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

Sep 2020

Project Reference

NIA_UKPN0064

Project Registration

Project Title

3D Printing of Network Assets

Project Reference

NIA_UKPN0064

Project Licensee(s)

UK Power Networks

Project Start

September 2020

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Kelvin Lee & Martin Payne

Project Budget

£307,000.00

Summary

UK Power Networks are putting together an electricity pole replacement programme to replace an increased number of electricity poles going forwards into RIIO-ED2.

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Problem Being Solved

UK Power Networks are putting together an electricity pole replacement programme to replace an increased number of electricity poles going forwards into RIIO-ED2. Existing electicity poles are solid wood poles, and there is a concern that the existing supply chain of wood poles cannot meet the current forecast of the number of poles required. The lead time for provision of a wood pole from source (i.e. felling a tree) through to installation is nearly two years, largely due to the impregnation time required for the creosote preservative. Secondly, the creosote preservative itself may be banned due to its toxicity, further exercerbating supply chain issues, which necessitates the search for alternative electricity poles.

Method(s)

The project will apply the following method in order to determine a suitable 3D printed design for an electricity pole, that will help meet

the demand for UK Power Networks' electricity pole replacement programme.

1. To carry out a workshop with the stakeholders to understand all the requirements of an electricity pole.

2. To review and understand the work that has currently been undertaken by other distribution network operators (DNOs) and research centres in this field. Establishing the potential of using additive manufacturing for producing overhead lines (OHL) supports and exploring the material options.

3. To create a Pugh matrix for the top five viable solutions and downselect the best solution.

4. To create a CAD design based on the downselected process.

5. To carry out initial build trials of small samples (the samples to be generated will be in the order of tens of centimetres) to assess the buildability of the chosen material and generate test samples.

6. To define a test plan and execution to assess whether the printed material meets the requirements (This will including basic mechanical testing on the material, including subjecting small samples to tensile, bend and compression tests).

Scope

The project consists of six stages, which will output the following deliverables:

Stage 1 - Requirements capture.
Stage 2 - Literature/Market review on current solutions.
Stage 3 - Review of potential materials and processes and downselection.
Stage 4 - Concept Design.
Stage 5 - Build trials.
Stage 6 - Test outputs.

Objective(s)

The key objectives will be to identify a suitable set of materials and manufacturing processes which can meet the standards and specifications for an electricity pole. This will then be assessed against the forecast future 'whole life' cost to understand whether there is a business case for further investment into another phase of the project. It should be noted that the stages are linear, and can be halted should it be determined that the business case is no longer viable.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Success will be a report that describes the following:
1. A 3D printed pole design in terms of its costs of industrialisation and production.
2. A 3D printed pole design that meets or exceeds present wood pole requirements for LV, HV and EHV lines.

Project Partners and External Funding

Manufacturing Technology Centre (MTC)

Potential for New Learning

Parties will learn about 3D printed designs of electricity poles that meet mechanical property requirements, and understanding the costs of manufacture of the identified designs.

Scale of Project

This project is of a fairly small scale, given that its remit is to come up with a successful design for a 3D printed pole, and test a small scale version of it. A smaller scale project may be one that is a desk based study with computer simulated structural tests. This approach would not yield the same level of confidence in both the economic and mechanical properties of the design.

Technology Readiness at Start

Technology Readiness at End

TRL3 Proof of Concept	TRL6 Large Scale

Geographical Area

This project will take place at an MTC site, with the eventual electricity pole products to be deployed to EPN and SPN.

Revenue Allowed for the RIIO Settlement

No expenditure on finding alternative electricity poles was included during the submissions of the RIIO-ED1 business plan submission.

Indicative Total NIA Project Expenditure

The total expenditure that UK Power Networks expects to incur for this project is £307,000, of which 90% will be recovered from NIA.

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)

In the specifications efined in the 'Engineered Pole Products' project NIA_UKPN0039, the pole products are expected to cost about £2200 per pole. This project seeks to produce poles which will cost on the order of than £2000, saving about £200 per pole. With an annual installation volume of 6000 poles, UK Power Networks expects to save on the order of £1.2m. It will follow on after the solution is industrialised, further tested, certified, and made ready for deployment.

Please provide a calculation of the expected benefits the Solution

This is a research project, as no scale model will be produced or used at the project level for the network.

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

After the solution is industrialised, further tested, certified, and made ready for deployment, this could be rolled out to 13 out of 14 license areas (LPN is excluded as it has negligible overhead lines).

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

Given that the cost of roll out across UK Power Networks' two license areas per year would be £8.8mn, an extrapolation based on the 13 license areas in GB with significant overhead line coverage would indicate a roll out cost of £57.2mn.

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)

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.

There is an existing project titled 'Engineered Pole Products' NIA_UKPN0039, that has developed a specification for alternative wood pole designs to conform to. This project seeks to develop a design of a 3D printed pole which is economic and meets the mechanical requirements of that specification.

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

3D printing as a technology is not new, however its application to create an electricity pole alternative product has never been trialled before. In addition to meeting the cost and physical requirements, the 3D printed pole would come in modular sections that can be transported far more easily than existing wood poles.

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

There is currently no off-the-shelf solution for an alternative electricity pole, this is a significant piece of development work in this project. In section 3.2 of the NIA Governance document, the DNOs are encouraged to pursue different types of Methods and Solutions. The development of a 3D printed pole and the associated benefits are in an area that is now beginning to get innovation stimulus. As such, this project does carry with it significant development costs, and a degree of risk, that neither the business, nor manufacturers are willing to undertake.

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 undertaken as an innovation pilot given the design and manufacture risks associated with the deployment of an unproven solution. As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain results. This is the case for with this project. There is a commercial risk that the solution developed as part of the project is not adopted by the stakeholders involved following the trial period. This could be due to the fact that the solution has not reach the level of maturity required for business-as-usual application. This risk is being mitigated against through this small scale project and by ensuring requirements are clearly defined and documented. If the project is successful, it will have a technical report on the economical and structural properties of the design. The specific details regarding the benefits are captured under section 2b of this document.

This project has been approved by a senior member of staff

☑ Yes