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 2019

### Project Reference Number

NIA_UKPN0044

## Project Registration

### Project Title

HV OHL Assessment

### Project Reference Number

NIA_UKPN0044

### Project Licensee(s)

UK Power Networks

### Project Start

January 2019

### Project Duration

1 year and 9 months

### Nominated Project Contact(s)

Babis Marmaras

### Project Budget

£408,378.00

### Summary

UK Power Networks has over 24,000 km (comprising of over 280,000 spans) of HV overhead line conductors on its distribution network but holds limited information regarding their age and condition. Conductors are visually assessed from the ground, during routine full patrols, every twelve years. However, there is engineering consensus that visual assessments alone are not sufficient to determine the condition of overhead line conductors, since they only correctly assess the condition of conductors when deterioration of the conductor is at an advance stage and evidence of the deterioration is evident through stranding or bird-caging (deformation of strands) of the conductor. As a result, the existing replacement strategy on HV OHL conductors is reactive (apart from load related reinforcement), and HV OHL conductors are replaced when they have failed (post-fault repair). In UK Power Networks, faults on the HV overhead line conductors represent approx. 15% of the HV faults volume per annum. These faults result in Customer Interruptions (CIs) and Customer Minutes Lost (CMLs) affecting the quality of supply and the overall experience of the consumers.

### Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

### Problem Being Solved

UK Power Networks has over 24,000 km (comprising of over 280,000 spans) of HV overhead line conductors on its distribution network but holds limited information regarding their age and condition. Conductors are visually assessed from the ground, during routine full patrols, every twelve years. However, there is engineering consensus that visual assessments alone are not sufficient to determine the condition of overhead line conductors, since they only correctly assess the condition of conductors when deterioration of the conductor is at an advance stage and evidence of the deterioration is evident through stranding or bird-caging (deformation of strands) of the conductor. As a result, the existing replacement strategy on HV OHL conductors is reactive (apart from load related reinforcement), and HV OHL conductors are replaced when they have failed (post-fault repair). In UK Power Networks, faults on the HV overhead line conductors represent approx. 15% of the HV faults volume per annum. These faults result in Customer Interruptions (CIs) and Customer Minutes Lost (CMLs) affecting the quality of supply and the overall experience of the consumers.

### Method(s)

UK Power Networks aims to improve its understanding of the deterioration rate of overhead line conductors to inform medium- and long-term plans to manage the distribution network. Improved understanding of deterioration rates will enable UK Power Networks to

build Health Index models for overhead lines, which will be used to more accurately assess the state of the overhead line network, identify overhead line sections that may require remedial work and trigger conductor replacements to pre-empt faults.

Within this project, approximately 300 representative samples of different types of overhead line conductors from different locations will be recovered and subjected to a series of electrical, structural and mechanical tests. The results from these tests will be used to develop a rule-based algorithm that estimates the end-of-life of HV overhead line conductors based on a set of attributes (e.g. age, location, size). The algorithm will then enable UK Power Networks to build a Health Index model on HV overhead lines and estimate the condition of its existing population of HV overhead conductors.

## Scope

The “HV overhead line assessment” project aims to determine the typical deterioration rates of HV overhead line conductors through testing a representative sample. The key objectives of these tests would be to determine the typical condition of conductors within specified age ranges, determine whether the condition of the conductors vary from one type of location to the next (e.g. coastal vs industrial) and to develop a deterioration algorithm. The algorithm will then enable UK Power Networks to build the Health Index model on HV overhead lines and estimate the condition of its existing population of HV overhead conductors.

This project will apply to EPN and SPN license areas and will involve the following:

1. Recovery of approximately 300 representative samples of HV overhead line conductors of at least 5m in length. The following information will be recorded with each sample: age of the selected sample, location, environment, conductor type and size.
2. Collection of HV overhead line conductor samples in batches from UK Power Networks’ depot site.
3. Performance of mechanical, structural and electrical tests on the recovered conductor samples.
4. Development of a deterioration algorithm to estimate the expected end-of-life of HV overhead line conductors.

## Objective(s)

The objectives of this project include:

1. Developing and performing a set of tests which test the mechanical, structural and electrical parameters of the OHL samples.
2. Calculation of the deterioration rate and expected end of life for HV overhead line conductors.
3. Development of an algorithm that determines the condition and expected end of life for HV overhead conductors based on a set of attributes (e.g. age, location, size).

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

The following criteria will be used to determine whether the project has been successful:

1. Completion of the agreed tests on the recovered HV conductor samples and reporting of the test results.
2. Completion and reporting of the calculations of the deterioration rate and expected end of life of the recovered HV conductor samples.
3. Development and reporting of the rule-based algorithm that determines the condition and expected end of life for HV overhead conductors based on a set of attributes (e.g. age, location, size).

## Project Partners and External Funding

The project partner for this project will be EA Technology Ltd, who will provide the services. There is no external funding.

## Potential for New Learning

This project has a high potential to deliver new learning with regards to:

1. The impact of different attributes like age/location/type on the deterioration rate of HV overhead line conductors.
2. Verify/challenge existing widely held views or assumptions on HV overhead line conductor deterioration e.g. copper “lasts for ever”.
3. The development of test-based rules to estimate the condition and expected end-of-life of HV overhead line conductors.
4. Understanding the condition of the existing HV overhead line network through testing a representative sample.

The learning from the project will be shared via the ENA smarter networks portal and other industry portals via reports.

## Scale of Project

The project involves testing approximately 300 HV overhead line conductor samples from the SPN and EPN areas. Based on existing literature, this sample size is sufficient to achieve an acceptable representation of a population of 280,000.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL7 Inactive Commissioning

## Geographical Area

The project involves taking samples from the HV overhead line network of South Eastern Power Networks plc (SPN) and Eastern Power Networks plc (EPN) license areas of UK Power Networks.

## Revenue Allowed for the RIIO Settlement

No revenue has been allowed for this project in the RIIO-ED1 settlement.

## Indicative Total NIA Project Expenditure

£408,378

# 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)

Gross Savings Assumptions:
• The NPV is based on implementing the solution in UK Power Networks and excludes the Project Costs and Development Costs
• Savings will be materialised through doing proactive replacements instead of reactive fault repairs
• It is estimated that approx. 8% of HV OHL faults will be avoided due to the proactive replacements

NPV (£k):
Base Cost: £982.51k
Method cost: £603.22k
Savings: Base Cost - Method Cost: £379.29k

## Please provide a calculation of the expected benefits the Solution

Total NPV (£k)
Base Cost: £982.51k
Method cost: £1,058.08k
Method Benefits: £4,201.48k
NPV: Base Cost - (Method Cost - Benefits): £4,125.91k

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

This method could be applied to every DNO in GB with an HV OHL network at a similar method cost considering/assuming the following:

1. Based on existing literature, a sample size of 300 can sufficiently represent a population of >100,000.
2. Every DNO uses the same method, using 300 samples to represent the HV OHL population from all their license areas.
3. Every DNO has similar internal costs to UK Power Networks (e.g. project management, conductor recovery).
4. The cost of testing the conductors is similar to this project.

Every DNO would have to collect HV OHL conductor samples and perform tests on them as the aging process of their conductors might be different to UK Power Networks, depending on the location and type of conductors. In addition, the installation date of a DNO's HV overhead conductors might be different from UK Power Networks, therefore their expected end of life would vary.

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

Total Cost (£k): £2,450.27k

(Note this is not discounted)

This cost is based on every DNO implementing this project, therefore it is calculated based on £408,378 x 6.

### 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)

This project addresses a number of areas identified in our Innovation Strategy under the Efficient & Effective element:

1. Increase efficiencies: Developing an algorithm to estimate the typical deterioration profiles for overhead line conductors will enable GB DNOs to build a Health Index model for overhead line conductors. Outputs from the HI model will help prioritise asset replacement schemes.
2. Improve quality of supply: By applying this approach to estimate the condition of HV overhead conductors, GB DNOs will be able to trigger condition-based proactive replacements and reduce the number of unplanned asset failures. This will reduce Customer Interruptions (CIs) and Customer Minutes Lost (CMLs) incurred each year.
3. Continuous improvement: This project proposes a new methodology for estimating the condition of HV overhead conductors and improves the existing asset management strategy.

☑ 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.

As part of the process to develop the project scope, UK Power Networks did a review of previous NIA and NIC projects and did not reveal any similar solutions for HV overhead line conductors.

### 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

The project is innovative because it is using existing technology (i.e. known tests on conductors) to develop a novel process to improve the knowledge of the wider electricity distribution industry regarding HV conductor deterioration rates and condition assessment. The key innovative aspect of this project is the development of an algorithm which estimates the condition and expected end-of-life of HV overhead line conductors, based on a set of attributes (e.g. age, location, size). A review of literature and past projects on similar initiatives did not reveal any projects with similar scope on HV OHL conductors.

### 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

UK Power Networks is not funding this project as business as usual because there is no proven business case on the solution yet.

### 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

There is no off-the-shelf solution for the problem identified so there is a level of implementation and operational risks that are unknown to the DNO.

### This project has been approved by a senior member of staff

☑ Yes