WESTERN POWER DISTRIBUTION

NETWORK TEMPLATES

LV NETWORK TEMPLATES FOR A LOW-CARBON FUTURE

SDRC Reward Submission

LCN Fund Low Carbon Networks

Llywodraeth Cymru Welsh Government

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1. EXECUTIVE SUMMARY

UK Government, together with Wales & Scotland have set challenging targets to increase the proportion of energy to be derived from renewable sources by 2020. These span electricity, heat and transport.[1] [2] [3]

The connection to the low voltage (LV) network of low carbon technologies (LCT) such as electric vehicle charging, heat pumps and photo voltaic (PV) generation all of which have different temporal footprints, requires that there is sufficient current carrying capacity and voltage headroom within the statutory tolerances on HV/LV substations and LV feeders at the relevant times of day. Since there has historically been little monitoring on such substations there is little detailed knowledge of actual half hourly loading and voltage patterns which can vary by day, week and season, making it difficult to efficiently accommodate the LCTs..

The substantial increase in LV PV generation presents difficulty to National Grid in understanding real time levels of "hidden" backed off demand as the only data available has been summation of individual Feed in Tariff (FiT) meter annual kwhr generated. This impacts National Grid in their short/long term forecasting and management of the wider GB network (e.g. spinning reserve capacity).

The LV Network Templates Project [4] sought to address these challenges by-

- Monitoring demand and voltage at some 824 HV/LV substations and the voltages at 3600 LV feeder ends, and applying advanced statistical techniques to that data set against various combinations of already available fixed data to see if it were possible to characterise substations into a number of so called "templates" that would accurately mimic the temporal load and voltage behaviours. If that could be achieved, it would enable further LCTs to be added to networks without the need to repeat the expense of monitoring. The LV Templates Project Proposal anticipated in its cost benefit analysis that results would be applicable to 50% UK HV/LV substations.
- By including within the monitored substations, example local areas known to be targeted and funded by Project Partners Welsh Assembly Government and NPower for dense installations of LCTs, which were predominantly PV
- Monitoring the outputs of individual LV PV installations and undertaking advanced statistical analysis to determine the viability of using real time monitoring of one as a proxy for all within a given local area, to provide a mechanism to give National Grid visibility of aggregated LV PV output.

Whilst it was presented [5] to the Expert Panel but never included as a potential benefit as it would need change in legislation to bring about, the LV feeder voltage measurements, would deliver valuable information that might support adoption of the wider EU LV +10/-

10% voltage tolerances which would provide significant additional headroom for connection of LCTs, reduce national demand, CO2 and enhance plant margins.

On completion, the Project was successful in identifying statistically robust templates. As a consequence of the positive stakeholder feedback from other DNOs, it was possible to undertake further validation across all other DNOs and it was found that the templates fitted some 82% [6] of UK HV/LV substations; far in excess of the 50% anticipated match, and resulting in adding the development of new User tools for use by other DNOs as part of the Project.

The PV Monitoring made a very significant finding that actual outputs were at least some 20% below installers declared rating; immediately freeing up an additional 20% installation capacity. The information has been widely shared with DECC, DNOs and the Solar Industry, and WPD have already modified network planning. The "Proxy" FiT metering was proven and demonstrated in a live link with National Grid SCADA.

The analysis of LV feeder substation and feeder end voltages demonstrated a strong case in support of changing statutory voltage limits, and a detailed Paper [7] put to DECC outlining scales of savings of 2 Million tonnes CO2 per year, 600 MW increase in plant margin and £450 M p.a reduction in energy costs. Following discussion with National Grid and other DNOs, a National Working Group has been established to examine the issue. In the meantime WPD have acted to reduce voltage across multiple primary substations in South Wales, saving in excess of 15.7MW in maximum demand, and some £ 9.4M p.a. in customer energy costs.[8] A report [21]on the Initial findings from this trial are now available on line,

It is respectfully contended that the value of the above in furthering connection of LCTs and in saving cost is such as to justify award of the full £896k award, as provided in the Project Funding Direction

2. SUCCESSFUL DELIVERY REWARD CRITERIA

The Project won approval on 29th November 2010 [9]. WPD were then required by Ofgem [10] to undertake consultation of other DNOs into the current availability of alternative viable products to measure demand with metering levels of accuracy at existing HV/LV substations, and to submit a Customer Engagement Plan for approval before commencing installations. Ofgem issued an amended formal Project Direction on 5th April 2011, [11] setting out the allowed Project Budget of £9015k (built up of an Approved Amount, plus WPD compulsory contribution and External Funding). It also barred WPD from spending more than 110% on any Budget Category total, e.g. Employment Costs, without the Authorities prior consent.
The Project Direction required that the Project be completed by 31st July 2013, and set in place 10 Successful Delivery Reward Criteria (SDRCs) which included specific milestones and dates by which they were to be achieved. In the event that issues arose subsequent to the

publication of the Project Direction, LCNF Governance provided for SDRCs to be modified by Ofgem if a formal change request was submitted and approved by Ofgem.

The SDRCs are set out below, and unless amended by any approved change requests, which are shown referenced against the SDRC, refer to the above 5th April 2011 Project Direction. In the event, WPD made just one submission [(12)] covering 4 change requests, none of which affected SDRC timescales or resulted in budget overrun in excess of 10% of any Budget Category. Two of those requests were to undertake additional work, identified as a result of the success of the initial findings and requested by other DNOs, to add further value to the Project. Ofgem's response letter [(13)] and amended Schedule [(14)] to the requests was,

> "We have approved these amendments because we consider they mitigated the challenges presented by material changes in circumstances that were beyond WPD's control and arose since we originally funded the project. These amendments allowed the project to continue to deliver value for money to customers".
>
> The change requests are described in Section 3 under Project Management.
>
> Each of the SDRCs as listed in the above 5th April 2011 Project Direction is set out below, with their timescales and proposed evidence listed against referenced actual evidence and timescale. Where an SDRC was subsequently amended through an approved Change Request, the amended SDRC is shown, and the Change Request referenced.
>
> Further information is included, as appropriate, to indicate the nature, quality and use of the related outputs.

SDRC 1	
Requirement	All data concentrators successfully deployed by 31.03.2012.
Proposed evidence	Evidenced by communications being established between data concentrators and Enmac with voltage data consistently being received
Actual evidence	Evidenced by communications being established between data concentrators and Enmac with voltage data consistently being received. As reported in the Jun 2012 6 monthly report. [(15)]
SDRC achieved?	Yes

SDRC 2	

Requirement	Back office systems upgraded and communications path to sensors proven by 13.09.2011 ready for data collection on 14.09.2011.
Proposed evidence	All ENMAC and other back office IT integration has been completed and WPD has visibility of monitoring equipment
Actual evidence	A proof of concept demonstration with GE proved the communications path throughout the system. As reported in the December 2011 6 monthly report. (16)
SDRC achieved?	Yes

SDRC 3	
Requirement	All sensors deployed by 07.04.2012] and operational
Proposed evidence	All monitoring data processed successfully and visible to WPD in database.
Actual evidence	All the monitors that were deployed were operational; however this was less than the originally proposed number, so installs continued until Dec 2012. Change request CCR 001 was submitted and formally agreed by Ofgem - 27th June 2014 (13).
SDRC achieved?	Yes
Further information	It was an Ofgem requirement that the Customer Engagement Plan included obtaining Householder permission for installation of (feeder end) voltage monitors at their meter positions. Such permission was sought by letter in line with the Approved Customer Engagement Plan, but had a low acceptance rate. The reasons for this were further researched, as described more fully in Section 3 below, and a revised approach improved take up by a factor of a half. Statistical research was undertaken to confirm study accuracy levels with lower numbers of sensors. This lead to development of additional installation arrangements of plug in monitors, which found more customer favour, and installations in street furniture, both with GPRS links.

SDRC 4	
Requirement	Data from 13.09.2011 onward sent securely in required format to Bath for analysis and modelling, through to the last set of data on 07.04.2013 Evidence of successful

	transfer evidenced by 25.10.2011.
Proposed evidence	Data sets received by Bath University in a manner that is applicable to statistical study confirmation of receipt received by Bath.
Actual evidence	Data sets were received from 13.09.2011 and increased as more monitors were installed. Data is continuing to be captured and securely sent to the University of Bath for the foreseeable future (16 - P10 para 4.3).
SDRC achieved?	Yes
Further information	Algorithms and processes were established by University of Bath to check the quality of outputs being received from sensors and communication paths. This was to ensure they were giving credible outputs and that measurements were not being corrupted by distribution network outages, sensor or communication path problems. Arrangements were established to identify and for WPD to check any suspect equipment. In all over 500 million measurements were assessed in the Project.

SDRC 5	
Requirement	Effects of stresses on the network from local low-carbon installations identified and significantly relevant, findings identified by 01.05.2013
Proposed evidence	The output of the analysis from Bath University will demonstrate these stresses and statistically prove that the findings are significant and relevant to prove the hypothesis correct.
Actual evidence	Refer to the published "Stresses on the LV Network caused by low carbon technologies" report (17)
SDRC achieved?	Yes
Further information	This report has identified a number of highly significant findings with substantial positive impact at national level on the ability to accommodate LCTs. Firstly, it found that the actual kW outputs of PVs are substantially lower than those declared by installers when advising the DNO after connection (which they are permitted to do up to 16A. Using readings from the entire time period Jan 1st to December 31st 0500 to 2200 hours, the maximum PV output within a postcode was

	81.1% of declared capacity. The consequence is that the voltage impact on the network is markedly lower, some 36%, than previously calculated when using declared installed capacity. There may be many reasons for this; whilst installers have a clear need to give customers realistic estimates of the forecast kwhr energy output of an installation, to indicate FiT income and payback periods, there is no incentive for accuracy when advising the DNO of the installed kW power output, providing it is less than 16A. Individual solar panels are manufactured to international standards and are rated on the basis of solar radiation of 1000W/m2. The actual peak output of any installation depends on many factors including solar radiation at that latitude, orientation, inclination, shading, inverter loss etc. There are many software tools available to installers to account for these should they wish. The situation is different for high voltage connections where the installer may have to pay for the capacity of the network connection. The consequence of this finding is that significantly more PV can be accommodated on LV networks without need for costly reinforcement or constraint of connection than previously thought. This important finding has been widely shared by WPD with DECC PV Solar Strategy Group - Grid Connection Sub Group [18], the Solar Industry via discussion with BRE Solar Centre, other DNOs and through Project dissemination events. In WPD's case, we have already updated and implemented changes to our version of the nationally used Windebut network planning tool, to reflect reduced outputs and enable more PV to be connected without reinforcement. WPD have continued to press the Solar Industry to issue guidance to installers to improve the accuracy of kW outputs made in connection notifications, for the benefit of all. Secondly the Report successfully identified from the measurements 10 statistically distinct clusters of substation "types" - i.e. "templates". From the demand and voltage profiles associated with each template it identified which were and which were not suited to accommodating different types of LCT. By way of example, a substation in template 1 which has a relatively high flat demand during daytime and lower demand overnight is not a suitable candidate for workplace or

	retail Electric Vehicle (EV) charging, but is well suited to a time restricted overnight EV charging regime. Thirdly, the report presented findings on the analysis of adherence to LV network statutory voltage limits in a study understood to be the largest ever check in the UK. It showed the spread of degree of headroom available within statutory limits and lends considerable support to the idea that a change in legislation, flagged up some 20 years ago by Government, to adopt the wider EU 230V +10/-10% tolerance would enable widespread reduction in network operating voltages with little need for corrective action. Such a move has enormous potential benefit to UK in reducing demand, and consequently carbon emissions, greater generation plant margin and freeing up voltage headroom to allow more LCTs to be connected. This topic has been the subject of a further paper [7] produced by WPD and shared with DECC, National Grid other DNOs and stakeholders. It used Government published energy use and generation data ("DUKES") [19] Elexon and Ofgem data to assess the potential scale of benefit of voltage reduction applied only to HV and LV networks, and suggests an order of savings up to - • 2 Million tonnes CO2 per year • 600 MW increase in plant margin • £450 M p.a reduction in energy costs, if passed on. The object of the Paper was to flag up the order of magnitude and to promote the opening of national debate on the issue, against the background of the voltage data obtained from the LV templates report. It resulted in a request for a meeting with Chris Nicholson of DECC, Special Advisor to the Energy Minister. Subsequently, the Energy Networks Association, Energy Network Future s Group (ENFG) have established a Working Group to further examine and report on the issue. The WG established terms of Reference and began work early in 2015. Whilst adhering to the existing LV tolerances, WPD have recognised that there are parts of its network where the operating voltage of its HV network could be lowered,

	thus also impacting the downstream LV network. This has now been implemented [8] on parts of WPD's South Wales Network and has provided valuable learning in support of the above more extensive voltage reduction proposition. It was estimated to provide savings of 15.7MW in maximum demand, £ 9.4M p.a. in customer energy reduction and some 41,000 Tonnes p.a. of CO2 [20] However, after 2 months in use a detailed analysis of measured data has been undertaken by the University of Bath and a report [21] published in April 2015 showing that the reduction in average energy demand has been significantly higher than previous estimates and also indicates that the reduction in annual maximum demand will be in excess of the original estimate.

SDRC 6	
Requirement	Bath University undertake a statistical comparison of data flows against templates and report findings by 01.07.2013
Proposed evidence	Report produced by Bath University demonstrating the templates, which are statistically proven to be relevant and reusable by other DNOs.
Actual evidence	Please refer to the published "Demonstration of LV Network Templates through statistical analysis" report [22]
SDRC achieved?	Yes
Further information	The primary goal of the Project was to see if HV/LV substation demand and associated voltage profiles could be split into a series of templates that could then be identified in a statistically sound fashion without the need for monitoring using data available. As a result of the analysis undertaken, 10 LV Network Templates were successfully developed with approximately 80% accuracy in being able to effectively estimate the load flows of a particular substation without the use of monitored data. When these findings started to emerge and were shared with stakeholders it was suggested at the May 2013 learning and dissemination event, that the quality of the outputs could be further enhanced by undertaking additional validation analysis against data provided by all other DNOs on their own networks. Whilst this was not

	in-scope of the original project objectives, which envisaged outputs applicable to 50% of the GB network, it was regarded by all DNOs and Ofgem as a valuable and timely exercise to undertake. The Project then created user guides for the other DNOs on where to find specific pieces of fixed data and provided tables for each DNO to complete. All DNOs provided both fixed and variable data to enable validation of the templates within other licence areas. The templates methodology was applied in each area: (i) sense-checking; (ii) classification into a cluster; (iii) scaling, followed by evaluation of estimated and actual measurements. The results from the analysis undertaken were extremely encouraging. Similar levels of accuracy were observed when comparing estimated with actual measurements of demand, resulting in accuracy levels of between 80 and 90%. The original proposal was that monitoring would be installed to capture data from 2.6% of South Wales ground and pole mounted substations and relevant associated LV feeder ends in South Wales. If the Project confirmed, which it has, that the knowledge would not have to be gained on those through the installation of sensors on those transformers and associated feeder-ends, the Project could save the variable cost element of monitoring 50% of UK ground mounted and pole mounted substations, by only installing at a rate of 2.6%. The outcome has been that the project has demonstrated applicability to levels far in excess of the 50% target and proportionately a higher cost savings than forecast In the light of these findings, additional work was undertaken to provide a relatively simple method of feeding in network data to produce the required template output, and lead to the development of a common "classification tool" to facilitate introduction of LV Network Templates into business as usual planning activities of DNOs. Whilst not in scope of the project, it was deemed as being both relevant and timely to do so. It provides a view of the scaled or un-scaled load and voltage flows at a given substation, allowing the user to have greater understanding of the impact that various Low Carbon Technologies will have at that given substation, during weekday, weekend and or season. The tool has been made available to all interested parties on project closedown.

SDRC 7	
Requirement	Ability to use proxy FIT meters to reflect local area generation output, draft report by 01.05.2013
Proposed evidence	Bath's statistical analysis report will demonstrate the ability to understand network headroom to absorb low-carbon stresses through using the templates
Actual evidence	Refer to the published "Report on the use of proxy PV FiT meters to reflect local area generation" (23)
SDRC achieved?	Yes
Further information	The detailed statistical analysis examined a number of approaches to the measurement of bias that could occur using such a model. It considered the data both at Post Code level and across the full study area and concluded that an accurate indication of aggregate PV output can be obtained by monitoring a single "proxy" installation at postcode level. This finding has benefit both to planning and the evolution of active network management at local distribution and primary substation level and to national system operation in assessing spinning reserve and day ahead level plant scheduling. The measurements of PV output required for this assessment also facilitated the significant findings described in SDRC 5 above.

SDRC 8	
Requirement	Provide Ofgem with a 6 monthly project review report starting from 6 months post installation start date 17.06.2011. The report will include updates such as: • Project status compared to plan • Learning's to date • Next steps and actions
Proposed evidence	Acceptance by Ofgem of a project review report
Actual evidence	Ofgem has provided WPD with acceptance of all the 6 monthly reports: 17.06.2011 6 monthly Report (24)

	16.12.2011 6 monthly Report [16] 15.06.2012 6 monthly Report [15] 17.12.2012 6 monthly Report [25] 16.06.2013 6 monthly Report [26]
SDRC achieved?	Yes
Further information	The reports demonstrated effective project management in action, resulting in successful completion of the Project on time, on budget, but additionally delivering work on national inter DNO template validation and creation of a classification tool that was not originally within scope.

SDRC 9	
Requirement	Demonstrate provision of actual live data of distributed generation to National Grid to assist them with improved forecasting and generation scheduling in the future, by 19.12.2011.
Proposed evidence	Data on embedded generation load on network areas sent to, and received by, National Grid, on a near-real time basis
Actual evidence	On the 19.12.2011, National Grid was provided with live sample, distributed generation data.
SDRC achieved?	Yes
Further information	The communication link and work to interface the systems was completed under Project WPDT1001 for which the close down report was sent to Ofgem on 30th April 2013. The LV Templates Project analysis of individual PV outputs demonstrated the ability to use a single "proxy" PV meter to reflect local aggregated PV output, described in SDRCs 5 and 7 above.

SDRC 10	
Requirement	Share learning's with all partners and other interested parties including Ofgem (1-2) throughout the project from 19.12.11 to 01.07.2013; (3-4) by 31.07.2013
Proposed evidence	1. Raw data received from sensing network and embedded generation load will be provided to other parties to utilise in their network scenario models;

	2. Participation in annual conference 3. Output analysis from Bath University publicly disseminated 4. DNOs provided with analysis and WPD commentary on application of output to network management in response to low carbon stresses and benefits
Actual evidence	1. Raw data has been requested from CSE, Loughborough University and Reading University. A data sharing agreement is in place and WPD have been and will continue to provide data as and when requested. 2. WPD participated and presented on LV Templates at all LCNF Annual Conferences - 25- 26 October 2012 Cardiff 13 - 14 November 2013 Brighton 20 - 22 October 2014 Aberdeen 3. Since knowledge capture and dissemination formed a key element of the Project, there was emphasis in seeking to explore beyond traditional approaches, and WPD used University of Bath to develop these. Pages 75 to 92 of the Project Close Down Report [27] describe the range of solutions adopted and briefly outlined below, together with a log of over 250 dissemination activities. The outputs and findings from Bath University, and those from WPD, have been extensively publicly disseminated through - • Industry Conferences and Seminars (internal and external audiences • Industry Reports (external audiences • Workshops (external audiences) • Direct DNO Engagement (external audiences) • Briefing to Energy Minister Special Advisor, DECC • Presentation to DECC WG on PV Solar Strategy • Websites (external audiences): • Publication of academic papers in international arena • Press Releases (external audiences

	• Gallomanor (providing educational materials on energy and LCNF projects to school audiences) • Publication to WPD internal audience 4. The following reports have been published and shared with other DNOs: a. "Stresses on the LV Network caused by low carbon technologies" (17) b. "Demonstration of LV Network Templates through statistical analysis" (22) c. "Use of proxy PV FiT meters to reflect local area generation" (23) d. As part of the Close Down Report - "Lessons learnt for future projects" (28)
SDRC achieved?	Yes
Further information	Additionally DNOs have been briefed in workshops as set out above, as a result of which they all decided to participate in a national templates validation study which in turn lead to the development of the Classification Tool. The public dissemination on the findings set out in these reports has resulted in promoting nationally significant debate on the argument for implementation of the wider EU LV voltage tolerances and the benefits that would bring to LCT roll out and UK plant margins. They have further identified substantial headroom for connection of additional LV PV without need for network reinforcement. The "lessons learnt" section of the close down report shared with other DNOs some 38 items categorised by topic. The Ofgem requirement placed on WPD in December 2010 for WPD to consult all other DNOs into the current availability of alternative viable products to measure demand with metering levels of accuracy at existing HV/LV substations, did not, at that time, identify such alternatives. However, nascent products were found, and

	these lead to a later successful joint LCNF Tier 1 project between WPD and UKPN which examined cost, accuracy and ease of installation etc. of sensors and published the findings. [29]

3 Cost Effectiveness

The overall Project budget was £ 9015k, being the sum of Table 2 Project Budget costs as set out in the Project Direction of December 2010. These remained unchanged during the period of the Project, for which the close down report was issued on 31st October 2013. After the Project close down, Ofgem amended the Project Direction on 27th June 2014, and required, to reflect "the reduction in costs associated with LVNT, and £314k will be returned to customers (this amount is equivalent to the cost of the monitors not used in the project) in addition to any other funding remaining in the project bank account. This currently amounts to a further £35k. The total amount of £349k plus any other amount remaining in the project bank account will be returned in the 2015/16 financial year". [30]

The SDRC Application Guidance requests explanation of any variance of expenditure in excess of 5 % at project budget line level , and for each line of the project budget in excess of 5% of the total project budget, (in this instance amounting to £450k) information on processes for deriving an efficient cost. These are set out in the following tables, Actual costs and % have been taken [31] from Project Close Down Report, rounded here to nearest £k

Budget Line	1 Substation monitor fitters		Budget Category	Employment costs	
Project Budget	£414k	Actual Cost	£434k	Variance %	4.8

Budget Line	2 Planning Manager		Budget Category	Employment costs	
Project Budget	£187k	Actual Cost	£178k	Variance %	-4.9

Budget Line	3 B2B External Relation Manager		Budget Category	Employment costs	
Project Budget	£112k	Actual Cost	£114k	Variance %	1.7

Budget Line	4 B2C Manager		Budget Category	Employment costs	
Project Budget	£112k	Actual Cost	£109k	Variance %	-2.6

Budget Line	5 Project Manager		Budget Category	Employment costs	
Project Budget	£187k	Actual Cost	£171k	Variance %	-8.4

Reasons for variance >5% The input from Accenture with project management (budget line 19), was particularly effective and reduced the Project Manager workload.[32]

Budget Line	6 Project Management Team (3 staff)		Budget Category	Employment costs	
Project Budget	£300k	Actual Cost	£299k	Variance %	-0.3

Budget Line	7 Call Centre Staff		Budget Category	Employment costs	
Project Budget	£35k	Actual Cost	£35k	Variance %	0

Budget Line	8 Data concentrator at substation		Budget Category	Equipment costs	
Project Budget	£200k	Actual Cost	£219k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15 21,22, all of which were contained within the contract with GE.					

Budget Line	9 ENMAC updates		Budget Category	Equipment costs	
Project Budget	£100k	Actual Cost	£109k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15,21,,22 all of which were contained within the contract with GE.					

Budget Line	10 Message switching / hub software		Budget Category	Equipment costs	
Project Budget	£150k	Actual Cost	£164k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15, 21,22 all of which were contained within the contract with GE.					

Budget Line	11 Enhanced FEP software		Budget Category	Equipment costs	
Project Budget	£95k	Actual Cost	£104k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15, 21,22 all of which were contained within the contract with GE.					

Budget Line	12 Data concentrator / substation monitoring		Budget Category	Equipment costs	
Project	£1190k	Actual Cost	£1302k	Variance %	9.4

Budget					
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15,21,22 all of which were contained within the contract with GE.					
Process for deriving an efficient cost - Please see paragraphs below on Budget line items 8 to 15, all of which were contained within the contract with GE.					

Budget Line	13 Data comms hub		Budget Category	Equipment costs	
Project Budget	£150k	Actual Cost	£164k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15,21,22 all of which were contained within the contract with GE.					

Budget Line	14 Data comms using meshed radio type technology		Budget Category	Equipment costs	
Project Budget	£735k	Actual Cost	£801k	Variance %	8.9
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15,21,22 all of which were contained within the contract with GE.					
Process for deriving an efficient cost - Please see paragraphs below on Budget line items 8 to 15, 21, 22 all of which were contained within the contract with GE.					

Budget Line	15 Data comms using PLC technology		Budget Category	Equipment costs	
Project Budget	£867k	Actual Cost	£949k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below on Budget line items 8 to 15,21,22 all of which were contained within the contract with GE.					
Process for deriving an efficient cost Please see paragraphs below on Budget line items 8 to 15, 21, 22 all of which were contained within the contract with GE.					

Budget Line	16 LV end voltage monitors		Budget Category	Equipment costs	
Project Budget	£ 1765k	Actual Cost	£1922k	Variance %	8.9%
Reasons for variance >5% Project change request CR1 set out the difficulties encountered in seeking Customer permission for installation of LV Voltage monitors in their homes. [(12)]. To meet planned project plan dates for installation, all monitors had been purchased. The low customer take up necessitated the identification and adoption of alternative options for connecting equipment to feeder ends, involving connection to street furniture etc. [(33)] at higher cost. In its June 2014 response to the change request, Ofgem noted [(34)] that the					

circumstances were beyond WPD's control, but in response to Ofgem's concern that "The result of this is customers paying for unused equipment. In response to our concerns WPD has committed to return these funds to customers. The funding (£314k) will be returned through the funding direction for this year's LCN Fund competition. Therefore we consider the amended project addresses this concern". * It was thus in June 2014, some 8 months after the Project had closed down and Project Management ceased, that this budget line was amended to show the recovery of the £314k.

Process for deriving an efficient cost.
It had been planned that alongside the provision of substation monitors (including Enclosures & Comms) that GE would also deliver the GPRS and PLC feeder-end monitors. Unfortunately the GPRS monitors were no longer able to be delivered, due to unforeseen manufacturing issues in GE's Bilbao manufacturing plant. As a result GE provided a full refund for the undelivered GPRS monitors, and a replacement was sourced, and delivered by EDMI. The selection criteria that identified EDMI as being the most cost-effective and suitable replacement solution were:

Cost of Meter: Due to the on-going relationship with EDMI for business as usual activities, discounted rates could be passed onto the Project in lowering the overall price of the meter
Quick Deployment: WPD already had a number of EDMI meters from their business as usual work; this meant that no time was spent in identifying a new meter vendor, negotiating on price and agreeing on contractual arrangements. Additional meters could then be simply procured through the existing framework agreement

In the light of the low customer take up of home installations, even after an improvement achieved through a revision to the Customer engagement letter, WPD engaged The University of Bath to undertake an in depth study on the maintenance of statistical integrity with a varied number of monitors. This was shared with other DNOs and WPD included the feedback it received from the DNOs in its amendment request to Ofgem .The University of Bath letter explained that the results delivered with a reduced sample size would deliver benefits equivalent to those that were claimed in the original full submission.[13]

Budget Line	17 LV FIT meter installs		Budget Category	Equipment costs	
Project Budget	£49k	Actual Cost	£54k	Variance %	9.4
Reasons for variance >5% Costs were increased due to delays in receiving radio and the consequent requirement to use extra contractors to meet installation deadlines [35]					

Budget Line	18 Monitor fitter contractors / appointment booking contractors		Budget Category	Contractor costs	
Project Budget	£727k	Actual Cost	£747k	Variance %	2.8

Budget Line	19 Project management / consultancy		Budget Category	Contractor costs	
Project Budget	£160k	Actual Cost	£164k	Variance %	2.2

Budget Line	20 Bath University analysis		Budget Category	Contractor costs	
Project Budget	£306k	Actual Cost	£282k	Variance %	-7-7
Reasons for variance >5% It is concluded that the decision to take up the opportunity to extend the work, in CCRs3 and 4 for extending analysis to include the DNO Validation exercise and development of the Classification tool software drawing on the Contingency budget line may have led to accounting allocation issues between the tasks, all undertaken by the same group of academics within University of Bath					

Budget Line	21 Radio site survey contractors		Budget Category	Contractor costs	
Project Budget	£80k	Actual Cost	£87k	Variance %	9.4
Reasons for variance >5% % Costs were increased due to delays in receiving radio frequencies and the consequent requirement to use extra contractors to meet installation deadlines [(35)] Please also see paragraphs below concerning items contained within the contract with GE.					

Budget Line	22 System testing / analysis contractors (SCADA)		Budget Category	Contractor costs	
Project Budget	£20k	Actual Cost	£22k	Variance %	9.4
Reasons for variance >5% Please see paragraphs below concerning items contained within the contract with GE.					

Budget Line	23 IT costs		Budget Category	Other costs	
Project Budget	£106k	Actual Cost	£110k	Variance %	3.3

Budget Line	24 Contingency		Budget Category	Other costs	
Project Budget	£820k	Actual Cost	£883k	Variance %	7.7
Reasons for variance >5% The Contingency budget line was drawn upon to address the following needs - a) for completing phase checks for the customer voltage monitor installations, and for					

installing street pillars with voltage monitors in as a result of a lack of customer consents [36] b) A hosted GPRS data collection service needed to be procured from GE. [36 - 1st ref c) The costs of extending the analysis with the University of Bath will be £61,509, also covering CCR4, the development and creation of the classification tool [37]. d) CCR3 for DNO Data Validation exercise
Process for deriving an efficient cost. The contingency spend was monitored closely at each 6 monthly report [15, 16, 24, 25, 26] and variances over the 5% threshold explained.

Budget Line	25 Public engagement / dissemination		Budget Category	Other costs	
Project Budget	£ 148k]	Actual Cost	£148k	Variance %	0
Reasons for variance >5%					

The following Sections are commercially confidential and should be redacted prior to any publication

Project budget variances on GE Contract - Budget Line items 8 to 15, 21, 22 above

Sensitive Content removed

Process for deriving an efficient cost - GE Contract Budget Line items 8 to 15, 21, and 22 above

Sensitive Content removed

4 Project Management

a) Project Management arrangements

Such a multi-disciplinary project of this type, involving a very wide range of external and internal partners required strong project governance arrangements. These were set in place via the establishment of a Project Board and a Project Delivery Team, immediately following the notification of Project award on 29th November 2010, in the format mapped out as part of the submission process, and were to be a requirement of the formal Project Direction issued by Ofgem on 5th April 2011 [(11)]. WPD engaged Accenture, who had detailed knowledge of the Project through their work on the submission, to provide expert Project Management guidance, monitoring and oversight.

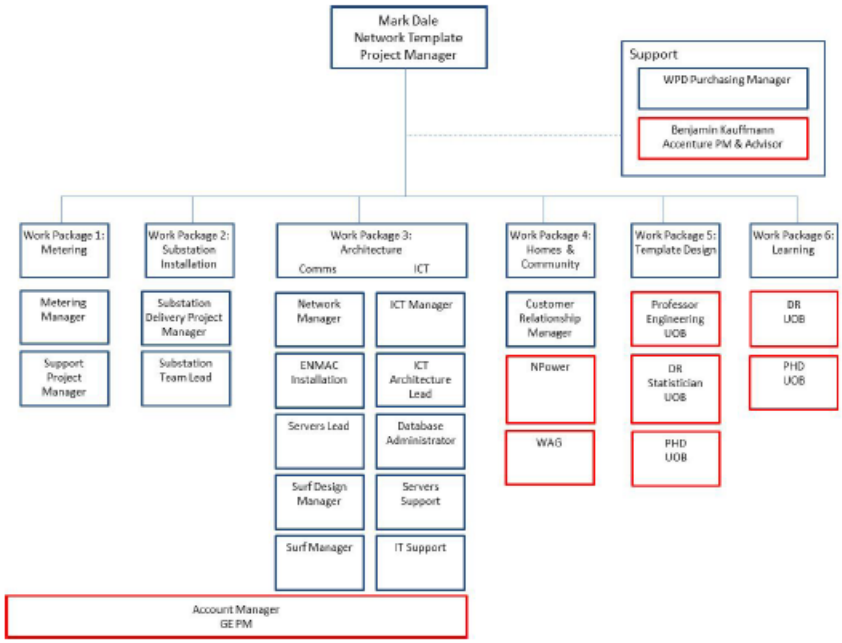
The Project Board membership encompassed -

- WPD LCNF Programme Manager
- WPD LV Network Templates Project Manager
- Accenture Project Consultant
- University of Bath
- WPD Metering, Comms and ICT Managers together with the Senior Managers having day to day responsibility for the distribution system and WPD Teams in the study area

Their role included [(38);]

- Coordination and monitoring of the Project
- Understanding, alignment and resolution of Project stakeholders' expectations, and establishing formal agreements
- Management of Project stakeholder involvement in Project tasks, including reviewing and signing off key Project tasks and deliverables, monitoring progress and critical dependencies, identification and management of issues and
- Periodic progress review meetings
- Monitoring changes in internal and external existing and potential stakeholder landscape and stakeholder satisfaction
- Provision of solutions to potential resourcing conflicts

The Project Delivery Team membership included the WPD LV Network Templates Project Manager with support from Accenture Project Consultant and WPD Purchasing Manager together with lead Managers covering each Work Package as illustrated below -



The role of the Project Delivery Team was to -

- Manage the involvement of the work package teams in Project Tasks including reviewing and signing off of key Project tasks and deliverables, monitoring Project progress and critical dependencies, and identifying and resolving issues and risk
- Assist the Project Board in discharging its role.

The Project Management (PM) arrangements employed a wide range of standards, methodologies and risk monitoring and, as would be expected, WPD applied its internal standards and methodologies such as Prince2, MSP, CIM as well as leveraging Accenture's delivery methodology. (39) These led to the establishment of a range of core Project Plan elements (40)

- Development and maintenance of a project plan: Detailed, scheduled monitoring and reporting arrangements of delivery milestones and costs were put in place to provide granular view of progress and flag need for early corrective action on potential track deviation. It began as part of the proposal and was carried forward throughout the Project to its close down
- Scope Control Management: a detailed scope management plan was developed to make sure that the Project is managed, controlled and verified throughout its lifecycle and that scope creep is avoided.
- Risk, Assumption, Issue and Dependency (RAID) Management: to log risks, issues, assumptions and dependencies to be effectively tracked and addressed. (Ref 42 to 47 incl.)

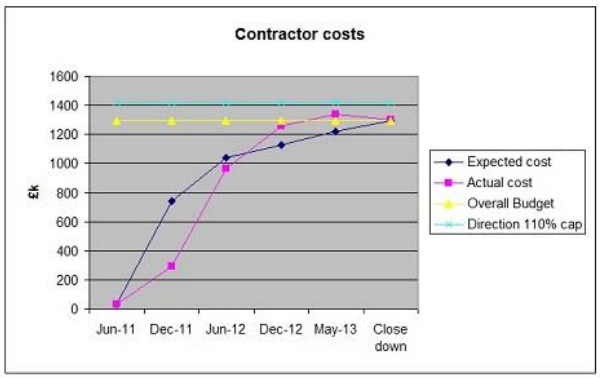
- Stakeholder and Communications Management: A core element of LCN funded Projects is knowledge transfer, to which Partners were committed [48] It spanned the identification of all the stakeholders involved, impacted or potentially interested; by the Project execution, findings and proposed changes. This approach contributed to the Stakeholder and Communications Management strategy, identifying when and how best to engage with internal or external stakeholders. This commenced prior to Project submission [49] with the preparation of a draft customer communications pack, produced by WPD, with the assistance of nPower's customer services division. It was also sent to Consumer Focus for their approval, prior to submission to Ofgem for Authority approval as required in the Project Direction.[50] Due to the initial poor take up of Customer Acceptance for installation of end of feeder voltage monitors in the home. further advice was sought on the wording of the letter, which resulted in a significant improvement in acceptance rates.[51]
- Quality Assurance: Accenture were appointed to undertake quality assurance, Project management and advisory support services. QA decisions were particularly important in the handling of more than 180 million measurements [52]
- Status Reporting: Structured reporting arrangements were established from the start of the Project to provide monthly Project updates to key stakeholders and to meet the formal 6 monthly reporting requirement to Ofgem and the wider industry
- Collaboration: A commitment for Partners to work as 'One Team' in delivering such a complex Project.

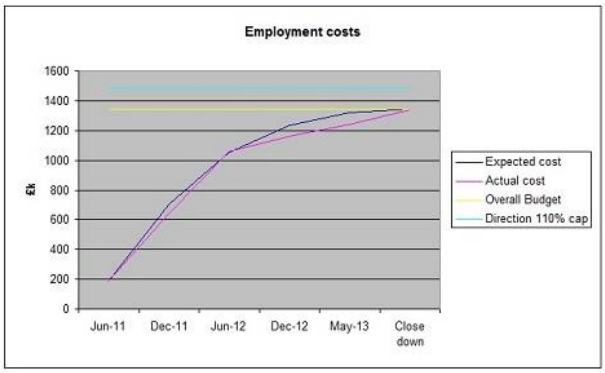
A detailed description of the PM arrangements is contained in the Project Close Down Report [39]

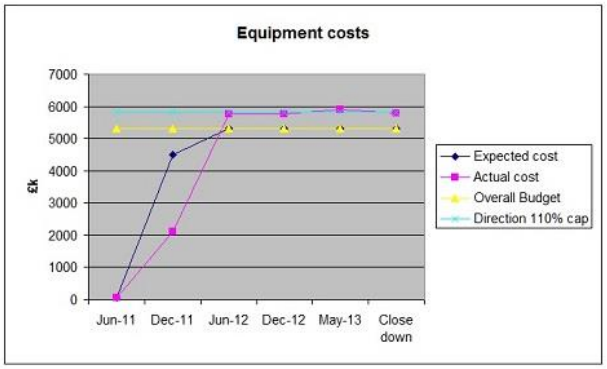
The arrangements put in place were successful in completing the Project on time and within Budget tolerance, whilst extending, with Ofgem's agreement, deliverables and findings beyond those initially envisaged

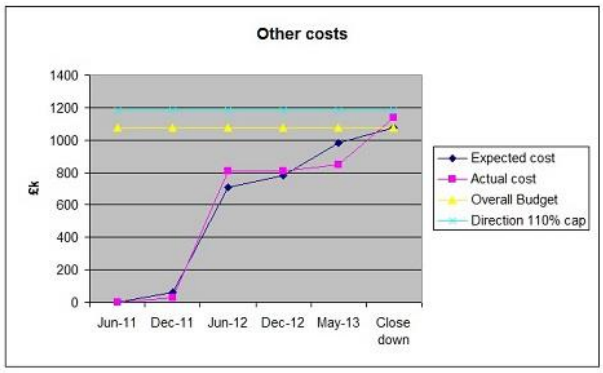
The Project Funding Direction [11] required 6 monthly reporting of expenditure against each line in the Project Budget, and explains any projected variance against each line total in excess of 5%. Whilst the out-turn expenditures are detailed in the section above, the actions of the PM Team in pre-emptive identification of risks and undertaking appropriate and measured interventions are evidenced in the six-monthly reports. These reports were all provided on time and accepted by Ofgem, and also detail risk management identification / actions as referenced above.

The stage by stage reporting of expected vs. actual costs at Budget Category level is shown below, and indicates that there was a short term excursion of projected cost track affecting Equipment and Contractor spend at one point in the Project. The actions taken by the PM Team were successful in restoring progress to track whilst containing costs to + 6.2% of the April 2011 Project Direction Budget.









b) Uncertainty and Change Management

The risk log discussed above, was set in place at time of project submission [42] and maintained throughout the project, with published updates in each six monthly report. [Ref 43- 47 incl.]

The submission risk log had not anticipated a scenario where the project was awarded, but could not begin until a consultation had been undertaken with other DNOs and then accepted by Ofgem, on the availability of suitable alternative current monitoring devices that would obviate the need to change current transformers on ground mounted substations**.** This introduced a two and a half month reset in the timings included in the submission and initial award, a was recognised by Ofgem in the issue of a Revised Project Direction issued on 3rd April 2011 (this was not as a result of a formal Change Request). Although the revised timing impacted on early actions, and key equipment contract placements, the Project Team was able to flex the later programme through acceleration of planned installation by use of additional resource.

The monitoring of 824 substations and 3600 feeder ends at 10 minute sampling over more than a year inevitably captured instances where supplies had been interrupted due to faults on the distribution system, such as third party damage or weather related faults. These would then have an impact on the respective measurement records; for example a supply

interruption that lasted 5 minutes, would produce an average voltage record for the ten minute period suggesting that volts were 50% for the entire period, thus distorting the information being sought. Similarly, communication faults could also impact on records. Accordingly, Quality Assurance measures were created with University of Bath to sense check each of the some 180 million measurements prior to upload into the detailed templates analysis. These QA checks are described in detail in ref 52

Public project progress workshops and publication of interim reports provided the opportunity further QA in testing the approach and initial findings with a wide audience which valuably included all other DNOs and Ofgem. During these workshops, when measurement data had become available and the statistical analysis by University of Bath was demonstrating that the templates hypothesis was working, there was favourable feedback and requests for WPD to extend the work. This entailed the undertaking of a detailed "validation" exercise to test the templates against some 284 sample substations selected by other DNOs [(53)], and the creation of new "templates classification" and "scaling" software tools to facilitate the uptake of the templates work into routine DNO usage. Accordingly WPD promptly submitted a Project Change Request [(12)] to Ofgem to cater for the addition of these added value elements In the event, the DNO Validation exercise, which could not have been anticipated at project initiation because the templates idea had yet to be tested, proved valuable in demonstrating applicability to some 82% of UK substations rather than the 50% anticipated in the submission.

The acceptance by the public of installation of (feeder end) voltage monitors in their homes was recognised as a risk and uncertainty at time of project submission (item 11 in ref 42). The initial Customer acceptance rate to the letter approach as set out in the required Customer Engagement Plan [(49)] for requesting permission for installation of feeder end voltage monitors was lower than expected, at 12%. The Project sought input from University of Bath Department of Psychology, and reworded the letter and provided a small prize draw incentive. This increased acceptance by a factor of a half; to 18%. This was still not sufficient and so WPD requested University of Bath to undertake a study into the statistical robustness of the Project with a reduced level of installation of monitors.

The emerging potential impact on the Project was raised at an early point with Ofgem, in June 2012, and further discussed in February 2013, prior to the submission of a formal Change Request in August 2013 [(12).] This entailed a reduction in the numbers and types of voltage monitors required and a Project Change Request (CCR1) was submitted to reflect use of 3500 feeder end voltage monitors, with request (CCR2) to enhance numbers by use of monitors connected to street furniture, which although more costly, enabled numbers to be increased to the statistically sound levels, determined by University of Bath. [(12)] In considering these two Change Requests, Ofgem concluded [(13)] "We have approved these amendments because we consider they mitigated the challenges presented by material changes in circumstances that were beyond WPD's control and arose since we originally funded the project. These amendments allowed the project to continue to deliver value for money to customers". Furthermore it stated "Our second concern was that WPD had purchased all the voltage sensors at the start of the project. The result of this is customers

paying for unused equipment. In response to our concerns WPD has committed to return these funds to customers. The funding (£314k) will be returned through the funding direction for this year's LCN Fund competition. Therefore we consider the amended project addresses this concern"

The above paragraphs provide information on issues and opportunities that resulted in a formal submission under the Change Request process; there were a number of other examples which serve to illustrate effective project management through flexing the approach utilised to deliver the project on time;

- On the installed performance of communication paths - with LV power line carrier proving less successful than Technology Readiness Level (TRL) and EU installation experience had indicated, WPD sought and obtained additional low power radio channels from the Government's Joint Radio Council (JRC), and made wider use of GPRC where practicable.
- On the delivery of substation data concentrators - there was a delay in provision of built up modules from GE's Bilbao plant. The Project used local assembly contractors to regain flow rates, and were able to move existing engaged contractors onto the required LV phase identification tasks earlier than originally envisaged to flex the approach without impact on overall cost and Project delivery

The pursuit of newly emerged opportunities created for DNO Validation and creation of Classification and Scaling tool software were set out in the above paragraphs describing Change Requests. The Project however, pursued with vigour dissemination and promotion of the key findings on the discovery of;

- substantial levels of headroom to accommodate further connection on PV at LV,[54] [18] , and adoption of these findings within WPD business as usual planning policy
- the actual LV feeder voltage behaviours sitting well within existing statutory voltage limits, illustrating the national scale for significant enhancement to the ability to connect more LCTs without the need for reinforcement, by adoption of wider EU LV voltage tolerances [55] [7] . Pending further national work on this issue, already in train, WPD have taken steps to reduce voltage, (within current statutory limits) across multiple Primary substations in South Wales, to reduce maximum demand, and free up capacity with direct cost benefits to Customers [8]

5 Basis of request for SDRC Reward

WPD believe that the Project has delivered outcomes of quality and value significantly in excess of those envisaged in the submission, and has achieved this within timescale and budget -

- The Templates concept has been proven, with applicability of some 82% UK networks as opposed to the 50% anticipated. The other DNOs have actively engaged with the Project resulting in a widespread Validation exercise and development of a Categorisation Tool, neither of which was included in the submission.
- The Project has discovered a circa 20% + increase in capacity headroom for connection of LV PV, previously unrecognised, communicated this to Government and the Solar Industry and resulting in early implementation of this into WPD day to day network planning activity with consequent cost benefit to Customers.
- The voltage monitoring part of the Project has shown that the lower voltage tolerance of current statutory voltage is not as widely exploited as it could be, providing for an early freeing up of headroom through changing target operating voltage on many HV networks with consequent cost benefits to existing Customers and new Connectees. WPD have implemented this in parts of South Wales. A review of its effectiveness and actual impact on demand and energy reduction has been undertaken and results published in April 2015. It has identified savings 50% higher than those envisaged in the earlier published paper [8]. Further details are included in Appendix 2
- The voltage monitoring has highlighted the opportunities for creation of further headroom at national level for connection of LCTs, reduction in energy costs, reduction in CO2 emissions and increase in plant margins. WPD have actively pushed forward the debate through discussion with National Grid, circulation of a Paper which sought to quantify the potential order of scale of benefit. That generated a direct approach from DECC for discussion and has subsequently led to the creation of a national working group, under the Energy Network Futures Group of ENA

All the above have made valuable contribution to furthering the ability of networks to accommodate and contribute to the low carbon future sought by Government. WPD respectfully submit that a request that the full potential award of £ 896k, as provided in the Project Funding Direction, be awarded.

Appendix 1

References

Executive Summary

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2. Wales 2020 carbon targets -

   http://gov.wales/topics/environmentcountryside/climatechange/emissions/?lang=en

3. Scotland 2010 - 2022 carbon targets

   http://www.gov.scot/resource/doc/346760/0115345.pdf

4. WPD LCNF Tier 2 submission for LV Templates Project

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5. WPD presentation of submission to LCNF Expert Panel 19th October 2010 - final bullet slide 9

   http://www.westernpowerinnovation.co.uk/Document-library/2011/WPD-Oral-presentation-to-expert-panel-Oct-2010.aspx

6. LV Templates Project Close Down Report - Page 93 4th paragraph and page 103 final paragraph

   http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

7. Discussion Paper on Adoption of EU low Voltage Tolerance - Western Power Distribution

   http://www.westernpowerinnovation.co.uk/Document-library/2013/EU-National-Voltage-Reduction-Discussion-Paper.aspx

8. Use of Project Findings to Implement Voltage Reduction at Primary Substations in South Wales Report

   http://www.westernpowerinnovation.co.uk/Document-library/2015/FINAL-South-Wales-Voltage-Reduction.aspx

Successful Reward Delivery Criteria

9. Ofgem Project award decision - 29th November 2010

   https://www.ofgem.gov.uk/ofgem-publications/45876/lcnfunddecisionfinal.pdf

10. Ofgem requirement for WPD to undertake short consultation on monitoring equipment (instead of Current Transformers) - 17 December 2010

    https://www.ofgem.gov.uk/ofgem-publications/45931/lcn-fund-project-direction-wpd.pdf (section 14)

11. Ofgem amended formal Project Direction issued 5th April 2011 (changed SDRC timescales in light of delays caused by above consultation)

    https://www.ofgem.gov.uk/ofgem-publications/45930/lcn-fund-direction-amend-project-direction-wpd.pdf

12. WPD Change request to Ofgem

    http://www.westernpowerinnovation.co.uk/Document-library/2015/FINAL-LVT-Change-Document-v1-0.aspx

13. Ofgem letter 24th June 2014 - response to WPD Change Request

    https://www.ofgem.gov.uk/ofgem-publications/92041/lvntchangedeicsionletternewtemplate.pdf

14. Project Direction revised by Ofgem to reflect change request - June 2014

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15. WPD 6 monthly report to Ofgem June 2012 Para 7.5 page 13

    http://www.westernpowerinnovation.co.uk/Document-library/2013/WPD-Tier-2-Network-Templates-Project-Progress-(2).aspx

16. WPD 6 monthly report Dec 2011 page 12 para 7.2

    http://www.westernpowerinnovation.co.uk/Document-library/2013/WPD-Tier-2-Network-Templates-Project-Progress-Repo.aspx

17. Report - Stresses on the LV Network caused by low carbon technologies

    http://www.westernpowerinnovation.co.uk/Document-library/2013/StressReport-final-submitted-v1-May-13.aspx

18. Presentation to DECC UK PV Solar Strategy Group - Grid Connection Sub Group

4th November 2013 , Victoria St, London
http://www.westernpowerinnovation.co.uk/Document-library/2013/PV-ratings-presentation-DECC-Nov-13.aspx

19. Digest of UK Energy Statistics ("DUKES") - DECC

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27. LV Templates Project Close Down Report - Knowledge dissemination Pages 75 - 92, schedule of dissemination activities pages 84 to 92 incl.

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Cost Effectiveness

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31. LV Templates Project Close Down Report - Pages 128 to 130 incl.

    http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

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33. LV Templates Project Close Down Report - Page 126 paragraphs under CCR002 Alternative Monitoring Methods.

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34. Ofgem letter 27th June 2014 - response to WPD Change Request - page 1 paragraph 2

    https://www.ofgem.gov.uk/ofgem-publications/92041/lvntchangedeicsionletternewtemplate.pdf

35. Dec 2012 6 month progress report - Page 11 final paragraph

    http://www.westernpowerinnovation.co.uk/Document-library/2013/WPD-PPR-LV-Templates-december-2012.aspx

36. Dec 2012 6 month progress report - Page 12 item 10.2

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and LV Templates Project Close Down Report - Pages 125 (consents) and 126 (alternative more costly methods) .
http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

37. LV Templates Project Close Down Report - Page 127 4th paragraphs

http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

Project Management

38. LV Templates Project Close Down Report - Page 20 final paragraph

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39. LV Templates Project Close Down Report - Project Management Method - Page 18

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40. LV Templates Project Close Down Report - Page 18 final 3 paragraphs and page 19 1st 4 paragraphs

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41. LV Templates Project Close Down Report - RAID log cited Page 18 final paragraph

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45. RAID log detail - 6 monthly report June 2012 - Section 10 pages 14 to 15 incl.

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46. RAID log detail - 6 monthly report Dec 2012 - Section 11 Pages 15 to 16 incl.

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48. LV Templates Project Close Down Report - Stakeholder and Communications Management first paragraph page 19

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49. Reference to development of Customer Communications Pack included in Appendix 3 of full submission

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50. Requirement for Ofgem approval of Customer Engagement Plan prior to initiation of any form of Customer engagement until the plan has been approved by the Authority - Project Direction Dec 2010 Section 12 pages 6 & 7

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51. 6 monthly report June 2012 - Page 5 Section 2.1, second paragraph.

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52. LV Templates Project Close Down Report - Quality Assurance -

    Pages 52 to 57 incl. - Section on "Step 1 Data sense checking
    Pages 63 to 66 incl. - Section on "Step 2 Analysis and Modelling: Quality Assurance (Update)
    Page 71 - Variable Data - Sense -checking
    Pages 93 to 95 - Quality Assurance
    http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

53. LV Templates Project Close Down Report - Pages 95 to 102 incl. DNO Validation Outcomes

http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

54. PV Findings specific dissemination events

Discussion Building Research Establishment, National Solar Centre, St Austell - 15 May 2013
Meeting Solar Trade Association - London 4 July 2013
Meeting - South West Solar Developers Forum - 9 July 2013
Meeting - DECC UK PV Solar Strategy Group - Grid Connection Sub Group - London 4 Nov 2013
Presentation to ENA DG Forum – Nov 2013
Referenced in dissemination log in LV Templates Project Close Down Report - Pages 89 to 91 incl
http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

55. LV Templates Project Close Down Report - Opportunity to adopt EU statutory voltage limits
Page 118 to 120 incl and Appendix B of that Report

http://www.westernpowerinnovation.co.uk/Document-library/2013/LVT-Closedown-Final.aspx

The following items are commercially confidential. Copies are available to Ofgem on request, but must not
be published

56. Initial offer from GE, dated 11th March 2011

57. Final offer from GE dated 6th May 2011

Appendix 2

See separate Report “South Wales Voltage Reduction Analysis”