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

May 2018

Project Reference Number

NIA_SPEN_032

Project Registration

Project Title

Transition to Dynamic Cable Rating Operation

Project Reference Number

NIA_SPEN_032

Project Licensee(s)

SP Energy Networks Distribution

Project Start

May 2018

Project Duration

2 years and 8 months

Nominated Project Contact(s)

Watson Peat/ David Ruthven

Project Budget

£60,000.00

Summary

Demonstrate the additional network capacity and boost confidence in deploying adaptable cable temperature monitoring systems as a BaU option.

Nominated Contact Email Address(es)

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Problem Being Solved

SP Energy Networks (SPEN) has conducted two previous projects in cable temperature monitoring. The first project conducted the installation of distributed temperature sensing (DTS) technology under the Tier 1 LCN Funding mechanism to monitor real-time temperature of three windfarm cable circuits which shared a common trench for the initial 10.7km length from the substation to minimise cost. During the project a delay in energising one of the 33kV circuits and inserting a fourth 33kV cable circuit in the same trench meant that the cable temperature monitoring trial did not see the full impact within the Tier 1 LCNF SPT1005 projects life-time. Consequently a second project was commissioned under the NIA funding mechanism to enhance the learning from the LCNF project. The second project focused on additional analysis of the recorded temperature data once all of the four 33kV cable circuits were energised. The analysis helped to identify the thermal pinch points and their causes along the cable circuits. This data analysis assisted with day to day cable activities and for estimating spare network headroom capacity.

Learning from the previous two projects provided validation from the data analysis that additional headroom was available. During the first LCNF project, one of the three windfarm developers had subsequently asked about the prospect of increasing their generation capacity in the future and if any spare headroom capacity might be available. It is therefore, important to enhance learning from this trial by conducting further analysis on the recorded temperature data considering an increase of power output by one of windfarm's to understand the impact on the cables. Data analysis is used to discover the thermal behaviour of the cable circuits and extra capacity available to drive new connections. This analysis can further validate the developed model for this new load profile and assist in establishing the process for estimating future network headroom. Further validation of the software using the new conditions with the increased generation will ensure it is fit for purpose.
As a result of further validation experienced during the NIA SPEN0003 project it was identified that a central dynamic cable rating (DCR) calculation engine would be required to enable a Business as Usual (BaU) roll-out. A central DCR calculation engine should be able to 'plugin' to any future schemes. The calculation engine needs to be flexible and expandable to analysis a diverse range of

systems. The policy documents which are needed to support DTS and DCR systems for BaU applications require finalising.

Method(s)

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

Work package 1 - Data Collection & Analysis
Monitoring the temperature of the fibre and conductor in the shared trench after an increase of power to one of the windfarm's for a minimum of 6 months to capture both seasonal and generation variations. Extracting data from the raw data files of the DTS system. Analysing the historic cable temperature data in conjunction with the windfarms outputs before and after the power output increase. This analysis aims to investigate if the additional power output will cause the cable temperature to exceed its permissible operational temperature.

Work package 2 – System Advancement and Validation
The requirements for a central DCR calculation engine will be developed based on the learnings captured and issues identified in the previous NIA "Enhanced Real-Time Cable Temperature Monitoring" SPEN0003 project.. We will engage with the original calculation engine supplier to validate the cable temperatures and thermal modelling of the cables under this new loading condition. Incorporating a review of the modelled thermal characteristics, the output of the calculations with cymcap and the comparison between their DCR models.,

Work package 3 - Transition to Business as Usual
The policy document which was drafted previously will be finalised in order to provide clear guidelines for deployment of DTS and DCR components in future installations.

Work package 4 - Dissemination
The outcomes and lessons learnt from this project will be disseminated through organising internal and external presentations to relevant stakeholders.

Scope

The scope of this project will include:

- Enhance the learning from the cable temperature monitoring system developed in SPEN'S previous Tier 1 LCNF and NIA projects by conducting additional monitoring and analysis under increased generating conditions , compare findings against modelled predictions and refining DCR calculation engine requirements.

- Carrying out data analysis over a 6 month period temperature data to understand the thermal capacity of the cable circuits and conductor temperature variations, identify potential additional headroom under enhanced generating conditions.

- Develop the functional specifications for an adaptable central DCR calculation engine.

- Finalise the policy documents and provide recommendation for full business adoption utilising the latest central DCR calculation engine.

- Dissemination of the outcomes and learning points

Objective(s)

The objectives of this project are:

- Demonstrate the additional network capacity and boost confidence in deploying adaptable cable temperature monitoring systems as a BaU option.

- Provide recommendations for a central DCR calculation engine to integrate with different DTS systems.

- Provide documentation for BaU adoption of the methodology

- Disseminate the key lessons learnt

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- Production of the data analysis report for a 6-month period which includes identifying any potential cable capacity headroom under enhanced generation conditions and compare against modelled predictions.

- Developing a functional specification for central DCR calculation engine compatible with the DTS systems.

- Delivering recommendations for developing and finalising relevant policy documents which includes a new central DCR calculation engine within the DTS for adoption to full business as usual.

Project Partners and External Funding

N/A

Potential for New Learning

- Dynamic thermal behaviour of a cable before and after an increase in export of power.

- Daily and seasonal temperature profiles of cables directly connected to wind farms.

- Requirements for implementations of a central DCR calculation engine, which can accommodate more DTS vendor schemes

- Requirements and challenges for a full business adoption of a DTS system utilising a central DCR calculation engine.

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 cables circuits located in South Lanarkshire, Scotland.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£50,000

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)

Cost Benefit Analysis (CBA) has been undertaken previously utilising Ofgem ED1 CBA tool, identifying an 8 year NPV ranging from £1.4M to £2.4M, this would still be expected.

Please provide a calculation of the expected benefits the Solution

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

Method Case:
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 all other Network licensees for establishing potential cable headroom. Network Licensees can use the outcomes of this project to enable a roadmap to full integration to be produced.

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.

Under the NIA SPEN00003 project it was demonstrated that to best of SPEN's knowledge it had not been trialled in the UK. This new project is an extension of the previous work and therefore, to the best of our knowledge, there is no duplication.

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

To our best knowledge monitoring the real time cable temperature of the cable and also development the functional specification of a

central calculation engine has not been carried out within the UK. This project will build up on learnings from two previous NIA and LCNI project to create new learning for SPEN and UK DNOs for BaU adoption of dynamic cable rating system.

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

The solution developed and trial in previous projects need further assessments and developments to firstly build the confidence in the performance of the system by further validation and also develop a fit for purpose functional specifications for a central calculation engine for adoption by BaU. These activities are still in research and development stage and cannot be funded or integrated by any BaU activities within the business.

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 is still in the evaluation stage due to uncertainties in the technology performance, there is no approved policy for ownership of the solution within the business, commercial arrangement for cost recovery of the assets and also operation and maintenance methodology.

This project has been approved by a senior member of staff

☑ Yes