

## **Low Carbon Network Fund Project Progress Report June 2012**

### **Flexible Networks for a Low Carbon Future**

**Version:** 1.0

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**Approved by:** Jim Sutherland – Engineering Director

## **Scottish Power Energy Networks**

### **Flexible Networks for a Low Carbon Future Project**

**Reporting period January 2012- June 2012**

#### **1. Executive summary**

##### **1.1. Project Background**

This project seeks to 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, heat pumps and EV charging points without the need for expensive network reinforcement. The project also intends to 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 in order to remove or delay the need for traditional network reinforcement through alternative solutions. This will enable networks to connect more customers and plan network reinforcement activities so that it happens only when genuinely needed.

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.

A foundation element of the project involves enhanced network monitoring, which will allow detailed analysis to accurately determine existing performance, and then influence how the deployment of the various technologies can improve the network design and utilisation, including the flexible control of load/voltage and network dynamic rating.

##### **1.2. Project Progress Highlights**

During the first reporting period of the project (January 2012 – June 2012) the project has commenced the initial phase work. In particular a number of key achievements have been made, such as:-

- All the Project Partner contracts have been signed by TNEI, BRE, Nortech and University of Strathclyde.

- A project launch meeting was held in February with all the Project Partner teams and the Scottish Power LCNF team, where all parties set out and clarified their individual work plans and scope details.
- The network monitoring and the data collection strategy has been finalised.
- The substation monitoring equipment specification has been completed and procurement process is underway.
- Internal workshops have been held to get effected staff buy-in to the project. This was well received and staff welcomed the opportunity to trial new ways of designing and operating the network.

## **2. Project manager's report**

### **2.1. Project Progress**

The project partners; TNEI, Nortech, BRE and University of Strathclyde, were all issued with contract terms setting out Scottish Power's obligations for the duration of this project. Embedded within these were the details of what the partners were contributing to the project, the work they would be carrying out and the payment stages aligned with appropriate milestones. All project partner companies have signed and returned their contracts. All partners have agreed to conform to the LCNF default IPR arrangements for this project.

A project launch meeting was held in February in order to bring all the project partners together with the Scottish Power LCNF project team to share their thoughts and plans of how they would be undertaking their specific work areas. During this a number of areas of linkage were identified and the aspects of work where partner-partner working together would be required. Each partner has been assigned a 'lead contact' from Scottish Power who can coordinate and oversee their input.

The difficult balance between collecting sufficient network monitoring data without falling in to the situation of having too much data which could be unmanageable, was a significant decision to reach after much deliberation. It has been decided that the network monitoring strategy will focus on collecting the key data that we believe will help us trial how we can increase the network capacity and develop/verify more accurate network modelling. Therefore the data to be collected is:-

- Primary and Secondary transformer loadings – to determine available transformer headroom capacity and load duration profiles.
- Selected circuit loadings – to determine available circuit rating utilisation and load duration profiles.
- Network node voltages - to determine available voltage bandwidth and the ability to vary the network voltage to facilitate micro generation whilst maintaining within statutory limits.
- Primary transformer operating temperature - to understand the heating and cooling effects during transformer loading cycles across load duration profiles.

- Weather parameters at the trial sites – to understand the temperature, wind speed/direction and solar radiation and their effects on the network apparatus performance against declared ratings.

Once the monitoring strategy had been decided, the specification of a suitable monitor was compiled. This was done after consulting other DNOs undertaking network monitoring projects and taking onboard their views and learning. The market place for electricity network monitoring is undergoing rapid development at present due to the high interest in this area.

## **2.2. Key Issues**

The actual installation and operation of the monitoring equipment is a key area where difficulties could be encountered. In order to build confidence for the installations each site has been surveyed to understand the range of network apparatus that will need to be fitted with the monitoring equipment. Also the communication of the data back from the monitors to the data hub and a test case is being undertaken to prove the effectiveness of the proposals.

## **2.3. Key Deliverables/Events**

The key delivery stages of the project are further ahead in the plan.

## **2.4. The next 6 months**

The next 6 months moves the project into a significant phase of the installation of the substation and network monitoring equipment. This will then be the enabler for the data availability and analysis stage of the project to commence next year.

Work is underway on the data processing approach and methodology in readiness for when the data is available. It is hoped that the proposed analysis methodologies will enable reduced data sets to be required in future by targeting the most useful specific data, to identify increased network utilisation.

## **3. Business case update**

The recent work of the Smart Grids Forum, especially Work stream 3, has emphasised the importance of network monitoring as a key enabling technology for the realisation of the Smart Grid of the future and will be an important consideration in the forthcoming SPEN price control submission for RIIO-ED1. General awareness of the potential data explosion is increasing and so the need for data reduction methods without the loss of any information is becoming increasingly recognised as an important issue to be addressed.

At this stage, no further information is available which changes the business case that was outlined in the Full Submission.

#### **4. Progress against plan for the Work Packages**

##### **Work Package 1.1 - Improved use of primary substation data;**

##### **Work Package 1.3 - Improved operational tools; and,**

##### **Work Package 1.4 - Improved planning tools**

The existing planning and operational tools which interface with the "PI" network data archive have been reviewed and recommendations have been made for their improvement.

A workshop has been held with the Design Section, focussing on making better use of existing primary substation data (including weather data).

Weather data (temperature, wind speed, direction, solar radiation) has been collated (from the data archive accumulated under the LCNF Tier 1 project "Dynamic Overhead Line Ratings" ) for use by Strathclyde University.

Collaboration and learning discussions have taken place with the Scottish Power project manager for the "Ashton Hayes – Smart Village" LCNF Tier 1 project and have successfully tried out some of the early prototype data processing techniques on real LV monitored data.

A detailed project plan has been developed, with the activities and inter-dependencies of the project partners being clearly defined.

Work Planned during the next 6 months:-

- Review GIS import capability and single phase modelling capability of both Digsilent and IPSA+ in order to establish most appropriate network modelling platform going forward.
- Prototype and validate improved and new software tools (Phase 1) which will interface with existing PI data collection system and provide appropriate presentation and output.
- Develop data retrieval and visualisation requirements for iHost (being delivered under Task 1.2) in collaboration with TNEI and Strathclyde University.

##### **Work Package 1.2 - Improved secondary substation data monitoring**

The substations at all the proposed sites have been surveyed and detailed information collated to map out the monitoring equipment configuration and installation at each site.

A monitoring test case has been undertaken, whereby a substation monitor has been trialled to gain understanding of the monitor installation, design and specification requirements for the project.

The monitoring equipment specification has been completed and the procurement/tender process is now underway.

The monitor installation methodology/safety method statement is being finalised.

Work Planned during the next 6 months:-

- Procurement and installation of the monitoring equipment is to be completed.
- The installation and set up of the "iHost" database servers are to be completed ready to receive data from the network monitors.
- The communications for all the network monitoring devices back to iHost is to be established.
- The availability of the network information from iHost commences.

### **Work Package 2.1 - Dynamic thermal ratings**

Learning from other DTR project will be applied to this work package, in particular our LCNF Tier 1 project in this area. Orders are being placed for two weather station units for St Andrews and Cupar Grid substations which are key components.

Discussions are ongoing with potential vendors on a method and the equipment available for Primary Transformer testing and dynamic assessment. Various equipment which is available for transformer thermal data acquisition is being evaluated.

Work Planned during the next 6 months:-

- Delivery and installation of the weather monitoring equipment to St Andrews, Cupar Grid and Whitchurch substations.
- Condition assessment of primary transformers at St Andrews and Whitchurch following tests to identify their suitability for being dynamically rated. Develop specification for DTR equipment and plan for integration into PowerOn.

### **Work Package 2.2 - Flexible network control**

Meeting to map out the scope of the work package have been held with various parties.

The Functional Design Specification for a system to provide the network automation and system logic has been produced to set out the requirements of the Flexible Network Control system.

Companies have been sought who can provide the necessary development for the automation equipment and systems. From which their "Technical offerings" have been received and evaluated for the best value solution.

Further technical meetings have been held with the chosen supplier and an order has been placed for trial CCU and enhanced radio.

Work Planned during the next 6 months:-

- Development of intelligence and algorithms for implementing novel control techniques.
- Installation and commissioning of trial network automation and communications equipment.

### **Work Package 2.3 - Energy efficiency**

Buildings Research Establishment (BRE) are fully engaged in completion of the tasks due for delivery during 2012. A project group has been established within BRE to undertake and complete technical evaluation of the three sites at St Andrews, Wrexham and Whitchurch.

An external resource has been employed by BRE and is now in place to draft Stakeholder Interaction Plan. This involves a complete technical evaluation for the three sites, identifying main user groups and high demand users. The stakeholder engagement plan will target high users first (Industrial & Commercial) and the current plan is to engage local trade bodies within each area in order to develop the objectives of the project.

Quarterly Project review meetings have been established with BRE to ensure progress and focus of their work as well as ad-hoc meetings on a more regular basis to address any outstanding issues.

The Scottish Power network diagrams have been provided to BRE to allow their analysis work of topography and demographics to get underway.

### **Work Package 2.4 - Voltage regulation**

It is the early stages of this work package therefore only initial discussions have taken place to identify the outline of the work to be undertaken, these include;

- (a) how the live testing of the packaged 3-phase voltage regulator will be done at the Power network Development Centre (PNDC),
- (b) how to package the three single phase units into a coherent 3-phase voltage regulator combined unit,
- (c) how the network modelling will be undertaken to identify optimal locations for the voltage regulators.

### **Work Package 3.1 - Internal stakeholder engagement**

Internal user workshops for both the SPD and SPM areas have been held with staff from the Operations, Planning/design and the Control room engineering teams, whereby the project aims and objectives and the impact to their work has been explained. The project plans were well received by the staff and they welcomed the opportunity to try out new ways of doing things.

This group also provided valuable input into the delivery of the project and some of the particular challenges we may face along with solutions for realising the ambition of the project.

### **Work Package 3.2 - External stakeholder engagement**

Members of the LCNF project team visited the SSE, WPD and ENW to discuss the monitoring equipment installed for various projects and to share learning and thoughts.

Members of the LCNF project team have also met with Northern Power Grid to collaborate and support their Customer-led Network Revolution Project, due to a density of heat pump installations taking place within the SPD network at Toryglen near Glasgow. Part of the NPG project is to look at heat pump usage and customer behaviour however they have not had any particular take up of these technologies in their network areas. We are currently considering how we could develop this scheme into a Tier 1 LCNF project to complement the activity being undertaken by NPG.

A number of meetings have been held with Wrexham Council to keep them informed of the project trial and of possible benefits to enable further renewable generation connections. Wrexham Council welcome the initiative and that their location has been chosen for the trial.

A meeting was held with Shropshire Business Enterprise, where details of the LCNF project were explained to them and the possible benefits for additional capacity availability, which they welcome to encourage local economic development.

Further dissemination has also taken place through presentations at various conferences including Smart Grid GB LCNF Overview and the SMi Smart Data conference to raise the awareness of this project and early learning outcomes.

### **Work Package 3.3 - Verification of experimental design**

The work is ongoing with University of Strathclyde for them to review the methodologies of the work packages. Resources have been identified who will be undertaking this activity.

### **Work Package 3.4 - DNO policy changes**

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



## 5. Progress against budget

Below is a summary table of the project budget position for the period 2011-2012. As this is a six month position, not all invoices have been received and many costs are expected to accrue in the second half of the year.

Activity	Budget Jan '12 to May '12	Actual Jan '12 to May '12	Variance	Comments
Labour	146,800	149,710	+2,910	
Equipment	0	1,000	+1,000	Purchase of communications signal meters.
Contractors	46,800	24,040	-22,760	Some contract work not invoiced for activities done since April 2012.
IT	0	0	0	
Travel & Expenses	2,100	14,987	+12,887	Additional collaboration visits to other DNO's and suppliers. Front loading of spend within this year.
Contingency & Others	1,685	0	-1,685	
<b>Totals</b>	<b>197,385</b>	<b>189,737</b>	<b>-7,648</b>	

## 6. 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 bank statements currently only show the credits to the account to date, the debits for the project costs will take place in due course. The account currently being used is in the process of transferring to online banking which will allow a more accessible statement to be available.

## 7. Successful delivery reward criteria (SDRC)

**Engagement, dissemination and adoption (criteria 9.6)** – The initial LCNF project user introduction workshops for both SPD staff (17th February) & SPM staff (19th January), in Operations, Planning/design and the Control room have been completed. Further formal dissemination workshops will be held following the monitoring and network trials to engage the staff and explain the learning and any changes in practice to the business as usual process currently in place. Consideration of the best time for external engagement and dissemination is ongoing.

**Engagement, dissemination and adoption (criteria 9.6)** - The opportunity has been taken to provide external stakeholders with visibility of the project and its early outcomes via presentations made at:

- Smart Grid GB LCNF Overview (London, 20th March 2012), and
- SMI Conference also in (London, 9th May 2012).

## **8. Learning outcomes**

At this first stage of the project we do not have sufficient learning outcomes of the trial to disseminate.

## **9. 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.

## **10. Risk management**

The project risks table below has been updated with any developments in the risks to the project. At this stage, the project management approach we have taken has meant that none of the risks have materialised.

The learning obtained so far in regards to the management of the risks, has been to establish contacts with other DNO's and equipment suppliers involved in network monitoring activities. This has enabled our project team to gain a far better understanding at the status and capability of the technology products available in the current marketplace. From this ideas have been shared and previous lessons learnt taken onboard of how to undertake the network monitoring element of the project.

Also the carrying out of a monitoring 'test case' at a typical secondary substation has been extremely useful, to gain a clear understanding of the practicalities and challenges of installing the monitoring equipment. The combination of the test case and the learning gathered from the Scottish Power LCNF Tier 1 Project at Ashton Hayes, have given us a high degree of confidence that we can specify, procure and install fit-for-purpose monitoring to support achieving the project objectives.

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 procurement process is currently progress. Early indications of compliance from Pre-Tender Qualification Questionnaire give comfort that devices which can meet the specification are available.
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.	No change. However, site surveys indicate that the customer interruptions to facilitate monitor installations should be minimal.
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.	Nortech are now engaged as a project partner and have previous experience of interfacing existing monitoring devices to the data hub and producing data processing algorithms.
5	WP 1.1 WP 1.2	Significantly more data will be generated to collect, communicate, store and process. Increase in costs of communication systems.	The magnitude of annual raw data storage required has been estimated. Work Packages 1.1 and 1.2 will explore the management of large datasets.	Sampling rate can be optimised as necessary.	Sampling rates have been specified for the monitoring equipment to maximise information without excessive quantity of data.
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.		No change.
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	No change.

				customers and ensuring P2/6 compliance.	
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. Initial workshops with internal users have shown a positive attitude from the staff who will be subject to the changes.
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 connections.	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.
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.	No change.
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.		No change.
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	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-	No change.

			efficiency measures are trialled to provide a technically sound appraisal of possible benefits.	benefit case.	
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 change.
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			No change.

## 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 Martin Hill – Future Networks Manager

18<sup>th</sup> June 2012

Signature (2): JSutherland Jim Sutherland – Engineering Director

## 12. Annex – Bank Statement

Please treat the attached bank statement as confidential