An exciting year ahead

Since our summer edition, our innovation portfolio has grown. We now have five Tier 1 projects under the Low Carbon Network Fund mechanism. The latest project to be added is the Smart Urban Low Voltage Network project, which will develop a new solid-state switching technology for use on low voltage distribution networks. We have also been awarded funding for our third Tier 2 project, Smarter Network Storage, a project that will explore if electricity storage is a viable option compared to traditional network reinforcement.

2013 will be an exciting and busy year for UK Power Networks as we enter delivery stage for many of our projects. We will start to see new technologies being deployed on to our networks as well as the development of new commercial arrangements being issued to customers. As these new developments take place, we will be sharing this new valuable knowledge with key stakeholders and playing our part in the smart grid revolution.

Martin Wilcox,
Head of Future Networks

Smart Urban Low Voltage Network

Registered with Ofgem in July 2012, the project aims to explore the benefits provided by an integrated Low Voltage (LV) remote control and automation system. Devices will be installed in two strategically selected areas of our London Power Networks region (LPN), both within the London Borough of Islington, in 54 substations supplying approximately 8400 customers, and 168 link boxes.

Once populated with the new technology we expect to see a significant improvement to LV network performance and management in the trial areas, with customers benefitting from an improved security of supply.

Objectives

- Industrialise the existing technology developed and supplied as part of the Innovation Funding Incentive (IFI) project.
- Integrate the LV remote control technology with our existing SCADA system and control platform via DNP3, a set of communication protocols used between components in process automation systems.
- Investigate how a greater understanding, visibility and control of the network can lead to LV active network management, facilitate the connection of low carbon technologies, and decrease the occurrence and impact of faults on the LV network.

Progress

✓ Industrialised designs have been finalised.
✓ The Power Line Carrier (PLC) technology for communication between substations and underground link boxes has been trialled and evaluated. Recent testing has produced promising results. Reliable communication over the LV network has been demonstrated on circuits up to 270m long.
✓ Site selection has been completed and site surveys carried out. Preparation of trial network area is under way. The deployment of equipment is expected to begin in July 2013.
✓ The approach to the SCADA development has been agreed.

Single phase fault-break/fault-make circuit breakers retrofitted in place of the existing LV fuses.

Local control of switches provided by a control panel (fits under link box lid).

Load-break/fault-make switches replace solid links in LV link boxes.
Objective
To enable faster and cheaper renewable generation connections to the electricity network by trialling new technologies and new commercial contracts.

The £9.7million project, sited in Cambridgeshire, an area in which we have seen an increase in wind generation connection requests, is now a third of the way through its project lifecycle. The first year has focused on stakeholder engagement and the development of the new commercial arrangements for “non-firm” or so called “interruptible” connections. We have also focused on the design of new technical solutions, as well as raising the profile of the project and sharing the knowledge generated in year one internally at UK Power Networks and externally at key industry events.

2013 will be the deployment year for the project. In March we offered six distributed generation developers the ‘Flexible Plug and Play’ interruptible connection offer, and we will see our new telecommunications platform go live. This new platform uses IP-based communications technology and the data protocol IEC 61850 to enable interoperability amongst the smart devices. In June, we will install a “Quadrature Booster” - a mature technology currently used on the transmission network, but will be trialled for the first time on the 33kV distribution network. The Quadrature Booster will be used to control active power flow on parallel lines.

The customer – the distribution generation developer
In order for the project to demonstrate the benefits it can deliver, it is...
Plug and Play trial area, an area around electricity connections in the Flexible generation developers seeking formally engaged with distribution The project team has proactively and formally engaged with distribution generation developers seeking electricity connections in the Flexible Plug and Play trial area, an area around 700km² between Peterborough, March and Wisbech in Cambridgeshire. These projects are seeking connections at constrained parts of the network in the trial area and as a result, their ‘conventional’ connection quotes include significant costs for provision of expensive sole-use assets. The Flexible Plug and Play technical team has identified opportunities to offer cheaper and faster connections through actively managed interruptible connections for these customers.

Six of those distribution generation developers are engaged in the trial (total generating capacity of 26.2MW) and they have been working closely with the project team. On 1 March 2013, the project team issued these six distribution generation developers the alternative Flexible Plug and Play connection offer proposal.

Commercial Arrangements

UK Power Networks has recently published the ‘Principles of Access’ report, which details the smart commercial arrangements for generators connecting to our network under the Flexible Plug and Play project. Using the research from the report, the project has developed a commercial framework suitable for offering distributed generation connections to constrained parts of the network on an interruptible basis. The project team has focused on exploring the different ‘principles of access’, analysing a number of different commercial options against a set of criteria.

Our project partner, the University of Cambridge, also carried out extensive research to understand best practices from around the world regarding interruptible connections for distributed wind generation. This research helped inform the Flexible Plug and Play approach.

Smart technologies

In order for the new smart technologies and devices to work, the project is installing a new telecommunications platform in the Flexible Plug and Play trial area. The detailed design and deployment of the communications infrastructure has been completed. The project is moving to the final stage of the testing phase and is on track for completion by the end of March 2013 as planned. The telecommunications platform will operate alongside UK Power Networks’ existing telecommunications platforms, but is being trialled specifically for the Flexible Plug and Play Active Network Management (ANM) system and the new smart devices that the project will be deploying.

One of the focal smart devices is a 30MVA rated Quadrature Booster that is designed to overcome an existing constraint due to sub-optimal load sharing on 33kV parallel circuits at UK Power Networks’ Wessington substation. During the Flexible Plug and Play trial, the Quadrature Booster will monitor and control the network to balance load flows and create additional headroom capacity to accept increased CHP exports to the distribution network.

The project team has made significant progress on the detailed design of the overall installation of the Quadrature Booster. It was dispatched from Australia in January 2013 and will be delivered on site in March 2013. The installation will start after delivery and the Quadrature Booster is on target to be commissioned at the end of June 2013, in line with the agreed project milestone – the Successful Delivery Reward Criteria.

Finally, the Flexible Plug and Play team has completed the design of the Active Network Management system that will be used to control the output of the participating distribution generation developers and is currently testing the system in a factory environment.

**Successful Delivery Reward Criteria (SDRC)**

The project has completed its first two SDRCs, which are contractual milestones with the GB regulator, Ofgem. The milestones are important as they demonstrate that the project is making good progress and will be completed on time.

- **December 2012**
  
  Completion of the Flexible Plug and Play: Principles of Access Report, which describes the analysis carried out on the smart commercial approach to connect distributed generation under interruptible terms. The report specifically concludes that the Flexible Plug and Play project will look to implement the principles of pro-rata curtailment.

- **September 2012**
  
  Completion of the Flexible Plug and Play: Stakeholder Engagement Report, which aims to better understand the needs, concerns and viewpoints of distribution generation developers, other DNOs, renewable generation developer trade associations, local government and regulatory and policy-making bodies in the context of the Flexible Plug and Play project.

The project is generating valuable knowledge that is shared at events and on the project website; copies of reports are in the Learning Zone: [www.flexibleplugandplay.co.uk](http://www.flexibleplugandplay.co.uk)
Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network

Objectives
To validate the capabilities of a small scale storage device, demonstrate a number of charging and discharging scenarios and understand the relative value to a distribution network operator and other network users. Anticipated benefits include improved modulation of power flows across the network by balancing demand and electricity generated by local wind farms, improved power quality and power factor through the power electronics interface between the storage device and our networks, and potentially improved network resilience by using the energy storage device to deliver power in the event of a network outage.

Progress
In addition to real power exchanges with the network (reported in Issue 1), the Energy Storage System (ESS) has been automatically providing or absorbing reactive power to the network. The objective has been to control the voltage should it fall outside of pre-determined limits. We have also demonstrated that by tightening the voltage limits, the Energy Storage System will respond with higher magnitudes, and more frequent exchanges of reactive power.

Analysis of first real power exchange schemes and STATCOM* have demonstrated that the storage device is able, as expected to:
• reduce demand by exporting real power
• reduce voltage fluctuations by either exporting reactive power to increase the voltage or importing reactive power from the network to lower the voltage should it fall outside of pre-determined limits (10.96kV ±0.11kV) (Hemsby 1, right). It has also been demonstrated that by tightening these limits to (10.96kV ±0.08kV), the Energy Storage System will respond with higher magnitudes, and more frequent exchanges of reactive power, keeping the voltage within stricter limits (Hemsby 2, right).

The benefits of being able to reduce fluctuations and manage demand are that it provides the possibility to accommodate additional demand or generation on the existing feeders, within the thermal limits of the plant and circuit, without breaching voltage limits or needing to curtail generation.

*A static synchronous compensator (STATCOM) is a regulating device used on alternating current electricity networks.
Overview
UK Power Networks is excited to announce the securing of £13.2 million from Ofgem’s Tier 2 Low Carbon Network Fund (LCNF) for the Smarter Network Storage (SNS) project. The project builds on the smaller scale project ‘Demonstrating the benefits of short-term discharge energy storage on an 11kV distribution network’ (page 4), which focuses on technical aspect of electrical storage. Smarter Network Storage will undertake a range of commercial and technical innovations to explore and improve the economics of electrical energy storage, allowing storage to benefit the full electricity system and provide a more sustainable and efficient way to reinforce the network.

Objectives
The Smarter Network Storage project will install a 6MW/10MWh electrical storage device. This device will be used as an alternative to the traditional reinforcement methods. It will help accommodate low carbon technologies and mitigate electrical capacity constraints at the site which currently limit the available capacity in very high peak demand times.

Simultaneously, the project will explore novel commercial arrangements and revenue streams from supporting overall system balancing and stability, in addition to wholesale electricity markets and the viability of offering multiple services.

Benefits
The project will help to understand and improve the overall economics of energy storage, facilitating the use of storage as a smart alternative to conventional reinforcement. For customers, this means reduced overall system operational costs and more efficient network investments, which will pass through to reduced electricity bills.

For Distribution Networks Operators (DNOs), including UK Power Networks, this means lower cost and more flexible alternatives to network reinforcement that can be used across the network. This will help us achieve our visions to be sustainably cost efficient and a respected corporate citizen.

Deliverables
Starting in January 2013, in conjunction with installing the UK’s largest DNO-operated storage device, the four-year project will deliver key learning relevant to the ownership and operation of such an asset. This information will be appropriately disseminated to key stakeholders, including the wider DNO community and policy makers, to bring the full benefits to the UK electricity system.

The project will also deliver a range of novel contractual arrangements for the provision of additional services, unlocking revenue streams and allowing the full value of energy storage to be realised.

Among the deliverables will also be a Smart Optimisation and Control System (SOCS) that will intelligently forecast demand and optimise the use of any remaining storage capacity that the DNO does not require. This system will integrate with ENMAC* to allow visibility from the control centre, while minimising any extra resource required. Such automation will be vital in the success of the wider adoption of such technology across the networks. Initial modelling scenarios undertaken during the bid phase have indicated that the potential net annual system benefits of deploying distributed energy storage are placed at £2 billion per year by 2030.

Partners
UK Power Networks will be leading the four-year project working with eight key proposed project partners to deliver the solution. The project partners are KiwiPower, Durham University, Swanbarton, Pöyry, National Grid, Imperial College London, Smartest Energy and AMT SYBEX. These partners have been chosen for their experience and expertise to explore the technical and commercial opportunities of the project.

*A tool used to record planned work.

Progress
- **January 2013**
  - First partner kick-off meetings held, and design brief underway for civil works.
- **February 2013**
  - Planning application completed and submitted for preferred trial site for storage development.

An example of a small scale storage device
Low Carbon London

January 2011 – December 2014

Project background
Low Carbon London is an innovative and ambitious project managing a number of physical demonstration trials to assess the impact of a wide range of low carbon technologies on London’s electricity distribution network. The project will also assess customers’ interactions and behaviours associated with those technologies in their everyday lives. The learning, insights and data collated from the trials will enable modelling and extrapolation to other large cities and GB-wide levels of forecasting.

Progress
2012 saw the completion of major design work for the Low Carbon London trials along with the recruitment of participants. 2013 will focus on the execution of the trials and collection of associated empirical data and 2014 will see the completion of the data modelling and analysis phase with the production of a wide range of publicly available reports.

These reports will mark the completion of the project and will detail the results of the trials and the implications for a successful move to a low carbon economy, particularly in relation to the effects and opportunities for the continued effective management of the electricity distribution network.

We have now moved into the trial operation phase of the Low Carbon London project which will concentrate on the collection of data from the various trials. Opportunities will arise during 2013 to share some of the interim findings from the trials with the final reports being published in 2014.

2013 sees Low Carbon London focus on trial execution and the collection of empirical data.

For more information about this programme, and to sign up for our newsletter, visit www.lowcarbonlondon.info

Michael Clark and Chris Pascall, UK Power Networks

www.lowcarbonlondon.info
EDF Energy smart meter customers have agreed to take part in a unique Low Carbon London Dynamic Time of Use trial. The demographic profiles of this group are closely aligned to those of London as a whole.

Eight organisations have agreed to have Active Network Management technology installed in 22 of their premises.

Small-scale embedded generation (SSEG) trial participants and still recruiting.

Low Carbon London is now capturing charging data from more than 900 publicly-accessible electric vehicle charging posts.

The charging patterns of 46 privately-owned and 52 commercially-owned electric vehicles now being monitored. These numbers will rise as recruitment to the innovative Low Carbon London electric vehicle leasing scheme takes place during the first quarter of 2013.

Three Engineering Instrumentation Zones (EIZs)

These have been formed from three previous Mayor of London Low Carbon Zones (Queens Park, Brixton and Wandle Valley), for intensive instrumentation and measurement. Thirty secondary substations within these EIZs have had network monitoring equipment installed.

Other monitoring tools

- Five centrally-located decentralised control and monitoring systems have also been installed as part of the Active Network Monitoring trial.
- Remote Terminal Unit (RTU) upgrades have been made to substation sites and upgrades to network control applications, such as ENMAC* and Power-On Fusion**, have also been completed.

* Used to record planned work.
** Used for real time management of the electricity network at the control centre.

Demand Response trials

Three separate trials have been conducted with a further trial planned for the summer of 2013. The winter 2011/12 trial had two participating customer and implemented three interventions and the summer 2013 trial had four participating customers with 12 interventions implemented. The winter 2012/13 trial was still underway at the time of writing but it was anticipated that there would be less interventions than the previous summer trial due to different network requirements.

The aforementioned three trials have used customers’ on-site electricity generation capacity to support the network at times of peak demand. It is proposed that the summer 2013 trial will include contracting with customers to reduce their electricity demand through ‘building turn down’. In addition we are intending to incorporate Active Network Management technology in this trial to enable us to monitor the London electricity network and send automatic signals to activate an intervention.
Distribution
Network Visibility (DNV)

Objectives
To maximise the use of our current Remote Terminal Units (RTUs) in London. The project demonstrates how a greater visibility of power flows and a smarter use of data will contribute to:
- managing more complex load profiles
- accommodating greater levels of distributed generation
- improving network performance.

Progress and benefits
✓ The Distribution Network Visibility web-based tool is live on UK Power Networks’ servers and available to an initial set of business users to analyse existing data from 9500 secondary substations and 115 primary substations.
✓ 500 Remsdaq RTUs have been successfully upgraded and additional data (voltage and current for all three phases) is now being collected.
✓ A number of case studies are currently being developed to demonstrate the benefits of the visualisation tools developed and the Pi processing engine that enables large amounts of network data to be easily analysed.
✓ It is expected that some data issues will be identified and that not all the anomalies detected will be genuine.
✓ The tool will help us work in a more co-ordinated manner to retrieve load information from Pi and it will reduce the number of occasions on which we need to install temporary monitoring to inform a connection study.

Case study | Benefit
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DNV 1: Generation is causing voltage issues | This could facilitate the connection of additional distributed generation on the network as network constraints are better understood and can be addressed.
DNV 2: Demand is increasing and exceeding the rating of the transformer | This will enable us to extend the life of distribution transformers by identifying and addressing overload issues early.
Having better visibility of spare capacity on the network will also assist the connection of additional load on the network.
DNV 3: High current unbalance between the LV Phases | Being able to identify current unbalance on the network will help reduce losses on the network by:
- Being able to remotely identify blown fuses on the interconnected network (which may not necessarily result in supply interruptions).
- Redistribute load between the phases by reconfiguring the network when possible.
- Target the deployment of future power electronics devices such as load balancing devices.