WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Date of Submission

April 2016

NIA Project Registration and PEA Document

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.

Project Registration

Project Title	Project Reference
LV Connect & Manage	NIA_WPD_014

Project Licensee(s)	Project Start Date	Project Duration
Western Power Distribution East Midlands, Western Power Distribution South Wales, Western Power Distribution South West, Western Power Distribution West Midlands	Apr 2016	3 Years

Nominated Project Contact(s)	Project Budget
Benjamin Godfrey - Innovation & Low Carbon Networks Engineer	£1,675,000

Problem(s)

Network reinforcement can be too expensive and too time-bound to respond to low carbon technology (LCT) connections on the low voltage (LV) network, particularly if rapid clustering occurs (such as with electric vehicles and PV installations). Due to uncertainties in volume, location and type of LV connections, it is not possible or efficient for WPD to plan network reinforcement ahead of need. However, when the need does arise, network reinforcement (traditional base-case solution) can be too expensive and can take too long to deploy, delaying customers' connections to the network.

A comparison of PV installations registered for the FiT and with WPD data shows only ~60% match in notified LV connections. Despite forecasting, there is still a lot of uncertainty as connections might not materialise or might materialise in more abundance than expected. Technology for LV ANM, which extends communications and controls to customers' meters and is able to deal with bi-directional power flows, is still unproven and needs to be trialed by WPD in a low-risk way, to assess whether or not this option is a viable alternative to network reinforcement.

Method(s)

This project will demonstrate and prove that LV ANM can be used as a short-term measure, whilst network reinforcement takes place, to facilitate the timely connection of customers. The solution can then be redeployed to another area when the need case arises. Moreover, the ANM solution provides a long-term alternative to network reinforcement in cases where the investment in traditional assets is not economically viable or other reasons (such as the disruption to customers) prevents reinforcement taking place. In order to maintain the highest standard to service to its customers, WPD plans to connect them as quickly and costeffectively as possible and then actively manage them, once connected.

The LV Connect and Manage Method involves the deployment of communications and control infrastructure to allow LCTs to connect to the network in a timely manner and be managed in an active way. This will involve, limiting the power exported by LCTs to the network at times of LV network congestion or increasing the power demand of LCTs (heat pumps, energy storage and/or EVs) to keep the network within technical limits.

The LV Connect and Manage Method will be delivered in three phases:

1. Mobilisation (including the procurement of equipment and services, and production of the customer engagement and data protection plans.
2. Connect and Manage Trials (including the recruitment of customers to participate in the trial and the installation of equipment in customers' premises and WPD's distribution substations).
3. Analysis and Close Down (including the analysis of results from trials and an evaluation of the LV Connect and Manage solution).

Scope

LV Connect and Manage Architecture

The architecture for the LV Connect and Manage solution will be developed, defining the specification and location of monitoring, communications and control infrastructure elements. This architecture will provide a replicable template for WPD and other DNOs to use in their Licence Areas.

Monitoring of LCTs

The aggregated impact of different types of LCTs (EV chargers and Solar-Battery installations) will be monitored in terms of three-phase power and voltage at up to 6 of WPD's distribution substations in the trial area. The monitored parameters will be compared with operational limits to understand the headroom that currently exists.

Active Management of LCTs

Based on the architecture and informed by the substation monitoring, WPD will design, build and operate the LV Connect and Manage infrastructure for the trial period. This will involve the installation of battery energy storage and EV charge point devices in up to 100 domestic dwellings (where PV installations and EVs have clustered). WPD will also install the systems to control the LCTs in real time, using a fine granularity of control signals to maximise the connection of LCTs to the network.

This project will result in a set of new policies for deploying the LV Connect and Manage solution. This will encompass guides for the specification, design and installation of the LV ANM technologies.

Objective(s)

The objectives of this project are to trial and demonstrate the following:

1. Broadband over powerline, providing the communications solution between distribution substations and customers (enabling the bi-directional power flow control of LCTs)
2. ANM solutions with intelligence distributed into the LV network to monitor and control LCTs in realtime and optimize import / export patterns within operational limits
3. ANM solutions, as a short or long term alternative to network reinforcement, in areas where network constraints are becoming a problem due to the localized uptake of LCTs
4. New business processes, based on proven, off-the-shelf technology, which can be quickly and costeffectively deployed to connect and manage LV customers' LCTs.

Success Criteria

1. Demonstration of the active management of low carbon technologies (energy storage and electric vehicles) by controlling load profiles and alleviating electricity network constraints.
2. Development of a replicable architecture for the LV ANM solution, which can be utilised by WPD in their other Licence Areas and by other DNOs, more generally.
3. Development of novel business processes for deploying ANM technologies into LV networks. (This will include the specification and development of an installation guide for the LV ANM technologies).

Technology Readiness Level at Start	Technology Readiness Level at Completion
5	9

Project Partners and External Funding

Nortech Management Limited – Project Delivery Support and provider of Active Network Management control system equipment.

Potential for New Learning

1. Understanding how to deploy the ANM solution for the connection of low carbon technologies (energy storage and electric vehicles.
2. Understand how load profiles can be controlled and adapted to alleviate electricity network constraints.
3. Specification and development of a replicable architecture for the LV ANM solution, which can be utilised by WPD in their other Licence Areas and by other DNOs, more generally.
4. Understanding how business processes need to evolve for deploying ANM technologies into LV networks. (This will include the specification and development of an installation guide for the LV ANM technologies).
5. Understanding how to engage effectively with customers who are looking to adopt LCTs such as EVs and PV with battery storage.

Scale of Project

In order to understand clustering effects of technologies and the extent to which LV ANM is appropriate, the battery energy storage trial will encompass up to 50 customers and the electric vehicle trial will encompass up to 50 customers.

Geographical Area

The battery energy storage ANM trial will take place in Milton Keynes.
The electric vehicle ANM trial will take place in Nottingham.

Revenue Allowed for in the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£1,675,000

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and 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	☐

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

Specification and development of a replicable architecture for the LV ANM solution, which can be utilised by WPD in their other Licence Areas and by other DNOs, more generally. Specification and development of an installation guide for the LV ANM technologies.

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

2b. Is the default IPR position being applied?

Yes	☒
No	☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2c. Has the Potential to Deliver Net Financial Benefits to Customers ☒

i) Please provide an estimate of the saving if the Problem is solved.

Carbon Saving:

LV Connect and Manage will facilitate the increased uptake of LCTs, enable the potential for higher-powered connections and reduce the time taken to connect customers;

The LV Connect and Manage solution will allow LCTs to connect to the network up to 9 months more quickly than traditional network reinforcement alternatives. This is based on a deployment timescale of up to 3 months for LV Connect and Manage technologies and up to 12 months for traditional network reinforcement. At least £13,500 of carbon savings per customer could be unlocked by the LV Connect and Manage solution. This is based on the LV Connect and Manage technologies enabling a conservative 438kWh of electricity generation from PV, during the nine-month period whilst network reinforcement takes place (i.e. a 3.7kW PV installation with a 10% capacity factor, generating electricity for 4 hours a day, with a conversion factor of 0.49426 and a non-traded price of carbon of £62/tCO2e).

Based on the expedited connection of several PV clusters (three or more customers), the project will have a major carbon benefit, grading it as 5, as published in the ENA NIA Benefits Guide (i.e. over £30,000/tCO2e will be saved).

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

LV Connect and Manage will implement a novel control system for demand side response of electric vehicles and battery energy storage, facilitating the control of bi-directional power flows.

Base case cost: £3,300 - £6,600 per LCT customer.

The typical cost of reinforcing an LV feeder is £40,000, based on ground mounted substation and cable upgrades, as published by WPD in their East Midlands QAS (part of the Connection Charging Methodology).

EATL's My Electric Avenue suggests that 44.4kW clusters of LCTs would be sufficient to trigger the reinforcement of an LV feeder. On a per-feeder basis, this is equivalent to:

- 12 EV slow chargers or 12 PV systems (3.7kW per charger or PV installed capacity) or a £3,300/LCT customer reinforcement cost
- 6 EV fast chargers (7.4kW per charger) or a £6,600/LCT customer reinforcement cost

LV feeder reinforcement would not necessarily be financially viable for smaller clusters of LCTs.

Method cost: £1,300 - £3,300 per LCT customer

The cost of deploying the LV Connect and Manage Solution is £1,300 - £3,300 per customer, including communications, controls, installation, O&M, and assuming the technology is re-deployed at least 3 times (for nine months) during the equipment lifetime.

Considering only a single deployment of the LV Connect and Manage solution, the equipment would cost £3,900 - £10,000 per LCT customer. Taking into account the carbon savings enabled by an expedited connection, the solution would generate benefits in excess of the Method cost in 3 – 7 months.

If the LV Connect and Manage equipment is re-deployed only three times during its lifetime (i.e. once the network has been reinforced, the LV Connect and Manage equipment is available to be re-deployed elsewhere), the equipment costs would reduce to £1,300 - £3,300 per LCT customer. In this case, the solution generates carbon saving benefits, in excess of the Method cost, in 1 – 2.5 months. This is significantly quicker than the expected time to reinforce the LV network.

Financial benefit: The financial benefit ranges from £2,000 per customer (low base case cost and method cost with 12 LCT customers per feeder) to £3,300 per customer (high base case cost and high method cost with 6 LCT customers per feeder).

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

The results of modelling activities within My Electric Avenue have shown that, across Britain, 32% of low voltage feeders (312,000 circuits) will require intervention when 12 or more customers per feeder have 3.7kW (16 Amp) charging installed.

On this basis, the LV Connect and Manage Method could be rolled out across 32% of the UK's LV networks.

The UK already has 2.5GW of PV installed in LV networks (UK Government Statistics on Solar PV deployment). This is forecast to be 4.5GW by 2020 (DECC's Solar PV Deployment Strategy). Based on clusters of 44.4kW of PV triggering an intervention, LV Connect and Manage could be rolled out on a further 45,000 circuits. This replicability could be even greater as LV networks become saturated and the size of PV cluster, which triggers reinforcement, reduces.

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

Based on rolling out the Method on 15% of the 357,000 circuits, the replication cost would be £0.8bn - £1.1bn, depending on the number of LCT customers connected per feeder. This would lead to projected savings of £1.1bn - £1.3bn through network reinforcement avoidance or deferral.

2d. Does Not Lead to Unnecessary Duplication 

i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

This project will demonstrate the active network management of multiple types of low carbon technologies (electric vehicles and battery energy storage) on the LV network. Traditionally ANM has been deployed on HV and EHV networks.

This project will demonstrate the active network management of technologies which can create bi-directional power flows. Management of LV load has traditionally focused solely on the control of demand (My Electric Avenue), using a relatively unsophisticated control method.

This project will feed into SSE's NIA project developing the communications and connection framework for connecting Smart EVs on to the LV network.

ii) If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A