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

Jul 2018

Project Reference Number

NIA_SPEN_034

Project Registration

Project Title

NCEWS2 – Network Constraint Early Warning System (Phase 2)

Project Reference Number

NIA_SPEN_034

Project Licensee(s)

SP Energy Networks Distribution

Project Start

October 2018

Project Duration

5 years and 3 months

Nominated Project Contact(s)

Fiona Fulton

Project Budget

£1,050,000.00

Summary

Automated verification of network connectivity
An essential building block in the development of automated schemes to reduce CI/CML with associated quantifiable benefits. Understanding of the LV circuit and transformer each customer is fed from allows expected benefits of SM data to be realised. This potentially includes the ability to verify customer phase feeding arrangement, assuming sufficient SM data availability.

Near real-time network connectivity understanding
Visibility of running arrangements at configurable network split points (link boxes). This will provide verification of ongoing operational network changes in as near-to-real-time as possible. This is an enabler for the enhanced level of LV network control which is an expected future requirement for DSO operation.

Improved LV network modelling capability
Development of capability to export LV network and associated network metrics (SM data, EV data, etc) into PSSE systems. Expected to become an essential tool as pressure on the LV network increases through the penetration of LCTs. Quantifiable benefits in terms of saving in design resources and reduced reinforcement through more accurate designs.

Scenario analysis of investment requirements for EV penetration
Development of real SPEN network topologies archetypes, including analysis of EV penetration density from understanding of customer EV charging requirements using GIS data, i.e. distributed on- & off-street parking and/or cluster EV charging locations. Supports the EV NIC proposal and informs SPEN reinforcement requirements for ED2.

Platform for EV connection management
Through the integration of LCT location data and improved LV circuit and transformer connectivity and rating understanding. This would be an overall LCT penetration visualization and access management platform for both internal designer and external customer use. Benefits would be achieved through streamlining the design process and improving customer service.

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

As Smart Meters (SMs) are rolled out across the UK, it is expected that this greater visibility of the LV network will provide sufficient intelligence to trigger Smart Grid dynamic network control, which will in turn release more capacity on the network for the likes of EVs & DG. To maximise the benefit of the SM data, however, supplementary analysis is necessary to ensure the data is correctly applied to the network for confident, timely and reliable DSO action:

1. Network connectivity validation

This will increase benefit from SM data integration in areas like load aggregation & losses modelling. Moreover, with increasing pressure on CI/CML improvement there is an increased emphasis on automatic restoration of LV faults. In areas where the network is complex (e.g. interconnected networks) this is only possible with a validated connectivity model which is not currently available and would be onerous to achieve using manual methods.

2. Network capacity/risk visualisation

Pressure on the LV network is expected to increase with further uptake of LCT. There are currently no tools available to support designers and customers to help to understand the available capacity on the LV network and, therefore, the risk associated with increasing loads/generation.

3. Power system analysis

LV networks are not routinely analysed in Power System State Estimation (PSSE) tools at present. As pressure on the network intensifies, in particular from EVs & DG, it is expected that this will become a requirement. To build these models manually would be extremely time consuming.Â Therefore, methods to automatically export network data to these tools are required.

Method(s)

NCEWS2 will build on the LV Connectivity Platform developed through the NCEWS1 project, adding a range of functionality, as well as increasing the geographical scope of the analysis. Six (6) work packages are proposed, discussed in detail below:

WP 1: Business-as-Usual investigation of NCEWS1 Platform
WP 2: LV / EV / DG Modelling Development / Enhancement
WP 3: Platform Development / Enhancement
WP 4: EV API Development
WP 5: Data Analytics Support
WP 6: Stakeholder Engagement / Dissemination

WP 1: Business-as-Usual Implementation of Innovation Platform

Taking output of NCEWS1 into Business-as-Usual Implementation of Innovation Platform for 20 users of NCEWS Platform and Web Portal. This will demonstrate scale and complexity of a BAU implementation, but without need to deploy full Enterprise Solution.

WP 2: LV / EV / DG Modelling Development / Enhancement

Development of power system analysis export function(s) for PSSE tools (primarily DIgSILENT, but other PSSE tools may be considered). Includes changes to portal interface required to initiate export and potentially initiate PSSE runs.

Development of improved LV network modelling capability.Â This will allow: scenario analysis of EV/DG penetration; and logging of EV/DG customer locations for enhanced network visibility. This data will be provided to the EV Working Group within SPEN, who are responsible for all EV modelling across the network.

Development of EV connection methodology using real/modelled EV data annotated to network.

WP 3: Platform Development / Enhancement

API Development. Development of API that aligns with SPEN 'Enterprise Service Bus' architecture for improved data transfer across multiple IT systems required for future DSO Operation.
Connectivity Improvement.Â Â Enhancement of network tree analysis, developed through NCEWS1, to create automated verification of network connectivity using Smart Meter (if available/accessible) and PowerOn data.

Data Aggregation. Demonstration of how aggregated data cannot be disaggregated by any user. Tuning of GIS visualisations

available to users through NCEWS2 Web Portal to ensure detailed data is not available to user, only aggregated data. Demonstration of how the use of project internal & external DBs shields core data from wider users, but ensures detail is available within NCEWS2 for quick aggregation of any new data received. This activity will be linked to NCEWS2 Privacy Impact Assessment (PIA).

WP 4: EV API Development
Development of an API that will allow EV charging data to be taken from the Transport Scotland EV database and brought into the NCEWS2 Platform via EnergyIP (Siemens Innovation Project), which currently handles all SM data. This will allow annotation to the LV network for both modelling and analysis. Once annotated to the LV network, PSSE modelling will assess the impact of known and anticipated EV chargers on the network allowing LV network constraints to be developed. These constraints will identify periods when EV charging, if running at full capacity, could stress the network. In response to this, DSM profiles will be generated that will indicate EV charger 'throttle' periods. These will be transmitted back to the chargers via the API, which will convey OCPP instructions to the relevant chargers to constrain them appropriately. High level tasks in this WP will include:

- API Development
- LV Profile Extraction
- Profile Calculator
- OCPP Instruction Generator
- Privacy Impact Assessment

Note that this WP will be carried out in collaboration with the RUGGEDISED project (http://www.ruggedised.eu), which will be monitoring a number of chargers across Glasgow. This will allow SPEN to verify that any throttle instructions sent to EV chargers were successfully enacted.

WP 5: Data Analytics Support
Continued support of Data Analyst. Tasks will include, but are not limited to:

Connectivity improvement. Based on output of Voltage Analysis in NCEWS1 project, develop techniques to improve the connectivity.

Phase identification using Voltage clustering & Aggregated Sum methods. [Note: these tasks should not be started until there is a good penetration of SMs on a number of circuits]

EV Analysis. Data analytical task using EV demand data from Transport Scotland. [Note: this is mainly the provision of data for EV Working Group within SPEN]

Other Smart Meter Analysis. In addition to specific uses of smart meter data in the above tasks, this activity will support the proposal made in the Losses Discretionary Reward Project.

WP 6: Stakeholder Engagement / Dissemination
SPEN Stakeholder Engagement / Project Management Support
Plan for transition to BaU

Scope

The project will increase the TRL of the core network data analytical model, working closely with existing Enterprise IT delivery teams to develop a model at near-to-Enterprise level. This will include integration within the current procurement of Enterprise Service Bus IT systems. This will allow users to evaluate the tool in daily activities and drive further insight which can be picked up by the NCEWS2 activity.

Using Agile IT Project Management and working closely with Business stakeholders within Design & Connections and beyond, the project will continue to build understanding and delivery of key business functionality. This will be delivered through specific project-led stakeholder workshops and other BAU Smart Meter Systems (SMS) project stakeholder interaction.

Ongoing development and presentation of key modelling functionality within online GIS platforms will also be a vital part of this engagement. Due to the nature of the data analytics techniques, once the functionality has been developed it is intended to deploy these over wide areas of the distribution network in both SPD and SPM.

There is projected to be major BAU IT investment in data integration IT systems, driven by the business benefit expected to be derived from the integration of Smart Meters. This project will test the business benefits from these systems and seek to integrate the Platform with existing and proposed IT applications.

Objective(s)

Automated verification of network connectivity
An essential building block in the development of automated schemes to reduce CI/CML with associated quantifiable benefits. Understanding of the LV circuit and transformer each customer is fed from allows expected benefits of SM data to be realised. This potentially includes the ability to verify customer phase feeding arrangement, assuming sufficient SM data availability.

Near real-time network connectivity understanding
Visibility of running arrangements at configurable network split points (link boxes). This will provide verification of ongoing operational network changes in as near-to-real-time as possible. This is an enabler for the enhanced level of LV network control which is an expected future requirement for DSO operation.

Improved LV network modelling capability
Development of capability to export LV network and associated network metrics (SM data, EV data, etc) into PSSE systems. Expected to become an essential tool as pressure on the LV network increases through the penetration of LCTs. Quantifiable benefits in terms of saving in design resources and reduced reinforcement through more accurate designs.

Scenario analysis of investment requirements for EV penetration
Development of real SPEN network topologies archetypes, including analysis of EV penetration density from understanding of customer EV charging requirements using GIS data, i.e. distributed on- & off-street parking and/or cluster EV charging locations. Supports the EV NIC proposal and informs SPEN reinforcement requirements for ED2.

Platform for EV connection management
Through the integration of LCT location data and improved LV circuit and transformer connectivity and rating understanding. This would be an overall LCT penetration visualization and access management platform for both internal designer and external customer use. Benefits would be achieved through streamlining the design process and improving customer service.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

Basic LV scenario analysis available for Business-as-Usual implementation.

Demonstration of a workable solution at LV for DER interaction and management.

SM analysis in aggregate form.

Project Partners and External Funding

Derryherk Ltd will contribute in-kind equivalent of 40 person days to the NCEWS2 project.

Potential for New Learning

The project will provide learnings through:

Increased understanding of the data and system requirements for automated verification of network connectivity, and the likely frequency of update possible.

Increased understanding of how network asset information can be used for near real-time network connectivity understanding

Development of improved LV network modelling capability (with and without PSSE tools), using GIS data combined with smart meter data, EV data and other associated data sets (DG, etc)

Development of scenario analysis methodologies for modelling of investment requirements for EV penetration

Development of platform and associated methodologies for EV connection management.

Furthermore, the project will be implemented on already-existing data/IT infrastructure, much of which will be similar to other GB DNOs, therefore the challenges of developing a near-to-Enterprise system will be of benefit to other DNOs seeking to implement a similar system.

Scale of Project

Phase 2 will incorporate the whole SPD region for the NCEWS2 platform.

For the BAU Innovation Implementation, both SPD & SPM will be incorporated.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

SPD & SPM.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

700,000

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)

It is anticipated the introduction of EV could drive reinforcement costs of over £2bn across the UK. If better visibility and modelling at LV, can defer or avoid even 1% of this costs then benefits to customers will be significant. This project is an enabler project which will support the LV Engine NIC, our EV management planning and our losses initiatives. Each of these has a specific, positive benefits case.

Please provide a calculation of the expected benefits the Solution

Based on the development system being successfully implemented as a pilot in 2 districts we estimate that it has the potential to save on 2FTE engaged in the manual analysis of the LV network with equivalent financial benefit of approx. £500k over a 5 year period.

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

The methodologies and analytical techniques proposed are entirely replicable across the whole of the GB energy network at LV.

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

Roll-out costs are dependent on the data available and IT systems in place across the GB DNOs, however the solution developed will sit alongside existing systems, minimising the integration requirements and removing the need to modify these already-existing systems. Assuming similar data availability/quality and IT infrastructure, it is expected that costs would be in the order of £250k per DNO to implement.

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

Demonstration of capability in LV scenario modelling and connectivity improvement will be applicable to all GB DNOs. Improvement in these areas will be needed by all DNOs to effectively manage Smart meter and EV rollout across the LV network.

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

Visibility and control in the network is being addressed.

☑ 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.

This project looks at a method of more intensive use of LV GIS data, combined with smart meter data, and does not replicate other projects in the LV area.

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

Smart meter data is only now becoming available, therefore, it has not been possible to perform the analysis detailed in this proposal until now. Furthermore, detailed analysis of the LV network - that allows the Smart Meter data to be annotated and aggregated at substation level and beyond - had not been performed as there was no requirement or perceived benefit prior to the existence of SM data. Finally, the capability to 'throttle' EV chargers centrally via OCPP has only become possible in the last year as both the OCPP specification evolves and compliant EV chargers are installed on UK streets.

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

There is no 'off the shelf' product that meets the requirements outlined above. This project is a development project to develop the system and techniques required. The Network Licensee will not fund a project from BAU funding during this development phase.

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 system and associated techniques are still in the development phase and there remain technical risks. There also remain commercial risks as the business case has yet to be validated. Therefore BAU funding cannot be justified at this stage and there is no alternative source of funding apart from NIA. If successful this pilot project will validate the business case and demonstrate a roadmap for BAU implementation.

This project has been approved by a senior member of staff

☑ Yes