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 2017

Project Reference Number

NIA_SPEN0012

Project Registration

Project Title

SINE Post

Project Reference Number

NIA_SPEN0012

Project Licensee(s)

SP Energy Networks Distribution

Project Start

January 2017

Project Duration

4 years and 1 month

Nominated Project Contact(s)

Geoff Murphy

Project Budget

£1,122,620.00

Summary

The scope of the project is to develop and demonstrate an expert system “SINE Post” for the more efficient location of overhead line faults, improved assessment of circuit breaker maintenance requirements and the improved assessment of power system harmonics, before and after DG/LCTs have connected to the distribution network. This system will overcome current business challenges due to limited numbers of experts and the labour-intensive time needed to carry out some power quality monitoring-related tasks at present. This is expected to lead to benefits for SPEN’s business and our customers through more efficient operations, environmental benefits by facilitating DG/LCT connections more quickly and cheaply and network performance improvements for customers (SPEN locating OHL faults more effectively).

Nominated Contact Email Address(es)

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Problem Being Solved

DNO business practices can, at present, require experts to undertake several manual activities which are time consuming, labour intensive and do not always deliver performance benefits to customers. Focusing on power quality monitoring (PQM), this is exhibited in the following problem areas, in particular:

- Location of faults on 11kV networks, (particularly OHL);
- Testing of circuit breakers (CBs); and
- Analysis and interpretation of harmonic excursions.

The accurate location of 11kV faults is currently inefficient as it requires one of SPEN’s PQM experts to (manually) link fault impedance data to network models to derive possible fault locations. This approach has been proven to generate accurate fault location results, however, due to the limited number of PQM experts and the manual interventions required, SPEN is not always able to respond to faults in a timely way.

Whilst condition-based maintenance of circuit breakers (CB) is common-place throughout UK DNOs, the CB trip 'timing tests' are labour-intensive and only provide a snapshot of the CB performance for the particular conditions under test. This may not represent the worst-case CB operation due to variation in operating conditions across the year. As a result, unnecessary outages can be caused by the unexpected slow operation of CBs to clear faults.

Engineering Recommendation G5/4 (ER G5/4) sets out the acceptable limits for the harmonic content of waveform quality and the compliance requirements for equipment connected to distribution systems. DNOs face a real challenge in ensuring that distribution networks continue to be compliant with ER G5/4 whilst, at the same time, accommodating increased levels of Distributed Generation (DG) and Low Carbon Technologies (LCT) such as electric vehicles and heat pumps. In this case, the Problem is accurately assessing the harmonic data, before and after DG / LCT customers have connected to the network, and presenting this in an efficient way to SPEN's design engineers and customers, without the need for significant manual analysis.

Method(s)

The Problems outlined above will be addressed by the development of an expert system "SINE Post", which encompasses the gathering, processing, analysis and interpretation of data from multiple sources, and makes this information available within SPEN's corporate systems (supporting system planning and operational decisions). These data sources already exist within SPEN's business but are disparate and not always utilised to their full potential in the most efficient way. SINE Post will demonstrate the automation of previously time consuming and labour-intensive tasks often undertaken by valuable experts. This will give design engineers, asset managers, control room staff and field staff within SPEN timely access to processed information, allowing them to make informed decisions more quickly. Ultimately, this will deliver performance benefits to SPEN's business (e.g. efficient data processing from multiple systems at scale) and its customers (responding to 11kV faults more quickly, enabling DG / LCT customers to connect to the network more quickly and cheaply).

SINE Post will be delivered in the following interactive stages:

Stage 1: Design and development
- Specifying the architecture of the solution;
- Offline development of system interfaces;
- Investigating and selecting appropriate communications media;
- Procuring equipment and services needed for the project;

Stage 2: Equipment installation and trialling
- Installation of the hardware and software components of the "SINE Post" system;
- Trialling the use of the SINE Post system for more efficient 11kV fault location, CB maintenance decisions and harmonic analysis pre and post-connection of DG/LCTs;

Stage 3: Analysis and reporting
- Evaluating the performance benefits derived by "SINE Post";
- Disseminating and reporting the project results;

Scope

The scope of the project is to develop and demonstrate an expert system "SINE Post" for the more efficient location of overhead line faults, improved assessment of circuit breaker maintenance requirements and the improved assessment of power system harmonics, before and after DG/LCTs have connected to the distribution network. This system will overcome current business challenges due to limited numbers of experts and the labour-intensive time needed to carry out some power quality monitoring-related tasks at present. This is expected to lead to benefits for SPEN's business and our customers through more efficient operations, environmental benefits by facilitating DG/LCT connections more quickly and cheaply and network performance improvements for customers (SPEN locating OHL faults more effectively).

Objective(s)

SINE Post has the following objectives:

- Development and demonstration of an IT and hardware architecture (infrastructure and interfaces) that will allow data to be gathered from remote sites, processed efficiently and used, together with data from existing systems (such as GIS), to unlock business planning and operational efficiencies;
- Use data sets from multiple sources corroboratively to support planning and operational decisions;
- Trial various communications methods to assess their reliability, compliance and performance as enablers for gathering data into

the expert system;

- Understand and document the effectiveness of developing and demonstrating SINE Post for 11kV fault location, CB maintenance decisions and harmonic analysis.

By achieving these objectives SPEN expects SINE Post to deliver customer service, financial and environmental benefits.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

It is expected that SINE Post will be successful if the following outcomes can be returned:

- A fully functional IT and hardware system facilitating the gathering of data from multiple remote sites and exchanging autonomously it between key corporate systems;
- Demonstrate that data for multiple sources can be use in a complementary way to support planning and operational decisions;
- Reliable communication channels established between the PQMs and the SINE Post system;
- Updated business case that outlines the performance improvements from SINE Post to inform UK DNOs of it suitability for BaU adoption.

Project Partners and External Funding

Nortech Management Limited (making a financial contribution of £71,500)

Potential for New Learning

SINE Post has potential to deliver the following new learning to UK DNOs:

- The effectiveness of embedding knowledge (from SPEN's in-house staff) within expert systems to achieve business efficiencies;
- The extent to which data from multiple sources can be brought together and used to enhance 11kV fault location, CB maintenance decisions and harmonic assessments;
- The benefits of using novel representations of data (such as power quality heat maps) to support business processes (such as the design of LCT connections);

The financial, environmental and customer service benefits derived from the SINE Post system. The learning will be disseminated using proven channels such as the LNCI Conference and regular progress reports. The project will culminate in a 'How to' guide, which will be made available to all UK DNOs and will summarise the outputs from SINE Post.

Scale of Project

In order to understand the effectiveness of the SINE Post solution, up to 60 primary substation sites will be selected for the trials. This allows site-specific variations to be identified and maximises the potential for new learning within a small subset of SPEN's primary network.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

Various sites across both SPEN distribution licenses. Sites yet to be confirmed.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£1,051,120

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 has undertaken Cost Benefit Analysis (CBA) of the incremental benefits SINE Post can deliver from autonomously processing data from the PQMs.

Baseline Scenario

The manual cost of processing the PQM data to deliver the same level of performance SINE Post will provide for the Location of faults on 11kV networks, testing of circuit breakers and analysis and interpretation of harmonic excursions.

SINE Post Option

The cost of delivering the SINE Post project and associated enduring costs to maintain its performance through to the end of ED2.

Cumulative Discounted Net Benefit

The CBA indicates that at the end of ED1 and ED2 this will be £0.35m / £1.78m.

Please provide a calculation of the expected benefits the Solution

Base Cost

The annual cost of processing the PQM data manually 2018-2023 is forecasted to be in the region of £3.05m.

Method Cost

Once established the SINE Post solution requires additional costs for additional PQMs to be connected and ongoing operation and maintenance costs. These costs 2018-2023 is forecasted to be in the region of £0.72m

Base Cost – Method Cost

£3.05m - £0.72m = £2.33m

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

Ultimately this solution is applicable to all of the GB DNOs, however to deploy the solution in full there is a prerequisite for them to have in place:

- PQMs at the desired locations
- Suitable communication channels to bring back PQM data
- 11kV network impedance models
- A suitable 'Field Data Adapter' such as iHost to process the PQM data and route it to existing corporate systems

All of the aforementioned are commonplace in GB DNOs but the exact percentage of locations can only be speculated to be 20% of all the primary substations and this will vary from DNO to DNO.

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

Once the SINE Post solution has been established the cost of replicating it will be much lower than the costs incurred in this project as the development costs will largely disappear. Assuming the cost halves the cost to the remaining 5 GB DNOs is estimated to be in the region of £2.5m.

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

SINE Post looks to address three problems encountered by all UK DNOs:

- Location of faults on 11kV networks;
- Testing of circuit breakers; and
- Analysis and interpretation of harmonic excursions.

These will be addressed through the novel processing of PQM data across corporate systems that are commonplace in all UK DNOs, such as iHost, PowerOn, GIS and SAP.

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.

At the time of writing SPEN are not aware of any other project or BaU activity by GB DNOs that performs the same function as SINE Post.

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