

**NEXT GENERATION
NETWORKS**

LV CONNECT AND MANAGE

WPD_NIA_014

**NIA MAJOR PROJECT
PROGRESS REPORT
REPORTING PERIOD:
APR 2016 – MAR 2017**



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Glossary

Term	Definition
ANM	Active Network Management
BAU	Business as Usual
BPL	Broadband-over-powerline
DG	Distributed Generation
DLC	Domestic Load Control
DNO	Distribution Network Operator
EV	Electric Vehicle
GB	Great Britain
HV	High Voltage
IPR	Intellectual Property Register
LCT	Low Carbon Technologies
LV	Low Voltage
NIA	Network Innovation Allowance
VPN	Virtual Private Network
WPD	Western Power Distribution

1 Executive Summary

LV Connect and Manage is funded through Ofgem's Network Innovation Allowance (NIA). LV Connect and Manage was registered in April 2016 and will be complete by March 2019.

LV Connect and Manage aims to demonstrate and prove that LV Active Network Management (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 arises. The ANM solution can also provide 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) prevent reinforcement taking place. In order to maintain the highest standard to service to its customers, WPD plans to connect them as quickly and cost effectively as possible and then actively manage them, once connected.

This report details progress of the project, since initial registration in April 2016 to March 2017.

1.1 Business Case

Network reinforcement can be too expensive and too time-bound to respond to low carbon technology connections on the low voltage 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 trialled by WPD in a low-risk way, to assess whether or not this option is a viable alternative to network reinforcement.

This project demonstrates 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) for the active management of low carbon technologies (energy storage and electric vehicles) by controlling load profiles and alleviating electricity network constraints. It also develops a replicable architecture for the LV ANM solution, which can be utilised by WPD in their other Licence Areas, and novel business processes for deploying ANM technologies into LV networks.

1.1.1 Carbon Benefit

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).

1.1.2 Cost Benefit

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).

1.2 Project Progress

This is the first progress report. It covers progress from initial registration in April 2016 to the end of March 2017.

From April to June 2016, contracts with Nortech Management Limited and Power Plus Communications were signed and individual partner supplier procurement was underway. The Customer Engagement Plan and Data Protection Strategy was prepared and submitted to Ofgem for approval.

From July to September 2016, the Customer Engagement Plan and Data Protection Strategy documents were reviewed and approved by Ofgem. Following this, a number of activities took place in parallel: (i) procurement of customer engagement contractors; (ii) site selection and surveys; (iii) technical assessment of EV charge point and PV battery/inverter technologies; (iv) design of the Domestic Load Control (DLC) box; and (v) specification of the solution architecture.

From October to December 2016, the customer engagement procurement process was completed and contracts were put in place with The Big Wheel (recruiting EV customers in Nottingham) and The Dairy (recruiting PV customers in Milton Keynes). A policy amendment for project equipment installation in distribution substations was drafted. EV fast charger and PV/battery/inverter technology selection activities were completed: ICU solution was selected for EV fast charger; Tesla/SolarEdge solution was selected for the battery storage/inverter solution. PPC's communications network management system was installed within Nortech's hosting environment and a bench test rig was deployed, demonstrating BPL communications in Nortech's Birmingham office. Limitations were identified with Lucy Electric's Gridkey device and an order was placed to enhance the monitoring functionality required for LV ANM.

From January to March 2017, a prototype Domestic Load Control (DLC) box and substation box was constructed, the algorithm for controlling the LVCM technologies was specified, the

control of the ICU charge point was demonstrated on the bench, the customer engagement activities kicked off and the end-to end transfer of data over the communications system was demonstrated. The communications test was from Nortech's Envoy via PPC's Compact Modem to a Head-end Modem (using Broadband-over-Powerline) through a 4G Westermo router (with secure VPN link) to iHost. The first installation of project technologies took place in the Hereford Depot: A Tesla PowerWall battery and SolarEdge Inverter (for photovoltaic systems), an ICU fast charger for electric vehicles, two domestic load control (DLC) boxes, a broadband-over-powerline (BPL) communications system and LV substation monitoring equipment.

Website content has been published at regular intervals:

<https://www.westernpowerinnovation.co.uk/Projects/Current-Projects/LV-Connect-and-Manage.aspx>

1.3 Project Delivery Structure

1.3.1 Project Review Group

The LV Connect and Manage Project Review Group meets on a bi-annual basis. The role of the Project Review Group is to:

- Ensure the project is aligned with organisational strategy;
- Ensure the project makes good use of assets;
- Assist with resolving strategic level issues and risks;
- Approve or reject changes to the project with a high impact on timelines and budget;
- Assess project progress and report on project to senior management and higher authorities;
- Provide advice and guidance on business issues facing the project;
- Use influence and authority to assist the project in achieving its outcomes;
- Review and approve final project deliverables; and
- Perform reviews at agreed stage boundaries.

1.3.2 Project Resource

WPD: Project Lead

- Mikhail Prokhnich (Project Manager)

Nortech Management Limited: Project Delivery Support and Active Network Management Control System Equipment supplier

- Samuel Jupe (Project Delivery Manager and Technical Lead, Power Systems)
- Simon Hodgson (Technical Lead, Technologies and Communications)
- Sid Hoda (Technical Lead, IT and Hosting)

Power Plus Communications: Communications solution provider

- David Pitcher (PPC Lead)

The Big Wheel: Customer Engagement (Nottingham)

- Gary Smerdon-White (Lead)

The Dairy: Customer Engagement (Milton Keynes)

- Nigel Rowson (Lead)

EV Charging Solutions: EV charge point supplier and electrical installer

- Chris Everitt (Lead)

Stratford Energy Solutions: Battery/Inverter supplier and electrical installer

- Jason Savidge (Lead)

1.4 Procurement

The following table details the current status of procurement for this project.

Provider	Services/goods	Area of project applicable to	Anticipated Delivery Dates
Nortech	DLC system and equipment, Project delivery support	Consultancy/control equipment	End Sept 2017
PPC	BPL system and equipment	Consultancy/comms equipment	End Sept 2017
Stratford Energy Solutions	Battery storage procurement and installation	Supplier/Installer	End Sept 2017
EV Charging Solutions	EV charges procurement and installation	Supplier/Installer	End Sept 2017
THE STC	EV customer engagement	Customer engagement (Nottingham)	End July 2017
THE DAIRY	Battery storage customer engagement	Customer engagement (Milton Keynes)	End July 2017
LUCY	Gridkey unit supply and upgrade	Supplier	End Apr 2017
SCHNEIDER	Fuse handles supply	Supplier	End Apr 2017

Table 1-1: Procurement Details

1.5 Project Risks

A proactive role in ensuring effective risk management for LV Connect and Manage is taken. This ensures that processes have been put in place to review whether risks still exist, whether new risks have arisen, whether the likelihood and impact of risks have changed, reporting of significant changes that will affect risk priorities and deliver assurance of the effectiveness of control.

Contained within Section 7.1 of this report are the current top risks associated with successfully delivering LV Connect and Manage as captured in our Risk Register. Section 7.2 provides an update on the most prominent risks identified at the project bid phase.

1.6 Project Learning and Dissemination

Project lessons learned and what worked well are captured throughout the project lifecycle. These are captured through a series of on-going reviews with stakeholders and project team members, and will be shared in lessons learned workshops at the end of the project. These are reported in Section 5 of this report.

2 Project Manager's Report

2.1 Project Background

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.

2.2 Project Progress

LV Connect and Manage is being delivered in three phases:

1. Mobilisation (including the procurement of equipment and services, and production of the customer engagement and data protection plans). This phase runs from April 2016 to September 2017.
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). This phase runs from May 2017 to September 2018.
3. Analysis and Close Down (including the analysis of results from trials and an evaluation of the LV Connect and Manage solution). This phase runs from January 2018 to March 2019.

2.3 Phase 1: Mobilisation

Progress within this reporting period

From April to June 2016, contracts with Nortech Management Limited and Power Plus Communications were signed and individual partner supplier procurement was underway. The Customer Engagement Plan and Data Protection Strategy was prepared and submitted to Ofgem for approval.

From July to September 2016, the Customer Engagement Plan and Data Protection Strategy documents were reviewed and approved by Ofgem. Following this, a number of activities took place in parallel: (i) procurement of customer engagement contractors; (ii) site selection and surveys; (iii) technical assessment of EV charge point and PV battery/inverter technologies; (iv) design of the Domestic Load Control (DLC) box; and (v) specification of the solution architecture.

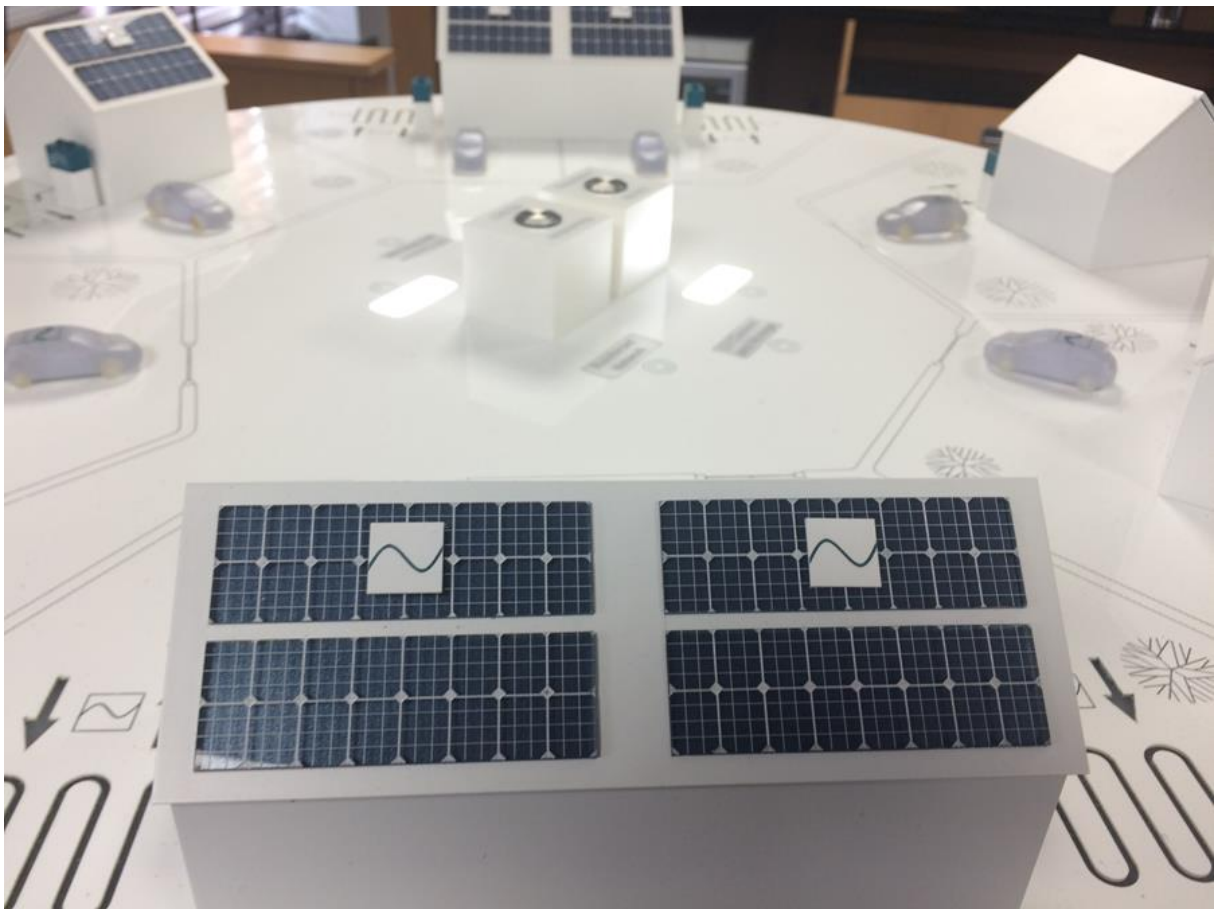
From October to December 2016, the customer engagement procurement process was completed and contracts were put in place with The Big Wheel (recruiting EV customers in Nottingham) and The Dairy (recruiting PV customers in Milton Keynes). A policy amendment for project equipment installation in distribution substations was drafted. EV fast charger and PV/battery/inverter technology selection activities were completed: ICU solution was selected for EV fast charger; Tesla/SolarEdge solution was selected for the battery storage/inverter solution. PPC's communications network management system was installed within Nortech's hosting environment and a bench test rig was deployed,

demonstrating BPL communications in Nortech's Birmingham office. Limitations were identified with Lucy Electric's Gridkey device and an order was placed to enhance the monitoring functionality required for LV ANM.

From January to March 2017, a prototype Domestic Load Control (DLC) box and substation box was constructed, the algorithm for controlling the LVCM technologies was specified, the control of the ICU charge point was demonstrated on the bench, the customer engagement activities kicked off and the end-to end transfer of data over the communications system was demonstrated. The communications test was from Nortech's Envoy via PPC's Compact Modem to a Head-end Modem (using Broadband-over-Powerline) through a 4G Westermo router (with secure VPN link) to iHost. The first installation of project technologies took place in the Hereford Depot: A Tesla PowerWall battery and SolarEdge Inverter (for photovoltaic systems), an ICU fast charger for electric vehicles, two domestic load control (DLC) boxes, a broadband-over-powerline (BPL) communications system and LV substation monitoring equipment.

Website content has been published at regular intervals:

<https://www.westernpowerinnovation.co.uk/Projects/Current-Projects/LV-Connect-and-Manage.aspx>



Above: the LV Connect & Manage interactive model which was produced to aid dissemination and recruitment.



Above: WPD fitter tests the EV charging device installed at WPDs Hereford Depot



Above: WPD fitter inspects the Active Network Management Controller installed at WPDs Hereford Depot



Above: WPD fitter configures the Battery Storage system installed at WPDs Hereford Depot.

Next steps

- Complete installation of demonstration system at Hereford;
- De-risk project through testing communications and controls prior to installation of equipment in customers' homes;
- Put contracts in place with technology suppliers and installers.

2.4 Phase 2: Trials

This phase runs from May 2017 to September 2018.

2.5 Phase 3: Analysis

This phase runs from January 2018 to March 2019.

3 Progress against Budget

Spend Area	Budget (£k)	Expected Spend to Date (£k)	Actual Spend to Date (£k)	Variance to expected (£k)	Variance to expected %
Project Delivery	200	76.606	76.606	0	0
Communications equipment	120	94.085	107.131	13046	13 ¹
Monitoring	40	19.525	19.525	0	0
Control	400	200	200	0	0
Batteries and inverters	250	0	0	0	0
EV charge points	25	0	0	0	0
Customer engagement and dissemination	200	30.274	30.274	0	0
Equipment installation	100	0	0	0	0
WPD PM + Installation	100	14.139	14.139	0	0
Dissemination Modelling	20	17	17	0	0
Contingency	220	0	0	0	0
TOTAL	1,675		464.675		

Comments around variance

1. Unexpected T&E. New sanction was raised to mitigate this.

4 Progress towards 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).

Project is on track to meet all the success criteria.

5 Learning Outcomes

- Requirements capture very important, particularly at system interfaces and for aligning business processes.
- BPL deployment process (installing devices from substation outwards) does not align with customer recruitment process (customer sign-ups are stochastic and we will not necessarily get customers closest to the substation signing up first).
- BPL equipment very sensitive to network topology – highly likely we will need repeater stations to pass the BPL signal through customers' distribution boards into the home (for technology controls).
- Supply chain technology changes, outside of the project's control.
- Having a flexible approach (a willingness to adapt business processes etc.) is more likely to lead to successful innovation.

6 Intellectual Property Rights

A complete list of all background IPR from all project partners has been compiled. The IP register is reviewed on a quarterly basis.

7 Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with WPDs risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- ✓ Defining the roles, responsibilities and reporting lines within the Project Delivery Team for risk management;
- ✓ Including risk management issues when writing reports and considering decisions;
- ✓ Maintaining a risk register;
- ✓ Communicating risks and ensuring suitable training and supervision is provided;

- ✓ Preparing mitigation action plans;
- ✓ Preparing contingency action plans; and
- ✓ Monitoring and updating of risks and the risk controls.

7.1 Current Risks

The LV Connect and Manage risk register is a live document and is updated regularly. There are currently 9 live project related risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. In Table 7-1 **Error! Reference source not found.**, we give details of our top five current risks by category. For each of these risks, a mitigation action plan has been identified and the progress of these are tracked and reported.

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
Delays with substation monitoring equipment procurement	48	Identify alternative suppliers	Substation monitoring equipment is upgraded, final tests are in progress
BPL technology does not work as expected / is not compatible with substations	40	De-risk by demo installation De-risk by site surveys Redundant comms (GPRS) built into solution)	Demo installation in progress DLC boxes are equipped with GPRS modems
WPD resources unavailable	24	Close working relationship between WPD and Nortech with Nortech making WPD's life as easy as possible (within responsibility boundaries)	Close working relationship between WPD and Nortech are established WPD staff is booked in advance
Nortech resources unavailable	24	Nortech to allocate dedicated resource to project	All project tasks have allocated member of staff
Fewer customers subscribe to trial than expected	18	Good quality customer engagement, use local firms, extend length of trials	Good quality customer engagement firms procured Customer engagement process has started

Table 7-1: Top five current risks (by rating)

Table 7-2 provides a snapshot of the risk register, detailed graphically, to provide an on-going understanding of the projects' risks.

Likelihood = Probability x Proximity	Certain/Imminent (21-25)	0	0	0	0	0
	More likely to occur than not/Likely to be near future (16-20)	0	1	0	0	0
	50/50 chance of occurring/Mid to short term (11-15)	0	0	0	1	0
	Less likely to occur/Mid to long term (6-10)	0	4	0	2	0
	Very unlikely to occur/Far in the future (1-5)	0	0	1	0	0
		1. Insignificant changes, re-planning may be required	2. Small Delay, small increased cost but absorbable	3. Delay, increased cost in excess of tolerance	4. Substantial Delay, key deliverables not met, significant increase in time/cost	5. Inability to deliver, business case/objective not viable
		Impact				

	Minor	Moderate	Major	Severe		
Legend	5	0	4	0	No of instances	
Total	9				No of live risks	

Table 7-2: Graphical view of Risk Register

Table 7-3 provides an overview of the risks by category, minor, moderate, major and severe. This information is used to understand the complete risk level of the project.

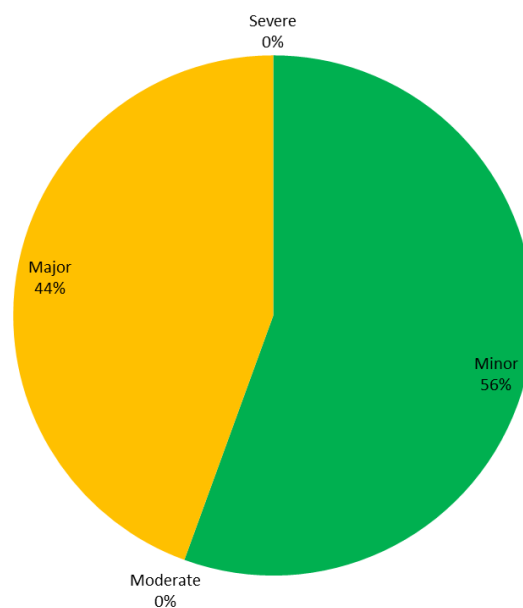


Table 7-3: Percentage of Risk by category

7.2 Update for risks previously identified

Descriptions of the most significant risks, identified in the previous six monthly progress report are provided in Table 7-4 with updates on their current risk status.

Details of the Risk	Previous Risk Rating	Current Risk Rating	Mitigation Action Plan	Progress
Ofgem does not approve engagement plan or delays with approval	24	0	Build in float to plan to allow for delays Use previous (good quality) engagement plans as worked examples	Ofgem approval received in mid-September 2016
Delays with equipment/service procurement	18	0	Identify key equipment and service providers early on Budget plenty of time for procurement process	This risk closed and four separate risks created to manage equipment procurement

Table 7-4: Risks identified in the previous progress report

8 Consistency with Project Registration Document

The scale, cost and timeframe of the project has remained consistent with the registration document, a copy of which can be found here:

<https://www.westernpowerinnovation.co.uk/Projects/Current-Projects/LV-Connect-and-Manage.aspx>

9 Accuracy Assurance Statement

This report has been prepared by the LV Connect and Manage Project Manager (Mikhail Prokhnich), reviewed and approved by the Future Networks Manager (Roger Hey).

All efforts have been made to ensure that the information contained within this report is accurate. WPD confirms that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

