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

Apr 2015

Project Reference Number

NIA_SPEN0003

Project Registration

Project Title

Enhanced Real-Time Cable Temperature Monitoring

Project Reference Number

NIA_SPEN0003

Project Licensee(s)

SP Energy Networks Distribution

Project Start

April 2015

Project Duration

2 years and 2 months

Nominated Project Contact(s)

Geoff Murphy

Project Budget

£995,000.00

Summary

The scope of this project will include:

1. Enhancing the cable temperature monitoring system developed in previous SPEN's Tier 1 LCNF project by conducting additional diagnostic tests and validations.

2. Carrying out data analysis of historical cable temperature data for at least 12 month period to Identify temperature hotspots and causes of temperature bottlenecks.

3. Design the architecture of an ANM system informed by real-time cable temperatures.

4. Updating the relevant policy documents and provide recommendation for full business adoption of the DTS system.

5. Dissemination of the outcomes and learning points through workshops with other UK DNOs and conferences as appropriate

Third Party Collaborators

Energy Innovation Centre

Sensornet LTD

Parsons Brinckerhodd LTD

University of Southampton

Nominated Contact Email Address(es)

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Problem Being Solved

Scottish Power Energy Networks (SPEN) has installed a distributed temperature sensing (DTS) technology, under the Tier 1 LCN Funding mechanism, for monitoring the real-time temperature of cable circuits connected to different wind farms in South Lanarkshire. The project was called “Temperature monitoring windfarm cable circuits” SPT1005 and it initially included monitoring temperature of three 33kV ducted cable circuits which partly share the same trench. One of the 33kV circuits, however, is not scheduled to be energised until the 2nd quarter of 2015. A fourth 33kV cable circuit was laid in the same trench as the other circuits during the project. Consequently, due to the delay in commissioning all the cable circuits, the cable temperature monitoring trial did not see the full impact within the Tier 1 LCNF SPT1005 project’s life-time.

It is important to enhance the learning from this trial by carrying out additional analysis on the recorded temperature data when all of the four 33kV cable circuits are energised. This analysis can help to identify the thermal pinch points and their causes along the cable circuits. Learning from data analysis will also inform day to day cable laying activities and the process for estimating network headroom. In order to boost the confidence in the implemented DTS system, dynamic cable rating (DCR) calculations and fully capture the thermal behaviour of the cable circuits, the cable temperature data for at least a 12-month period covering different weather conditions and season affects in conjunction with full generation conditions should be considered.

The main benefit of deploying a real-time cable temperature monitoring system can be achieved in an Active Network Management (ANM) application where the outputs of generators are controlled based on the available real-time network capacity. Building up on previous learning points from SPEN’s ANM trials, the requirements for integrating a DTS system into an ANM architecture and transition to full business adoption need to be identified. The relevant internal policy documents also need to be updated. For a successful integration to Business as Usual (BaU), an end-to-end solution covering from the design phase to day-to-day operation should be considered. This project provides an opportunity to investigate all of these requirements and make all the necessary preparations for operating the wind farm cable circuits based on DCRs as aBaU practice.

Method(s)

The methodology used in this project will be research, development and demonstration. The project will be conducted under five work packages as follows:

Work package 1 – System Enhancement

The performance of the DTS system will be enhanced based on the issues identified in the previous Tier 1 LCNF “Temperature monitoring windfarm cable circuits” SPT1005 project. This will include reporting the critical data to PI (SPEN data historian), carrying out further system diagnostic tests, and validating dynamic cable rating calculations.

Work Package 2 – Data Analysis

A comprehensive data analysis will be conducted on the historic cable temperature data in conjunction with wind farms’ outputs for at least a 12-month period. This analysis will aim to investigate the causes of thermal pinch points causes along the cables, seasonal cable temperature profiles and potential cable headroom. The outcomes of the data analysis will be also used to provide recommendations on future cable route planning and the tools required for estimating the available firm and non-firm network capacity for future connection applications.

Work Package 3 – Application in an ANM System

The requirements for application of real-time cable temperature monitoring in an ANM system will be investigated. In order to avoid duplication, the ANM system, which SPEN has already trialled in Tier 2 LCNF “Accelerating Renewable Connection”(ARC) project, will be considered as the base model, but further developments for integrating real-time cable monitoring will be recommended. The main outcome of this work package will be the specifications of an ANM architecture informed by the DTS system. The benefit of the proposed ANM system will be demonstrated through desktop analysis based on historic data and examples of existing connections.

Work package 4 – Dissemination

The outcomes and lessons learnt from this project will be disseminated through organising internal and external workshops with other UK DNOs.

Work Package 5- Transition to Business as Usual

In order to prepare a DTS system for full business adoption, relevant policy documents will be identified and recommendations for modifying them will be made. The policy documents and technical recommendations should provide clear guidelines for DTS equipment specification, design phase practices and rolling out the DTS system within SPEN for future generation connections.

Scope

The scope of this project will include:

1. Enhancing the cable temperature monitoring system developed in previous SPEN's Tier 1 LCNF project by conducting additional diagnostic tests and validations.
2. Carrying out data analysis of historical cable temperature data for at least 12 month period to Identify temperature hotspots and causes of temperature bottlenecks.
3. Design the architecture of an ANM system informed by real-time cable temperatures.
4. Updating the relevant policy documents and provide recommendation for full business adoption of the DTS system.
5. Dissemination of the outcomes and learning points through workshops with other UK DNOs and conferences as appropriate.

Objective(s)

The objectives of this project are:

1. Use 12 month period cable temperatures of wind farm circuits to demonstrate the additional network capacity and boost the confidence in deploying cable temperature monitoring systems.
2. Design the ANM system informed by real-time cable temperatures.
3. Provide recommendations for full business adoption of DTS system.
4. Disseminate the key lesson learnt within SPEN and to other UK DNOs.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

1. Production of the data analysis report on at least a 12-month period which includes identifying the thermal pinch points and their causes and recommendations for elevation of thermal constraints.
2. Designing an ANM system informed by real-time cable temperatures.
3. Providing recommendations for developing and updating relevant policy documents for adopting DTS in full business as usual.
4. Receiving feedback from other UK DNOs on dissemination of findings and lessons learnt.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The scale of this project will include 33kV cable circuits connecting to Calder Water, West Brown Castle, Dungavel and Ardoch over Enoch wind farms.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

The project will focus on the four cable circuits located in South Lanarkshire, Scotland. The simulation and desktop analysis will also be carried out in Scotland.

Revenue Allowed for the RIIO Settlement

NA

Indicative Total NIA Project Expenditure

£300,000

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)

SPEN have undertaken Cost Benefit Analysis (CBA) utilising the Ofgem ED1 CBA tool and have identified a number of feasible rollout scenarios and benefits achieved from the application DTS with ANM should it prove successful. The CBA identified an 8 year NPV ranging from £1.4M to 2.4M.

Please provide a calculation of the expected benefits the Solution

Base Cost

The base cost would be for the upgrading of at least one of the 33kV cables along the 10km shared route (£1.5M) if one of the existing wind farms seeks a marginal increase in their export capability.

Method Cost

The method cost would be for the provision of equipment, labour and materials etc. to install a full DTS with ANM system on one circuit, which would be expected to cost in the region of £0.4M.

Base Cost – Method Cost

£1.5M - £0.4M = £0.9M

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

The method proposed in this project can be potentially deployed for all of the future cable circuits, in particular wind farm connections across GB. Because the method requires micro-duct installation which should take place in the same time as cable installation, this method is applicable for future connections.

In addition, the learning and recommendations from this project can inform assumptions used for cable rating calculations for both existing and future cable circuits across GB.

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

An indicative cost for implementation of a DTS integrated to an ANM system is around £480k for a 15km cable circuit. That includes

£280k for DTS installation and around £200k for implementation of an ANM system. For future applications, it is expected that the DTS and ANM technologies improve and the costs reduce over time. Assuming that each Licence Area utilises a DTS/ANM system once for a 15km circuit the GB cost would be £6.72M.

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

The learning from this project can be used by other Network Licensees for cable rating calculations and causes of thermal pinch points along the cable. Network Licensees can also use the outcomes of this project for creating a roadmap to full integration of the cable temperature monitoring system into BaU and ANM systems.

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