and techniques for condition assessment can provide a good assessment, however, they are limited and require direct interactions with the assets. This can lead to data not being collected as frequently as may be required to deliver value.

There is an opportunity to extend the life of cable systems or optimise intervention plans, if we can understand their condition in more detail and the factors which contribute to changes in condition. Finding ways to estimate cable condition, based on existing data sets could provide significant value, as this could allow for high fidelity conditions assessments to be made at a limited additional cost.

Method(s)

This project will make use of multiple sources of data that may correlate to underground cable asset condition data. Best-practice approaches to data analytics will be applied to filter and pre-process all sources of data. Once the data has been cleaned and organised, an exploratory data analysis will be performed to identify data sources that could be indicators of asset condition. Finally, the most promising combination of data sources will be identified and discussed, with clear recommendations for further work after

this initial study is complete.

This project will investigate the following data sources:

1.   Historical loading of cable circuits (Voltage and current)
2.   Alarm data
3.   Dissolved Gas Analysis (DGA)
4.   Defect Data
5.   Work order data
6.   Weather data
7.   Local soil data

By considering a wide range of different input data sources during this feasibility-level study, the project will ensure that future, more detailed, studies are cost-effective by narrowing the scope and reducing data volume overheads.

Scope

This project will cover the following four work packages.

WP1.   Data collection and generation

Data will be collected from multiple sources from across our business and from external parties to support the main body of work. Data will also be generated where required from weather models or purchased from external suppliers.

WP2.   Data 'scrubbing'/pre-processing

The data collected during WP1 will need to be processed and cleaned to different extents in preparation for any analysis or modelling. A 'scrubbing' phase will include:

·   Removal of any anomalous data from consideration

·   Clarification where necessary

·   Data processed into a standard format and central database ready for further analyses

WP3.   Data analysis

During the exploratory data analysis phase correlations or patterns will be assessed between data sources. The project will attempt to identify utilisation factors which correlate his historic changes in our condition assessment of cable systems; providing new tools to asset manager. This could lead to the conclusion that additional data may be required, or whether any data source needs further clarification.

WP4.   Historic Temperature Profile Estimation

In this work package, the project will attempt to create historic temperature profiles for each cable circuit in the country. This will use the existing load data, historic weather data and a suitably parametrised thermal model for a cable circuit. These temperature profiles will then be combined with existing research on how cables degrade with temperature and method for estimations of remaining life will be made.

This work package will also involve the design of a suitable thermal model for this type of analysis, as there are multiple factors which need to be considered for this type of analysis.

WP5.   Identification of key variables/combinations of variables

Key variables identified in WP3 will be further assessed in combination with other variables, with the aim of concluding which data sources are good indicators of the condition of underground cables. A report summarising the findings from all four work packages, with recommendations for further work, and highlighting the lessons learned during the project.

Objective(s)

To identify key data sources (or combinations of sources) that may be used to estimate underground cable asset condition, which can be used to support our condition assessments.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be considered successful if:

1. New utilization factors for condition assessment can be identified
2. Historic temperature profiles are generated and an estimation of remaining life can be made
3. Links can be found between condition score and either environmental data or operational data

Project Partners and External Funding

No external funding

Potential for New Learning

Successful completion should result in:

·   Improved understanding of key environmental and operational data sources that can influence the condition of underground cable assets

This learning will benefit any network licencees with underground cable assets.

Scale of Project

Data will be analysed for over 1,400 km of underground cables within NGET's transmission network. These assets are geographically diverse, and will cover a broad range of environmental conditions across England and Wales. This scale is required to take into account the differences between cable systems.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This project will be a desktop exercise

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£405,000

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)

If a new method of assessing cable condition can be found through our existing data sets, this could support our asset management for all our cable assets. This could enable life extensions or prevent early failures of cable systems

Please provide a calculation of the expected benefits the Solution

Assuming that we can life extend of a cable system which would delay the need for an investment of £30m for a suitable replacement, this would save the consumer approximately £1.5m per year; Assuming that the cost of capital is 5%.

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

The methodology for linking asset conditions with environmental data will be applicable to the same or greater extent across all Network Licensees with underground cable assets.

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

The cost of rolling out the outcomes of this project will likely be £50,000 per licensee. These costs would cover the required updates to assessment management policy.

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

The project will provide recommendations, applicable to all utilities operating underground cables, for how different factors can influence cable condition. This could come in the form of policy changes or modification to asset condition classification rules.

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

This project fits within the value area of the Electricity Innovation Strategy:
Managing Assets - Managing assets throughout their lifecycle

☑ 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.

A review of existing NIA-funded projects has highlighted the following in relation to asset management of underground cables:

· NIA_NGET0103: Modelling the tape corrosion process for oil-filled underground cables

· NIA_NGTO027: SMART GEO GRID

· NIA_UKPN0013: Underground HV Cable Research
The projects above consider specific aspects of asset health of underground cables in fine detail (e.g. soil condition, or tape corrosion). The project described in this document will consider a wide range of data sources, and combinations of these, as opposed to single aspects in isolation. The results will be useful for future detailed studies in this area.

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

This project is unique because it is seeking to leverage existing data sets to provide insight into the condition of our cable systems; rather than trying to develop a novel technology or interpreted new readings in a different manner. This project has not been attempted previously due to the lack of data availability

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 outcome of this project may be that further research is required to unlock value, or that no link between the large data sets can be found. This creates significant uncertainty around how and when the benefits of this Innovation project will be realised. The NIA funding allows this type of Innovation to be attempted by the business.

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 project can only be funded through the NIA as there are significant risks which warrant further investigation and development of this research area, prior to its use within the business. The main risks are: • No proven business case – While a value case has been defined for this project, it is contingent on obtaining an as yet unknown level of technical knowledge. No matter what the outcomes of this project are, these will be valuable to utilities managing their assets; even if this demonstrates that certain avenues are not worth exploring further. However, these benefits are not sufficient for the business to justify this project's budget. • Uncertainty of outcome – The links between the large datasets could provide significant value to the business. However, these links may not exist and the exact amount of valuable information that can be drawn from these data sets is not yet known. This creates significant technical uncertainty around what could be achieved at the end of this project. Without the NIA funding these risks would never be mitigated, and the business would justifiably not research this area; resulting in the potential benefits never being obtained or investigated. If this Innovation is successful, the information will also be very valuable to other licensees; using the NIA funding ensures that the outcomes of this project can be shared widely.

This project has been approved by a senior member of staff

☑ Yes