SP ENERGY NETWORKS

Low Carbon Network Fund Project Progress Report December 2013

Flexible Networks for a Low Carbon Future

Version:	1.0
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1. Executive summary

1.1. Project Background

This project will trial a combination of smart network interventions and customer energy efficiency measures at three network locations. The objective is to demonstrate how they can release capacity on the HV network, allowing greater take up of low carbon technologies such as solar PV and heat pumps without the need for traditional network reinforcement. The project will also encourage specific I&C customers to improve the energy efficiency of their buildings to reduce their electricity demand in order to alleviate the need for reinforcement.

The results from these trials have the potential to inform future network planning and operational practices. This project will help DNOs more accurately assess operational plant ratings using dynamic techniques and how best to actively control the network at the EHV/HV level. It aims to provide evidence of the capacity headroom available in existing networks that can be used before traditional network reinforcement needs to take place. This will enable networks to connect more customers and plan network reinforcement activities to be timed optimally.

The overall project is divided in to 12 distinct work packages which complement each other and provide multiple methods which work together to achieve the overall aim of a 20% increase in network capability.

1.2. Project Progress Highlights

During this fourth reporting period of the project (June 2013 – December 2013) the project has completed a number of key milestones and continued to progress on many others.

The analysis of the new network monitoring data has now commenced and the interventions being deployed can be further assessed for their effect.

The new data has also been shared with WPD for use in their LV Templates LCNF Tier 2 project, where WPD have run their template modelling and analysis tools on the SPM & SPD monitoring data to verify that their templates are also applicable on other DNO's networks.

A Knowledge Transfer Lead has been appointed into the Future Networks team. This role includes developing improved knowledge sharing for all LCNF projects both internally and externally and to other DNO's and stakeholders.

A Flexible Networks Project learning event to share the learning that we have developed to date was held in the Power Network Demonstration Centre (PNDC) in Cumbernauld, Scotland on the 10th October. The event was well attended with representatives from other DNO's and various stakeholders. The event gave a detailed view of the key work packages, with progress and learning. The general feedback from the participants was that the event was successful in that it achieved its objective of imparting the information about the project progress and learning so far. This event was preceded by an internal event with the same purpose to ensure

that our own staff from across the business are equally informed of the learning.The contract for undertaking an assessment of the primary transformers for the application of dynamic rating has been placed and assessment work has commenced. This will identify the suitability of the trial sites primary transformers for application of any dynamic rating. Following the assessment the suitable transformers will have the equipment fitted.

The installation of the network automation in the St Andrews area is almost complete and the system configuration and the mapping of the new control interface into PowerOn is to commence next. The network automation equipment in Whitchurch has commenced installation and is due for completion early in the New Year.

1.3. Key Risks

Recruitment Risks – BRE have led engagement with Industrial and Commercial customers within the trial area to examine the scope for energy efficiency to reduce electricity consumption. Engagement has proven to be challenging however a number of customers have been identified to progress discussions with to participate in trialling energy reduction measures. There is a risk that insufficient participation may not realise the target reduction of 2%. We do however believe that the shortfall in any capacity gains through energy efficiency will be achieved by other elements of the project.

Procurement risks – We have encountered a general risk for procurement matters in that, to ensure best value is secured and robust governance procedures are followed, the timescales for procuring equipment are longer than expected. This project has encountered delays in the procurement of high value equipment for the enhanced network monitoring. The risk of the delays of obtaining the monitoring equipment was mitigated to some degree by accelerating the installation program. Other instances where delays have been incurred include the contract for assessment of transformers for real time thermal rating (RTTR) which took 5 months longer than originally planned, and the contract for real time thermal rating of the 33kV overhead lines which is currently 7 months behind the award date originally planned.

Integration of Voltage Regulators – Following the assessments at Whitchurch and Wrexham trial sites, the scenario to utilise voltage regulators in a flexible network has not arisen. Therefore it has been decided not to deploy voltage regulators at these two sites. The deployment in St Andrews remains valid and will go ahead as planned. The risk of losing learning from this change is being mitigated in two ways, firstly the Power network Demonstration centre (PNDC) will be utilised to fully test the regulators through extreme network conditions and secondly a non LCNF voltage regulator set has been installed for a new connection in Ruthin, Wales from which we can capture the design and engineering. The delay in the monitoring deployment, has resulted in a delay to the data being available to determine the application of the voltage regulators. This in turn has caused a delay in the procurement of the apparatus and the installation with be approximately 6 months behind plan.

System Development Risk - Flexible Control implementation is reliant on business as usual upgrades to our main SCADA system, PowerOn. These upgrades have not yet been implemented within the business. Our best estimate at the moment is that the Flexible Control implementation will be delayed by 6-8 months from the date originally planned. This specific risk may introduce a delay in the project which the team is unable to mitigate, as the key staff involved in our main SCADA system changes are not available to carry out the Flexible Networks PowerOn interface work.

When the series of above delays are considered against the project timescales, we are currently considering an extension request to the project timeframe.

Other Risks – An ongoing risk is that a substantial change to the load in the area (such as a new customer) may change the need for the project by automatically triggering necessary reinforcement as it cannot be accommodated even with a successful outcome from the Flexible Networks project. At this time no major changes are known within the time period of the project.

1.4. Learning Outcomes

Learning points are reviewed by the Flexible Networks project team at regular meetings to establish what was learned from the activities undertaken.

A key lesson learnt from the development work so far is that early engagement, buy-in and input from the main business units is essential to ensure that the work addresses the needs of the business properly.

The specification and procurement of new technology has been more difficult than originally anticipated as there are companies in the market place with the technology or expertise to develop products, however it can prove difficult to secure, via the normal procurement route, a contract for a developing product type. In certain cases we have engaged in a collaboration agreement to enable the supplier to work with us and accept that development of this type can't be tendered per the normal purchasing process.

Engagement with I&C customers has proven more challenging than initially anticipated, key challenges have included contacting the appropriate person in the organisation, gaining interest and trying to overcome misconceptions such as the purpose of the contact.

The process for learning capture is generally achieved through reporting and project documentation. The innovation website for Scottish Power has been updated with information, brochures and presentations about the project and the various work packages.

2. Project manager's report

The last six months period has seen progress in a number of areas and the project is close to plan apart from a few specific areas. The progress and details of each of the work packages is set out below

Work Packages 1.1 - Improved use of primary substation data

The network capacity headroom report has been completed and is ready to be placed on the SP Energy Networks learning dissemination portal. A design tool has been developed which enables the load growth and maximum demands at primary substation level to be forecasted, based on historical load growth information. The tool is designed to work with real-world data, identifying and in some cases correcting, errors in the source data before calculating load growth and maximum demand. As well as providing a forecast for maximum demand, it also examines more of the detail around the demand peak – for example the likely number and duration of exceedance events around the peak of the load duration curve in order to make a clearer assessment of potential future network capacity and risk.

Work Planned during the next 6 months:-

- Completion of the report associated with load growth forecasting tool, for public dissemination on our project information portal.

Work Package 1.2 - Improved secondary substation data monitoring

The early analysis of the enhanced monitoring data has commenced and this is informing the determination of where the LV network monitors need to be installed. These will then allow a better picture of the network voltage profiles and not just those at the substation busbars.

To date the substation monitors have performed well and the data has been stored in the data server iHost. There were some initial teething issues over weak GPRS communication signals which were rectified with external aerials being fitted.

The data storage in iHost has worked well and some modifications to the archiving system were implemented to streamline how the data was handled within the system. The access to the data by the project partners and other users has been without any issues. The data volumes have also been within expectations and have not caused any problems so far.

The data is currently being analysed for load and voltage profiles across the trial site substations, to determine what network interventions can be applied. We are planning to run trials of varying the transformer output voltages to determine the latitude of the network capability and from this determine the potential for additional microgeneration. Also the load profiles of the substations are being analysed to determine the load duration capacity versus the maximum demand capacity of business as usual.

The new network data has also been shared with WPD for use in their LV Templates LCNF project. From this WPD were able to apply their analysis model to the data and verify their 'templates' as being suitable for other DNO's networks.

Work Planned during the next 6 months:-

- Continue monitoring of the operation and reliability of the devices, data communication and storage.
- Install LV network voltage monitors.
- Continue analysis of data for other work packages.
- Identify the interventions to trial on the network; such as, reduced transformer output voltage.

Work Packages 1.3 and 1.4 - Improved operational and planning tools

The University of Strathclyde has begun the initial assessments of the secondary substation monitoring data. The first assessments included an overall analysis of the general data quality, aiming to identify site anomalies that could be due to, for example, installation issues and equipment failure or telecommunication problems. The aim is to maximise the availability of good quality data for subsequent detailed analysis as part of the project.

The UoS and TNEI have begun the process of developing the operational and design tools. These tools are being developed with the stakeholders in the different parts of the business taking in to account their requirements. It is likely these tools with be Excel based which simplify the extraction of key data. A key feature is to bring together the different tools which are currently being used for design and operations and provide a common framework. It is likely that the different tools will be retained in order to best match the differing user requirements between operation and design. However, the tools will be developed to access new, common library functions in order to ensure consistency across the business. For example, a common "dynamic transformer rating model" will be developed, to be adopted by operations, design and asset management.

A key lesson learnt from the development work so far is that early engagement, buy-in and input from the main business units is essential to ensure that the work addresses the needs of the business properly. The traditional approach of preparing a detailed "functional specification" at the start does not always foster good quality business input for innovative projects of this nature, but rather a "rapid prototyping" methodology , whereby the skeleton functionality can be demonstrated to potential users is much more effective. This encourages better quality of feedback from the users, resulting in a more efficient development of the design and operational tools.

Work planned during the next 6 months:-

- Continued evaluation of the secondary substation data by the University of Strathclyde.

- The new network monitoring data will be used to validate the network models developed by TNEI

- Develop data retrieval and visualisation requirements for Nortech's iHost system, based on the initial findings from the University of Strathclyde analysis.

Work Package 2.1 - Dynamic thermal ratings (DTR)

The weather stations have been installed at the selected Primary locations and are sending data into the "iHost" server to correlate the monitoring (in WP 1.2) and to provide an input for dynamic rating of equipment.

Corroboration of output data to local meteorological data identified errors. This was identified as a criticality in the power supply unit voltage settings, which has been rectified.

A contract has been awarded to KEMA DNV for Primary Transformer testing and initial assessment is currently underway. . Historical and supporting documentation is currently being analysed in this stage. Site surveys are programmed for late January

Contract negotiations with the supplier of the existing NMS for the development of the DTR have not been concluded. These delays in the procurement process are raising concern in the project timelines. Considerable system development is required to achieve the functionality expected. Thereafter testing monitoring outputs and verification against modelled values will evolve. .

Work Planned during the next 6 months:-

- To evaluate the condition assessment of the primary transformers at St Andrews, Cupar, Whitchurch, Liverpool Road, Ruabon and Yockings Gate following survey.

- Apply the KEMA DRS (dynamic rating system) to model the determined dynamic rating of Primary transformers at selected Primary substations.

- Instrumentation and further site testing will then be undertaken to verify the modelled outputs..

- Installation of the 33kV OHL conductor temperature sensors is programmed to coordinate with planned outages.

Work Package 2.2 - Flexible network control

The Central Communications Unit (CCU), with enhanced radio bandwidth to serve the purposes of the project have been installed at the selected sites. The introduction of the new radio frequencies is a development stage with extensive demand on a select resource. The testing regime involves pairing dedicated Control staff with the field resource through the winter period where priority to maintain system integrity is critical may affect projected timescales.

Data gathered from WP 1.2 will be analysed by University of Strathclyde (UoS) to understand network characteristics, develop models which will inform the structure from which logical sequence switching logic is developed.

There is a training rollout to commence in January for technicians to carry out configuration and extensive testing in Q1 and Q2. Also an initial overview for other operational staff in January. In Q2 further training modules will follow network configuration.

The delivery of the Network Automation system relies upon the support from the specialised PowerOn SCADA team to integrate the new Smart Grid Networks automation equipment into the PowerOn system. Currently the SCADA teams focus is on business as usual work to complete the implementation of the new company PowerOn SCADA system and solving operational issues. Therefore there is a risk of delays in this area which the project team may not be able to mitigate..

Work Planned during the next 6 months:-

- Complete the snagging and testing of the installations at the additional automation points across the Network.
- Training rollout to technicians for commissioning and operation of new systems
- Training all operational staff in trial area to operational competency
- Development of mapping processes to integrate the Primary CCMU to each individual intelligent device. As stated above, business as usual upgrades to the PowerOn fusion system have been delayed and until these are implemented the development work for Flexible control cannot progress.
- Data analysis by UoS to create operating limits of individual circuits
- Modelling load flows which derive from proposed automated switching, impacts on plant, protection systems and system stability

Work Package 2.3 - Energy efficiency

Since the last update SPEN and BRE have been continuing to create and develop trusting relationships with various stakeholders. This has predominantly been delivered via focussed follow up one-to-one, meetings with key parties that have been most willing to engage with the project and whilst this has been more time consuming, it has benefitted the project by both developing good relationships with key parties that may otherwise have not engaged and also by enabling key site (/stakeholder) specific issues to be raised, investigated and considered in greater detail via the one-to-one forum. As a direct result site surveys have been be progressed with the majority of engaged stakeholders, the aim of which has been to formally evaluate and assess the potential for installing technically relevant and feasible intervention measures to help realise the project aims. A number of performance specifications are also being developed in relation to the most common

interventions measures and upon completion of the surveys we will be preparing detailed option assessment reports in order to: provide independent and authoritative feedback to stakeholders; as well as inform the development of a number of theoretical intervention scenarios for each of the trial areas. The development and review of these scenarios will be a main focus of ongoing works and this review will include cost benefit analysis and energy modelling predictions of the various scenarios options in order to assess their relative impact and merits. This will, in turn, inform the targeting and installation of intervention measures. Additional energy modelling has also been carried out (at an increased level of detail) for specific areas of the network where monitoring equipment is installed to enable a better understanding of the connected loads in selected areas.

Site surveys have been arranged with:

Whitchurch:

Grocontinental (completed)

Belton Farm (completed)

BT exchange (completed)

(lots of effort put in with the following large consumers which did not materialise: Shropshire Council, Befesa aluminium refinery, NHS Trust, Carehome, TC Bolts (manufacturer), combermere abbey (luxury listed hotel/lets)).

Ruabon:

Wrexham Borough County Council: 4 x schools (completed)

BT Exchange (completed)

(lots of effort put in with the following large consumers which did not materialise: Clwyd Componders Ltd, Wrexham Mineral Cables)

St Andrews (ongoing):

BT

St Andrews University

Royal and Ancient (Golf museum, clubhouse, admin offices, research lab, members club, small hotel)

Fairmont Hotel and Resort (luxury hotel)

Stagecoach (bus depot and offices)

Historic Scotland (visitor centres (cathedral and castle)

Fife Council (schools and town hall)

(did not materialise – Scottish Water, St Andrew's Links Trust, Old Course Hotel, various other hotels.)

Work Planned during the next 6 months:-

- Continued refinement of load modelling and comparison with actual substation monitoring data
- Further surveys now agreed with Historic Scotland and golf related businesses
- Collaboration with St Andrews University to trial voltage reduction where there are sole use supplies
- Prepare detailed option assessment reports in order to: provide independent and authoritative feedback to stakeholders;
- The development of a number of theoretical intervention scenarios for each of the trial areas.

Work Package 2.4 - Voltage regulation

Using the enhanced network monitoring data and further detailed assessment of the Whitchurch and Wrexham network, this has now confirmed that these are not suitable for the deployment of an automatic voltage regulator (AVR) as part of a flexible network control (FNC) scheme. Work is therefore now focussing on AVR deployment within the rural/isolated urban network around St Andrews, where data from recently-installed monitoring equipment is currently being assessed to identify the optimal location for the new AVR and the order for this AVR is in progress. Therefore the budget for the voltage regulator work package with be under spent as the Whitchurch and Wrexham AVR sets are not required.

An opportunity for the Flexible Network project to capture learning has arisen from a connection funded AVR installation which has been deployed to the SPEN Network in Ruthin, to facilitate a new connection of renewable generation. This particular AVR deployment required the immediate development of a telecontrol solution for the device, which can be used to facilitate control of the St Andrews AVR as part of a FNC scheme, as well as a package of standard installation design documents. Both will be used to inform the development of standard designs, thereby reducing future AVR deployment lead times, consistent with the development of the "plug and play" philosophy envisaged by this project.

A detailed programme of characterisation tests, aimed at providing definitive information on the performance of AVRs in the network under a variety of operating configurations and control modes, is currently being drawn up. These tests will, subject to the final commissioning of the PNDC 11kV system, commence in early 2014. The results from the tests will inform SPEN policy development in respect of AVR deployment and also serve to validate the AVR power system models currently under development as part of the Flexible Networks project, both of which will also contribute significantly to reducing future AVR deployment lead times.

Also with the longer term objective of transitioning to the Business As Usual use of AVRs, consideration is also being given by the project to the development of maintenance and spares-holding strategies for these devices.

The internal dissemination objectives of the project are also being served through the development of the detailed PNDC AVR test programme where input to the definition of the test programme from a variety of internal stakeholders from within the company is being sought. This involvement from the wider organisation is, in turn, also laying down the foundations for the wider use of AVR technology becoming part of Business As Usual.

Through the Flexible Networks project SPEN has also developed stronger links with the supply chain for AVR devices and the communications channels opened up by this engagement are beginning to be accessed by engineers from across the business, which, again, is advancing our wider understanding of AVR technology, thereby assisting in bringing the "business as usual" deployment of this technology a step closer.

Work planned to be undertaken during the next 6 months:-

- Deploy a new telecontrolled AVR to the St Andrews network.
- Apply Envoy monitoring equipment to the St Andrews AVR and to a further three AVRs currently installed on our 11kV networks.
- Develop a telecontrol solution to allow the automatic, sequenced control of an AVR thereby allowing them to be used as an enabling technology for Flexible Network Control.
- Carry out a series of AVR performance characterisation and model validation tests at the PNDC.
- Use the existing PNDC AVR to trial a new CL-7 type control and communication device.

Work Package 3.1 - Internal stakeholder engagement

An internal innovation event was held at the PNDC in October to share with staff the activities of the Future Networks team on LCNF Tier 1 & 2 and IFI projects. The event was well attended and nurtured two-way discussions about what was being done and feedback gained from the attendees. This engagement helps bring fresh views and ideas for direction of the Future Networks team and supports adoption of new technologies and business operation.

Internal staff continue to be briefed on the LCNF activities and projects to gain support and nurture ideas for any other operation benefits that can be derived via a variety of approaches including team briefs, intranet updates and other ad-hoc meetings.

Demonstrations of the LV monitoring units have generated requests for additional network data from both Operations and Connection businesses.

Work Package 3.2 - External stakeholder engagement

BRE have had a number of meetings with larger customers around the trial sites to discuss and advise of possible energy efficiency measures, as well as extensive telephone and electronic communication. Historic Scotland who are currently engaged with the project as a potential site for energy efficiency solutions are intending to include a story on their blog discussing involvement.

A Flexible Networks Project LCNF learning event to share the learning that we have encountered to date was held in the Power Network Demonstration Centre (PNDC) in Cumbernauld, Scotland on the 10th October. The event was well attended with representatives from other DNO's and various stakeholders. The event gave a detailed view of the key work packages, with progress and learning to date.

A Knowledge Transfer lead person has been appointed within the Scottish Power Future Networks team to focus the capture of the various LCNF Tier 1 & 2, and IFI projects both internally and externally undertaken.

The Flexible Networks project was presented at the annual LCNF conference in Brighton in November. The presentations covered predominantly the lessons learnt from the network monitoring activity and the early data analysis. The Scottish Power stand had many visitors who were able to discuss further details of the project and take away information.

BRE and SPEN met again with St Andrews University to discuss BRE undertaking some additional energy surveys. The University has expressed interest in trialling voltage reduction on some sites. Further meetings have been held with Wrexham County Borough Council to keep them informed of the project progress and to identify where they would like to install more PV. We are now analysing the new network data to determine how this can be achieved and what amount of additional PV can be connected without the need for reinforcement versus the original position based out the business as usual approach.

Work Package 3.3 - Verification of experimental design

Work is ongoing with University of Strathclyde for them to review the methodologies of the work packages.

Work Package 3.4 - DNO policy changes

The activities of this work package do not commence until the latter stages of the project plan.

3. Key Issues

Specific issues in the overall delivery of the project: -

- The delays to the network automation PowerOn SCADA interface are delayed due to resources and the voltage regulation work is delayed due to the delay in data being available to analyse the AVR applicability.

- Procurement delays to the award of contracts could result in duration of the trials being cut short, which would reduce the quantity of data available and thus affect the results.

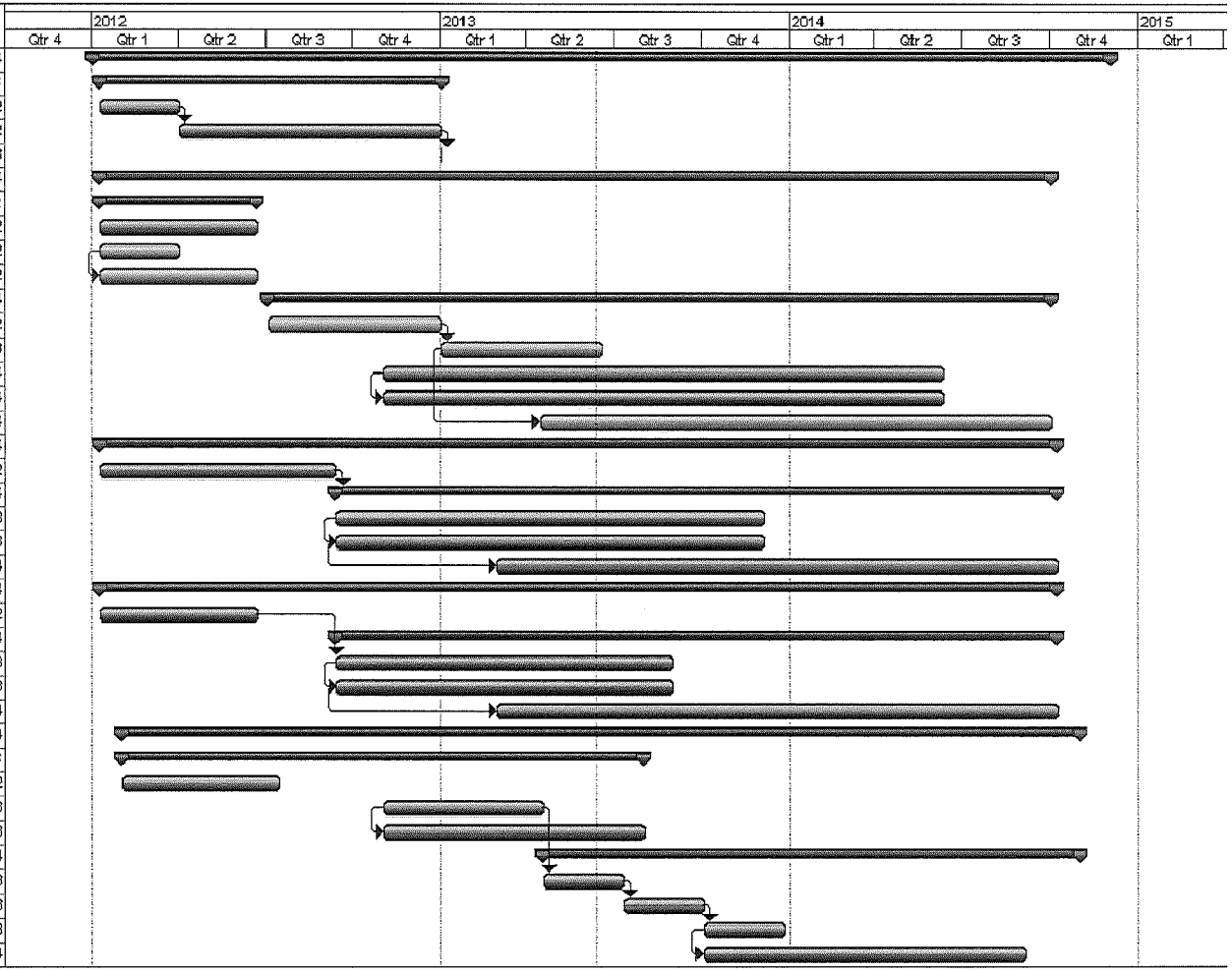
- Flexible Control implementation is reliant on business as usual PowerOn upgrades which have not yet been implemented within the business. Testing and trialling of the host system are programmed for July 2014 with potential go live in September 2014. This delay also affects the resource required for the development of the network automation logic.

- The finite limitation on resources with the necessary expertise combined with resourcing other innovation activities continues to be a challenge.

We are currently working to mitigate these issues. We recognise that changes will be required to our full submission in order to address these issues and we intend to submit a change request early in 2014 to address these points. At present the project budget is under spent and it is expected that the project will out turn an overall underspend. This is due to several reasons, but the main areas of under spend are in labour, equipment and contingencies.

Project **Plan**

ID	Task Name	Start	Finish
1	**Work Packages**	**Mon 02/01/12**	**Wed 03/12/14**
2	**Work Package 1.1**	**Mon 09/01/12**	**Tue 01/01/13**
3	Design	Mon 09/01/12	Fri 30/03/12
4	Development and Testing	Sun 01/04/12	Mon 31/12/12
5	Issue of good practice guide	Tue 01/01/13	Tue 01/01/13
6	**Work Package 1.2**	**Mon 09/01/12**	**Wed 01/10/14**
7	**Engineering Design**	**Mon 09/01/12**	**Thu 21/06/12**
8	Test case design methodology	Mon 09/01/12	Thu 21/06/12
9	Functional and Integration specifica	Mon 09/01/12	Fri 30/03/12
10	Installation methodology	Mon 09/01/12	Thu 21/06/12
11	**Monitoring Deployment**	**Mon 02/07/12**	**Wed 01/10/14**
12	Equipment procurement	Mon 02/07/12	Mon 31/12/12
13	Installation	Tue 01/01/13	Mon 17/06/13
14	Software development	Thu 01/11/12	Wed 11/06/14
15	Procedure development	Thu 01/11/12	Wed 11/06/14
16	Testing and Validation	Mon 15/04/13	Wed 01/10/14
17	**Work Package 1.3**	**Mon 09/01/12**	**Wed 08/10/14**
18	Design	Mon 09/01/12	Wed 12/09/12
19	**Development and Testing**	**Thu 13/09/12**	**Wed 08/10/14**
20	Software development	Thu 13/09/12	Wed 04/12/13
21	Procedure development	Thu 13/09/12	Wed 04/12/13
22	Testing and Validation	Thu 28/02/13	Wed 08/10/14
23	**Work Package 1.4**	**Mon 09/01/12**	**Wed 08/10/14**
24	Design	Mon 09/01/12	Thu 21/06/12
25	**Development and Testing**	**Thu 13/09/12**	**Wed 08/10/14**
26	Software development	Thu 13/09/12	Fri 30/08/13
27	Procedure development	Thu 13/09/12	Fri 30/08/13
28	Testing and Validation	Thu 28/02/13	Wed 08/10/14
29	**Work Package 2.1**	**Wed 01/02/12**	**Fri 31/10/14**
30	**Engineering Design**	**Wed 01/02/12**	**Wed 31/07/13**
31	Test case design methodology	Wed 01/02/12	Fri 13/07/12
32	Functional and Integration specifica	Thu 01/11/12	Wed 17/04/13
33	Installation methodology	Thu 01/11/12	Wed 31/07/13
34	**Technology Deployment**	**Thu 18/04/13**	**Fri 31/10/14**
35	Equipment procurement	Thu 18/04/13	Wed 10/07/13
36	Installation	Thu 11/07/13	Wed 02/10/13
37	Testing and Verification	Thu 03/10/13	Wed 25/12/13
38	Software development	Thu 03/10/13	Wed 03/09/14



ID	Task Name	Start	Finish
39	Procedure development	Thu 03/10/13	Wed 03/09/14
40	Testing and Validation	Thu 03/10/13	Fri 31/10/14
41	**Work Package 2.2**	**Mon 09/01/12**	**Thu 30/10/14**
42	**Engineering Design**	**Mon 09/01/12**	**Thu 21/06/12**
43	Test case design methodology	Mon 09/01/12	Thu 21/06/12
44	Functional and Integration specifica	Sun 01/04/12	Thu 21/06/12
45	**Technology Deployment**	**Sun 01/04/12**	**Thu 30/10/14**
46	Equipment procurement	Fri 22/06/12	Fri 28/06/13
47	Installation	Mon 01/04/13	Fri 19/07/13
48	Testing and Verification	Mon 22/07/13	Thu 30/10/14
49	Software development	Sun 01/04/12	Wed 09/10/13
50	Procedure development	Sun 01/04/12	Wed 09/10/13
51	**Work Package 2.3**	**Wed 01/02/12**	**Mon 01/09/14**
52	**Energy Surveys**	**Wed 01/02/12**	**Fri 28/02/14**
53	Customer engagement	Thu 01/11/12	Wed 17/04/13
54	Energy surveys	Mon 01/04/13	Fri 28/02/14
55	Modelling	Wed 01/02/12	Mon 30/09/13
56	**Network trials**	**Tue 09/07/13**	**Mon 01/09/14**
57	Installation	Tue 09/07/13	Mon 30/09/13
58	Testing and Verification	Tue 01/10/13	Mon 01/09/14
59	**Work Package 2.4**	**Mon 09/01/12**	**Fri 28/11/14**
60	**Engineering Design**	**Mon 09/01/12**	**Fri 21/12/12**
61	Test case design methodology	Mon 09/01/12	Thu 21/06/12
62	Functional and Integration specifica	Sun 01/04/12	Fri 31/08/12
63	PNDC test methodology	Mon 01/10/12	Fri 21/12/12
64	**Technology Deployment**	**Thu 01/11/12**	**Fri 28/11/14**
65	Equipment procurement	Thu 01/11/12	Wed 17/04/13
66	Installation Ph1	Thu 18/04/13	Wed 10/07/13
67	Installation Ph2	Thu 11/07/13	Wed 02/10/13
68	Testing and Verification Ph1	Thu 11/07/13	Wed 02/10/13
69	Testing and Verification Ph2	Thu 03/10/13	Wed 25/12/13
70	Procedure development	Thu 26/12/13	Fri 28/11/14
71	Testing and Validation Ph1	Thu 03/10/13	Wed 11/06/14
72	Testing and Validation Ph2	Thu 26/12/13	Wed 26/11/14
73	**Work Package 3.1**	Mon 09/01/12	Fri 28/11/14
74	**Work Package 3.2**	Mon 09/01/12	Wed 03/12/14
75	**Work Package 3.3**	Mon 02/01/12	Wed 02/10/13
76	**Work Package 3.4**	Fri 01/11/13	Thu 02/10/14

4. Consistency with full submission

The solution being developed and the methods being trialled in the project remain consistent with those set out in the full submission. However to address the key issues set out in 3. above we are considering a change request submission to Ofgem which requests an extension to complete the project and a restructuring of the budget. If this change request is approved we believe that the project will deliver its objectives at the required level of quality within the original funding. Within the Work package 2.4 - Voltage regulation, it was anticipated in the submission that the application of a flexible network at the three trial sites would become a suitable test-bed to trial voltage regulation within a Flexible Network with arising network voltage issues. The further network analysis and enhanced network data has revealed that the voltage issues we anticipated with the deployment of the network automation have only arisen in the St Andrews site. Therefore we intend to focus the learning we want to achieve for Voltage regulator deployment at the St Andrews, the PNDC and capture further learning from some recent connections projects which use voltage regulators in a main-line situation, which has not been trialled before in SPEN.

5. Risk management

The main risks currently facing the project are to do with timescales in that the delivery of the Network Automation system relies upon the support from the specialised PowerOn SCADA team to integrate the new Smart Grid Networks automation equipment into the PowerOn system. Currently the SCADA teams focus is completing the implementation of the PowerOn system and solving operational issues. Therefore we are currently experiencing delays in this area and preparing a change request for an extension to the project timescale.

Several original submission risk perceptions have been updated in the table below, to reflect how certain risks have not materialised in those aspects of work completed with a review and consideration for those risks that still exist.

No.	WP	Risk Description	Mitigation	Contingency Plan	Current Perception
1	WP 1 WP 2	The network trial sites may not be representative enough in terms of topology, and load and generation issues to provide learning for other UK DNOs.	Three network trial locations have been selected with different topology, varying levels of PV connection and different customer demographics. UoS will also provide expert review of experimental design to ensure that outcomes are technically robust, representative and verifiable.	Monitoring can be transferred to other sites relatively easily if required. It would not be necessary to repurchase monitoring equipment.	The three trial sites are still considered suitable for the experiments of this trial, i.e. Wrexham – high penetration of PV, St Andrews – increasing load and generation in a radial type network, Whitchurch – increasing load in an interconnected type network.
2	WP 1.2	There is a risk that procurement timescales could lengthen if monitoring equipment is not readily available.	The majority of the monitoring equipment has been deployed before by SPEN so procurement timescales are well understood.	As equipment for network trials becomes available, it will be installed at each of the 3 network trial areas consecutively with sites prioritised depending on criticality of network benchmarking. This will prevent any significant slip of project timescales.	The monitoring equipment is now delivered and installed. Only risk remaining is large scale failure of the population of units, this is perceived as low risk, as they are performing satisfactorily to date. There are further risks in the procurement of other equipment for Transformer Dynamic rating following the transformer assessments.
3	WP 1.2	Customers may suffer supply interruptions during installation of monitoring equipment.	Installation of monitoring at substations should not require an outage in most cases and if outage is required, it should be possible to minimise customer supply interruptions by load shifting.	It has been assumed that a small percentage of secondary substations will result in supply interruptions and a detailed customer engagement strategy has been developed to deal with this.	There have been no interruptions to customers during the monitoring equipment installations.
4	WP 1.2	The development of a "smart" monitor, may require additional time due to unforeseen development risk.	To mitigate this, SPEN will be engaging with a technology partner (Nortech) with expertise in developing algorithms for these devices and with a clear business plan in line with the aims and objectives of the LCNF project.	This is not on the project critical path.	The equipment development work has been completed, with the monitor suppliers. No delaying issues arose and all equipment is working satisfactorily.
5	WP 1.1 WP 1.2	Significantly more data will be generated to collect, communicate, store and process.	The magnitude of annual raw data storage required has been estimated. Work Packages 1.1 and 1.2 will explore the management of	Sampling rate can be optimised as necessary.	Sampling rates and data size have shown to be acceptable for the data being collected.

		Increase in costs of communication systems.	large datasets.		
6	WP 1.2	There could be data privacy issues for customers due to the extensive programme of monitoring to be deployed.	The existing SPEN regulations governing data privacy for customers will be used in this project.		There are no data privacy issues. Ofgem have approved our 'Customer Engagement Plan' and this includes how we will ensure customer privacy.
7	WP 1.2	Increased visibility of the network through enhanced monitoring may actually erode anticipated headroom.	Traditionally, there has been a degree of conservatism applied to network design.	Greater knowledge of headroom will improve risk management and reinforcement prioritisation for the network, protecting customers and ensuring P2/6 compliance.	No change. However the early data analysis has shown that this risk is very minimal.
8	WP 1.3 WP 1.4	The development of new tools and processes for the control room and network design involves some complexity and time/cost risk.	SPEN has engaged partners with expertise in the development of tools/software for this application (UoS, TNEI).	This is not on the project critical path.	No change.
9	WP 1.3 WP 1.4	Failure of internal user to adopt new tools and processes.	This project contains a detailed component of internal stakeholder engagement (WP 3.1), from the start of the project, to obtain user input and maximise likelihood of adoption. Business change techniques will also be utilised.	Executive buy-in could be utilised	No change. Business champions at manager level are being used to ensure adoption of LCNF learning. A specific role has been identified to transfer learning into BAU.
10	WP 1.3 WP 1.4	The 11kV network has not been modelled in entirety, only in limited network areas when it has been required. The LV network is not modelled in detail at all. There is minimal data available on legacy assets at these voltage levels. Once 11kV and LV network models are created, there needs to be a clear maintenance strategy to reflect new	The impact of this on the value of data will be investigated through a detailed uncertainty analysis. In addition, tools that can be used to automate the process of model creation will be investigated. It is not the intention to model all LV networks in detail but rather to improve representation of them. Strategies for model maintenance, through engagement with key customers for example, will be developed.	UoS has developed a GIS software that could be used to accelerate input of overhead line lengths.	No change.

		connections.			
11	WP 2.2	From investigation of flexible network control, it may be found that the trial networks are already running efficiently or that there are diminished returns associated with the use of this network technology.	A range of representative network area topologies and characteristics are being investigated.	This will be a learning point in itself. This should provide some excellent insight into the capacity headroom increases possible with this technology for a range of representative topologies and characteristics.	The Whitchurch network investigation has shown a worthwhile return for the application of flexible network control.
12	WP 2.3 WP 3.2	Engagement with external stakeholders i.e. customers, other DNOs, academia, local councils and authorities, community groups, may not be very effective.	A detailed element external stakeholder engagement is included in the project and UoS is providing support on knowledge dissemination. A customer engagement strategy has already been developed and BRE Trust will be involved in carrying out the energy surveys.		The engagement with customers has been difficult with a lower take up that expected. Generally customers have either already carried out energy efficiency or do not see the time involved worthwhile. We continue to pursue further engagement.
13	WP 2.3	It may not be possible to achieve the expected energy efficiency savings or there may be a lack of customer uptake.	A focussed approach will be used to target customers who should be able to achieve the most energy savings through proposed energy efficiency measures. A network benchmark will be established through monitoring before energy efficiency measures are trialled to provide a technically sound appraisal of possible benefits.	A customer cash incentive of £100k in total will be made available to encourage uptake. A reasonable outcome may be that energy efficiency measures do not have an adequate cost-benefit case.	We consider that the 2% capacity gain through the energy efficiency work package may not be achieved. However we expect to mitigate the shortfall with additional gains from other work packages.
14	There is a possibility of the unforeseen appearance of a load of up to 5-6MW at St Andrews or Whitchurch before the next price control period, that would require reinforcement. Even though this load is a marginal increase, it may cause P2/6 non-compliance.		Use early outcomes from LCNF project to delay reinforcement where possible.	Typically, the onus would be on the connecting customer to subsidise network reinforcement although regional development agencies may contribute. The network may need to be reconfigured but would still provide useful learning on network behaviour.	No significant load or generation has been seen in the trial sites to date.

15	The project may not provide the expected capacity headroom increases and St Andrews and Whitchurch may need to be reinforced using the traditional approach and/or it is not possible to connect much additional PV at Wrexham.		This project is based on a methodology of integrated, discrete work packages which have all been identified as having the potential to provide headroom increases. Risk is mitigated through		The project is expected to deliver varying degrees of benefit across the work packages which have more or less application on different network scenarios. We still hope to achieve the overall project goal.
Additional risks identified since original submission					
15a	WP 2.2	Resource availability for integration of new network automation technology into existing company SACDA system PowerOn.	There are no other available resources to mitigate this risk.	Request project timeframe extension.	It was considered that this would be achieved within the project original timescales. However due to development delays of the company SCADA system, the specialised resource cannot be made available for the Flexible network automation technology integration until late 2014
15b	WP2.4	Suitability for trial sites for the deployment of Automatic Voltage regulators (AVR).	To use a new connections AVR installation to capture learning of the design, specification and engineering for the equipment. Also use PNDC AVRs to carry out enhanced testing of functionality and performance.	To consider alternative locations for AVR use.	The capture of the other non-LCNF AVR deployment within SPEN will give a similar level of learning for the design, specification and engineering for this equipment.
15c	WP 1.2	Availability of new enhanced network monitoring data to inform and develop other work packages.	Increase monitor installation program to speed up delivery of new network data.	Advance preparation work for other work packages reliant on new network data. Use early data analysis to steer direction of other work packages.	Even though the monitoring installation program was reduced from 6 months to 3 months the original procurement delay has meant the late delivery of the new network data has impacted the progress of some other elements of the project, e.g. the voltage regulator deployment analysis.
15d	Procurement of new technology products.		Consider the use of collaboration agreements.	Use prototype equipment in test case trials before committing to contract.	The procurement of new innovation technology products for the project has encountered some delays due to the specification of such equipment typically needs to be developed with suppliers rather than a traditional procurement tender process.

6. Successful delivery reward criteria (SDRC)

Project budget (criteria 9.1) – At present the spend is lower than budget to date for a number of reasons;

- The expenditure on most of the Voltage regulation equipment has not yet been incurred. Also the voltage regulation equipment at Whitchurch and Wrexham is now not needed.
- The Dynamic rating software integration costs are not yet incurred.
- The procurement cost of the monitoring equipment was lower following the tender process.
- The installation costs for the monitoring equipment were lower than expected.
- None of the contingency budget has been required to date.
- No payments to users have yet been made to date.

Project Milestone Delivery (criteria 9.2) – As we approach the start of the final year of the project we have experienced delays in a number of areas, as may be expected in any major innovation project of this type. The dependency upon other elements of the normal business activity is causing delay, such as the completion of the introduction of the new company SCADA system PowerOn. The knock-on effect of this is that the Flexible Network automation system integration in to PowerOn cannot commence until this normal work is completed and as a consequence work package 2.2. will run into 2015. Also the voltage regulation work package is approximately 6 months behind plan. Therefore we are preparing a project change request for an extension to the project timescale. We do believe however that a considerable amount of learning will still be available by the end of 2014.

Creation of a Flexible Network (criteria 9.3-9.5) – no update can be provided until the project is complete however we remain confident that a 20% headroom can be created, although the make-up of the 20% may be different across the trial sites due to the applicable benefit variations that each site is able to offer.

Engagement, dissemination and adoption (criteria 9.6) –

A Knowledge Transfer lead person has been appointed within the Scottish Power Future Networks team to focus the capture of the various LCNF Tier 1 & 2, and IFI projects both internally and externally undertaken.

A person has recently been selected within Network development to undertake the specific role of looking at how the successful elements of innovation projects can be transferred into business as usual processes.

The Flexible Networks project team continue to regularly engage with Energy Networks staff to ensure the support and acceptance of the project methodologies and application.

The annual innovation dissemination event was held in October for Scottish Power staff across various business areas to learn about and give feedback of the various innovation initiatives underway within the company. Any ideas are captured and help shape the direction for future innovation projects.

The Scottish Power Innovation website has been enhanced with information about the Flexible Networks project with brochures and information from the learning event.

A Flexible Networks LCNF learning event to share the learning that we have encountered to date. was held in the Power Network Demonstration Centre (PNDC) in Cumbernauld, Scotland on the 10th October. The event was well attended with representatives from other DNO's and various stakeholders,

The Flexible Networks project was presented at the annual LCNF conference in Brighton in November. The presentations covered predominantly the lessons learnt from the network monitoring activity and the early data analysis. The Scottish Power stand had many visitors who were able to discuss further details of the project and take away information.

7. Learning outcomes

The monitoring equipment has been proving useful for other aspects of the business and we are hopeful that further gains will be identified over time. These include:-

- As the SP Manweb area network is run interconnected, it is sometime difficult to ensure that the transformer group separation is always maintained when the network is reconfigured for outages and backfeeds. An routine network fault occurred in which the supplies were not sectionalised correctly to the confusion of the operational fault teams. Following analysis of the substation monitoring data it could be seen that a large LV backfeed current was present to one of the substations while the HV network was in isolation. This additional information helped the operational staff to identify where the spurious backfeed was coming from and they could restore the group splits to the correct position.
- The Asset Replacement department were planning a switchgear change and discovered that additional load had appeared at the substation. By use of a monitor a clear picture of load distribution was gained and a suitably sized generator installed to enable the sw/gr change whilst maintaining customers.
- Connections department have used data available from St Andrews to make informed Connection offers. On one occasion the data enabled further load to be connected to existing network. In the second case it was clear that an additional substation was required, the current LV network was insufficient for the increased demand.
- The Nortech Envoy unit which is capable of extracting analogues from IEDs (intelligent equipment devices) has been trialled on several overhead line ccts

with transient faults. The additional data collected has assisted Operations with fault location, reducing customer interruptions.

8. Business case update

We have no changes or update to the business case to date.

We are preparing a request for an extension to the project timescale due to the various issues described previously in this report.

Progress against budget

Table 1 below is a summary of the total project budget position from commencement to December 2013.

Table 1.

Activity	Budget to June 2013 (£k)	Actual to date (£k)	Funding carried forward (£k)	Commentary
Labour	1,684	777	-907	The monitoring installation labour costs were less than forecast. Other work package labour costs have not yet been incurred or charged to the project.
Equipment	1,910	1,225	-684	Reduced equipment costs, not requiring the Whitchurch and Wrexham AVRs and costs yet to be invoiced make up the majority of the under spend.
Contractors	1,084	842	-242	The difference is due to some contactor work slightly behind plan and works yet to be invoiced.
IT	335	204	-131	The Dynamic rating IT changes are defined but the costs have not yet been incurred.
Travel & Expenses	27	22	-5	Project exceptional travel has been less than expected to date.
Contingency & Others	497	2	-495	No spend of contingency has been required to date and is unlikely to be incurred.
Payments to users	88	0	-88	No payments to users have been made to date. We are currently identifying and prioritising any payments to users.
Totals	**5,625**	**3,072**	**-2552**	

The above table shows a variance between the initial budget to December 2013 and the actual to date. This is due to a number of costs to the project having not been incurred in line with the project progress and some costs have yet to show against the project.

The contingency budget for the project elements which have been completed to date has not been required.

In line with the funding arrangements, SPD have contributed to costs incurred for a proportion of the expenditure for which they receive a direct benefit, detailed in table 2 below. Costs for the LCN funded element have been transferred from the bank account and a copy of the statement is included in the Appendix.

Table 2.

Activity	SPD & Partners Contribution to date (£k)	LCNF costs (£k)	Total/Actual to date (£k)
Labour	320	457	777
Equipment	868	357	1,225
Contractors	412	430	842
IT	97	107	204
Travel & Expenses	10	12	22
Contingency & Others	0	2	2
Payments to users	0	0	0
Totals	**1707**	**1365**	**3,072**

9. Bank account

A copy of the bank statement detailing the transactions of the Project Bank Account since its creation is attached to this report. The figures in the statement relate to the LCN funded costs only and not the total project costs. The total debit from the LCNF bank account is lower than the LCNF until the date of the next costs reconciliation. Minor differences in the reconciliation between costs and funding being transferred from the bank account are due to timing of transactions.

10.Intellectual Property Rights (IPR)

The project is not funding the development of any technology which should create foreground IPR. All partners have accepted the LCNF default IPR arrangements. This approach has not changed since the project commenced and we do not anticipate any further changes.

11.Accuracy assurance statement

The Project Manager and Director responsible for the 'LCNF - Flexible Networks Project' confirm they are satisfied that the processes and steps in place for the preparation of this Project Progress Report are sufficiently robust and that the information provided is accurate and complete.

Steps taken to ensure this are:-

- Regular update reports from each project team member for their area of responsibility.
- Evidence of work undertaken by the project team is verified by the section manager as part of their day-to-day activities. This includes;
  - Checking and agreeing project plans.
  - Holding regular team project meetings and setting/agreeing actions.
  - Conducting frequent one-to-one meeting and setting/agreeing actions.
  - Confirming project actions are completed.
  - Approving and signing off completed project documents.
  - Approving project expenditure.
- Weekly reports are produced by each section manager of the progress of the work their department is undertaking.
- Director and Senior Management summary reports for the project progress are produced.

Signature (1): _____ Martin Hill – Future Networks Manager

Signature (2): _____ Jim Sutherland – Network Development Director