# Flexible Plug and Play Low Carbon Networks

## Project Progress Report June 2013



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# 1 Executive Summary

The Flexible Plug and Play (FPP) Low Carbon Networks project aims to demonstrate how, through the innovative integration of technological and commercial solutions, a cost effective connection of distributed generation (DG) to constrained parts of the distribution network can be achieved.

The FPP project was awarded funding of £6.7million by Ofgem, under the Low Carbon Networks Fund ("LCNF") scheme, on 19 December 2011 and the project officially started on 1 January 2012.

This six monthly reporting period (January 2013 – June 2013) is the third one for the project. The first year of the project delivered the mobilisation of the team and resourcing, design of the technical platform, targeted engagement with the project's stakeholders (primarily the DG Customers) and development of the commercial framework for 'interruptible' connections.

The main focus of the second year of the project is the building, testing and commissioning of the technical platform, the further progress on recruitment of DG customers to participate in the project, and finalisation of contracts with the participating generators and the development of the investment model. As such, and as seen in Section 8, the amount of Intellectual Property (IP) for use by other Distribution Network Operators (DNO's) has greatly increased in this reporting period. The third and final year of the project will focus on structured trials that deliver the learning outcomes set out in the bid use cases and the final commissioning of the FPP connections for the participating customers.

Specifically, this reporting period saw the successful completion of the third Successful Reward Criterion (SDRC) deliverable (SDRC 9.3 – IP Communication Platform go live) as planned by the end of March 2013. The fully operational innovative communications platform is based on Internet Protocol (IP) and Radio Frequency wireless mesh technology is the cornerstone of technical platform as it will transfer all the data traffic for the FPP smart solutions.

The FPP project recognised from the bid stage that a key risk to demonstrating the technical and commercial innovation developed by the project is the lack of real customer participation to its trials. In order to mitigate the risk, the project has made customer recruitment as one of its key priority since the start.

Significant progress has been made in this respect, DG customers are engaged and six connection offers were issued by the self-imposed deadline of 1 March 2013. Furthermore, the project is ahead of plan and on target to meet SDRC 9.7 (Facilitation of faster and cheaper DG connections), with six customers (total capacity 25.2MW) seeking connection within the FPP trial area. The FPP connection offer comprised of suite of documents including curtailment studies, description of the commercial framework and a draft contract for entering into an 'interruptible' connection.

The project team has since been supporting further analysis and clarification, working closely with these customers and their due diligence teams. Three of the six customers have planning permission for their projects and are keen to progress with them, they are currently assessing the FPP connection offers as a valid alternative option to the

standard grid connection offering. The feedback has been positive to date and a conclusion to their due diligence is expected by mid-July 2013.

The other three of the six customers have provided positive feedback on their FPP offers and decided to pursue their planning permissions and will consider the grid connection offer again later in 2013.

In addition, UK Power Networks continues to monitor all formal applications for connection within the FPP trial area to ensure that all projects that could potentially benefit from an FPP 'interruptible' connection solution are offered the option.

Focus for this reporting period has been the deployment of the Quadrature-booster transformer. The successful deployment of Quadrature-booster (SDRC 9.8) as outlined in the project direction was due to be completed by the end of June 2013.

Over the second and the third reporting period the project team recovered the delays incurred by the change of Quadrature-booster supplier in June/July 2012. As a result and although the plan was on target, there was very limited float to accommodate any further delays that might arise. The Quadrature-booster was manufactured and delivered to site and all civil works had been completed to accommodate its arrival in April 2013. However at that stage, the project had come up against a key challenge associated with the finalisation of the protection scheme design. The actual design proved to be significantly more complex than originally thought and a number of validation exercises were required.

The validation exercises included internal peer reviews, an independent assessment by a third party engineering consultancy and a series of laboratory based simulations using a Real Time Digital Simulation (RTDS) system in order to conclude on the proposed configuration.

Furthermore, during the cold commissioning of the Quadrature-booster transformer (May 2013), a number of technical queries were raised that resulted in additional site tests of the device. Specifically, the additional testing simulated on-site real operational conditions for the Quadrature-booster (i.e. the effect it will have when connected on an electrical line with lower impedance that is in parallel connected to an electrical line with higher impedance) and proved the principle of operation both in theory but also in application. These additional tests took four weeks as equipment was required to be procured and set up (load banks, reactors, voltage regulators), safety documentation to be produced for test set-up and analysis to be carried out after the conclusion of the tests in order to determine whether these were conclusive.

The team has managed to date to overcome and mitigate the issues with the protection scheme design and the Quadrature-booster as described above in terms of technical risk and safety. However as both were on the critical path for completion of the Quadrature-booster, the net effect is approximately a four week delay to the completion which is now projected for end of July 2013. In parallel to this report we are submitting a change request to Ofgem, and will intentionally add an appropriate level of contingency beyond the current forecast commissioning date to accommodate any remaining issues which occur during the remaining works on site.

One of the smart devices to be installed is the frequent use switch (2 units), these would be used to support seasonal network reconfigurations with the aim to maximise DG export into the distribution network. The project has determined that equipment (Ring Main Units) that are currently installed at the required location under a business as usual project can deliver the functionality without the need for installing the two frequent use switches. As such, we

have formalised a change to the project to not install two frequent use switches and to return the associated budget for the equipment and works as part of the parallel change request to Ofgem (see section 2.1.3).

The delivery of the activities associated with SDRC 9.4 (Demonstrate FPP technical characteristics of FPP solution) has made good progress in this reporting period and is on schedule to be completed by the end of September 2013 as planned. The following key progress highlights for this reporting period are:

- the completion of the design and manufacturing of over 50% of the of the smart devices,
- the commissioning in operation of the pre-production platform for the Active Network Management and
- the initial interoperability integration of the smart devices into the pre-production platform.

The FPP project is pushing the boundaries of technical innovation by integrating a number of smart devices that can be used to manage distribution network constraints utilising the IEC 61850 network over the deployed IP communications. The pre-production platform for the Active Network Management system is located in UK Power Networks premises and acts as the FPP lab where the initial interoperability between the technical components of the FPP architecture is proven. The integration of the Active Network Management system with the Dynamic Line Rating system and the Quadrature-booster Control system was proven in the lab during this reporting period.

Finally, the commissioning of the Active Network Management production system has progressed well. The system will be fully operational by the end of July 2013. A first curtailment signal from the Active Network Management server located at UK Power Networks Control Centre has been sent successfully to a test generator controller within the trial area utilising the deployed IP communications.

Risks

**Recruitment risks**
The key risk the project has been working to mitigate is the recruitment of real customers for participation in the trials (risk reference R004). As highlighted in the Executive Summary and also captured under sections 2.1.1. , In order to mitigate this risk, significant work has taken place to identify and recruit potential customers following knowledge developed from the Stakeholder Engagement Report (SDRC 9.1). The project has proactively and formally engaged with six DG customers, which have been offered the FPP 'interruptible' connection offer (1 March 2013). The project team has maintained on going contact to address any concerns and to ensure that the customers accept the FPP offer.

**Installation risks**
Due to technical innovation involved and as experienced with the commissioning of the Quadrature-booster, it might prove that integrating the different smart devices and applications take longer than initially envisaged. This is raised in Risk Management section (R0079) and the project has put in place a very extensive and thorough testing process that includes lab testing prior to field deployment in order to mitigate this risk.

Finally, it recognises that the deployment of smart devices over the summer 2013 relies on operational resources and network outages (risk reference R0177). Both of these parameters can vary depending on operational needs and network incidents. The FPP project team is working closely with the operational teams to secure resources and our control team to confirm the outages in order to ensure all field deployments remain on target for completion by September 2013. We will provide regular updates to Ofgem through our appointed project officer given that this will fall within the next reporting period and prior to our next 6-monthly report.

**Learning outcomes**
The key areas where the project has seen significant learning outcomes relate to:

- Development of the new FPP Commercial Arrangements and engaging with the customers (see sections 2.1.1 and 7.1.1)
- Specification, design and installation of a Radio Frequency mesh IP communications platform that utilises the IEC 61850 protocol (see sections 2.1.2 and 7.1.2)
- Specification, design and installation of a Quadrature-booster transformer for distribution networks (see section 2.2 and 7.1.3)

Knowledge Dissemination continues to be a core and integral part of the project, with all the project team and partners driving its delivery. As described in the Knowledge Dissemination Roadmap, (Appendix B in the June 2012 Project Progress Report), there are three key elements to FPP's approach to Knowledge Dissemination:

1. **Internal communications –** raising the profile of the project to ensure that 'key players' are aware of the end-to-end project and are engaged.
2. **External communications** – raising the profile of the project through conference to a targeted audience and through PR to a more generic audience
3. **Knowledge dissemination** – embedding the new knowledge into business as usual processes

In accordance with its strategy, the FPP project continues to engage external audiences and disseminate the findings through its own focused learning and dissemination events (two carried out this reporting period), presentations at relevant conferences and production of academic and industry papers. Full details are presented in section 7.2.

One of the key underlying principles of the FPP project is to deliver as much of the project as possible in a business as usual way. This means engaging the relevant UK Power Networks departments at an early stage and involving them in carrying out the required work where possible. An example of this approach is the deployment of the communications platform that was carried out by UK Power Networks suitably trained personnel. This approach also supports skills development within the DNO and builds the necessary momentum for business-as-usual deployment of these solutions.

Also, it is important to note that the FPP project team consists mainly of internal UK Power Networks staff who are being significantly up- skilled and also ensure that the knowledge is captured and transferred within UK Power Networks.

To support the above objectives, a series of internal learning workshops and training sessions were delivered this reporting period. Full details can be found in section 7.2.

## 2. Project Manager's report

The FPP project aims to demonstrate how, through the innovative integration of technological and commercial solutions, a cost effective connection of renewable generation to the distribution network can be achieved.

Significant progress has been made and the recruiting of DG customers to the FPP trial and issue of connection offers is well ahead of plan and on target to meet SDRC 9.7 (Facilitation of faster and cheaper DG connections).

In accordance with the original bid plan, the project met SDRC9.3 (Telecommunications platform) and has been making good progress on the rest of the technical elements and the investment model work.

The deployment of the Quadrature-booster transformer has been delayed due to technical reasons. The projected completion date for its energisation which is linked to SDRC 9.8 has been delayed and is being discussed as part of a parallel change request submitted to Ofgem. A summary is provided in Section 2.2

Consistent progress has been made on the rest of the project elements and all the remaining SDRC are on target as per the original bid submission dates.

The first part of section 2 details progress during this reporting period and highlights some of the key deliverables, discusses the main challenges and how these were overcome during the current reporting period (January 2013 – June 2013). The second part provides an outlook into the next reporting period, including key planned activities and key challenges.

### 2.1 Progress in current reporting period

#### 2.1.1 Customer engagement

FPP connection offer

The main focus of the project in its first year was the development of the new commercial framework and engagement with customers for participation in the trials.

The key principle of the FPP commercial arrangement is that the DG customer now has the option of the FPP 'interruptible' connection in addition to the standard business-as-usual firm option. The FPP 'interruptible' option can deliver significant capital savings (typically 80-90% within the FPP trial area) on the connection costs through avoided grid reinforcement provided that the DG customer agrees to accept curtailment of its output by the distribution network operation in order to keep the network within operational limits.

The most important deliverable for the Commercial workstream this reporting period has been the development and the delivery of the committed 'interruptible' connection offers on 1 March 2013 to the developers that the project engaged with throughout 2012 and that accepted to opt-in to receive an FPP 'interruptible' connection offer.

At the end of December 2012 a report on commercial arrangements (SDRC 9.2 Principles of Access report) was issued to Ofgem describing the proposed alternative of connecting all FPP generators under a Reinforcement Quota based on pro-rata (or shared) curtailment access.

During this reporting period further work in January and February was completed to refine the commercial framework, determine the connection terms to be offered to customers and the detailed curtailment assessments for each individual offer. The output of this work was delivered as offer variations to the customers in the project on 1 March 2013.

Each one of our FPP customers received the following five documents:

1. **Variation to the connection offer letter.** This letter describes the cost of the FPP connection as well as the 'interruptible' characteristic of the FPP connections.
2. **Connection agreement template.** This agreement is based on a business as usual connection agreement. Clauses introducing the concept of 'interruptible' capacity have been added as well as the terms and conditions to indicate how pro-rata curtailment will be administered.
3. **FPP Connection Offer Briefing Document.** This document gives an overall description to the project and the technologies and solutions proposed.
4. **Quota calculation report.** This document explains the methodology for assigning a revenue cost for curtailment and comparing it to the reinforcement cost to identify the Capacity Quota, also referred to as the Capacity Limit. It outlines the commercial methodology the project has used and key assumptions associated with it.
5. **Curtailment estimates.** This deliverable has been produced in collaboration with our project partner Smarter Grid Solutions describing the methodology used for modelling curtailment and presenting all the assumptions that underpin the results. The curtailment report contains the estimate curtailment the project is projected to face under different scenarios.

Customer Recruitment

The table below summarises the six DG developers with which the FPP project has engaged so far and the status of their FPP Opt-in offers that were issued on the 1 March 2013.

Since issuing of the offers, the key focus of the FPP project team has been engaging with the participating customers to explain the offers, the rationale of the modelling, then addressing their questions and carry out additional analysis where needed. This is a new commercial approach to DG connections and learning is being generated continuously during this process both in terms of know-how and information, but also in new ways of working between the DG customers and the DNO. Further detail on the learning generated has been included in Section 7 of this report.

Table 1: The status of the FPP 'interruptible' connection offers

| Project | Capacity | Technology | Status |
|---|---|---|---|
| Gen A | 5 MW | Wind (33kV) | Decided to not proceed due to lack of planning permission. Looking to re-apply later in the year. |
| Gen B | 0.5 MW | Wind (11kV) | Decided to not proceed due to lack of planning permission. Looking to re-apply later in the year. |
| Gen C | 10 MW | Wind (33kV) | In the process of technical due diligence on the FPP offer. Planning consent has been granted. |
| Gen D | 7.2 MW | Wind (33kV) | In the process of technical due diligence on the FPP offer. Planning consent has been granted. |
| Gen E | 1.5 MW | Wind (11kV) | In the process of technical due diligence on the FPP offer. Planning consent has been granted. |
| Gen F | 1 MW | Wind (11kV) | Decided to not proceed due to lack of planning permission. Looking to re-apply later in the year. |

Three of the six customers have planning permission for their projects and are keen to progress with those; they are currently assessing the FPP 'interruptible' connection offers as a valid alternative option to the standard grid connection. The feedback has been positive to date and a conclusion to their due diligence is expected during summer 2013. The other three projects have decided to re-apply for planning permission now that a viable grid connection is available and might re-apply for a connection later in 2013.

In addition, UK Power Networks continues to monitor all formal applications for connection within the FPP trial area to ensure that all projects that could potentially benefit from an FPP 'interruptible' connection solution are offered.

As part of this on-going process seven new projects that represent 21.50MW of additional generation, including a 6.6MW solar plant project have been identified. All these projects would potentially feed into the March Grid substation if they connect at their closest 11kV or 33kV point of connection. Engagement with these projects has included contacting the customers to explain the FPP technical and commercial solutions and provide initial estimates of the expected levels of curtailment. Additional FPP offers will be issued in due course.

### 2.1.2 Communications Platform (SDRC 9.3)

The Communications Platform Report (SDRC 9.3 – Communications Platform) was the first technical installation, commissioning and tested deliverable of the FPP project. The innovative communications platform based on Radio Frequency wireless mesh technology is the cornerstone of technical platform as it will transfer all the data traffic for the FPP smart solutions and applications to facilitate the integration of DG customers.

Detailed description of the work carried out and the key deliverables produced is included in the report "Flexible Plug and Play – Communications platform" submitted to Ofgem on 28 March 2013.

The report is available in the learning zone of the Flexible Plug and Play website: www.flexibleplugandplay.co.uk

The SDRC 9.3 (Communications Platform) set the objective for the FPP project to deploy an IP-based communications solution by Q1 2013 within the trial area.

Key activities included:

- the successful installation and commissioning of the combined Radio Frequency mesh network Internet Protocol-based communications solution; and
- executing IEC 61850 trials using IEC 61850 simulators within the trial area to demonstrate the capabilities and functionality of the communications solution.

Extensive testing was carried out to validate the IP-based communications infrastructure capabilities and functionality. Most importantly, the ability for the communications platform to transport simulated IEC 61850 traffic.

The IP-based communications infrastructure went live on 28 February 2013; complimented with the supporting arrangements and service desk function going live on 25 March 2013. It has been fully operational since.

### 2.1.3 Smart Devices

As part of the smart devices workstream, progress has been made with the Modern Protection Relays, modern transformer tap changer control relays, Dynamic Line Rating and the Quadrature-booster, a summary of which is as follows:

Quadrature-booster
The Quadrature-booster manufacture, factory acceptance tests and delivery on site was completed on time. The civil works on site and installation of switchgear were delivered on target to enable the Quadrature-booster to be delivered, assembled and cold commissioned for 3 May 2013 target date.

In addition, the Quadrature-booster Control System design was successfully completed, the system was manufactured and it was factory acceptance tested as per the plan.

However, technical issues associated with the finalisation of the protection scheme design and additional testing required during cold commissioning introduced delays in the programme resulting in the Quadrature-booster now being planned for energisation at the end of July 2013. This is approximately a month later than initially planned and committed under SDRC 9.4. In parallel to this report we are submitting a change request to Ofgem, and will intentionally add an appropriate level of contingency beyond the current forecast commissioning date to accommodate any remaining issues which occur during the remaining works on site.

The technical issues relevant to the Quadrature-booster are discussed in section 2.2.

Dynamic Line Rating
A dynamic line rating system is scheduled for deployment on a section of 33kV overhead line. Design activities are complete, factory acceptance tests have been completed, and installation activities are scheduled to be completed in early July 2013. Three other dynamic line rating systems are being deployed in other parts of the 33kV network in September 2013 as planned.

In addition, work is underway to structure the Dynamic Line Rating trials. The project is trialling a weather-based line dedicated system provided by Alstom but also the Real Thermal Ratings wide-area smart application provided by Smarter Grid Solutions.

Modern Protection Relay

The distribution network at March Grid currently consists of two 45MVA grid transformers with a limit on the reverse power flows of 75% of the transformer rating, which is introduced by the directional overcurrent protection that provides the secondary protection for these transformers. With the reverse power flows created by existing and confirmed connections of DG, this 75% limit has been reached and no additional reverse power flows can currently be accepted.

We are addressing the constraint in two ways, linked to the commercial and technical workstreams of the project. Firstly, and to enable the commercial workstream of the project, we will immediately relieve the constraint and provide capacity to customers in the FPP trial area by deploying a second intertrip system. This ensures that customers accepting our connections offers can be immediately accommodated. However, the intertrip system is currently not the optimum solution, consisting of installations at both the substation site and the remote end.

For this reason the technical workstreams of the project will install a more optimum solution and which is self-contained within the substation site, by making measurements on the incoming and outgoing feeders at the switchboard. This is enabled by a new protection relay operating with a combination of directional negative phase sequence overcurrent and voltage dependent overcurrent protection philosophies. This solution will operate in alarm-only mode in the first instance, so as to prove its suitability to replace the intertrip system. The design of the Modern Protection Relay, along with the trial testing methodology, has been complete and is scheduled for installation in July 2013.

A similar scheme is also planned for deployment at a second grid substation in August 2013.

Advanced Automatic Voltage Control

As part of the bid submission, the project included an advanced voltage control trial. Since the last report the team has carried out a number of studies and simulations to identify network issues in the 33kV and 11kV networks that could be resolved utilising the advanced voltage control method.

One grid and one primary substation have been identified as the best candidates for deployment of the equipment and this work will take place during the summer 2013.

Frequent Use Switches

The deployment of frequent use switches in the network will enable different running arrangements aiming to optimise the amount of DG in the trial area network. The original scope of the project provisioned two frequent use switches to be deployed at a strategic location on 33kV overhead line circuits between Peterborough Central and March Grid substations.

The FPP team is also monitoring a reinforcement project currently being carried out at the same strategic location that once complete will utilise equipment (Ring Main Units (RMU) in this instance) that can deliver the same functionality. The reinforcement project had been delayed for over the last five years due to consents and wayleaves issues; however it has now started and has a target completion of Q1 2014.

The project has determined that, once installed, it can utilise the RMU to deliver the use case without the need for installing the two frequent use switches. As such, we have formalised this change and to return the associated budget for the equipment and works as part of our parallel change request to Ofgem.

Remote Terminal Unit (RTU) Deployment

The RTUs that are currently in situ within twelve grid and primary substations located in the Flexible Plug and Play trial area need to be upgraded to incorporate the IEC 61850 server functionality. The upgrade, which is being completed, funded and delivered as a business as usual activities has been accelerated for the specific needs of the project and started in the April. The design for seven of the sites has been complete, as has the installation works within six of these sites. The commissioning is due to commence in July and priority will be given to the substations with smart devices installed. This will ensure that the system integration can be achieved successfully as per the SDRC 9.4 (demonstrating FPP characteristics of the project solution) in September 2013.

### 2.1.4 Smart Applications

During the previous reporting period the project finalised the detailed specification of the Active Network Management system. In this reporting period, the project focused on commissioning the Active Network Management platform; the characteristics include:

- The pre-production platform that constitutes the FPP lab testing facility and it is located in the UK Power Networks' Operational Telecommunications workshop
- The production platform which is the actual operational system that will control the DG participants for the trial and it is located in the UK Power Networks' Control Centre

The pre-production platform is a reduced version of the Active Network Management system which will be used during the trial. The platform aims to validate the functionalities implemented into the final system and also to be used as an integration tool to demonstrate the interoperability between the smart applications and the smart devices. The pre-production platform consists of two servers incorporating the communication front end and the core application. It also includes two local controllers used to interact with the generators.

As part of this reporting period, successful integration between the Active Network Management system and the Quadrature-booster Control System and the Dynamic Line Rating system has been completed in the lab.

The production platform installation and commissioning has also progressed well and it is on target for completion by the end of June 2013, ahead of the end of September SDRC 9.4 milestone (Demonstrating FPP characteristics of the project solution).

### 2.1.5 System Integration

The FPP technical solution relies on the roll-out of Smart Applications and Smart Devices. One of the main challenges of the project is the integration of all these components to form a scalable architecture. In order to tackle this challenge the implementation will use the IEC 61850 standard to facilitate the setup and the integration of the trial platform. The system integration workstream covered various technical activities in this reporting period:

- The preparation of the integration stage by:
  - selecting the relevant configuration, analysing and simulation tools to handle the various aspect of the IEC 61850
  - defining the data model for the upgraded RTUs
  - specifying the interoperability tests to commission field devices (RTU program upgrade and also smart devices as the Quadrature-booster Controller System and Dynamic Line Rating).

Some of these activities are reported in the Design Authority section of this report. The following key deliverables were completed:

IEC 61850 RTU Server Functional Design Specification
The server functionality will allow the RTU to exchange information with the Active Network Management system which will act as a client. The Functional Design Specification document details the required new developments. It includes the implementation of a new RTU configuration tool to design and configure the Logical Nodes used to model the substation (the Logical Nodes are developed into the IEC 61850 standard as a key element to define the information encapsulated by a substation device). It also requires developing the appropriate communication interface based on Manufacturing Message Service (MMS) protocol.

IEC 61850 data model
The Smart Applications and the Smart Devices implement an IEC 61850 data model in order to enable the exchange of information through standard interfaces. As part of the configuration stage, the Intelligent Electronic Device (IED) Intelligent Capability Description (ICD) file defines the complete capability of a smart device. This configuration is defined for each smart device (Quadrature-booster Controller System and the Dynamic Line Rating relay). For the RTUs that will be upgraded to implement an IEC 61850 Server, a similar ICD file has been designed to cover the existing functionalities inside the substations. Finally the aggregation of all the configuration files will form the final data model used by the Active Network Management level.

### 2.1.6 Design Authority

The Design Authority team has been closely involved in supporting the delivery of key milestones of the project. Through specifying, designing and approving the test and acceptance process for the telecoms platform, the Active Network Management and the smart devices. The most significant technical input by Design Authority team have been for deployment of Quadrature-booster transformer, design of data modelling and communications using IEC 61850 and successful delivery of communications platform.

There has been close collaboration with UK Power Networks' Design and Planning team in tackling technical issues and challenges in relation to the protection design, testing and commissioning of the Quadrature-booster transformer. Significant time and effort was allocated to the additional challenges that the Quadrature-booster implementation posed, these are discussed in section 2.2.

In order to ensure a common understanding of the operations, control and maintenance of the Quadrature-booster before it is commissioned for 'live' operation on the network, technical training has been delivered to the Commissioning team and further training is planned for the Network Control team as part of the handover to business as usual. An Engineering Operating Standard was produced to ensure a common understanding of the operations, control and maintenance of the Quadrature-booster before it is commissioned for 'live' operation on the

network. The Engineering Operating Standard is therefore developed as a deliverable to enable clear understanding of operating and controlling the smart device and on-going deployment as a business-as-usual solution.

In relation to the delivery of the communications platform, the Design Authority team has ensured the implementation of a robust design which not only meets current project requirements but also able to support future technologies and further developments. The key design highlight include enhancement of original design to implement dynamic routing between four Radio Frequency mesh master eBridges and all the remote eBridges, which means any remote eBridge at any time can find its own efficient route to Active Network Management via any of the master eBridges. This will further enhance the flexibility, resilience and availability of the RF mesh network.

In conjunction with design of communications platform, the Design Authority team has been developing the overall IT and communications architecture to capture every network component of the project. This is a live project document in the form of overall architecture, covering IT network connections and IP addressing schemes. In addition, the Design Authority team has carried out cyber security design for the project. This involved adopting Plan-Do-Check-Act approach where physical and logical architectures were combined together to enable risk identification. An industry expert and internal stakeholders were engaged in carrying out FPP cyber security design reviews, risk assessments and risk mitigation action planning.

Another important activity carried out during this period was the detailed design of the substation LAN (Local Area Network). The purpose of this design product is to specify the design of the substation LAN with close consideration of already existing as well as future designs in UK Power Networks' substations. This was developed in close collaboration with key internal stakeholders such as IT security, Operational Telecoms and Asset Management. In essence, this design ensures a secure interconnection of FPP substation equipment with existing Supervisory Control and Data Acquisition (SCADA) equipment with LAN architecture, LAN topology, equipment and security.

As part of the IEC 61850 design work, the Design Authority has been heavily involved in scoping, resourcing, specifying and designing activities. Multiple brainstorming workshops were also conducted with key internal UK Power Networks stakeholders, Subject Matter Experts (SME) and project partners in establishing UK Power Networks' requirements, design methodology and approach for implementing IEC 61850. One of the key outputs was the development of the first ICD file for a RTU, which defines complete capability of an IED. This process involved defining IEC 61850 logical nodes for all possible data points used in UK Power Networks' network and mapping the required logical nodes for the first UK Power Networks RTU in form of an ICD file. This was achieved with input from consultants DNV KEMA, internal experts and the FPP system integration workstream.

Technical documents such as design specifications, design briefs, technical schematic, operating standard and scoping documents have been produced in relation to the smart devices and in support to the work described in progress section 2.1.3 Smart devices.

### 2.1.7 Strategic Investment Model

A key deliverable for this reporting period has been the Requirements Document as well as the Design Document for the Strategic Investment Model (SIM). The Requirements Document specifies the objectives of the SIM which aims to allow DNOs to quantify, for different demand and generation scenarios, the integrated value and benefits of different smart technologies, smart commercial arrangements and smart applications. This document specifies the requirements for the model to determine, from both an economic and carbon perspective, whether at a given point

in time or network status, it is better to reinforce the network, use smart alternatives or pursue a combination of both.

The requirements document specifies the capabilities of the model which include optimising operation decision, investment in smart applications and connection of DG. The input requirements are detailed within four categories: network, generation, demand, and grid supply point data. The output requirements will include optimisation decisions in investment of smart devices, reinforcement of overhead lines, power flow, curtailment and corrective settings operation decisions, and location and capacity connected to the network. Finally, a detailed description of the usability, software, hardware, hosting, testing and documentation and training requirements is provided.

The proposed Design Document outlines the characteristics of the model, how it will operate, in which order the inputs will be integrated, what calculations will be embedded to the document, how the model will define the scenarios, how the it will obtain the results and how the results will be presented by the model.

Importantly, the SIM Design Document describes the structure of the model which has four interfaces: input, simulation, engine and output. Input, simulation and output will be excel based interfaces where the user will be able to input generation, network and load data. The simulation interface will allow users to select an input output file, set the parameters of the study, run the simulation by calling the main engine and passing all the necessary parameters and access the output file.

## 2.2 Key challenges during this reporting period

The key challenges the project has faced this reporting period have been focused on the deployment of the Quadrature-booster transformer and in particular the development of the Quadrature-booster protection scheme and the commissioning of the device.

Since the change of Quadrature-booster supplier in summer 2012 and the delays in procurement of the device, the delivery plan was left with very limited float. However the project team comprising of staff from UK Power Networks, Wilson Transformers and Fundamentals worked very hard to maintain all activities within the agreed plan.

The Quadrature-booster transformer technical parameters were modelled and specified using the software PowerFactory (from DigSILENT). The network model used was the first of its kind and the design was reviewed by UK Power Networks and its delivery partners. At that stage, the type of testing that was later required on site was not deemed necessary as the network modelling results deemed conclusive.

<u>Quadrature-booster commissioning delays</u>
During the cold commissioning of the Quadrature-booster transformer, a number of technical queries were raised that resulted in additional site tests of the device.

Additional testing was required to simulated real operational conditions for the Quadrature-booster (i.e. the effect it will have when connected on an electrical line with lower impedance that is in parallel connected to an electrical line with higher impedance) and proved the principle of operation both in theory but also in application.

The Quadrature-booster has two modes of operation, which the tests were designed to prove in application:

- Boosting i.e. its effect is to draw power on the line it is connected; and

- Bucking i.e. its effect to push power away from the line it is connected.

The additional tests took four weeks as equipment was required to be procured and set up (load banks, reactors, voltage regulators), safety documentation to be produced for test set-up and analysis to be carried out after the conclusion of the tests in order to determine whether these were conclusive.

The tests proved that the device was providing the magnitude of bucking and boosting that was specified, but that the polarity was reversed. At the time of writing (June 2013), investigations are underway to understand in the modelling, design and specification process where this reversal occurred. The practical consequences are being addressed across all of protection settings, modelling, nameplate, documentation and training material, and are not a significant contributor to the delay in energisation.

Significant learning has been generated as part of this process in two key areas:

- Network modelling and specification of Quadrature-boosters in distribution networks
- Commissioning process and plan for Quadrature-boosters in distribution networks

The expectation is that future installations would be able to rely solely on the design and specification stage and/or the Factory Acceptance Tests (FATs) and 'traditional' commissioning tests, and would not need to repeat the type of tests which took place on site on this occasion.

Quadrature-booster protection scheme design

The Quadrature-booster protection scheme was initially designed to the IEEE International Standard C57.135-2001 "IEEE Standard for the application, specification and testing of phase-shifting transformers". UK Power Networks also sought to understand the protection scheme used by National Grid – the only user to date in Great Britain of Quadrature-booster transformers. It is important to note that the Quadrature-boosters that National Grid uses at transmission level have different characteristics and as such different network integration requirements when compared to the one procured by UK Power Networks for use at 33kV.

Extensive reviews conducted by engineering teams in UK Power Networks and the manufacturer of the protection relays to be used raised a number of questions on the proposed scheme and a validation exercise was required to confirm the actual configuration to be used.

The validation exercise included internal peer reviews, an independent assessment by a third party engineering consultancy and a series of laboratory based simulations using a Real Time Digital Simulation (RTDS) system in order to conclude on the proposed configuration.

The above exercise has generated significant learning as it has produced the first reference of a protection scheme design for Quadrature-booster in distribution networks.

However and because of the extensive validation required the overall finalisation of the protection scheme design and in consequence the finalisation of the overall electrical design has taken considerably longer than initially planned, affecting the ability of the project to meet 28 June 2013 planned SDRC date.

The team has managed to date to overcome and mitigate both the issues described above in terms of technical risk and safety, however as both drove on the critical path for completion of the Quadrature-booster, the net effect is approximately four week delay to the completion.

The revised energisation date for the Quadrature-booster is the end of July 2013 (previously 28 of June). In parallel to this report we are submitting a change request to Ofgem, and will intentionally add an appropriate level of contingency beyond the current forecast commissioning date to accommodate any remaining issues which occur during the remaining works on site.

### 2.3 Outlook for next reporting period

The project has entered a period of intense installation and testing period during summer 2013 which should see the following elements being delivered:

- Installation and commissioning of smart devices (Quadrature-booster, Dynamic Line Rating, Reverse Power Flow protection scheme, Automatic Voltage Control)
- Upgrade of the RTUs within the FPP trial area
- IEC 61850 data modelling and traffic optimisation
- IEC 61850 server functionality for the Remote Terminal Units
- Commissioning of the Active Network Management System (SDRC 9.4)
- End to end testing of the FPP platform

The above will culminate to the completion of SDRC 9.4 (demonstrating FPP characteristics in the project solution) in September 2013 which is the major contractual milestone of the next reporting period.

In addition, the recruitment of customers will continue. The discussions with the customers offered the FPP option on 1 March 2013 will enter their final stages in terms of technical clarifications and due diligence with the aim of signing up these customers over the summer. Additional offers will also be issued to DG developers that have been identified.

### 2.4 Key challenges for next reporting period

Since January 2013, the FPP project team has been carrying out testing of the various components that will comprise the FPP platform. The testing approach has three phases:

- Unit testing, completed by the supplier prior to hand over to the FPP team
- Lab testing, completed at the FPP lab facilities where the pre-production environment has been set up
- Site testing, completed on site prior as part of the final testing regime

The key characteristic of the FPP platform is that enables the integration of multiple devices from various vendors using the IEC 61850 protocol and the IP-Communications platform.

The IEC 61850 integration element and proof of interoperability is a truly innovative aspect of the project and one that expects to generate important learning. It is however technical very challenging and this has been recognised by the approach utilised in:

- Having a clear test approach and test plan for all smart devices and applications
- Ensuring that the right resources both from UK Power Networks and the project partners are available to support the successful completion of the tests

It is expected that the overall integration and testing process has posed and will keep posing challenges due to its highly complex technical nature and innovative methods used. It currently remains on target for completion in September 2013.

## 3. Business case update

As per the initial business case of the FPP project, all savings/benefits are attributed to the generators and these form the business case for an 'interruptible' connection and the FPP project. The FPP offers provide generators with an immediate saving on their connection cost. The level and cost of curtailment is the main consideration of the DG developers to determine their choice of connection option. Each developer, depending on the size and technology of their project will have a specific financial model that will determine the expected revenue loss.

The curtailment estimates indicate that these developers would be experiencing approximately 5.33% curtailment of expected yearly output when the quota is full, i.e. when we connect 33.5MW in the March Grid constraint. This curtailment has an estimated cost of £122,000/MW.

The Table 2 below has been updated to provide the actual amounts in the connection offers that were sent out on 1 March 2013.

Table 2: The comparison between a business as usual connection offer and FPP 'interruptible' connection offer and the status of the offer to the first six DG developers

| Project | Capacity | BAU connection offer | FPP Offer | Savings (%) | Status |
|---|---|---|---|---|---|
| **Gen A** | 5 MW | £1.2m | £649,788 | 45.2% | FPP offer sent |
| **Gen B** | 0.5 MW | £1.9m | £234,779 | 87.6% | FPP offer sent |
| **Gen C** | 10 MW | £4.8m | £590,817 | 87.8% | FPP offer sent |
| **Gen D** | 7.2 MW | £3.5m | £881,611 | 74.9% | FPP offer sent |
| **Gen E** | 1.5 MW | £1.9m | £157,137 | 91.9% | FPP offer sent |
| **Gen F** | 1 MW | £2m | £384,711 | 81.2% | FPP offer sent |

Further connections identified represent more savings that add up to avoided connection costs. However, these will only be accountable once connections have been accepted. Please refer to the Table 3 below for the connection costs and savings of these new projects.

Table 3: The comparison between a Business as Usual connection offer and FPP 'interruptible' connection offer and the status of the offer to the three new DG developers

| Project | Capacity | BAU connection offer | FPP Budget Estimate | Savings (%) | Status |
|---|---|---|---|---|---|
| **Gen G** | 0.5 MW | £1.9m | £350,000 | 81.6% | FPP 'interruptible' connection offer will be sent Q3 2013 |
| **Gen H** | 0.5 MW | £2.5m | £100,000 | 96.0% | FPP 'interruptible' connection offer will be sent Q3 2013 |
| **Gen I** | 0.25 MW | £2.2m | £117,450 | 94.7% | FPP interruptible' connection offer will be sent Q3 2013 |

Consistently with the initial assumptions, the savings presented in the business case are significant and the project will continue monitoring and presenting information to the DG developers

The University of Cambridge are currently evaluating the commercial framework developed by the FPP project and comparing them to other 'interruptible' connection alternatives implemented in the UK and around the world. Please refer to the Learning Zone for the research to understand best practices regarding 'interruptible' connections for DG (www.flexibleplugandplay.co.uk)

The work consists of an analysis of the regulatory framework and incentives for connecting DG. It then looks to identify costs and benefits that producers and DNOs in general could face under the FPP proposal. An impact assessment of implementing the proposal has started by doing a cost benefit analysis based on the March Grid case study. One of the areas it will focus on is exploring the optimal and fairest options for allocating reinforcement costs and the findings from this case study will become available in July 2013.

Initial findings show a very strong overall benefits case for implementing smart commercial arrangements such as the ones developed by UK Power Networks under the FPP project.

## 4. Progress against budget

This section is provided as a confidential appendix.

## 5. Bank account

This section is provided as a confidential appendix.

## 6. Successful delivery reward criteria (SDRC)

Table 4: Delivery required in 2012

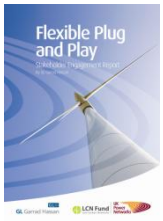
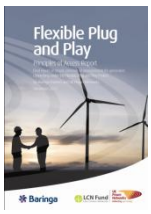
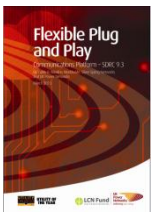
| SDRC | | | Progress/Status |
|---|---|---|---|
| 9.1 | **Stakeholder Engagement Report 1**   | ***Evidence***<br>• *Publication of a stakeholder engagement report ("Stakeholder Engagement report I").* | **Completed**. Stakeholder engagement report submitted to Ofgem on 28 September. The report was written in collaboration GL Garrad Hassan on behalf of the FPP project and it includes a foreword by Renewable UK.<br><br>The report has been shared with GB DNOs and other key stakeholders. It is available in the learning zone of the FPP website, at www.flexibleplugandplay.co.uk |
| 9.2 | **Development of smart commercial arrangements**   | ***Criterion***<br>*Development of smart commercial arrangements, which will provide a number of options that can be tested and implemented in new types of connection agreements with generation developers. These will be established in conjunction with key stakeholders. The development of smart commercial arrangements will be completed by the end of December 2012 in accordance with agreed specifications.*<br><br>***Evidence***<br>• *Publication of a report on Principles of Access, which will determine the Principles of Access for smart commercial arrangements.*<br>• *Connection agreements templates (new model forms) for actively managed generator connections, to be established in conjunction with key stakeholders.* | **Completed**. Principle of Access report submitted to Ofgem on 28 December. The report was written in collaboration UK Power Networks and Baringa Partners.<br><br>The deliverable to Ofgem included:<br>• Report on smart commercial arrangements for generators connecting under the FPP project, including a regulatory analysis on underwriting curtailment risk. The Principles of Access report has been shared and published and can be found on the FPP website Learning Zone: www.flexibleplugandplay.co.uk<br>• UK Power Networks Connection Offer and Connection Agreement templates for implementing non-firm generation connections.<br>• The Report on international experience of the use of smarter connection arrangements for DG by the University of Cambridge. |

Table 5: Delivery Required in 2013

| SDRC | | | Progress/Status |
|---|---|---|---|
| **9.3** | **IP (Internet protocol) Communications Platform – Go Live**<br>  | ***Criterion***<br>*Full deployment of an Internet Protocol (IP) communications platform across the FPP trial area to support open standards communication protocols. This will be completed by the end of March 2013.*<br><br>***Evidence***<br>• *Installation and commissioning documentation of Vodafone Multi-Service Platform (MSP) network and Silver Spring Networks Radio Frequency mesh network in the FPP trial area and in accordance with the specification included in the contracts with the relevant partners.*<br>• *Recorded results of IEC 61850 communication trials using IEC 61850 simulators at installed locations in the FPP trial area.* | **Completed**. The project successfully installed and commissioned an IP-based communications solution across the FPP trial area by Q1 2013.<br><br>It also demonstrated through IEC 61850 trials that the end-to-end communications solution was and is capable of trafficking IEC 61850.<br><br>The Communications Platform SDRC 9.3 Report was delivered to Ofgem on 28 March 2013. The report was written in conjunction with Vodafone *(formally Cable & Wireless Worldwide)*, Silver Spring Networks and UK Power Networks.<br><br>The report has been shared with GB DNOs and other key stakeholders. It is available in the learning zone of the FPP website, at: www.flexibleplugandplay.co.uk |
| **9.8** | **Deployment of Quadrature-Booster within trial area** | ***Criterion***<br>*Successful deployment of a Quadrature-booster within the FPP trial area. This will be completed by end of June 2013.*<br><br>***Evidence***<br>• *Installation and commissioning of a Quadrature-booster and in accordance with the specification included in the contracts with the relevant partners.*<br>• *Demonstration of improved* | The deployment of the Quadrature-booster is currently planned for July 2013. Please refer to section 2.2<br><br>Key activities that were completed during this reporting period are:<br>• Final design of protection and control systems.<br>• Design and manufacture of Quadrature-booster control system.<br>• Quadrature-booster factory acceptance test.<br>• Quadrature-booster control system factory acceptance test.<br>• Civil works including transformer bay and switchgear room. |

| SDRC | | | Progress/Status |
|---|---|---|---|
| | | *balance between the circuits allowing increased power flow headroom of approximately 10MW* | • Quadrature-booster on-site assembly (including cold commissioning).<br>• SCADA equipment installed.<br>• Switchgear and protection equipment installed.<br>• Awareness training complete.<br><br>Due to the reasons discussed in section 2.2 this SDRC is delayed and has been raised with Ofgem via a parallel change request.<br><br>June and July will be spent completing and outstanding installation activities and commissioning of the system. |
| **9.4** | **Demonstrate FPP technical characteristics of FPP solution** | ***Criterion***<br>*Demonstration of Flexible Plug and Play capabilities of the overall FPP technical solution following completion of the FPP installation phase. This will be completed by the end of September 2013.*<br><br>***Evidence***<br>• *IEC 61850 certification for all relevant Remote Terminal Units (RTUs), Intelligent Electronic Devices (IEDs) and other IEC 61850 field devices.*<br>• *Installation and commissioning documentation of IEDs and other field devices necessary to support the trials and in accordance with the specification included in the contracts with the relevant partners.*<br>• *Installation and commissioning documentation of production of Smart Applications in accordance with the* | Activities associated with SDRC 9.4 are progressing according to plan and, as such, are scheduled to be completed by the end of September 2013.<br><br>Key progress highlights for this reporting have included:<br><br>• The commissioning and the acceptance of the pre-production in the project integration lab.<br>• The integration of the Smart devices (Dynamic Line Rating and Quadrature-booster Control system) into the pre-production platform.<br>• The interoperability assessment of the overall components.<br>• The commissioning and the acceptance of the Production platform to be used for the trial.<br>• Design and manufacture of the Dynamic Line Rating system<br>• Factory acceptance tests of the Dynamic Line Rating system<br>• Design and manufacture of the Modern Protection Relay system<br>• Factory acceptance tests of the Modern Protection Relay system |

| SDRC | | | Progress/Status |
|---|---|---|---|
| | | *specification included in the contracts with the relevant partners.*<br>• *Pre-production interoperability test results for FPP's Smart Devices and Smart Applications.* | • Specification and procurement of the Advanced Voltage Control system |

Table 6: Delivery Required in 2014

| SDRC | | | Progress/Status |
|---|---|---|---|
| **9.5** | **Strategic Investment Model** | ***Criterion***<br>*Delivery of the FPP strategic investment model including validation and testing of the model utilising data captured within the FPP trials. This will be completed by the end of December 2014.*<br><br>***Evidence***<br>• *Completion documentation for the strategic investment model development and build phase.*<br>• *Recorded validation and test results.*<br>• *Delivery of the strategic network investment model in a fully usable and external issue format.* | Activities associated with SDRC 9.5 are progressing according to plan.<br><br>SDRC 9.5 is on schedule to be completed by the end of December 2014.<br><br>The project has delivered the requirements document and is in the design phase.<br><br>The design documentation for the model will be completed in June 2013 and the model is planned to be ready for testing in November 2013 as originally planned. |

| SDRC | | | Progress/Status |
|---|---|---|---|
| 9.6 | **Implementation of active power flow and voltage management within FPP trial area** | ***Criterion***<br>*Deployment of active power flow management and active voltage management within the FPP trial area. This will be completed by the end of December 2014.*<br><br>***Evidence***<br>• *Pre-production functional test results for active power flow management and active voltage management applications.*<br>• *Installation and commissioning documentation of production active power flow management and active voltage management applications in accordance with the specification included in the contracts with the relevant partners.*<br>• *Suitable agreements with generators in place (if required).*<br>• *Trial results for the active power flow management and active voltage management trials* | SDRC 9.6 is on schedule to be completed by the end of December 2014.<br><br>The key progress highlights for this reporting period are:<br><br>• Finalisation of functional design specification for deployment of the Active Network Management system and the implementation of the smart applications<br>• Interoperability tests between the Active Network Management and the Smart Devices using IEC 61850 interface<br>• Commissioning of the pre-production Active Network Management platform<br><br>The commissioning of the production platform for the Active Network Management is expected to be completed in June 2013.<br><br>In addition, the FPP project has made significant progress in offering real customers an FPP connection offer and has developed a suitable connection agreement for them to sign up and participate in the trial.<br><br>The Active Network Management system will be used to control the generators output and prove the concept of active power flow management in accordance with SDRC 9.6. |

| SDRC | | | Progress/Status |
|---|---|---|---|
| **9.7** | **Facilitation of faster and cheaper connection of DG to the distribution network, as compared to timescales and costs of connection utilising traditional approaches.** | ***Criterion***<br>*Facilitation of faster and cheaper connection of* DG *to the distribution network, as compared to timescales and costs of connection utilising traditional approaches. To be completed by end of December 2014.*<br><br>***Evidence***<br>▪ *Demonstration that* DG *connection offers are: 1 - Cheaper; and 2 - Offer faster project connection timescales, than offers based traditional reinforcement. The evidence for this criterion will be met through the provision of one connection offer to generators using the FPP methods. If during the duration of the FPP project other generators are in a position to accept a connection offer, then we will use that as evidence supporting this criterion.* | SDRC 9.7 on schedule to be completed by the end of December 2014.<br><br>On 1 March 2013 six offers were delivered to six DG customers. These offers were indeed cheaper than their original business as usual offer representing savings of up to 91%. Once acceptance, these connections will required less work than the original offers as the connection, in most cases, the connections are much closer to the sites as opposed to needing to install lengthy new underground cables.<br><br>Section 2.1.1 explains in detail progress made with the connection offers. However, the project team continues to monitor the connection projects pipeline and will be offering the FPP connection option to more customers throughout 2013. |

## 7. Learning outcomes

The key areas where the project has seen significant learning outcomes relate to the development of the new FPP Commercial Arrangements, the installation of the Telecommunications Platform and the progress to the installation of the Quadrature-booster.

7.1 Key Learning Outcomes

### 7.1.1 Commercial Arrangements

On 1 March 2013 the project issued new 'interruptible' commercial contracts to six generation developers wanting to connect within the FPP trial area. These new commercial contracts, which are compliant with the current regulatory framework, have generated three significant learning points for the project.

1. **Comparison of different commercial packages:** As part of the analysis conducted throughout 2012, a full report analysing the different curtailment alternatives as well as different commercial packages was presented to key stakeholders. This report outlines the pros and cons of each option and concludes that the

pre-agreed capacity limit is the most attractive alternative to explore in practice with the current FPP customers.

2. **Smart commercial framework (or 'interruptible' connections)**: The framework describes how all new connections to March Grid will be connected to Active Network Management. Curtailment will be applied in a pro rata scheme and UK Power Networks will limit the total capacity of generation connected within the constrained area to a pre-agreed cap (Capacity Limit). Finally, once the capacity is reached any generator who connects will get curtailed before the generators in the capacity limit. These rules provide a solid methodology for offering 'interruptible' connections which will be tested throughout the project.

3. **Treatment of reinforcement:** Another key learning outcome has understood the options of how to treat reinforcement once the capacity limit is full. One of the key benefits of applying pro-rata curtailment is that by sharing the cost of curtailment customers are incentivised to eventually share the cost of reinforcement or upgrade of the network to alleviate the constraint. However, UK Power Networks has learned that at the moment, and due to the unfamiliarity of the actively managed connections, customers are not willing to commit to pay for reinforcement in an uncertain future.

   The detailed analysis regarding how best to treat reinforcement once the capacity limit is full, has been discussed in detail with the Regulation, Connections, Income Management and Legal departments to understand risk and compliance challenges and will be subject to further discussion by the FPP project.

### 7.1.2 Customer Engagement

There are four key learning outcomes taken from our engagement with customers:

1. **Financial models:** As studied throughout the process of defining the quota, each project, depending on the size, the technology and the timescales, has a very different financial model. However, one interesting finding has been to understand the role of the developer versus the owner of the project. Developers many times wish to sell their projects so are very keen on obtaining the most accurate curtailment figures that make financing more accessible. This means that if they can finance their projects on lower curtailment figures the better the project financial outcomes may look. However, for owners they are very keen on understanding the maximum curtailment they will experience. Another key element to the financial model is the tariff expected to determine the revenue of the project. This variable involves political and market external influences that sets out specific deadlines for each project. For example, one project has indicated that all of their financial estimates are based on the current ROC tariff; therefore, any revision programmed for March 2014 will affect the project's financial model.

2. **Planning consent:** Planning consent has been proven to be the key element for customers to accept their connection offers. This presents a problem for the project because most customers require an estimate of the connection cost before they are willing to spend more time and resources in appealing their planning consent. Specifically, three of the projects in the pipeline do not have planning consent and they will not accept the FPP offers at this stage but are now confident that they have a viable proposition for their grid connection and on that basis they will seek to re-apply for planning permission.

3. **Curtailment levels:** The initial verbal feedback from engagement with the DG developers is that they are comfortable with the expected levels of curtailment presented (ranging from 3% to 5.3% reduction in expected annual output).

4. **New ways of working with DG customers:** Three main outcomes have come out of our extensive engagement with DG customers:

    I. **Technical and commercial audience:** When dealing with customers in charge of both commercial as well as technical assessment of the FPP proposal, the need to engage both audiences is a constant challenge. As mentioned in the deliverables section, each offer received a briefing document describing the technical characteristics of the proposed connection. Finding the balance of a simplified and easily understandable technical description and an overall comprehensive outline of the technology has proven to be a challenge. These documents are subject to due diligence that has proven to raise more technical queries on how for example Dynamic Line Rating will address constraints in the network.

    II. **Information provision:** The novelty within the FPP offers has presented the need to provide more information that the regular connection offers. For example, as some of the customers have contracted third party experts to assess the curtailment estimates, UK Power Networks has been asked to share detailed network configuration information for consultants to replicate the relevant modelling.

    III. **Level of interaction:** These offers have also involved much more interaction with the customers in order to follow through all their queries around the technical as well as commercial aspects of the offers.

### 7.1.3 Communications platform (SDRC 9.3)

The process of designing, installing, commissioning and testing the IP-based communications infrastructure generated a number of firsts for UK Power Networks and the project partners, Vodafone and Silver Spring Networks:

- The UK's first Primary and Grid level smart grid RF Mesh solution
- UK Power Networks' first deployment using the smart grid standard, IEC 61850, to and between substations
- Vodafone first smart grid deployment

The key learning outcomes:

Design and install of the FPP communications solution

- Visibility of the design stages for the production of the overall communications solution allowed for an increased understanding of how the IP-based communications infrastructure operated. This led to the refinement and enhancement of the communications solution to meet the requirements and optimise the technical approach for the FPP project.

- As part of the design stages for the RF Mesh Network, site surveys were undertaken to select an optimal install location for the Relay. This was an integral phase to undertake as 13 of the 14 install locations identified in the initial desktop survey were amended due to the site survey results showing unfavourable environmental conditions likely to cause a negative impact on the performance of the communications solution.

- The installation of the IP-based communications infrastructure generated knowledge and up skilling within UK Power Networks' Operational Telecommunications departments.

- The learning generated through involvement in the design and install phase of the FPP communications solution, informed our preparations for the solution to be deployed as a business-as usual service. This was further supported by specifically targeting the UK Power Networks' departments for training that would own, manage and maintain the solution going forward.

- It was apparent through the first-hand experience of installing the RF Mesh Network that the communications solution could be flexibly deployed within short timescales. For instance, the Relay, which is installed at a LV distribution pole, can be pre-assembled before going to site. Furthermore, the arrangement at the grid and primary substations simply involved the connection of the eBridge (Master and Remote) and configuration check after the required antenna and power supply infrastructure was in place. The only additional requirement at the grid substation was the prerequisite that the WAN had been commissioned.

- An appreciation was gained on the use of a remotely provided Software as a Service (SaaS) solution for the management of communications.

- An understanding of the routing within a combined RF Mesh Network/MSP IP-based communications solution.

- Learning on how to set-up support arrangements and a dedicated service desk function to assist with the on-going management of the communications solution. This included generating and testing fault notices to ensure the relevant work party amongst UK Power Networks and C&WW would be correctly identified and mobilised to investigate and remedy the fault.

<u>IEC 61850 communications trials using IEC 61850 simulators</u>

- The experience in developing an IP-based communications infrastructure capable of sending data packets using the open standard IEC 61850 protocol generated new knowledge and skills amongst all parties.

- IEC 61850 Lab Tests: The RF Mesh Network component successfully passed all functional verification lab tests to prove its ability to pass IEC 61850 traffic.

- IEC 61850 Field Tests: Two test phases were executed using IEC 61850 simulators at various locations within the FPP Trial Zone as part of a sub-set of acceptance tests and end-to-end tests. The tests confirmed that the communications platform was and is capable of trafficking IEC 61850.

### 7.1.4 Quadrature-booster (SDRC 9.8)

The Quadrature-booster being installed at the British Sugar factory will be the first to be deployed on the 33kV distribution network. Consequently new knowledge has been generated throughout the entire process from the design, to the installation, the commissioning and ultimately to post-go-live maintenance.

The key learning points include:

Network modelling
The learning points surrounding the Quadrature-booster have been ground breaking as it is the first of its kind to be installed on the 33kV network, thus making all knowledge truly valuable.

The Quadrature-booster is not a standard element within UK Power Networks modelling software (DIgSILENT PowerFactory) and, as such, a template was required to enable it to be effectively modelled so as to enable identification of design requirements and to ensure the accuracy of future assessments of the networks, such as those undertaken when planning network outages. Initially a template used by National Grid was adopted and customised to suit the FPP Quadrature-booster parameters. During the testing of the Quadrature-booster an anomaly in the results of the modelling has been identified which has put in question the suitability of the template in this application and which may have been the source of the reversal in polarity found during commissioning. This is currently being investigated further to ensure that the final template incorporated within the network model is suitable for the application of the Quadrature-booster on the distribution network.

Policies and procedures
Engineering operating standards have been developed for both the Quadrature-booster and the Quadrature-booster control system. These documents describe the operation of each of the systems so as to provide operational and control staff, responsible for carrying out safe operations and maintenance of the Quadrature-booster, or who may gain access to the Quadrature-booster, an appropriate level of awareness to do so. Training and developing policies have been core elements to the installation of the Quadrature-booster as this is a new device for the distribution network.

## 7.2 Update on internal communications and knowledge dissemination activities

A number of internal dissemination activities have taken place over the past six months, mainly comprising of internal learning and training workshops relating to the commercial arrangements, the communications platform and the Quadrature-booster. These workshops provide the vital incremental steps that will contribute to a deeper understanding of the project, which is core to the process of embedding any new knowledge. FPP is essentially 'passing the baton' as we share knowledge with colleagues and increasing the engagement.

Commercial Arrangements (SDRC 9.2)
There have been multiple workshops to strengthen the on-going collaboration with internal key players such as Connections, Regulation, Income Management and the Major Connections, Competition in Connections teams was crucial to the development of the new FPP connection offers that were issued to the six FPP engaged DG developers.

The workshops also provided an update to the project and are customised to the audience to enhance key-player buy-in.

Communications Platform (SDRC 9.3)
Between November 2012 and January 2013, there were number of technical training sessions in preparation for the installation of the telecommunications platform.

In April 2013 the project held a cross-project learning event to share value knowledge with colleagues also working on LCNF and IFI projects.

Quadrature-booster (SDRC 9.8)
There is on-going collaboration with internal key players such as Asset Management and Capital Programme, as well as with Wilson Transformers and British Sugar. In February, the project hosted a classroom activity to prepare internal key players for the arrival of the Quadrature-booster in the UK and ahead of installation. The learning event comprised of providing an overview of the journey from concept to the finished Quadrature-booster to providing an understanding of what a Quadrature-booster is, what it can do, how to handle the unit safely on site for installation, operation and maintenance.

In recognition of the fact the FPP Quadrature-booster is the first of its kind in the DNO community; the project has prepared an internal communications campaign to ensure that employees are aware of the device and how it will work in simple terms. The campaign will consist of vodcasts, a storyboard, news articles and images.

Systems Integration
The implementation of the IEC 61850 at the project level contributed to assess the potential use of this new standard from a company perspective and also to develop new skills through training sessions and workshops involving engineers from business units.

7.3 Update on external communications and knowledge dissemination activities

FPP continues raising the profile of the project through conferences and PR:

- **Commercial Arrangements workshop** – London (March 2013)
  - A learning session to provide an insight into the process of deciding which 'interruptible' commercial alternatives are most suitable for developers looking to connect their distributed generation project to the network under the FPP offer.

- **TechCon Asia Pacific** – Sydney (April 2013) – Paper submitted in February 2013
  - The Design, Manufacture and Operation of a 33kV Quadrature-booster
  - Presentation of the paper (via Skype) in April 2013

- **All Energy 2013** – Aberdeen (May 2013) – Abstract submitted December 2012
  - Flexible Plug and Play: The Integration of Renewable Generation
  - UK Power Networks was part of the expert panel to discuss how to make DG a reality.

- **CIRED 2013** – Stockholm (June 2013) – 4x CIRED papers submitted in January 2013

- Active Network Management – oral presentation (Paper 874)
- Commercial Arrangements for an Active Network Management – oral presentation (Paper 768)
- Modern Communications Platform – non-interactive poster session (Paper 739)
- Quadrature-booster Trial at 33 kV – non-interactive poster session (Paper 789)
- Round table discussion participation on innovative Distributed Energy Resources connections (Round table 4a)

- **Telecommunications workshop** – London (June 2013)
  - The focus included how communications will facilitate and play a key role in the development of smart grids and meet DECC's targets of connecting 13GW of onshore wind generation to the network; the event also talked through the FPP technical architecture, as well as provided an appreciation of the design, the installation and test phases to develop and deploy the FPP communications platform.

- **5th Smart Grids & Cleanpower Conference** – Cambridge (June)

- **Articles/press releases/features**

  - IET Energy Sector newsletter – issue 1 – article on FPP (February 2013)
  - Business Design & Construction (BDC) magazine (March 2013)
  - UK Power Networks Innovation newsletter – Issue 2
  - Quadrature-booster article in Power Transmission and Distribution (PT&D) magazine worldwide (April 2013)
  - Telecommunications Platform press release (May 2013)
  - Twitter: Multiple tweet relating to FPP reports, press releases and where the team are speaking at conferences

**7.4 Learning and Dissemination activities in the next reporting period (Jun 2013 – Dec 2013)**

| Activity | Main Audience | Date |
|---|---|---|
| IET Innovation Awards (P.0286) | Industry-wide | July 2013 |
| IET Energy Sector newsletter – issue 2: article on FPP (P.0289) | Industry-wide | July 2013 |
| Future Networks' microsite combining all innovation projects – July | All interested parties<br>DNO community<br>Ofgem<br>Domestic customers | July 2013 |
| Innovation newsletter – issue 3 – August – (P.0288) | DNO community | August 2013 |
| IET Communities – online – (P.0285) | Industry-wide | August 2013 |
| FPP 'course' on iTunes U – online – (P.0224) | Students | August 2013 |
| Quadrature-booster learning event (P.0287) | DNO community<br>Ofgem<br>DECC<br>Industry key players | September 2013 |

| Activity | Main Audience | Date |
|---|---|---|
| 12th International Workshop on Large-Scale Integration of Wind Power into Power Systems<br>Abstract to be submitted<br>Commercial Arrangements/ANM<br>(P.0072) – will need a product reference per abstract | DG community<br>DNO/TSO community | October 2013 |
| Annual Low Carbon Network Fund conference 2013 –Brighton - P.0030 [UK Power Networks are co-hosting] | DNO community<br>Ofgem<br>DECC<br>Industry key players<br>(open to public) | November 2013 |
| Ofgem DG Forum – November – UK | DG community<br>DNO community | November 2013 |
| CIGRE 2014 – Paris (Papers);<br>• Active Network Management synopsis<br>• Quadrature-booster synopsis | Industry-wide | December 2013 |

## 8. Intellectual Property Rights (IPR)

During the current reporting period the following IPR has been generated (January 2013 – June 2013):

| Workstream | IPR description | IPR Owner |
|---|---|---|
| **DA** | P.0209 – Short Term Security Actions Scope | UK Power Networks |
| **DA** | P.0213 – FPP Substation LAN design | UK Power Networks |
| **DA** | P.0248 – FPP Overall Project Schematic | UK Power Networks |
| **DA** | P.0250 – Scope of Work WS8 testing and system integration | UK Power Networks |
| **DA** | P.0269 – Scope of Work WS8 substation LAN installation | UK Power Networks |
| **DA** | P.0282 – IEC 61850 Test Tool Selection report | UK Power Networks, KEMA |
| **DA** | P.0283 – IEC 61850 Data model and Engineering Tool Selection report | UK Power Networks, KEMA |
| **WS1** | P.0190 – End-to-End Acceptance Test Report v6 | Vodafone, Silver Spring Networks |
| **WS1** | P.0205 – EnhancedFieldNetworkDesignv1.6 | Silver Spring Networks |
| **WS1** | P.0207 – Work Method Statement Silver Spring eBridge Installation v1.0 | UK Power Networks,<br>Silver Spring Networks |
| **WS1** | P.0208 – Work Method Statement Silver Spring Access Point Installation in Substation v1.0 | UK Power Networks,<br>Silver Spring Networks |
| **WS1** | P.0214 – InitialLogicalReferenceDesignv1.3 | Vodafone |
| **WS1** | P.0230 – Work Method Statement Silver Spring Relay Installation v1.0 | UK Power Networks,<br>Silver Spring Networks |
| **WS1** | P.0260 – RF Mesh and IEC 61850 Sub-Set Acceptance Tests Report v2 | Silver Spring Networks |
| **WS1** | P.0265 – Work Method Statement Silver Spring eBridge Installation Wissington BSC v1.0 | Silver Spring Networks,<br>UK Power Networks |
| **WS1** | P.0259 – Work Method Statement Silver Spring Relay Decommission v1.0 | UK Power Networks,<br>Silver Spring Networks |
| **WS2** | P.0102 – Factory acceptance test for the Quadrature-booster control system | Fundamentals |
| **WS2** | P.0150 – Dynamic Line Rating Design Deployment Brief | UK Power Networks |
| **WS2** | P.0218 – Quadrature-booster control system scheme design drawings | Fundamentals |
| **WS2** | P.0219 – Reverse power flow control drawings | Alstom |

| Workstream | IPR description | IPR Owner |
|---|---|---|
| **WS2** | P.0220 – Dynamic Line Rating control drawings | Alstom |
| **WS2** | P.0251 – Factory acceptance test for Quadrature-booster | Wilson Transformer |
| **WS2** | P.0252 – Modern Protection Relays a Solution for Reverse Power Flows Design Deployment Brief v1 | UK Power Networks |
| **WS2** | P.0263 – Modern Protection Relay Functional Design Specification | Alstom |
| **WS2** | P.0264 – Quadrature-booster control system production specification (February 2013) | Fundamentals |
| **WS2** | P.0270 – Dynamic Line Rating Factory acceptance test results | Alstom |
| **WS2** | P.0271 – Dynamic Line Rating Protection programmable scheme logic and settings files | Alstom |
| **WS2** | P.0272 – Protection programmable scheme logic and settings files | UK Power Networks |
| **WS2** | P.0275 Quadrature-booster engineering operating standard | UK Power Networks |
| **WS2** | P.0276 Quadrature-booster control system engineering operating standard | UK Power Networks |
| **WS2** | P.0278 – Dynamic Ratings C50 presentation, technical spec and control unit | Alstom |
| **WS2** | P.0279 – Protection programmable scheme logic and settings files | Wilson Transformer |
| **WS3** | P.0271 – Connection Agreement template | UK Power Networks |
| **WS3** | P.0291 – Connection Agreement Template Capacity Quota | UK Power Networks, Baringa |
| **WS4** | P.0130 – Active Network Management system Acceptance Test Specification | UK Power Networks , Smarter Grid Solution |
| **WS4** | P.0202 – Active Network Management system Functional Design Specification | UK Power Networks , Smarter Grid Solution |
| **WS6** | P0184 – Strategic Investment Model Scope of works.v1.0 | UK Power Networks |
| **WS6** | P.0249 – Strategic Investment Model Requirements Document | Imperial College London |
| **WS7** | P.0242 – CIRED 2013 paper – Modern Communications Infrastructure | UK Power Networks |
| **WS7** | P.0243 – CIRED 2013 paper – Quadrature-booster | UK Power Networks |
| **WS7** | P.0024 – CIRED 2013 paper – Commercial Arrangements for Active Network Management | UK Power Networks |
| **WS7** | P.0240 – CIRED 2013 paper: Active Network Management | UK Power Networks |
| **WS7** | P.0004 – TechCon 2013 – full paper – Quadrature-booster | UK Power Networks |
| **WS8** | P.0146 – Dynamic Line Rating integration Tests Report | UK Power Networks, Smarter Grid Solution |
| **WS8** | P.0261 – Functional Design Specification_T5500 RTU IEC 61850 Server | UK Power Networks |
| **WS8** | P.0226 – Functional Design Specification for IEC 61850 implementation into the RTU | UK Power Networks, GE Power Conversion |

## 9. Risk management

The FPP project has established a risk management process, as described in detail in the FPP Project Handbook. Please see Appendix 1 for an extract of the risk management process from the FPP Project Handbook. It allows for the communication and escalation of key risks and issues within the project, and defines where decisions will be made and how these will be communicated back to the workstream where the risk or issue has arisen. Risks are reviewed weekly at workstream level and fortnightly at project level by the Project Board. Key project risks are then escalated to the Project Steering Committee for review and approval of the mitigation on a six week cycle basis.

| Ref# | W/S | Risk & Impact Description | BID Mitigation | Mitigation (update) | Status |
|---|---|---|---|---|---|
| BID R0001 | WS1 | The Communications platform may not meet the smart applications' performance requirements leading to system incompatibilities and unsatisfactory trial results | The Communications platform should be subject to performance testing using smart devices or simulators under various operating conditions. Communications requirements to be defined at design stage and suitable Communications technology chosen for the purpose of the trials. UK Power Networks to agree Service Level Agreements for Communications platform. | As part of the acceptance tests performed for the communications platform, IEC 61850 communication trials were included both in the lab and in the field using IEC 61850 traffic simulators.<br><br>The test demonstrated that the communication solution deployed in the trial area was and is capable of trafficking simulated IEC 6150 traffic. | |
| BID R0002 | WS1 | Failure to secure suitable mounting positions/space for the communications equipment due to limited space in UK Power Networks-owned premises or assets e.g. poles – leading to lengthy negotiations with property owners resulting in programme delays | Optimise design and minimise mounting positions/space required.<br>Investigate alternative options for mounting such as a third party provider.<br>Carry out detailed site surveys early in the project. | Suitable mounting locations for the communications equipment, relays, have been identified at UK Power Networks Low Voltage (LV) distribution pole infrastructure. All installs at LV distribution poles were completed. | Closed |
| BID R0003 | WS1 | Silver Spring Networks may have to use an unlicensed spectrum if they are unable to get a trial licence on time leading to possible adverse perception from other project stakeholders | Establish whether trial licenses would be available by Q1 2012. | Silver Spring Networks was awarded an Ofcom development licence on 19 December 2012 for the duration of the project. | Closed |

| Ref# | W/S | Risk & Impact Description | BID Mitigation | Mitigation (update) | Status |
|---|---|---|---|---|---|
| BID R0004 | WS3 | Insufficient levels of Renewable Generation (RG) connecting – Generators may not want to participate (if for example the project interferes with their normal operations) during the FPP project timescales leading to failure to fully trial the FPP in the planned timescales | Engage with generators as early as possible to understand the risks and issues likely to impact their (generators) normal operations in order to actively manage/mitigate them | FPP has successfully engaged with six developers that have now been offered connections which if accepted will materialise within the timeframe of the FPP project.<br><br>In addition, the FPP project continuously monitors the connections pipeline and will be issuing additional offers to interested DG customers. | |
| BID R0005 | DA | Different vendor protocols/ characteristics could potentially compromise the interoperability trials which may cause delays during system integration and trials | Ensure that ALL communications application is based on international standards, and all devices and systems are tested and certified to these standards<br>Ensure that ALL devices are subject to testing in pre-production environment | Two of the smart devices have already been certified to IEC 61850 standard, and the remaining three are pending certification over the summer. Interoperability tests have commenced ahead of certification to avoid delay.<br><br>Extensive testing is also being carried out to mitigate any issues that could appear during the later stages of systems integration. | |

| Ref# | W/S | Risk & Impact Description | BID Mitigation | Mitigation (update) | Status |
|---|---|---|---|---|---|
| BID R0006 | PM | Project Partner(s) withdrawing their participation in the FPP project at a late stage leading to lengthy programme delays to institute their replacement(s) and in the worst case the collapse of the FPP | Issue principles of collaboration and request official Letters of Intent from Partners to reduce probability of partners withdrawing from the project<br>– Reduce dependency on specific partners – this is a vendor agnostic project | All contracts with Partners have now been completed with clear technical and commercial scope. Relevant exit clauses have been incorporated to ensure project continuity in the event of an early withdrawal of one of the parties. | Closed |
| BID R0007 | DA | If actual MWh or hours of RG operation diverge (adversely) significantly from results within smart grid application feasibility assessment then this may lead to possible complaints from generators. | Ensure that RG developers are made aware in advance that the Assessment Results are based on estimates and that the Actual Levels of curtailment are likely to change year on year. Data used in studies should be as accurate as possible and assessment methods agreed by all stakeholders as being suitable. Develop suitable commercial and legal framework for making such connections offers. | Technical Mitigation unchanged – data used in studies should be as accurate as possible and assumptions used fully transparent. In addition, the project is working closely with the DG customers to support them through their due diligence process by providing additional information/analysis and clarifications as required. This will ensure better understanding of the mechanics of the curtailment and increased confidence in the curtailment analysis presented. | |

| Ref# | W/S | Risk & Impact Description | BID Mitigation | Mitigation (update) | Status |
|---|---|---|---|---|---|
| BID R0008 | PM | Delays in resourcing and negotiation/drafting of delivery contracts could result in delays in project delivery. | The resourcing process/production of job descriptions and contract drafting to start pre-contract award. UK Power Networks to partly resource project. Contracting resource has been allowed for key roles. | The team is now fully established, most resource are permanent UK Power Networks employees, but where key skills are not available internally interim consultants have been engaged.<br><br>The resourcing situation is being monitored and action will be taken if necessary. | |
| BID R0009 | WS03 | Local Opposition to Wind Energy development contributing to negative publicity for UK Power Networks within the project area | UK Power Networks will proactively engage local stakeholders and promote the work the project is doing (looking at alternative to reinforcement and new lines/cables) | There has been no local opposition to date and therefore no further action is required. | |
| BID R0010 | WS8 | System integration issues occurring due to inadequate testing in technical workstreams (WS) leading to delays | Ensure that the deliverables from each workstream are appropriately tested prior to system integration activities and allow sufficient time to develop test specifications and to conduct the testing | High-level test plan and detailed pre-production environment specification currently being developed. The relevant activities are being incorporated into the detailed project plan. Extensive lab and field testing will be carried out to ensure no issues in commissioning. | Closed |

The key risks that have arisen in the reporting period are:

**Risks:**

| Ref# | Workstream | Risk | Mitigation | RAG |
|---|---|---|---|---|
| R0063 | WS3 – Smart Commercial arrangements | Level of curtailment is unacceptable to customer and customers do not sign up to the FPP trials | We have chosen to offer developers an 'interruptible' connection based on pro-rata curtailment. The results give an average of 5.33% curtailment of annual output, which until now has been positively accepted by customers.<br><br>In addition, we are working closely with the customers to ensure that they have all the information required to support their decision making and fully understand the FPP connection offer. Please also refer to Bid Risk R0007. | |
| R0079 | WS4 – Smart Applications | The integration of RTU and IED with the ANM system is more complex than planned | Identify at early stage the interdependencies, produce a test specification and test plan and regularly update it.<br><br>Ensure at early specification phase that the interfaces requirements are shared and agreed between the technical workstream. Also the overall test approach will ensure a clear robust integration process. | |
| R0177 | WS2 – Smart Devices | The deployment of smart devices over the summer 2013 relies on operational resources and network outages. Both of these parameters can vary depending on operational needs and network incidents. | Work closely with the Network Operations team to secure resources and Network Control to confirm the outages. | |

| Ref# | Workstream | Risk | Mitigation | RAG |
|---|---|---|---|---|
| R0178 | WS2 – Smart Devices | During testing, technical queries have been raised that could suggest the Quadrature-booster transformer does not perform in accordance with the specification and it is not suitable for the proposed application. This will potentially cause delays in meeting the SDRC 9.8 milestone. | Additional testing has been concluded and the operation of the Quadrature-booster has been proven. Minor modifications on site are required as a result of this and these are planned to be completed in June 2013. The project delivery team can proceed then with the final commissioning and energisation which is planned for the end of July 2013. | |
| R0122 | WS2 – Smart Devices | In January 2013, the project identified the opportunity to deliver the seasonal running arrangement use case using business as usual equipment that will be installed at the proposed locations by end of Q3 2013. That would negate the need for installation of the two Frequent Use Switches but would still deliver the learning and the relevant use case as the business as usual equipment would be installed in the same location and would have the required functionality.<br><br>Delays in delivering the business as usual project would impact the ability of the project to meet the Frequent Use Switches part of the SDRC 9.4 milestone in September 2013. | The project has carried out technical analysis which has confirmed that there is no need for installation of Frequent Use Switches and the functionality can be delivered using the RMU that will be installed at the proposed locations.<br><br>It has been monitoring the progress of the project and has raised internally the dependency that it has on the FPP project. However the completion of the project could potentially slip to Q1 2014 and as such a change request to Ofgem will be raised (June 2013). | |

## 10. Other

No additional information to report.

## 11. Consistency with the full submission

The work currently being undertaken within the project is consistent with the bid submission with the exception of the following:

- SDRC 9.8 – Quadrature-booster completion date. Due to the challenges discussed in section 2.2 and associated risk R0178, the planned energisation date has been delayed. A change request to that effect has been submitted to Ofgem.
- In the original bid submission, the budget allows for the deployment of two frequent use switches at identified locations to facilitate the trial of seasonal running arrangements for the distribution network. It has since been identified that UK Power Networks will be installing RTUs that can provide the required functionality at those identified locations. The project considers that there is no technical or economic justification for the deployment of frequent use switches since the business-as-usual equipment can deliver the same functionality, scope and learning. However, the RTU's will not be available until Q1 2014 while the frequent use switches were planned for implementation by September 2013 in accordance with SDRC 9.4. A change request to that effect has been submitted to Ofgem.

## 12. Accuracy assurance statement

The project implemented a project governance structure, as out lined in the project handbook that effectively and efficiently manages the project and all its products.. All information produced and held by the project is reviewed and updated when required to ensure quality and accuracy. This report has gone through an internal project review and a further review within UK Power Networks to ensure the accuracy of information.

We hereby confirm that this report represents a true, complete and accurate statement on the progress of the Flexible Plug and Play Low Carbon Networks project in its third reporting six monthly period and an accurate view of our understanding of the activities for the next reporting period.

Signed ..... Ben Wilson .....

Date ..... 19/6/13 .....

Ben Wilson
Director of Strategy & Regulation and CFO
UK Power Networks

## 13. Appendix

**Appendix 1 – Risk Management**

To support the FPP Risk Management process each risk is given a RAG Status to provide visual representation and understanding of the risks current status. The RAG status is determined upon the probability of the risk occurring and the consequences if the risk eventuates. Please see below for the Probability and Consequence Table Calculator:

**Probability and Consequence Table Calculator:**

| | Rare | Unlikely | Possibility | Likely | Probable |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Probability | Rare | Unlikely | Possible | Likely | Almost certain |
| Consequence | Minimal | Minor | Moderate | Major | Catastrophic |

**Probability**
1. Rare – May occur in exceptional circumstances - 0-10%
2. Unlikely – Uncommon but has been known to occur - 10-20%
3. possible – Could occur 20-75%
4. Likely – May occur 75%-90%
5. Almost certain – Expected to occur 90-100%

**Consequence**
1. Minimal
2. Minor
3. Moderate
4. Major
5. Catastrophic

Once a rating has been determined for the probability and consequences the RAG status (high, medium and low) is calculated by multiplying the probability against the consequences, e.g. taking a probability of 4, which is classified as likely, and multiplying this against a consequence of 2, which is classified as a Moderate, would give you and overall risk rating of 8, which would be risk rated as a RAG status of GREEN (Low)

| Probability | | | | | | |
|---|---|---|---|---|---|---|
| | 5 | 5 | 10 | 15 | 20 | 25 |
| | 4 | 4 | 8 | 12 | 16 | 20 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 1 | 1 | 2 | 3 | 4 | 5 |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Consequence | | | | |