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## NIA Project Registration and PEA Document

### Date of Submission

Sep 2015

### Project Reference Number

NIA\_UKPN0013

## Project Registration

### Project Title

Underground HV Cable Research

### Project Reference Number

NIA\_UKPN0013

### Project Licensee(s)

UK Power Networks

### Project Start

September 2015

### Project Duration

1 year and 10 months

### Nominated Project Contact(s)

Lynne McDonald & Maxi Faridi

### Project Budget

£932,477.00

## Summary

The scope of this project is to build an underground cable prioritisation model for HV underground cables by using a proactive and methodical approach. This will be achieved by using forensic analysis results on number of HV cable samples and data collated from various UK Power Networks systems.

### Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

## Problem Being Solved

Underground cables in distribution network system offer improved security of supply compared to overhead line systems. However a large portion of underground solid HV cables are nearing the end of their useful life which may require significant investments in order to maintain system reliability. UK Power Networks run approximately 44,422km of HV underground solid cables within its three licence area. This equates to approximately 28% of national population of HV underground cables. We had approximately 10,326 HV cable faults recorded in the last five years.

There are various factors that may have an impact on the life expectancy of underground cables. These factors are related to thermal, electrical and mechanical issues which need to be identified. A proactive and methodical approach is required for prioritising investment on the basis of worst performing circuits. In order to achieve this it is vital to understand the condition of HV underground cables and to develop a HV cable prioritisation model.

## Method(s)

The project is divided into two phases:

### Phase 1:

Following tasks are planned to be carried out:

- Number of cable samples will be collected from selected areas of UK Power Networks based on high frequency of HV faults due to deterioration. Condition assessment will be carried out on these samples through forensic analysis in order to understand degradation mechanism.
- Historic fault data will be reviewed for all the HV underground cables within UK Power Networks
- Asset information (including cable type, year of manufacturer, manufacturer, location etc.) will be collated from various UK Power Networks systems for analysis

## **Phase 2:**

HV underground cable prioritisation model will be developed by using data collated during phase 1, analysis of fault data and forensic analysis of HV cable samples. Health indices for underground HV cables will be calculated to prioritise the investment strategy.

## **Scope**

The scope of this project is to build an underground cable prioritisation model for HV underground cables by using a proactive and methodical approach. This will be achieved by using forensic analysis results on number of HV cable samples and data collated from various UK Power Networks systems.

## **Objective(s)**

The objective of the project is to identify high risk underground HV cables. This will enable us to carry out planned interventions and to manage fault occurrences, thereby maintaining system reliability.

Condition assessment through forensic analysis will enable us to better understand the degradation mechanism of high voltage underground cables which can be used to potentially prevent any fault occurrence due to degradation.

Collation of asset information from various sources and forensic analysis results will allow us to build an underground cable prioritisation model. This model will be used to optimise asset investment by targeted intervention of high risk HV cables.

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

n/a

## **Success Criteria**

The following will be considered when assessing if the project has been successful:

- Successful collection of a number of HV underground cable samples for forensic analysis
- Improvement in the understanding of HV underground cables and their deterioration through forensic analysis
- Collation of cable information from various UK Power Networks systems
- Development of cable prioritisation model

## **Project Partners and External Funding**

n/a

## **Potential for New Learning**

n/a

## **Scale of Project**

The project will collect a number of HV underground cable samples from three license areas of UK Power Networks. Underground cable information (including cable type, year of manufacturer, manufacturer, location etc.) for three license areas will be collated from various UK Power Networks systems.

## **Technology Readiness at Start**

TRL5 Pilot Scale

## **Technology Readiness at End**

TRL8 Active Commissioning

## **Geographical Area**

Eastern Power Networks;

London Power Networks; and

South Eastern Power Networks

### **Revenue Allowed for the RIIO Settlement**

Approximately on average £2.45m per annum has been allocated for the replacement of unplanned HV underground cables across all three DNO's during RIIO-ED1 period. However the investment needs to be optimised to target intervention of high risk HV cables.

### **Indicative Total NIA Project Expenditure**

£925,897.90

## 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)

The savings associated with the solution are from the reduction of CIs and CMLs and better profiling of HV underground cables optimizing asset investment.. It is expected 1.87m without taking out project cost of model implementation can be made. If taken account saving is £1.64m as the project cost would equate to £0.23m.. This is based on the assumption that 10% savings would be made on allocated budget for HV underground cables due to prioritising high risk cables and undertaking early intervention.

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

##### **Base Cost: £18.7m**

Based on the capex expenditure is required for any unplanned replacement and maintenance of existing 44,422km of HV underground cables.

##### **Method Cost: £17.06m**

This is the made up of the following:

£0.23m – the repeatable implementation costs that includes the cost of all HV cable data extraction and its analysis if and the ongoing maintenance cost of resource allocation to make useful decisions from the tools output. A licence fee for the tool has not been included as it is planned that the developed model will be integrated into an existing asset risk model which would not elicit any further licence costs.

£16.83m – it is assumed the project will introduce 10% savings through optimising the allocated budget for HV underground cables. The remaining 90% of the budget would be unchanged and would still require to be spent. Therefore 90% of the base cost £18.7m is £16.83m.

##### **Benefits: £1.64m**

Benefits will arise from better planning and 10% efficiencies on HV underground solid cables.

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

Altogether across the DNOs of Great Britain there are 157,100km of HV underground cables. Therefore all have the potential to adopt

the same methodology to develop a degradation model to prioritise their investment strategy and potentially reduce the number of HV faults from poor condition.

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

Based on the following assumptions, it is estimated that the cost of rolling out to GB would be approximately **£ 0.813m**

- The cost of deploying the solution to all UK Power Networks HV underground cables (44,422km) is approximately £0.23m.
- Across the DNOs in GB, there are approximately 157,100km of HV underground cables. The cost of rolling out to that volume would be approximately £0.813m.
- This is based on the 10% benefits expected on required capex expenditure and the remaining 90% would remain unchanged.

### 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

If the project is successful, the learning on HV underground cables can be used by other network licensees to identify poor condition HV cables and prioritise their replacement. Methodology used to develop a prioritisation model can be used and adopted by other network licensees to carry out targeted intervention on high risk cables potentially prior to occurrence of any HV cable fault due to poor condition.

#### 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.**

n/a

**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