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## NIA Project Registration and PEA Document

### Date of Submission

Apr 2016

### Project Reference Number

NIA\_WPD\_015

## Project Registration

### Project Title

Superconducting Cables – Network Feasibility Study

### Project Reference Number

NIA\_WPD\_015

### Project Licensee(s)

National Grid Electricity Distribution

### Project Start

May 2016

### Project Duration

1 year and 3 months

### Nominated Project Contact(s)

Yiango Mavrocostanti (Innovation & Low Carbon Networks Engineer)

### Project Budget

£95,000.00

## Summary

The project will assess the benefits and technical issues of using superconducting cables to provide additional capacity in dense urban environments. In such locations land prices or availability can be problematic in establishing new substations.

## Problem Being Solved

The increasing number of electricity distribution networks reaching their capacity limits means that the need for network reinforcement will continue to grow. Reinforcing our networks using conventional approaches involves among others, building new electricity substations and installing additional transformers at the sites where capacity needs to be enhanced. This is incredibly challenging in urban environments due to limited land availability and high costs, creating the need to investigate alternative solutions.

## Method(s)

The problem can be solved by installing new transformers or substations where it is easy to do so and then transferring their capacity to the networks that need it. Due to their high efficiency, small volume and high capacity, superconducting cables are an attractive solution for connecting new equipment to the physically remote networks that require the additional capacity.

In this project, a feasibility study will be performed to determine whether such an implementation should be considered.

The project will consist of the following 3 work packages:

1. Review of superconducting cable technologies (3 months)

This involves a comprehensive Cost Benefit Analysis of different superconducting cable technologies and comparison to traditional cable solutions. As part of this work package a number of manufacturers will be asked to provide information on their products including their benefits and limitations, the installation, operational and repair procedures and their capital and operational costs. The learning from previous trial projects will also be captured.

## 2. A case study of installing a demonstration cable in WPD's networks (6 months)

In this work package, a site for the possible installation of a trial superconducting cable in WPD's network will be selected and a detailed study will be undertaken to justify the selection of the site, explain the installation procedures and requirements and present the costs. The study will also consider the future requirements of the installation including operational procedures, maintenance, response to faults, repair and modelling of installation in WPD's power system analysis tools. Finally, all of the aspects of the proposed implementation will be compared to a conventional solution to provide clear conclusions.

## 3. Learning overview and recommendations (3 months)

The final work package will provide an overview of the learning that was captured in the previous two stages of the study and based on the outputs recommendations will be made for a network trial.

### Scope

The project will assess the benefits and technical issues of using superconducting cables to provide additional capacity in dense urban environments. In such locations land prices or availability can be problematic in establishing new substations.

### Objective(s)

This project is a feasibility study with the aim to improve knowledge of the technology's benefits, challenges and costs to determine whether a demonstration project is appropriate.

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

n/a

### Success Criteria

A comprehensive review of superconducting cable technology is presented. A case study of how the technology can bring benefits to WPD's networks is demonstrated and a relationship with manufacturers has been established. A viable pathway leading to a trial project is recommended where full details of capital and operating costs is documented.

### Project Partners and External Funding

n/a

### Potential for New Learning

n/a

### Scale of Project

This project is a 14 month feasibility study.

### Technology Readiness at Start

TRL3 Proof of Concept

### Technology Readiness at End

TRL4 Bench Scale Research

### Geographical Area

Areas that require additional capacity but do not allow the implementation of traditional solutions due to land availability, cost or other constraints will have the biggest benefit from a superconducting cable technology implementation. This would typically represent a dense, urban environment. Therefore, cities such as Birmingham, Bristol, Cardiff and Nottingham will be considered.

### Revenue Allowed for the RIIO Settlement

N/A

### Indicative Total NIA Project Expenditure

£85,500

## 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)

This is a research project, so the exact saving is not known at this stage but this is exactly what the project will examine.

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

Research Project - Not required.

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

Research Project - Not required.

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

Research Project - Not required.

### 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

Other DNOs will be able to gain a comprehensive understanding of superconducting cables after reviewing this project's reports and results. They can use the presented case study as an example to evaluate the benefits that could be brought to their networks by this technology. The knowledge from manufacturers could also be used by other DNOs if they wish to pursue trial projects.

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

In dense, urban environments it is not possible to build new substations to provide additional capacity due to land availability and cost constraints. This creates the need to investigate new solutions for capacity enhancement in such areas.

- 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