WESTERN POWER DISTRIBUTION

OPEN LV

OPENING UP THE SMART GRID

PROJECT PROGRESS REPORT
REPORTING PERIOD:
JUNE 2019 – NOVEMBER 2019

ea technology

RIIO NIC NETWORK INNOVATION COMPETITION

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Glossary

Term	Definition
Background IPR	Intellectual Property Rights owned by or licensed to a Project Participant at the start of a Project.
Customer Engagement Plan	The plan that the Network Licensee must submit to Ofgem setting out how it or any of its Project Partners, will engage with, or impact upon, Relevant Customers as part of the Project.
Distribution Network Operator (DNO)	Any Electricity Distributor in whose Electricity Distribution Licence the requirements of Section B of the standard conditions of that licence have effect (whether in whole or in part).
Expert Panel	A panel of independent experts who together provide knowledge and expertise under the following headings: energy network industries, environmental policy, technical and engineering, economics and financial and consumer interests. The panel is appointed by Ofgem to advise the Authority's decision-making process on the selection of Projects for funding.
Foreground IPR	All Intellectual Property Rights created by or on behalf of any of the Project Participants, their sub-Licensees, agents and sub-contractors as part of, or pursuant to, the Project, including all that subsisting in the outputs of the Project.
Full Submission Pro-forma	Pro-forma which Network Licensees must complete and submit to Ofgem in order to apply for funding under the NIC.
Funding Licensee	The Network Licensee named in the Full Submission as the Funding Licensee, which receives the Approved Amount and is responsible for ensuring the Project complies with this Governance Document and the terms of the Project Direction.
Intellectual Property Rights (IPR)	All industrial and intellectual property rights including patents, utility models, rights in inventions, registered designs, rights in design, trademarks, copyrights and neighbouring rights, database rights, moral rights, trade secrets and rights in confidential information and know-how (all whether registered or unregistered and including any renewals and extensions thereof) and all rights or forms of protection having equivalent or similar effect to any of these which may subsist anywhere in the world and the right to apply for registrations of any of the foregoing.
ITT	Invitation to Tender
LV	Low Voltage
LV-CAP™	Low Voltage Common Application Platform.
NIC	Network Innovation Competition.
Project	The Development or Demonstration being proposed or undertaken.
Project Bank Account	A separate bank account opened and used solely for the purpose of all financial transactions associated with a NIC Project.
Project Direction	A direction issued by the Authority pursuant to the NIC Governance Document setting out the terms to be followed in relation to the Eligible NIC Project as a condition of its being funded pursuant to NIC Funding Mechanism.
Project Participant	A party who is involved in a Project. A participant will be one of the following: Network Licensee, Project Partner, External Funder, Project Supplier or Project Supporter.

Term	Definition
Project Partners	Any Network Licensee or any other Non-Network Licensee that makes a contractual commitment to contribute equity to the Project (e.g. in the form of funding, personnel, equipment etc.) the return on which is related to the success of the Network Licensee's Project.
Project Supplier	A party that makes a contractual commitment to supply a product or service to the Project according to standard commercial terms that are not related to the success of the Project.
Relevant Background IPR	Any Background IPR that is required in order to undertake the Project.
Relevant Foreground IPR	Any Foreground IPR that is required in order to undertake the Project.
Successful Delivery Reward Criteria (SDRC)	The Project specific criteria set out in the Project Direction against which the Project will be judged for the Successful Delivery Reward.
WPD	Western Power Distribution

1   Executive Summary

The OpenLV Project "the Project" is funded through Ofgem's Network Innovation Competition (NIC) funding mechanism. The Project commenced in December 2016 and is scheduled to complete in April 2020.

The Project has three phases:

1) Mobilise & Procure   (the period from commencement to the end of June 2017);
2) Design & Build   (the period from July 2017 to end of March 2018); and
3) Trial, Consolidate & Share (the period from April 2018 to the end of the project).

This Report details the progress of the Project, finalising the first phase "Mobilise & Procure" and progress made in the "Design & Build" phase. This is the fifth Project Progress Report (PPR) for the Project and details progress on the last six months, December 2018 to May 2019.

The three methods being considered in this project are:

Method 1 - Network Capacity Uplift: Delivers additional capacity from existing assets therefore avoiding or deferring significant LV network reinforcement and also, the installation of new underground cables and transfer of services, which can have a significant 'behind the scenes' impact on customers;

Method 2 - Community Engagement: Provides communities with relevant LV network data will empower customers to understand how their energy use impacts the distribution network and the ability to deploy innovative algorithms and applications designed to benefit the community will provide significant benefits directly to customers. For example, many customer impacts are 'behind the scenes', which can lead to a disconnect between DNOs and customers. Increasing understanding and aligning aims so that customers also become actors in low carbon networks could be the part of a paradigm shift that de-risks the transition to a low carbon economy for both parties; and

Method 3 - OpenLV Extensibility: Provides academics and new and innovative service providers (including non-energy companies) with relevant LV network data and the ability to deploy innovative algorithms and applications designed that will ultimately provide significant benefits to customers.

1.1   Overall Project Progress

The key achievements in the reporting period are as follows:

* Across all three Methods within the OpenLV Project, the planned 80 units have now been installed and commissioned.
* It should be noted that five installed locations are 'shared' between Methods 2 and 3, due to proximity of suitable installation locations and benefits for communities and third parties derived from pooling the available data.
* The Method 2 Community Engagement has now been completed and all the participating groups have been interviewed to capture their experiences and learning from the trial.

- CSE have submitted a report 'Learning gained from engaging with and supporting Community Groups' capturing learning from supporting the Method 2 community groups,
    - CSE have added further functionality to the community web app, including the capability to display data from other API such as community owned solar farms or assets,
    - Community groups continued to use the data from their substation(s) to communicate with their communities according to their requirements up to and beyond the official end of the trial.
    - A Workshop was organised at SS Great Britain in Bristol on 20th November for Method 2 and 3 trial participants to share learning and experiences.
- The project team initially received 23 applications to take part in the Method 3: OpenLV Extensibility trials. All these applicants were interviewed, and 17 organisations were, at first, selected to take part in this trial. Of those 17, 2 companies expressed their inability to proceed with the projects at a later stage but, since then, 14 further organisations have shown their interest on the project and 8 of those decided to go ahead with the trials. There is currently a total of 23 third parties involved on the Method 3 trials with a total of 25 different ideas.
- Since the last project update, we realised the desirability of showing how OpenLV enables the transition to electric vehicles. Although we had one app which may have demonstrated this capability, there was at the time uncertainty surrounding the developer would be able to deliver the app. We are now glad to report that the trial will now be able to demonstrate an appetite from two trial participants to deliver car charging apps.

1.2   Business Case

At the time of writing, there have been no changes to the anticipated benefits to be gained by the Project.

1.3   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. These are reported in Section 8 of this report.

Key dissemination activity within the reporting period are as follows:

- An event was held in November 2019 at which Method 2 and 3 participants provided updates on the progress of their projects and shared learning. The feedback was very positive, and the opportunity was taken to capture video interviews of participants and project partners;
- A Stakeholder newsletter was produced in November 2019;
- Knowledge capture sessions have commenced between method 3 participants and the project for use within SDRC 4;
- On the 9th of October Imperial College delivered a webinar to CIGRE members on Active network management in LV networks: a case study in the UK. This research was based upon OpenLV data;

- A progress leaflet "What we've achieved" was created to disseminate learning so far. Printed versions were available at all dissemination events through the winter and it was downloadable from the project website;
- The project was represented at the LCNI conference in Glasgow, the WPD Balancing Act conference in London and at the Regen Renewable Future conference in Bath; and
- The project website has been updated to include more case studies and an interactive geographical view of trial sites, allowing access to specific trial at each site.

1.4   Risks

The OpenLV risk register is a live document and is updated regularly. A total of 54 risks have been raised, 41 of which have been closed, leaving a total of 13 live 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. Of the 13 live risks none are ranked as severe or major, 3 are ranked as moderate and 10 are ranked as minor.

2   Project Manager's Report

2.1   Project Background

The OpenLV Project "the Project" is funded through Ofgem's Network Innovation Competition (NIC) funding mechanism. The Project commenced in December 2016 and is scheduled to complete in April 2020.

The Project Partners are as follows:
1) Western Power Distribution (WPD): The Lead/Funding DNO (licensee); and
2) EA Technology: The 3rd Party Lead Supplier who is responsible for the overall delivery of the Project.

The Project has three phases and four work packages as shown in Figure 1. This Report details the progress of the Project, focussing on the last six months, June 2019 to November 2019. The reporting period is depicted on Figure 1 by the grey shaded box.

Figure 1: OpenLV Timeline

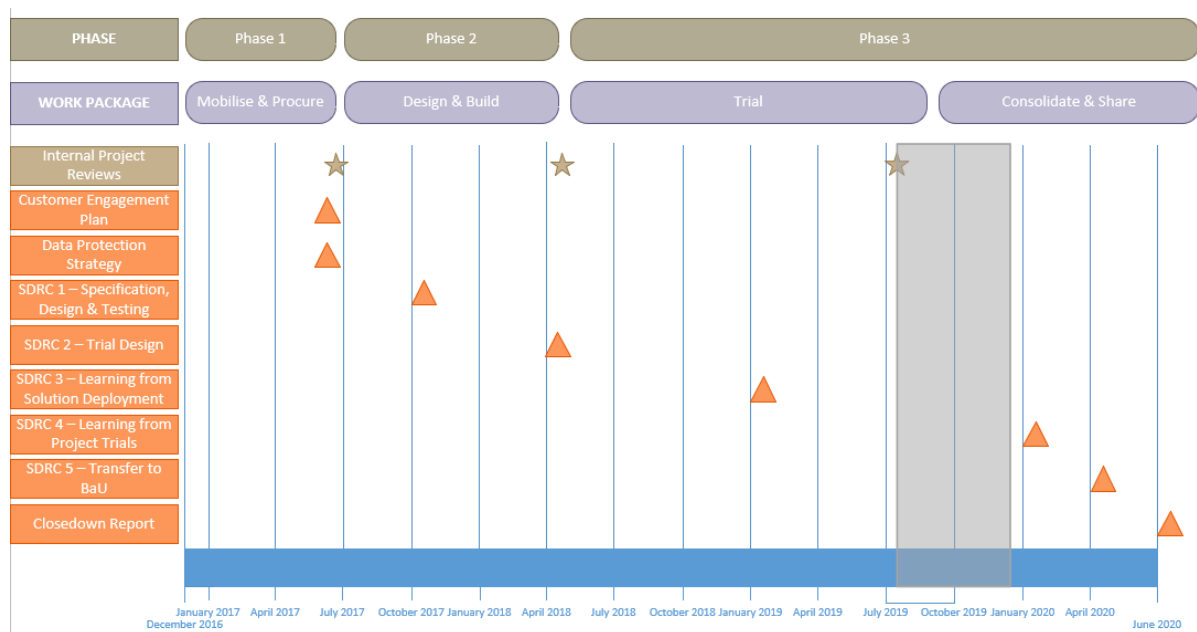### 2.2   Project Progress

2.2.1   Overall Progress

During this reporting period the key achievements are as follows:

- The 80 OpenLV platforms planned for installation across WPD's licence areas, spanning all three Methods, were commissioned and operational;
- The trial periods for Methods 1 and 3 ended on 31 October 2019
- The trial period for Method 2 ended on 30 September 2019

- It should be noted that five installed locations are 'shared' between Methods 2 and 3, due to proximity of suitable installation locations and benefits for communities and third parties derived from pooling the available data;
- The project team initially received 23 applications to take part in the Method 3: OpenLV Extensibility trials. All of these applicants were interviewed, and 17 organisations were, at first, selected to take part in this trial. Of those 17, two companies expressed their inability to proceed with the projects at a later stage but, since then, 14 further organisations shown their interest on the project and 8 of those decided to go ahead with the trials. There is currently a total of 21 third parties involved on the Method 3 trials with a total of 25 different ideas;
- It should be noted that the final number of the Method 3 participants has varied during the trial. Since the last trial we have had one additional app added to the portfolio of apps being trialled.

2.2.2 Procurement

No change. All the required commercial agreements for the Project are in place.

2.2.3 Trials

This phase of the Project included setting up the overall OpenLV Solution as defined in the bid submission document and underpins the ability of the Project to test each of the proposed Methods. This phase provided the overall OpenLV Solution to be trialled for each of the three Project Methods:

Method 1 - Network Capacity Uplift: demonstrated how the OpenLV platform can be utilised to increase the capacity of the LV network. Importantly, this Method sought to prove how network control can be carried out, effectively and securely, via a highly decentralised architecture. This will enable costly and disruptive network reinforcement costs to be deferred or avoided.

Method 2 - Community Engagement: demonstrated the value of providing LV network data and an 'open platform' to communities, who want to be part of a smarter grid, to better understand their electricity use (and generation). This enabled communities to take action, for example, to reduce their impact on the environment, energy use and energy costs or to deploy innovative apps on the intelligent substation devices.

Method 3 - OpenLV Extensibility: demonstrated the benefits of providing an 'open platform' that enabled academics, companies (including non-energy companies) and communities to develop innovative algorithms and apps that could be deployed on intelligent substation monitoring devices to improve network performance, facilitate non-traditional business models and support the uptake of Low Carbon Technologies (LCTs) like electric vehicles, localised generation / energy storage, etc.

For reporting purposes, the progress under the Design & Build phase was been split into the following categories:

1) **Enabling Works:** Provides an overview of the work completed on the overall OpenLV Solution that will support the three Project Methods.
2) **Network Capacity Uplift:** Provides an overview of the work completed to support the Project trials under Method 1.

3) **Community Engagement:** Provides an overview of the work completed to support the Project trials under Method 2.
4) **OpenLV Extensibility:** Provides an overview of the work completed to support the Project trials under Method 3.

It is confirmed that the following progress, under the **enabling works** category has been made within the reporting period:

- All 80 OpenLV platforms have been built, tested, deployed and commissioned on the LV Network.
- Over the course of the OpenLV Project, transient power outages and other events outside the Project's control have required some OpenLV trial units to be manually reset. Between now and decommissioning of the equipment, any such outages will not be rectified as it is not deemed a worthwhile use of Project resources.
- The actions recommended by the cyber-security assessment of the overall OpenLV Solution have been completed and verification of the updates has been undertaken by experts from cyber-security specialists NCC Group. The assessment report is currently under development.

Following the success of the initial OpenLV trials, EA Technology continued development of the LV-CAP™ software platform outside of the OpenLV project, including the development of a custom hardware package to replace the 'off-the-shelf' hardware utilised in the trials.

As such, it is important to clarify the following distinctions between the trial and future BAU deployments when considering the outcomes of NCC Group's cyber-security evaluations.

Within the OpenLV Project, the software deployed on the trial platforms comprises an Ubuntu Linux operating system, with an LV-CAP™ software layer running 'on top', drawing on several core software applications to provide the essential system functionality.

Since the OpenLV Project deployed the trial platforms, the software has been significantly altered at an architectural level. The operating system is now a custom Linux build, utilising only the functional components required for the platform, reducing the space required on the hardware, the available attack surfaces and processing capabilities needed to operate effectively. The core LV-CAP™ elements installed as an additional software 'layer' in the Project Trials are now embedded within this custom operating system with core software functionality that may need future adaptations remaining as discrete software applications.

For example, the applications relating to data communications can be replaced, or reconfigured to meet client requirements, and this is easier to accomplish through changing discrete software applications.

For the purposes of clarification, the software platform tested by NCC Group is that deployed within the OpenLV Project trials, and not the later version being deployed by EA Technology in recently released BAU products.

The penetration and subsequent verification testing undertaken on the trial system, are expected to show in some instances, that the identified issue has not been fully resolved; this is

due to resolution having been achieved through hardware changes (the new BAU hardware), software architectural changes (the new OS build), or updates to the core application containers.

It is confirmed that the following progress, under the **network capacity uplift** category has been made within the reporting period:

- Method 1 Phase 1: All 50 allocated units are installed;
- Method 1 Phase 2:
    - All 10 allocated units are installed;
    - The control trial has been implemented on three of the five pairs and been demonstrated successfully in all instances;
- Detailed analysis of the data gathered is underway in preparation for SDRC 4.

The primary technical aim of the trials, to demonstrate that LV-CAP™, as a distributed intelligence platform, can fill the multiple roles of network monitoring, data processing, decision making and network implementation, has been a clear success as a demonstration of the potential for LV Automation. The system is functioning as expected, implementing LV network automation without requiring intervention by EA Technology or WPD beyond assignation of operating thresholds.

It is confirmed that the following progress, under the **community engagement** category has been made within the reporting period:

- CSE have continued to develop the functionality of the community web app, adding the ability to include data from other API such as the community solar farm owned by the Yealm community groups or the conglomerated battery data from the Bath and West Community Group,
- Community groups continued to use the data from their substation(s) to communicate with their communities according to their requirements. CSE are providing them with professional guidance on how to communicate with their community as required,
- CSE have interviewed participating groups to capture their experiences and learning from participating in the trial. This learning was captured in their report 'Learning gained from engaging with and supporting community groups,' delivered in November 2019,
- EA Technology and Regen hosted a community energy hub at their renewable futures event in Bath on the 27th of November. This hub showcased the work done by the method 2 participants. In addition to this, a roundtable event was undertaken where community groups who did not participate in the trial were able to discuss their views on how open data would enable them to participate in the net zero transition.
- A Workshop was delivered for Method 2 and 3 organisations participating in the project in November 2019 at SS Great Britain in Bristol. This event allowed groups and organisations participating in the project to meet each other, learn about the projects that other groups were involved with, find out more about the wider project and meet representatives from WPD and EA Technology. Participants also discussed their future aspirations for using LV network data;

It is confirmed that the following progress, under the **OpenLV extensibility** category has been made within the reporting period:

- A further 14 organisations showed interest in taking part on the OpenLV project after the application process was finalised in February 2018. It was decided that the project management time required to accommodate these new organisations could still be provided, should the parties only require OpenLV data to undertake their investigations. As such, parties that are interested on accessing OpenLV data are still being welcome to join the trials and a further organisation has been taken on board on this reporting period;

- Since the last reporting period, no further developers have withdrawn from the trial, although at one point there was a risk of a key use case not being demonstrated. For this reason, an additional app was taken on to ensure we could conduct a trial on managed car charging. Development of this app has proceeded within the expected trial deadlines and demonstration of the app by the developer is expected to be reported within SDRC 4.

  - EA Technology have held regular catch up calls with project developers and over this period to support development. EA Technology have provided platform support to trial participants, with the effect of achieving the trial status summarised in Table 1.

Table 1: Method 3 - Operational Status

Idea Type	Number of Ideas	App Certification	App Deployment	API enabled
App	8	8/8	4/8[1]	
Server Link	4			4/4

- One of the apps quoted in Table 1 refers to an instance of the LV-CAP™ platform running on a 3rd party piece of software. Whilst this isn't strictly an app, it does prove a willingness to extend the use of the LV-CAP™ platform across hardware to expand the supply chain.

2.2.4   Key Issues

The following key issues were encountered and managed within the reporting period:

- **Time frame** - Community groups are dependent on the time available from volunteers who have other responsibilities as well as trying to deliver objectives for the group or organisation. Trying to achieve this trial in the short timeframe available was not conducive to maximising learning;

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[1] 8/8 expected within four weeks

- **Data losses** – various technical issues resulted in substantial gaps in the data that was provided to a few community groups or delays in them receiving the data. These gaps were due to equipment being installed for short term usage rather than BAU. This was not ideal. It reduced confidence of the effected groups in the project team, hindered development of the web app and delayed data processing by the groups.

- **Method 3 trials challenges**:

    o We still continue to observe differing levels of commitment to trial conduct. Particular themes of trial commitment include
        ▪ Parties have benefitted from external research funding are generally able to commit more fully to the project. Parties who are funding development out of their own R&D budget sometimes come under pressure to direct development staff towards paid work at the expense of trial progress.
        ▪ Parties whose app can be shown to offer value immediately, find it easier to progress at a faster rate. Parties who have proposed an app, which is likely to create value, subject to regulatory or industry changes may not be as able to commit R&D resource to app development as strongly.

    o Within the population of app developers, we have observed different levels of software development experience. The amount of support required to help trial participants has therefore varied and caused an element of uncertainty to the deployment date for certain apps.

    o Some developers have struggled to keep the size of their apps within the size limits of the platform. This has been attributed to a dependency of some of these apps on including libraries which allow standardised functions to be called by their source code. Inclusion of entire libraries has the effect of vastly increasing the size of the app with content that is not called by the source code. This effect has caused at least two of the apps non-compliances during the testing stage. At this stage, our perception is that this effect may be linked to the experience of the developers and that there are efficient software development techniques which can overcome this. We shall explore this factor further during our close down interviews.

    o One of the participants trialling a car charging app is dependent on the availability of a particular vehicle. This vehicle has recently been unserviceable, which has impacted on trial availability. This vehicle has recently become available again and trial demonstration of the car charging app is expected to resume.

2.2.5 Deliverables

The following key deliverables were completed in this reporting period:

- Methods 1, 2 and 3 trial periods were ended, although the equipment and support systems will remain active until decommissioning in early 2020.
- Method 1 Phase 2 trials continued – in this period the control triggers were set to a constant value for an extended period, to represent a BAU scenario where the transformer may be operating near capacity. Rather than actively seeking to demonstrate

switching functionality, the Project has now demonstrated that switching operation will be curtailed, ceasing as necessary when ambient temperatures reduce.

- A set of three mid-trials reports were delivered by Regen between January and October 2019.
- A community engagement report, 'Learning gained from engaging with and supporting community groups', was delivered by CSE in November 2019.
- A workshop event for Method 2 and 3 trialists was held at SS Great Britain in Bristol on the 20th November. The event was attended by participants of Methods 2 and 3. Its aim was to allow project trialists to discuss topics of interest and get a better insight of the OpenLV project and to meet representatives of the project partners and relevant suppliers. Presentations were given by several project partners; two different community groups and one academia participant and networking tables were also prepared for active discussions.
- A roundtable discussion was held at Regen's Renewable Futures: The Net-Zero Summit on the 27th of November. These round tables were designed to explore attitudes to community groups of how open data will enable them pursue net zero. This event raises awareness of the OpenLV project and also explores attitudes to community participation following on from international declarations of climate emergency.

2.3   Outlook to the Next Reporting Period

During the next reporting period the Project will continue to complete key tasks to finalise the Design & Build work package and continue the Trial work package. The project team will:

- Produce and submit SDRC 4: Learning generated from the OpenLV project trial for all methods;
- Complete data analysis and determine wider deployment benefits of OpenLV solution;
- Produce and submit SDRC5: Knowledge capture, dissemination and transferring the OpenLV solution to business as usual;
- Produce and submit the project closedown report;
- Continue to share learning from the Project through newsletters industry publications and conferences and news articles;
- Create more case studies to disseminate Lessons Learned from the project;
- Attend and present at relevant industry and community events;
- Decommission the trial equipment deployed by the OpenLV Project.

3   Business Case Update

At the time of writing, there have been no changes to the anticipated benefits to be gained by the Project.

4   Progress Against Plan

4.1   This Reporting Period

Table 2 summarises the progress in this reporting period against the project plan. Key issues encountered during the reporting period are provided in Section 2.2.4.

Table 2: Progress Against Plan

Item	Milestone Description	Status	Due Date	Revised Due Date
1	Method 1 trial	Complete	Jun-19	Oct-19
2	Method 2 trial	Complete	Jun-19	Sep-19
3	Method 3 trial	Complete	Jun-19	Oct-19
4	Compare LV-CAP™ against BAU and compare alternatives using TRANSFORM	In Progress	Jun-19	Jan-20
5	Evaluation of the effectiveness of LV-Cap™ for Communities	Complete	Aug-19	Nov-19
6	Evaluation of the effectiveness of LV-Cap™ for 3rd party organisations	Complete	Sep-19	Nov-19
7	Decommission equipment Method 1	Not started	Nov-19	Mar-20
8	Decommission equipment Method 2	Not started	Nov-19	Mar-20
9	Decommission equipment Method 3	Not started	Nov-19	Mar-20
10	Create network models for undertaking LV-CAP™ simulation	Complete	Mar-19	Nov-19
11	Method 1 Simulate networks with and without LV-CAP™ deployed as per the OpenLV Project.	Complete	May-19	Nov-19

The OpenLV FSP outlines an 18-month duration for the Method 1 network capacity uplift trials. The trials of the first 4 OpenLV platforms started on 13th December 2017, with the remainder of devices added over the subsequent ten months. As a result, the trials ran for a from January 2018 to at least October 2019. This enabled the project team to collate the learning from the trials and this will be reported in "SDRC-4 Learning Generated from the OpenLV Project Trials for All Methods", which is scheduled for delivery in January 2020.

Due to the delays in site identification, equipment deployment and hence full commencement of the trials, the simulation work necessary for extrapolative analysis of both WPD's and GB licence areas remains underway.

It had been expected during the bid development stage that the LV Network Template Data (LVNT) would be available for the correlative analysis from the OpenLV trial locations to WPD's

four licence areas. Combining the input data and processing it through the LVNT tool has required significant effort to allow the project outputs to be achieved, although with the additional benefit of having processed that information for the entirety[2] of WPD's network.

Implementation of system updates following the cyber-security evaluation undertaken on the LV-CAP™ platform early in the OpenLV Project, a verification check has been completed. It is noted that within the bounds of the OpenLV Project, the LV-CAP™ software has been updated as far as necessary to maintain the necessary security when deploying 3rd Party Applications. As the hardware utilised in the OpenLV Project is fundamentally different to that now being utilised for BAU deployments of the LV-CAP™ software the 'final iteration' of software within the Project is several iterations behind the latest BAU version.

This latest software, having been developed for the bespoke, BAU hardware, has not been tested or deployed on the now obsolete hardware utilised within the project. Consequently, the verification testing undertaken was on a 'snapshot' of the software improvements and demonstrates the development process underway.

For verification that all issues are resolved, a further series of penetration tests would be required on the latest hardware and software combination, but this remains outside the scope of the OpenLV Project.

Due to the extended trial periods for each method the decommissioning of trial equipment will commence in January 2020 and is scheduled to complete in March 2020.

4.2   Next Reporting Period

Table 3 summarises the key planned activities for the next reporting period. Description(s) of key planned activities for the next reporting period are provided in Section 2.3. Items 7 and 8 were scheduled to be completed within this reporting time period but have been re-scheduled. It is confirmed that re-scheduling these items has had no impact on key deliverables.

Table 3: Progress Against Plan

Item	Milestone Description	Status	Due Date	Revised Due Date
1	Compare LV-CAP™ against BAU and compare alternatives using TRANSFORM	In Progress	Jun-19	Jan-20
2	Decommission equipment Method 1	Not started	Nov-19	Mar-20
3	Decommission equipment Method 2	Not started	Nov-19	Mar-20
4	Decommission equipment Method 3	Not started	Nov-19	Mar-20
5	SDRC 4 Learning generated from all trials from all methods	In Progress	Jan-20	

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[2] Less a relatively small minority of substations where critical information was not present in the available datasets and would have required a disproportionate amount of time to locate manually.

6	SDRC 5 Knowledge capture, dissemination and transferring the OpenLV solution to BaU	Not started	Apr-20	
7	Cyber-security workshop on business as usual deployment of OpenLV solution	In progress	Mar-20	
8	Anonymisation of all data	Not started	May-20	
9	Securely archive data	Not started	May-20	
10	Project closedown report	Not started	May-20	

5   Progress Against Budget

Table 4 shows the baseline budget as outlined in the FSP.

Table 4: Progress Against Budget

Cost Category	Total Budget £k	Expected Spend to Date Nov-19	Actual Spend to date Nov-19	Variance £k	Variance %
Labour	267.3	237.8	239.0	-1.2	0%
Equipment	853.6	852.7	812.0	40.6	5%
Contractors	3,775.1	3,513.3	3,337.3	176.0	5%
IT	2.5	2.3	1.5	0.9	38%
IPR Costs	0.0	0.0	0.0	0.0	0%
Travel & Expenses	29.7	26.4	22.6	3.8	14%
Payments to Users	0.0	0.0	0.0	0.0	0%
Contingency	451.5	451.5	25.0	426.5	94%
Decommissioning	66.0	44.0	0.0	44.0	0%
Other	0.0	0.0	0.0	0.0	0%
TOTAL	5,445.7	5,128.0	4,437.4	690.6	

In terms of the variances shown no line items are in excess of the -5% threshold requiring explanation. For reporting against baseline, contingency spend is assumed to be linearly distributed across the project timescale. However, only a relatively small amount of contingency budget has been accessed to date. £15,000 of contingency has been used to develop a community group LV-CAP™ application and an associated webapp to enable visualisation and dissemination of OpenLV data. This was done to address the issue of community groups not having the skills to develop their own applications. An additional £5,000 was sent on several webapp enhancements in response to requests from community groups. A number of requests were received, assessed and those delivering significant benefits were approved. A further £5,000 of contingency has been used to bring Yealm Community Energy into the project as a replacement for Method 2 participant WHG.

6 Bank Account

The bank account statement for the project, for the reporting period is provided in a separate confidential Appendix.

7   Successful Delivery Reward Criteria (SDRC)

Table 5 details the status of each SDRC outlined in the Project Direction [Ref. 2]. No SDRC reports were due within this reporting period. The following SDRC report will be delivered within the next reporting period:

- SDRC 4: Learning Generated from the OpenLV Project Trials for All Methods.
- SDRC 5: Knowledge Capture, Dissemination & Transferring the OpenLV Solution to Business as Usual.

Please note that all SDRCs that are currently flagged as 'Not Started' were not planned on being underway at this point in the Project and so should be considered as on-schedule.

Table 5: SDRCs to be completed

SDRC	Description	Due Date	Status
SDRC 1	Specification, Design and Factory Testing of the overall OpenLV Solution	27/10/17	Delivered
SDRC 2.1	Community Engagement Plan & Interim Results of Assessing Market Potential (Methods 2 & 3)	31/12/17	Delivered
SDRC 2.2	Identification of Target Networks (Method 1), Update of Assessing the Market Potential (Methods 2 & 3) and Detailed Trial Design for all Methods	30/05/18	Delivered
SDRC 3	Learning from Deployment of the Overall OpenLV Solution & Standard Guidelines for Application Development	08/02/19	Delivered
SDRC 4	Learning Generated from the OpenLV Project Trials for All Methods	31/01/20	In progress
SDRC 5	Knowledge Capture, Dissemination & Transferring the OpenLV Solution to Business as Usual	30/04/20	Not Started

8   Learning Outcomes

8.1   Learning Outcomes

The high-level learning outcomes recorded within the reporting period have been categorised under the following headings:

- Commercial, Project Management & Dissemination; and
- Overall learning points for each of the OpenLV Methods.

8.1.1   Commercial, Project Management & Dissemination

The commercial and project management learning points recorded within the reporting period are as follows:

➢ **Media Engagement:** The energy media "get" the OpenLV concept, and the value of case studies should not be underestimated. A portfolio of case studies has now been established and is available on the website and in print form. Regular tweeting about new case studies appears to be an effective way to drive traffic to the project website; and

➢ **Value of Dissemination:** The value and overall impact of dissemination should not be under-estimated. The project received strong interest from both UK and international visitors at the recent LCNI conference.

8.1.2   The Project Methods

Community Engagement (Method 2) – Trial Learning

➢ **Web app –** Allow longer timeframes for community groups to test out web app functions and make best use of data. Provide training on web app at the start of project delivery, with regular refreshers and opportunities for users to share learning;

➢ **Interpreting data -** Ensure time is made available for support with accessing and interpreting data where needed. Develop narratives to present opportunities arising from use of the data to improve success of community engagement activity.

➢ **Trial duration –** Build in more time for community trials (ideally several years as a minimum).

➢ **Topography** - Manage expectations around substation selection and build in more time for identifying and checking substation suitability. Neighbourhoods do not generally correlate with substation maps, projects using LV substation data at community level may be better delivered either with specific streets or with access data from multiple substations

➢ **Data format -** Clarify at the start of the web app development process the formats that would be most useful for exporting data (to facilitate modelling and manipulation outside the web app).

➢ **Recruitment -** Consider time of year when planning recruitment. Allow sufficient time to allow community organisations to apply. Use case studies to recruit a wider range of organisations by showing range of potential benefit of accessing LV data;

OpenLV Extensibility (Method 3) – Project Trials

- **Data sharing –** Several organisations initially requested access to a minor set of substation's data but realised that having access to a wider set of information would allow them to analyse more scenarios. Consequently, interested participants were provided with access to more substation's data than the originally planned;
- **Testing capabilities –** It is important to have an open mind and various plans of action when referring to testing in a trial environment. This was the case on IBM's trial where the availability of a Tesla car was not feasible for field tests and IBM are now trying to adapt their application to interact with other EVs or event test their application with a simulated vehicle instead. We now expect to use an actual vehicle for this part of the trial
- **Project publications –** Parties need to be reminded of their contractual agreements from time to time, specially related to the publication of papers/articles, so that any information released by them (e.g. magazines, conferences, social media, etc.) with regards to their trials follow the guidance and requirements of the project partners and OpenLV project;
- **Participant's forum –** A few participants proposed the idea of the project offering a shared platform to allow organisations to share information between themselves so that learning and project ideas/developments from one party can also be used by others while the project is in progress. This could help participants to avoid repeating work that may have already been done;
- **Regular progress reviews –** Monthly telephone and skype calls were held with the participants to ensure the right technical and project management support was provided to the trialists. More frequent meetings and/or email communications were also exchanged when required. The regular progress updates were appreciated by all parties and encouraged them to keep on track with their project plans
- **Commercial innovation model –** It is important to recognise different participants pursue different levels of commercial risk with developing their plans. For example, participants developing apps which can be applied to benefit the existing industry see less risk in developing apps than participants who are dependent on future industry evolution before benefits from their app can be harnessed.

8.2   Learning Dissemination

The following dissemination activities have been completed within the reporting period:

- New project update brochure produced "What we've achieved" in September – this was available as a printed leaflet at events held during Autumn and Winter 2019, and downloadable from the project website

- New project case studies produced in summer and autumn 2019

- LCNI conference in October, Glasgow

- Method 2 and 3 participant workshop held in November, Bristol

- WPD Balancing Act project presentations in November, London

- Regen Renewable Futures event in November, Bath

- Project newsletter prepared in November 2019

- Eighteen tweets have been published in twitter with 53 re-tweeted. The project account now has 507 followers and there were nearly 29,000 impressions over this reporting period

- Imperial College has written two papers related to their project trial: Active network management in LV networks: a case study in the UK; and Self-learning Control for Active Network Management

9 Intellectual Property Rights

9.1 Overall IP Statement

Table 6 outlines the details of the Background IP that will be brought to the Project and the Foreground IP that either will or could be generated on the Project. No changes have been made to the IP Register during this reporting period.

Table 6: IP Summary

IP No.	Description	Detail of IP	IP Type	IP Created By	IP Assignment
IP001	Core LV-CAP^TM system	Comprising the operating system image including Internal API, 3rd Party Developer API (v1.0) and the following containers: MQTT, Data Storage, Sensor Reads, Container Manager	Background	EA Technology & Nortech	EA Technology[3]
IP002	LV-CAP^TM Comms. Container (Method 1)	Comprising of the Nortech iHost comms. container	Background	Nortech	Nortech
IP003	iHost (Application Deployment Server Method 1)	Pre-Existing iHost platform	Background	Nortech	Nortech
IP004	Container Management from iHost (Method 1)	Development of iHost capability to manage & deploy container	Background	Nortech	Nortech
IP005	Cloud Based Hosted Platform (Method 2 & 3)	Existing Lucy Electric GridKey platform	Background	Lucy Electric GridKey	Lucy Electric GridKey
IP006	LV-CAP^TM Comms. Container (Methods 2 & 3)	Comprising of the Lucy Electric GridKey communication container	Background	Lucy Electric GridKey	Lucy Electric GridKey

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[3] Pre-existing commercial agreement in place between EA Technology and Nortech for this purpose

IP No.	Description	Detail of IP	IP Type	IP Created By	IP Assignment
IP007	WeatherSense™ Transformer RTTR (DTR App)	EA Technology implementation of University of Manchester algorithm	Background	EA Technology & University of Manchester	TBC
IP008	LoadSense™ the LV Control App for Method 1 (Network Meshing App)	Application developed on the Project to enable automation of LV network meshing	Foreground	Western Power Distribution (via EA Technology)	GB DNOs
IP009	3rd Party App Containers (Methods 2 and 3)	To be defined on the Project	To Be Confirmed	Dependent upon funding mechanism	App developer / funder
IP010	LV-CAP™ API v2.0	A second iteration of the API to allow third party Apps to be created on the LV-CAP™ platform following learning from Methods 2 and 3	Foreground	Western Power Distribution (via EA Technology)	GB DNOs
IP011	Method 1 Communication Container	Development of the iHost communications container and iHost server to enable the wide scale deployment of LV-CAP™ for the OpenLV project.	Relevant Foreground	Nortech	Nortech
IP012	GridKey LV Monitoring Equipment	Use of the Lucy Electric GridKey "substation monitoring equipment" as part of the overall OpenLV solution	Relevant Foreground	Lucy Electric GridKey	Lucy Electric GridKey

IP013	Method 2 & 3 Communication Container	Development of the Application container to enable communication between the LV-CAP™ platform and the Lucy Electric GridKey platform (allowing extraction of data through network monitoring and system updates)	Relevant Foreground	Lucy Electric GridKey	Lucy Electric GridKey
IP014	Alvin Hardware	Use of the EA Technology Alvin platform as part of the overall OpenLV solution	Relevant Background	EA Technology	EA Technology
IP015	Alvin Communication Protocols	Development of the Alvin communication protocols into the LV-CAP™ solution to enable communication links between Alvin devices.	Relevant Foreground	EA Technology	EA Technology
IP016	LV Monitoring Hardware	Use of the GridKey MCU520, as part of the overall OpenLV Solution, to provide monitoring of LV substations.	Relevant Background	Lucy Electric GridKey	Lucy Electric GridKey

9.2   Current Reporting Period

There is no IPR generated or registered during this reporting period.

9.3   Overall IP Statement

It is not expected that we will register any IPR in the next reporting period.

10   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 and EA Technology's 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 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
- ✓ Regular monitoring and updating of risks and the risk controls.

10.1   Current Risks

The OpenLV risk register is a live document and is updated regularly. A total of 54 risks have been raised, 41 of which have now been closed, leaving a total of 13 live 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.

Of the 13 live risks none are ranked as severe or major, 3 are ranked as moderate and 10 are ranked as minor. Table 7 details the three moderate risks. For each of these, a mitigation action plan has been identified and the progress of these are tracked and reported. A number of risks have been closed since the last reporting period, mainly due to the trials ending and it is expected that the remaining minor risks will be closed within the next reporting period.

Table 7: Top current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
Resource - there is a risk that key project staff are either not available or move on to new roles (within or outside their existing companies)	Moderate	Good management of staff	Additional resource has been assigned to the project
There is a loss of data on the OpenLV platform(s) or the data collected is not fit for purpose.	Moderate	Regular checks on the data collected and post installation checks to ensure the correct data is being collected	Communications checks being made and database routines to ensure valid data and/or feedback on shared datasets
There is a risk that funding cannot be secured for the development of 'Apps' for Method 3.	Moderate	Active involvement with 3rd party organisations early in the Project and testing the market.	Organisations have been selected and risk is reducing now trial MoU and data share agreements are in place

Table 8: Graphical View of Risk Register
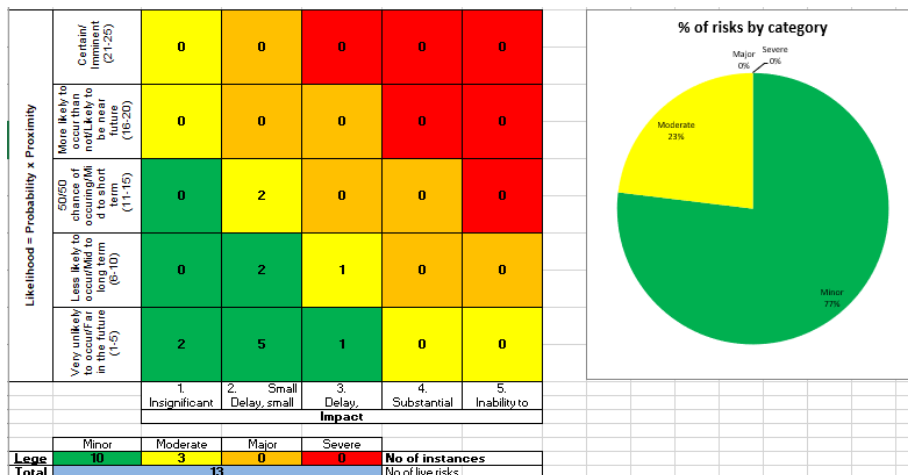
10.2   Update for risks previously identified

One of the top four risks from the last reporting period has been mitigated by disabling network switching operations at four sites. An update on progress on the top 3 risks has been provided in Table 7.

Descriptions of the most prominent risks, identified at the project bid phase, are provided in Table 9 with updates on their current risk status.

Table 9: Key Risks Identified at Bid Stage

Details of the Risk	Bid Stage Risk Rating	Current Risk Rating	Comments
There is a risk that funding cannot be secured for the development of 'Community Apps'.	Major	Closed	N/A
There is a risk that the integration of LV-CAP™ with generic hardware and the use of Alvin switching devices is more complex than expected and delays the OpenLV programme.	Major	Closed	N/A
There is a risk that the last mile communications between the distributed LV-CAP™ devices and the switches on the LV network is not robust and the devices cannot be switched as expected.	Major	Closed	N/A

11   Accuracy Assurance Statement

This report has been prepared by: 1) the WPD Project Manager (Sam Rossi Ashton) and 2) the EA Technology Project Manager (David Russell), recommended by: 1) the DSO Systems and Projects Manager (Roger Hey) and 2) the EA Technology Delivery Manager (Paul Barnfather) and approved by: 1) the Resources & External Affairs Director (Alison Sleightholm) and 2) the EA Technology Strategy & Interventions Director (Dave A Roberts). Both WPD and EA Technology confirm that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.

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Annex 1 – Media Coverage

Source	Date	Link
APB	09-Oct-17	http://www.abpclub.co.uk/bodyshop-news.php?story=OpenLV-project---sharing-electricity-usage-data-about-levels-of-capacity-for-charging-EVs-on-local-electricity-networks-139460
Automotive Industry Digest	11-Oct-17	http://www.automotiveindustrydigest.com/latest-fleet-news/network-capacity-for-charging-electric-vehicles-to-be-further-aided/auto-news
Blue and Green Tomorrow	05-Dec-16	https://blueandgreentomorrow.com/news/ofgem-funding-game-changing-project/
Bristol Energy Network	21-Jul-17	http://bristolenergynetwork.org/centre-for-sustainable-energy-openlv-project/
CIRED	07-Jun-18	https://www.eesa.org.au › LiteratureRetrieve
Clean Energy News	20-Sep-17	https://www.cleanenergynews.co.uk/news/efficiency/open-access-substation-data-being-primed-by-western-power-distribution
Community Energy Hub		http://hub.communityenergyengland.org/resources/resource/228/openlv-your-local-electricity-data/
Community Land Trusts		http://www.communitylandtrusts.org.uk/_filecache/252/f9f/390-open-lv-more-information-23617.pdf
Community Land Trusts	28-Jun-17	http://www.communitylandtrusts.org.uk/article/2017/6/28/take-part-in-the-centre-for-sustainable-energys-survey
Community Links	07-Dec-17	http://communitylincs.com/open-lv-project-invitation-parish-councils/
Community Open Energy Monitor	13-Nov-17	https://community.openenergymonitor.org/t/openlv/5643
CSE		https://www.cse.org.uk/projects/view/1335
CSE	15-Mar-19	https://www.cse.org.uk/local-energy/news/view/2322
CSE	17-Oct-18	https://www.cse.org.uk/local-energy/news/view/2270
CSE	04-May-18	https://www.cse.org.uk/news/view/2238
CSE	04-Dec-17	https://www.cse.org.uk/news/view/2214
CSE	30-Aug-17	https://www.cse.org.uk/news/view/2199
Current News	20-Sep-17	https://www.current-news.co.uk/news/open-access-substation-data-being-primed-by-western-power-distribution
e-Hike		http://e-hike.net/content/network-capacity-charging-evs-be-further-aided-opening-data-substations
DriveEV	09-Oct-17	http://driveev.net/2017/10/09/electric-car-charging-project-help-manage-capacity/#.WejQassZOL8
EA Technology		https://www.eatechnology.com/projects/openlv/
EA Technology	09-Oct-17	https://www.eatechnology.com/blog/2017/10/11/network-capacity-for-charging-electric-vehicles-to-be-further-aided-by-opening-up-data-from-substations/openlv-balancing-act/
EcoPlugg		https://www.ecoplugg.co.uk/openlv-project-aims-to-aid-network-capacity-for-charging-electric-vehicles/
EcoTopical	10-Oct-17	http://ecotopical.com/green-car-congress/196331/openlv-project-proposes-opening-up-local-electricity-usage-data-to-improve-ev-charging/
Efficient Energy		http://www.efficientenergy.net/nl/2016/dec16.htm
Electrans	02-Nov-17	https://www.electrans.co.uk/openlv-looks-network-capacity-evs/
Electric Cars Report	15-Oct-17	https://electriccarsreport.com/2017/10/network-capacity-charging-evs-aided-opening-data-substations/
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Energy Capital	11-Jul-17	http://www.energycapital.org.uk/2017/07/11/open-lv/
Energy Capital	08-Nov-17	https://www.energycapital.org.uk/uncategorized/open-lv/
Energy Innovation District	19-Sep-17	https://energyinnovationdistrict.com/blog/2017/9/19/record-year-for-energy-tech-company-ea-technology
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Energy World	01-Apr-18	https://knowledge.energyinst.org/search/record?id=109571
EV FleetWorld	09-Oct-17	http://evfleetworld.co.uk/ev-initiative-to-help-overcome-challenges-with-network-capacity/
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Future Power Magazine		http://www.nridigital.com/future-power-magazine/january-2018.html?ww=s%2FFuture%2520Power%2520Technology%2Fdecd27fe-818b-5bd7-bc09-07effeb97bb5%5FFuture%2520Power%2520Technology%2520Jan18%2FopenLV.html
Green Car Congress	10-Oct-17	http://www.greencarcongress.com/2017/10/20171010-openlv.html
Greenfleet	10-Oct-17	http://www.greenfleet.net/news/10102017/openlv-project-open-local-electricity-usage-data
Herefordshire Green Network	29-Jun-17	http://www.hgnetwork.org/centre-for-sustainable-energy-project/
Impulse	26-Feb-18	http://www.impulse-corp.co.uk/news/impulse-support-openlv-with-embedded-computing-for-substations.htm
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Tavistock Today	20-Oct-18	http://www.tavistock-today.co.uk/article.cfm?id=433207&headline=Ground-breaking%20trial%20by%20energy%20group%20should%20benefit%20local%20residents&sectionIs=news&searchyear=2018
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Website analytics