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

Jan 2022

Project Reference Number

NIA2_NGET0011

Project Registration

Project Title

Alternative Approaches to Tower Painting Preparation

Project Reference Number

NIA2_NGET0011

Project Licensee(s)

National Grid Electricity Transmission

Project Start

February 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Anusha Arva (Box.NG.ETInnovation@nationalgrid.com)

Project Budget

£238,880.00

Summary

Corrosion causes material loss from steelwork on lattice OHL towers, which can be minimised through the application of an optimal painting regime. Approximately 1,200 towers are repainted every year on NGET's network of OHLs. Current NGET policy dictates that high pressure water jetting may only be employed up to a height level with the bend line of a tower (i.e. a height beneath the lowest phase conductors). Above the bend line, preparation requires wire brushing and anti-fungal treatment (where required) due to concerns about the use of high pressure water jetting in proximity to live conductors. This project investigates the viability of adopting alternative approaches for surface preparation of steel lattice towers prior to painting, specifically: High pressure water jetting and Dry ice (CO_2) cleaning.

Nominated Contact Email Address(es)

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Problem Being Solved

National Grid Electricity Transmission (NGET) maintain around 22,000 steel lattice towers as part of the overhead line (OHL) network. Out of these, approximately 1200 towers need to be repainted every year to prevent material loss through corrosion. The current practice of tower preparation (and painting) is typically executed whilst live conductors are present on one side of the tower. NGET are interested in improving the performance of current tower painting preparation practices, particularly with regards to the health, safety and environmental considerations associated with wire brushing and anti-fungal treatments currently employed in tower preparation.

Anti-fungal treatments are harmful and present an irritant risk to working parties. Wire brushing has the potential to cause harm due to the creation of airborne fibres. It is expected that alternative approaches may reduce the time and/or cost as the current approach is perceived to be labour-intensive.

Method(s)

NGET are commissioning a study to investigate the viability of two alternative approaches to preparation of OHL towers for painting. To employ an alternative practice, NGET must be satisfied that there is no risk to working parties of flashover from live conductors and thus the work can be carried out safely. Towards this, the alternate methods would be tested extensively using samples from the network, under HV laboratory conditions.

This project will benefit NGET and our stakeholders by committing to deliver a better preparation standard to its towers, using faster and more sustainable methods. It is estimated that if the new practice is proven to be viable, it could be employed on 80-90% of towers on the network (access issues may prevent adoption on 100% of the network).

Data Quality Statement (DQS):

- The project will be delivered under the NIA framework in line with OFGEM, ENA and NGGT / NGET internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal sharepoint platform ensuring access control, backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

- The methodology used in this project will be subject to our supplier's own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with the ENA's ENIP document, the risk rating is scored Low.

TRL Steps = 1 (1 TRL step)

Cost = 1 (~ £290k)

Suppliers = 1 (2 suppliers)

Data Assumption = 1 (data supplied by suppliers for analysis)

Scope

The study will cover:

1. Review of literature and standards to summarise all available evidence about the behaviour of HV electricity in vicinity to water spray/dry ice.

2. Development of a working hypothesis on the level of risk that can be expected using water spray/dry ice in comparison to atmospheric conditions.

3. Agreement of a test arrangement to be deployed within the laboratory.

4. Assessment of the effectiveness of the following methods for surface preparation prior to painting:

- High Pressure Water Jetting
- Dry-ice cleaning
- Wire brushing

5. An initial assessment of the likely carbon footprint of the above activities.

6. Evaluation of the technical/commercial/environmental impact of the differing approaches.

Subject to the availability of samples provided by NGET, it is proposed that the above assessment is carried out for the following:

- Algae removal
- Preparation of grade 1-3 steelwork
- Preparation of grade 4 steelwork (required for dry ice cleaning only)

For high pressure water jetting:

1. For a given configuration of free-issued water jetting equipment, establish the limits and conditions for which a flashover occurs, when considering the associated switching transients/impulses voltages for the following HVAC electricity transmission systems:

- 400kV
- 275kV
- 132kV

2. Determine the impact (if any) of varying atmospheric conditions on the required electrical safety clearance, including varying intensities of precipitation. Lightning events do not need to be considered.

3. Provide recommendations on alterations to the configuration/specification of the free-issued equipment to reduce the required electrical safety clearance.

For dry ice cleaning:

1. Determine the parameters for effective surface preparation; including pellet size, blast pressure and rate, nozzle type, configuration, etc. It is assumed this will be established as part of the deliverable above.

For high pressure water jetting and dry ice cleaning:

1. Feasibility study covering:

- Application of the process in an operational environment
- Sourcing of sufficient quantities of CO2 to allow adoption for NGET assets

2. Assessment of the implications of implementing the use of high-pressure water jetting and dry ice cleaning as operational practices.

Objective(s)

The objectives of this project are to:

- Assess the viability of high pressure water jetting or dry ice cleaning as viable alternatives for the preparation of entire tower structures.
- Establish optimal ranges of variables in these methods (conditions related to flashovers in water jetting method and pellet size, blast pressure, rate, nozzle type etc. in dry ice cleaning) for use in operational environments.
- If found feasible, establish procedures conforming to NGET safety standards, carbon impact and techno commercial aspects relating to these alternate methods.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The project is expected to provide energy networks with alternate methods of tower painting preparation. These methods can be adopted by any network licensee operating steel lattice towers. If the methods are proven viable and eventually adopted into Business As Usual (BAU), it is expected to reduce the unit cost for the tower painting preparation activity carried out annually on approximately 1200 towers, resulting in benefits to consumers. The alternate approaches are also expected to be more sustainable, providing health and safety benefits to line workers and environmental benefits to all consumers, due to reduction in use of harmful chemicals (used in Algae wash) as well as air borne fibres created during abrasive methods such as wire brushing. These financial and environmental benefits will apply to all consumers and are not restricted by any sort of consumer vulnerability relating to, but not limited to: Dwelling and location (potentially including tenure), Readiness for digital technology or Personal and social factors (for example, households with disabilities and medical conditions, or which speak English as a foreign language).

Success Criteria

The project will be considered successful if the following criteria are achieved:

- Hypotheses and test arrangements are designed successfully to validate the effectiveness of the two alternate methods: high pressure water jetting and dry ice cleaning.
- The two alternate methods are found to be suitable for use on the entire tower structure, particularly above the bend line of the tower.
- Risks of application of the two methods in operational environment are reduced through the development of optimal ranges for variables involved.
- Techno-commercial assessment of the methods is carried out, covering all potential areas of concerns for future deployments.

Project Partners and External Funding

Not applicable as this work will be carried out by NGET.

Potential for New Learning

The study will help NGET and other GB network licensees understand the opportunities and implications of using alternative approaches for OHL tower preparation. New learning will stem from the literature survey on alternate tower preparation methods and the tests conducted on the use of these methods in HV lab conditions. This study will also throw light on challenges related to use of alternate methods in operational conditions, particularly for sections above the bend line of a tower. Comparison of alternate methods against current practice, particularly around effectiveness, optimal cleaning conditions, conformity to safety standards, and carbon footprint will be useful information for network licensees operating OHL steel lattice towers.

Scale of Project

For an alternative practice to be adopted, the study must conclusively prove that there is no risk to working parties from flashover, therefore the study must be comprehensive and robust in its approach. Hence, this project will involve literature review on use of water/dry ice in the close vicinity of HV assets, detailed tests on use of alternate methods on steelwork samples in HV laboratory conditions, techno-economic analysis including worker and environmental health & safety aspects.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project will carry out testing in a lab environment within the UK. The tower samples will be collected from NGET network.

Revenue Allowed for the RIIO Settlement

Not Applicable

Indicative Total NIA Project Expenditure

£214,992

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:

The aim of the project is to test and assess the feasibility of alternate methods that in future may be used to prepare OHL tower steelwork surfaces for painting, as part of maintenance regimes. These methods have the potential to be more effective, more sustainable, and safer for workers. Implementing such methods into practice aligns with energy system transition through the reduction of carbon footprint of our practices as well as improved health and safety conditions for workers.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable

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)

Not applicable

Please provide a calculation of the expected benefits the Solution

The baseline method considers the costs incurred on two major routes, as furnished by a supplier on tower painting framework. These costs are representative of costs charged by 3 suppliers on the tower painting framework. As per annual targets, 1200 towers need to re-painted every year, out of which 90% of towers are cleaned using algae wash for the whole body. For 10% of annual volume, water jetting is being used below the bend line of the tower (that is, tower bases) and algae wash for above the bend line.

As observed on the two representative routes, water jetting for the whole tower body can be implemented on 63% of towers, while the remaining towers would have access constraints required to facilitate the alternate methods. It is assumed that innovation method cost will be the same as BAU cost during 2021/22 and 2022/23 during which innovation project will be carried out. During the rest of RIIO-2 period, innovation method, if found successful, would replace the BAU method. It is assumed that cost of innovation method will reduce to 75% of the initial value due to widespread use of innovative approaches in BAU.

Considering the above, the innovation method has a benefit of approx. £254,000 to NGET and in turn, to UK consumers. Additionally, there are benefits from improvement in health and safety for workers and use of more environment friendly materials, which are not quantified at this stage.

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

It is estimated that if operative safety is successfully proven, the new working practice could be employed on 80-90% of the NGET network of around 22,000 towers. The findings have the potential to benefit all GB network licensees (at both Transmission and Distribution level) that own and operate steel lattice towers.

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

Costs of rolling out the alternate approaches will be assessed as part of the techno-economic assessment to be undertaken in this

project. At the onset, we anticipate these to be initial training costs and modified equipment costs to the contractor (expected to be minimal).

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

All network licensees that maintain steel lattice structures face similar challenges around development of sustainable and cost effective maintenance practices. Learnings generated in this project regarding effectiveness, optimal cleaning conditions, conformity to safety standards, and carbon footprint of alternate methods will be help utilities gain insight on feasibility of the methods and support their plans to adopt the sustainable as well as safe practices into their tower painting regime.

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

Not applicable

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.

The adoption of alternative preparation methods above the bend line of OHL towers has not yet been investigated / employed in the UK.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

Not applicable

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

The project will aim to provide a viable alternative to wire brushing and anti-fungal treatments. The study is a UK first at the scale and scope to which it has been commissioned. It aims to innovate towards cost effective and sustainable OHL tower preparation methods.

Relevant Foreground IPR

The foreground IPR will be reports detailing the HV laboratory testing carried out, health and safety as well as techno-economic assessments of alternate tower preparation methods and any learning that may be relevant to the future trials or use of alternate methods on the network.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. National Grid already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrid.com/uk/electricity-transmission/innovation
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Due to the speculative nature of the study and no guarantee of a successful outcome, it cannot be funded as part of business as usual.

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

Current NGET policy does not permit the use of water or dry ice pellets as cleaning media for surface preparation, particularly, above the bend line of an OHL tower. As a result, high pressure water jetting or dry ice cleaning have not yet been developed for use on the entirety of an OHL tower body. There are several unknowns relating to these methods, for example, efficiency of surface cleaning, optimal parameters to use such as configuration of equipment, nozzle pressure, pellet size etc., safety precautions and guidance for workers. Additionally, since surface preparation for OHL tower painting is carried out whilst live conductors are present on one side of the tower, there is a risk of flashovers and other unforeseen consequences, which is yet to be validated. Owing to the abovementioned unknowns and risks, these methods need to be investigated and de-risked for use in operational environments through NIA funded innovation.

This project has been approved by a senior member of staff

☑ Yes