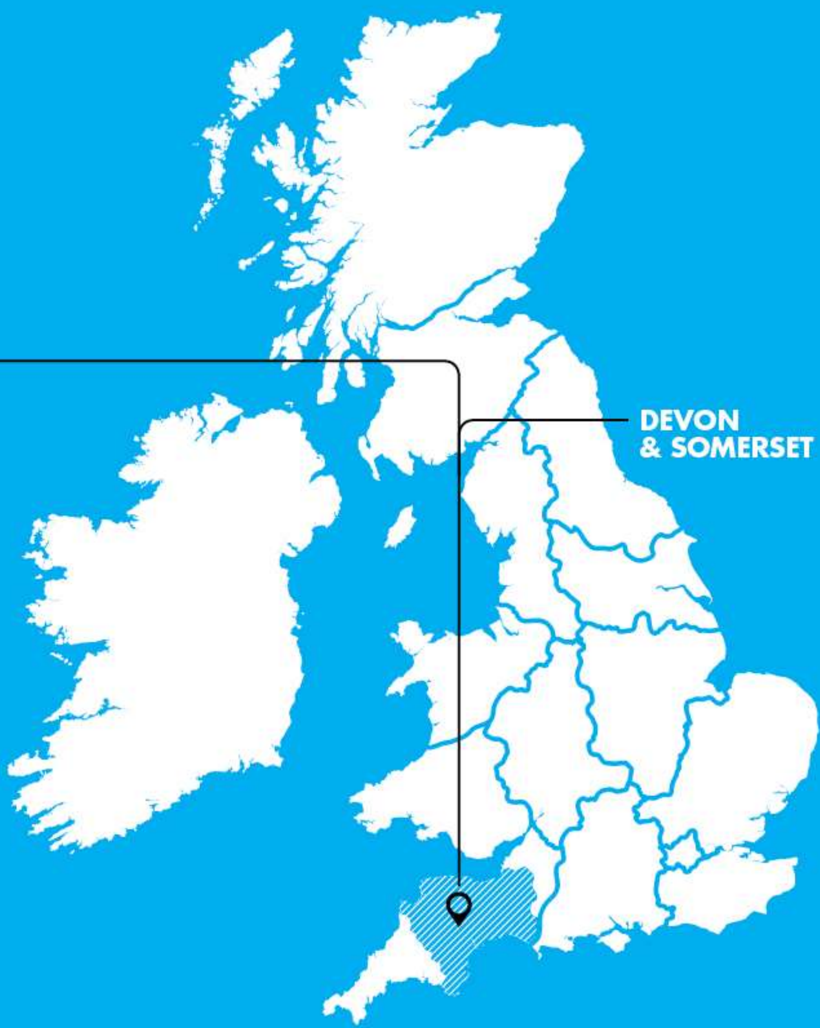
WESTERN POWER DISTRIBUTION

NETWORK EQUILIBRIUM

BALANCING GENERATION AND DEMAND



PROJECT PROGRESS REPORT
REPORTING PERIOD:
DECEMBER 2015 – MAY 2016

LCN Fund
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Contents

Glossary

Term	Definition
ABSD	Air Break Switch Disconnector
AC	Alternating Current
AIS	Air Insulated Switchgear
APT	Advanced Planning Tool
AVC	Automatic Voltage Control
BAU	Business as usual
BSP	Bulk Supply Point
CB	Circuit Breaker
CT	Current Transformer
DC	Direct Current
DG	Distributed Generation
DNO	Distribution Network Operator
EHV	Extra High Voltage
ENA	Energy Networks Association
ER	Engineering Recommendation
EU	European Union
EVA	Enhanced Voltage Assessment
FPL	Flexible Power Link
FTP	File Transfer Protocol
GB	Great Britain
GIS	Gas Insulated Switchgear
HSOC	High Set Overcurrent
HV	High Voltage
IDMT	Inverse Definite Minimum Time
IPR	Intellectual Property Register
ITT	Invitation to Tender
LV	Low Voltage

LVAC	Low Voltage Auto Changeover
NMS	Network Management System
NOP	Normal Open Point
OCEF	Overcurrent Earth Fault
OHL	Overhead Line
OLTC	On Load Tap Changer
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SDRC	Successful Delivery Reward Criteria
SLD	Single Line Diagram
SVO	System Voltage Optimisation
TSDS	Time Series Data Store
UK	United Kingdom
VLA	Voltage Level Assessment
VT	Voltage Transformer
WG	Working Group
WPD	Western Power Distribution

1 Executive Summary

Network Equilibrium is funded through Ofgem's Low Carbon Networks Second Tier funding mechanism. Network Equilibrium was approved to commence in March 2015 and will be complete by 14th June 2019. Network Equilibrium aims to develop and trial an advanced voltage and power flow control solution to further improve the utilisation of Distribution Network Operators' (DNO) 11kV and 33kV electricity networks in order to facilitate cost-effective and earlier integration of customers' generation and demand connections, as well as an increase an customers' security of supply.

This report details progress of the project, focusing on the last six months, December 2015 to May 2016.

1.1 Business Case

The business case for Network Equilibrium remains unchanged. The request for low carbon load and generation connections in the project area, Somerset and Devon, continues grow.

1.2 Project Progress

This is the third progress report. The period covered in this report is further focussed on the method designs, technical contract provision and data gathering for the successful delivery of each method.

SDRC-1 was submitted in this reporting period and focussed on the recommendation and suitability to extend the existing voltage limits on the 11kV and 33kV networks. Within this reporting period the SVO system contract has been signed and awarded to Siemens. The FPL tender stage has been finalised and a successful supplier has been identified, however, throughout the latter stages of this reporting period this element of work has focussed on finalising the testing and integration requirements of the device prior to contract signature.

During this reporting phase three SDRCs have been completed and approved:

- SDRC-1 – Detailed Design of the Enhanced Voltage Assessment Method;
- SDRC-2 – Detailed design of the SVO Method; and
- SDRC-3 – Detailed design of the FPL Method.

During this reporting period Network Equilibrium has also made significant progress working towards the next three SDRCs, 4, 5 and 6.

1.3 Project Delivery Structure

1.3.1 Project Review Group

The Network Equilibrium Project Review Group met once during this reporting period. The main focus of this meeting was to determine and approve the delivery strategy for the SVO and FPL methods following the submission and approval of SDRCs 2 and 3.

1.3.2 Resourcing

Following a re-structure of WPD's project team, whereby the Project Manager and Technical Lead roles have been combined it was highlighted that specialised engineering resource was also required to successfully deliver the technical project requirements. A contract has now been put in place with WSP|Parsons Brinckerhoff to provide this engineering resource to support the SVO and FPL deliverables.

1.4 Procurement

The procurement activities for Network Equilibrium focus on the SVO and FPL methods. Throughout the project supporting procurement activities will take place in order to facilitate the successful delivery of all project methods, however, there are two formal procurement activities as part of the project.

Manufacturer	Technology	Applicable Substations	Anticipated Delivery Dates
Siemens	SVO System	16 Substations (Installed in 1 central location)	October 2017
TBC	FPL	Exebridge	April 2018

1.5 Installation

Following the completion of the detailed design SDRCs the next reporting period will see the first elements of installation works progressed. These first installation activities will be:

- AVC relay changes at three sites; and
- Cable and Overhead Line diversionary works at Exebridge.

1.6 Project Risks

A proactive role in ensuring effective risk management for Network Equilibrium is taken. This ensures that processes have been put in place to review whether risks still exist, whether new risks have arisen, whether the likelihood and impact of risks have changed, reporting of significant changes that will affect risk priorities and deliver assurance of the effectiveness of control.

Contained within Section 8.1 of this report are the current top risks associated with successfully delivering Network Equilibrium as captured in our Risk Register along with an update on the risks captured in our last six monthly project report. Section 8.2 provides an update on the most prominent risks identified at the project bid phase.

1.7 Project learning and dissemination

Project lessons learned and what worked well are captured throughout the project lifecycle. These are captured through a series of on-going reviews with stakeholders and project team members, and will be shared in lessons learned workshops at the end of the project. These are reported in Section 6 of this report.

A key aim of Network Equilibrium is to ensure that significant elements of the work carried out for network modelling, monitoring, design and installation are captured and shared within WPD and the wider DNO community. During this period the main focus has been to be capture the SVO and FPL design principles, as recorded in SDRCs 2 and 3.

A System Voltage Optimisation Workshop was held on the 27th January 2016 in Birmingham. This workshop was attended by several DNOs and enabled the wider DNO community to input into the design requirements for the SVO method and to proactively influence the detailed design of the method.

In addition to this we have shared our learning (where applicable), through discussions and networking at a number of knowledge sharing events hosted by other organisations.

2 Project Manager's Report

2.1 Project Background

The focus of Network Equilibrium is to balance voltages and power flows across the distribution system, using three Methods to integrate distributed generation within electricity networks more efficiently and delivering major benefits to distribution customers.

The Problem that Network Equilibrium addresses is that electricity infrastructure in the UK was originally designed and developed for passive power distribution requirements. As a result, the integration of significant levels of low carbon technologies (LCTs) within our present electricity networks can cause voltage management and thermal issues. For business as usual (BAU) roll-out we need to develop solutions, which take a strategic engineering approach, considering the whole system and not solving constraints on a piecemeal basis. The Problem will be investigated using three Methods, and their applicability to 33kV and 11kV distribution networks assessed. Each will involve testing within South West England:

(1) Enhanced Voltage Assessment (EVA);
(2) System Voltage Optimisation (SVO); and
(3) Flexible Power Link (FPL).

The aims of Equilibrium are to:

- Increase the granularity of voltage and power flow assessments, exploring potential amendments to ENA Engineering Recommendations and statutory voltage limits, in 33kV and 11kV networks, to unlock capacity for increased levels of low carbon technologies, such as distributed generation (DG);
- Demonstrate how better planning for outage conditions can keep more customers (generation and demand) connected to the network when, for example, faults occur. This is particularly important as networks become more complex, with intermittent generation and less predictable demand profiles, and there is an increased dependence on communication and control systems;
- Develop policies, guidelines and tools, which will be ready for adoption by other GB DNOs, to optimise voltage profiles across multiple circuits and wide areas of the network;
- Improve the resilience of electricity networks through flexible power link (FPL) technologies, which can control 33kV voltage profiles and allow power to be transferred between two, previously distinct, distribution systems; and
- Increase the firm capacity of substations, which means that the security of supply to distribution customers can be improved during outage conditions, leading to a reduction in customer interruptions (CIs) and customer minutes lost (CMLs).

2.2 Project Progress

This is the third progress report. The period covered in this report is further focussed on the method designs, technical contract provision and data gathering for the successful delivery of each method. SDRC-1 was submitted in this reporting period and focussed on the recommendation and suitability to extend the existing voltage limits on the 11kV and 33kV networks. Within this reporting period the SVO system contract has been signed and awarded to Siemens. The FPL tender stage has been finalised and a successful supplier has been identified, however, throughout the latter stages of this reporting period this element of work has focussed on finalising the testing and integration requirements of the device prior to contract signature. Significant progress has been made in relation to the detailed site design requirements of both the SVO, to include adaption or new AVC relays, and the FPL, which have been reported in SDRC-2 and SDRC-3 in this reporting period.

2.3 Enhanced Voltage Assessment

Enhanced Voltage Assessment (EVA) consists of two parts. Part 1 is the Advanced Planning Tool (APT) and part 2 is the Voltage Limits Assessment (VLA) work package. In this reporting period, the development of the APT has progressed and the VLA work has been completed.

In January 2016, SDRC-1 Detailed Design of the Enhanced Voltage Assessment method was submitted. SDRC-1 included the key findings and learning from the Voltage Limits Assessment work package and the design and implementation of the Advanced Planning Tool.

2.3.1 Advanced Planning Tool

The Advanced Planning Tool is the first part of EVA and involves the creation of a planning tool which aims to enable better network and outage planning of distribution networks with increasing penetration of variable generation and demands. This will be achieved through the tool's advanced functionalities. These include the production of forecasted power flows using weather forecasts and the network analysis using typical demand and generation profiles.

The continuing development of the Advanced Planning Tool (APT) in this reporting period offered valuable learning which helped refine the required functionalities and shape the tool.

The network modelling has been completed with the import of WPD's existing 33kV PSS/E models and 11kV DINIS network models into IPSA. After the truncation of the 11kV network, the 33kV and 11kV models were merged together to form the APT base network. This is shown in Figure 2-1.

Using historic demand and generation data of the previous two years, typical profiles have been created representing a weekday, a Saturday and a Sunday of each month of the year. Furthermore, specifying the relationship between the demand/generation and the weather forecasts formed the basis of the developed forecast models which provide predictions for demand/generation using 48-hour weather forecasts provided by the Met Office. This completes all of the work associated with the creation of the typical and forecast profiles.

The development of the SVO and FPL plugins is progressing and is expected to be complete by the end of Q3 2016.

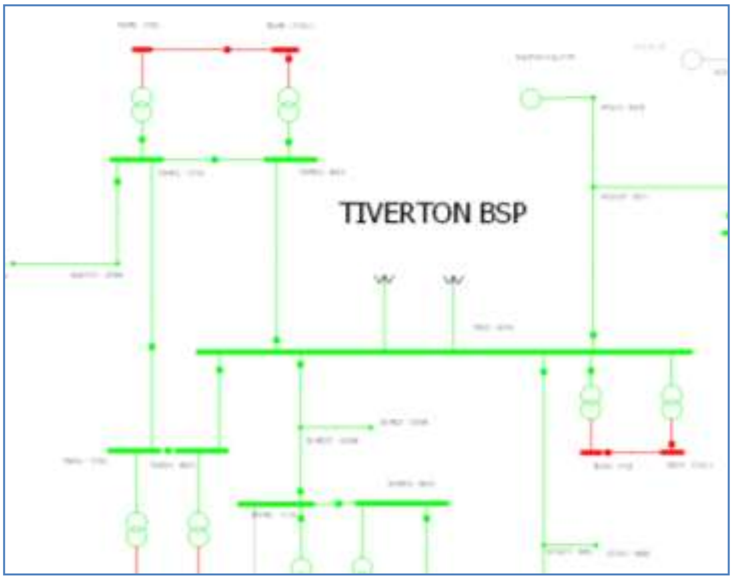


Figure 2-1 - APT Network Model

The APT server has been installed at WPD offices in Plymouth and all the identified users now have access to the APT client on their machines. After agreeing the provision of the 48-hour weather forecasts by the Met Office, a File Transfer Protocol (FTP) link has been established between WPD and the Met Office in January to automatically receive the weather forecasts at midnight every day.

With the completion of the network modelling work and the delivery of the typical and forecast profiles, the APT can now perform power flow analysis on the entire network for typical times of the year or for up to two days in the future. The user interface for the creation of a new job is shown in Figure 2-2 and an example of the results display for a branch flow is shown in Figure 2-3.

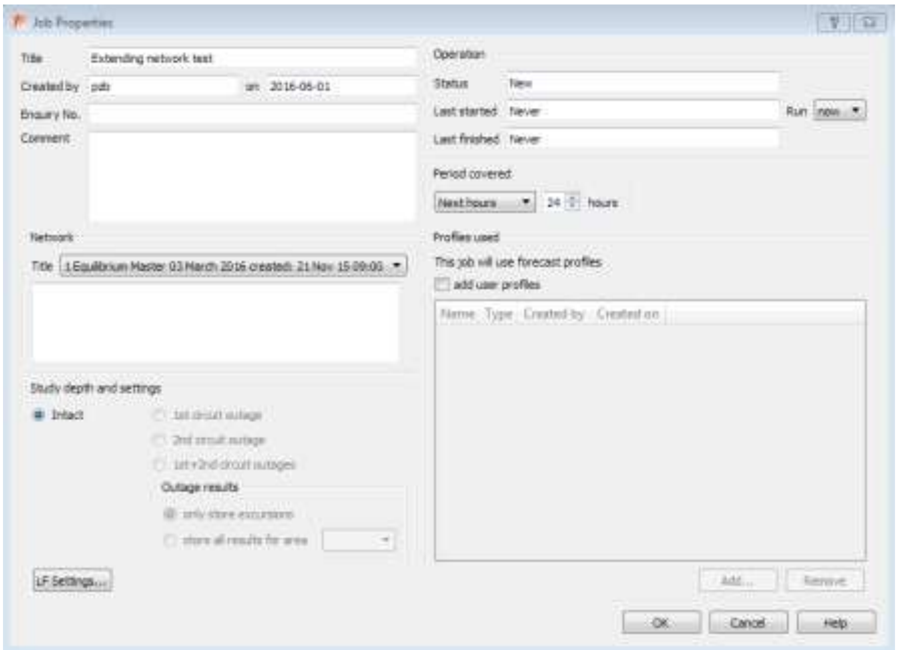


Figure 2-2 - User Interface for creation of new job

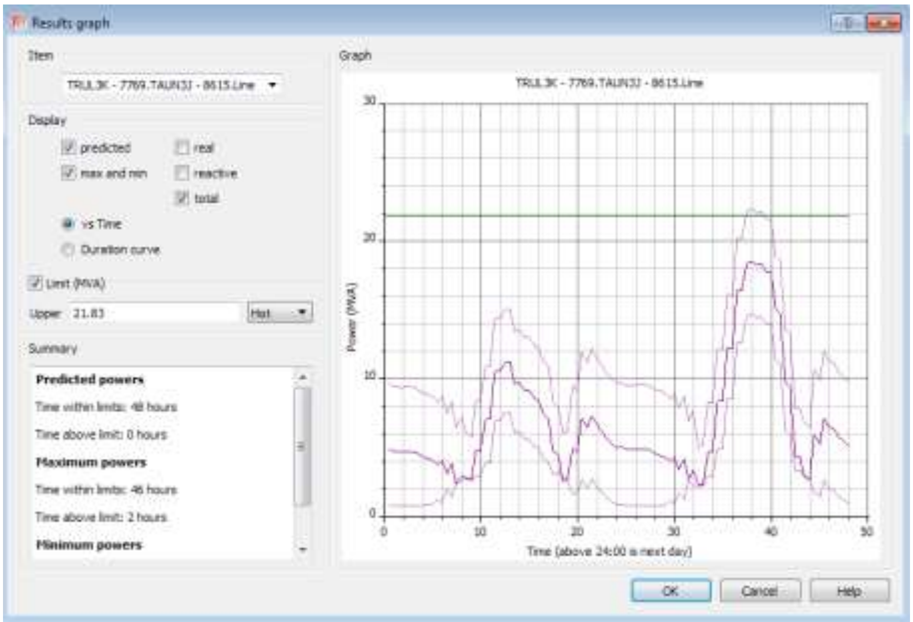


Figure 2-3 - Branch flow results example

An initial session with the group of users was held in March that offered valuable feedback. In that session, the users were introduced to the user interface and received an overview of the basic functionalities of the tool.

Representatives of the three main user groups (Primary System Design Engineers, Control Engineers and Outage Planners) were engaged in the development process to ensure that the final tool meets all their requirements. This continuous consultation led to the addition of certain functionalities.

For full network visibility, the entire 11kV network will replace the truncated model and to ensure that the speed of the tool is not compromised, the user will be able to select the area they wish to investigate instead of performing the analysis on the whole network. Furthermore, to provide a view of the real network operation, the half-hourly historic demand and generation data will be incorporated to the tool, enabling the user to see what has actually happened in the network. This will allow comparisons to be made between the real network performance and the indications given by the typical profiles, helping establish how and whether the typical profiles should be used for planning purposes. To make the tool ready for use by Primary System Design engineers, the extreme scenarios that are currently considered as part of the existing planning procedures will be added to the tool as additional profiles. Not only this will allow Primary System Design engineers to make immediate use of the tool to plan using existing practices but it will also enable consistent comparisons to be made between current planning methods and the advancements the tool will offer.

The refinement of the tool functionalities required the review of the delivery timescales. By prioritising the outstanding tasks, the completion of the remaining deliverables including SDRC-4 is still as originally scheduled.

2.3.2 Voltage Limits Assessment

VLA, Part 2 of the EVA method, has now been completed. Through stakeholder engagement, equipment specification investigations, literature reviews and system studies, VLA aimed to explore the rationale behind the UK statutory voltage limits and step change limits and the possibility of their amendment.

From the stakeholder engagement, it was clear that the industry generally agreed that a possible amendment of the UK statutory voltage limits aligned with the recent evolution of electricity distribution networks. It was recognised that the relaxation of voltage limits could have positive effects in the connection of higher levels of embedded generation, reducing the timescales and costs of new connections. A number of interesting technical considerations were also raised. The need for an active voltage control system was highlighted and the possibility of losing regulation at certain parts of the network and requiring transformer changes was discussed. It was also noted that a potential widening of statutory limits may need to be accompanied by a review of G59 settings. Regarding step change limit amendments, these were associated with the operation of sensitive and protective equipment, resulting in commercial implications for DNOs. All of these aspects were further investigated in the following parts of the study.

The equipment specification investigations showed that the vast majority of equipment connected at 11kV and 33kV would not require replacement. This is provided the new range of voltage variation would not be greater than ±10%, applied in a probabilistic manner so that operation in the extreme ends of that range would only be allowed for short periods of time.

The system studies showed that for the 33kV network a maximum limit of +-10% should be considered while for the 11kV a tighter range would be suitable due to voltage regulation and equipment sensitivity. Regarding the voltage step change limits, the 3% limit for infrequent planned events and the 10% limit for infrequent unplanned events are proposed to be maintained.

The outputs from the study have been forwarded to the industry for further investigation and consultation. It is anticipated that additional work will be undertaken as part of the formal consultation process, associated with exploring future change, between stakeholders and various working groups concerned with voltage limits. Consultation with customers connected to the network, liaison with distribution network regulators in the UK and EU, further system modelling to examine potential impacts in other parts of the UK network and more extensive dissemination of learning between DNOs are recommended. Coordination with other working groups (WG) such as ER P28 WG and the LV harmonisation group is also advisable.

2.4 System Voltage Optimisation

The System Voltage Optimisation (SVO) method of Network Equilibrium aims to dynamically manage the system wide voltage to maximise the level of Distributed Generation that can be connected to network while maintaining statutory limits. During the reporting period Successful Delivery Reward Criteria (SDRC) 2 “Detailed design of the System Voltage Optimisation Method” was completed. The report detailed the operation philosophy of the SVO, the substation selection process and the Automatic Voltage Control (AVC) relays suitable for use with in the SVO Method.

During this reporting period the contract for the provision of the SVO system was signed and the successful tenderer was Siemens.

2.4.1 SVO-Spectrum Power 5 implementation overview

The SVO implementation consists of a centralised system that will be assessing the state of the network in real-time to calculate and send optimised voltage control settings to Bulk Supply Points (BSPs) and Primary substations.

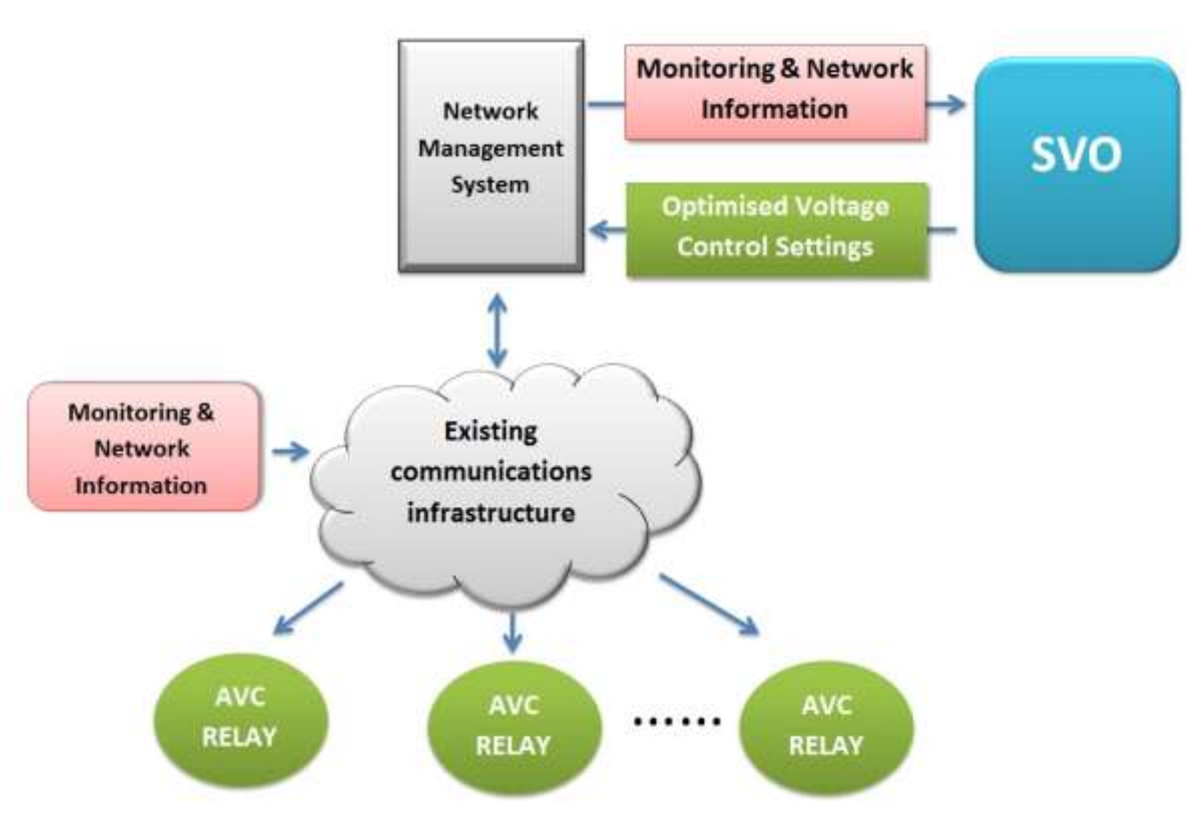


Figure 2-4- SVO Architecture

Siemens' Spectrum Power 5 is SVO's centralised system and will be communicating with WPD's Network Management System (NMS) to receive information about the real-time operation of the network in order to assess its state. The algorithms within Spectrum Power 5 will perform the required relevant calculations to determine the optimised voltage control settings, which will then be sent to the AVC relays at the selected BSPs and Primary substations through the existing communications infrastructure. Figure 2-4 illustrates the SVO architecture and communications methodology for the SVO system.

Progress since contract signature

An initial planning meeting has been held with Siemens in May to finalise the timescales for the deliverables and specify the preparation work required for the technical workshop scheduled for June. The aim of the technical workshop is to agree the technical details of all aspects of the solution.

Network Modelling and Data Provision

For SVO to be able to assess the network state and find optimised target voltage settings, it needs the full electrical model of the network under consideration. This network model will form the basis of all calculations and is therefore a very important part of the system.

For this reason, a network modelling strategy has been put in place detailing the procedures that will be followed to build the model and focusing on the collection of the required electrical data.

SVO will be implemented at eight BSPs and eight Primary substations in the Equilibrium trial area. The network model will include the full 33kV networks associated with each SVO controlled BSP and the entire 11kV network of the area. This is to ensure that the system will be able to correctly assess the network state under both normal and abnormal operating conditions.

The electrical data for these networks will be collected from WPD's Geographic Information System (GIS), which includes the type of cable/overhead line and length of each network section, geographic location of circuit breakers and basic connectivity information. This will be used to model the 33kV feeders associated with the SVO BSPs and the 11Kv feeders in the trial area. The methodology on how this information will be extracted from the GIS has been agreed with WPD's mapping team and a sample of the data has been sent to Siemens for review ahead of June's technical workshop.

To fully model the network, all of the transformers need to be accurately represented. The collection of the transformer information is a manual process as it can only be obtained from the transformer test certificates.

2.4.2 Substation Selection

At the bid stage of Network Equilibrium a short list of 12 BSPs and 10 Primaries within the trial area were selected. In SDRC2, site investigations and further power system studies were completed to prepare a final list of eight BSPs and eight primary substations that would take part in the SVO trials.

In order to ensure a good representation of the entire network and to gain valuable understanding on the implementation of the SVO into business as usual, it was decided to categorise groups of BSPs and Primaries based on their modelled voltage reduction capability. The BSPs were split into four categories and the Primaries into two.
Each site was then individually assessed against the following weighted criteria to provide a site hierarchy within each category. The criteria and the weighting factor applied are shown in Table 2-1 below:

Table 2-1: Criteria and Weighting for Substation Selection Scoring

Area	Weighting
Existing AVC capability	50%
Site Condition	30%
Connected customer impact	10%
Customer connection activity	10%

The high ranking sites in each category were then selected to create to the final list of BSP and Primary substations for the SVO trial as per Table 2-2 and Table 2-3 below.

Table 2-2: BSP Substations selected for SVO

	Bulk Supply Point
1	Bowhays Cross
2	Radstock Main
3	Tiverton
4	Taunton
5	Paignton
6	Exeter Main
7	Exeter City
8	Bridgwater Main

Table 2-3: Primary Substations selected for SVO

	Primary Substation
1	Waterlake
2	Lydeard St Lawrence
3	Marsh Green
4	Dunkeswell
5	Colley Lane
6	Tiverton Moorhayes
7	Millfield
8	Nether Stowey

2.4.3 AVC Relay Capability

During the detailed design of the SVO Method documented in SDRC2, the capability and suitability of various AVC relays was examined. This included all currently installed AVC relays in the selected substations plus other available relays.

Table 2-4: AVC Relay Function Overview

	Fine Control	Group Setting	DNP3 Comm.	Hard Voltage Limit	Tap Stagger	Line Drop Comp.	Embed. Gen.
Fundamentals Super TAPP SG	✓	✓	✓	✓	✓	✓	✓
Fundamentals SuperTAPP n+	✓	✓	✓	✓	✗	✓	✓
MR TAPCON ISM	✓	✓	✓	✓	✗	✓	✓
A-Eberle REG-D	✓	✓	✓	✓	✓	✓	✓
Siemens MicroTAPP	✗	✓	IEC60870-5-103[1]	✓	✓	✓	✓
Alstom KVGC202	✗	2 Groups[2]	RS232[3]	✓	✗	✓	✓
Reyrolle SuperTAPP	✗	✗	✗	✓	✗	✗	✗
GEC MVGC01	✗	✗	✗	✗	✗	✓	✗
GEC AVE5	✗	✗	✗	✗	✗	✗	✗

The relays are currently installed at the substations selected for the SVO method are shown in Table 2-5 below and images of each relay are shown in Figure 2-5 to Figure 2-8.

Table 2-5: AVC Relays Currently in use at SVO selected Substations

Relay	Number of Sites
MVGC01	5
KVGC202	7
MicroTAPP	3
Fundamentals SuperTAPP n+	1

[1] MicroTAPP uses IEC60870-5-103 communication protocol which does not interface with WPD's NMS
[2] Only 2 Group Settings are available in the KVGC202 limiting the performance of SVO
[3] KVGC202 use RS232 as the protocol which does not interface with WPD's NMS

Despite not being able to receive a fine control setting, it was decided that due to the age of the relays and the ability to programme multiple settings groups, sites that equipped with MicroTAPP relays would not be replaced for a more capable model. All the sites containing MVGC01 and KVGC202 relays require replacement for the deployment of the SVO method.

Figure 2-5: MVGC01 AVC Relay

Figure 2-6: Fundamentals SuperTAPP N+ AVC Relay

Figure 2-7: KVGC202 AVC Relay

Figure 2-8: MicroTAPP AVC Relay

During the reporting period a number of discussions have taken place with WPD policy and engineering teams regarding the preferred AVC relay for the SVO Method. Following detailed assessment of each relay it was determined that the Fundamentals SuperTAPP SG should be used for SVO. Primarily this is because the Fundamentals SuperTAPP N+ is currently on the approved relay list and the SG model is building on this already approved relay with more advanced features. The relay is currently undergoing type testing and discussions are underway with the manufacturer regarding timescales for testing and delivery. Internally, the process of approving the relay for use on the WPD network has also been started and is currently on-going awaiting final testing data.

2.4.4 Network Monitoring

During the trial phase of Network Equilibrium two types of network monitoring will be required:

1. Voltage levels on the 33kV and 11kV networks at both substations and feeder remote ends; and
2. Transformer tap changer position, to ensure both SVO substations On Load Tap Changer (OLTC) or other down-stream OLTCs do not reach the three most extreme taps of its tapping range with the SVO in operation.

Remote Voltage Monitoring

As standard practice, WPD BSP and Primary substations are installed with voltage transformers on the LV side of transformers for the operation of an AVC relay and other functions. The installation of an HV voltage transformer at primary substations is non-standard in most cases. Therefore to monitor the 33kV voltage at primary substations without an HV VT, it is proposed that the SVO algorithm will use the impedance data of the 33/11kV transformer along with the LV voltage and tap position to calculate a 33kV voltage.

Currently no voltage information at remote points on the 11kV network is recorded in WPD's Network Management System (NMS). Therefore, system modelling of the 11kV network will be carried out to locate the point on each 11kV circuit with the lowest theoretical voltage, typically the point furthest from the substation. At that point either HV or LV voltage monitoring equipment will be installed with the data sent back to the NMS for processing as part of the SVO.

For the additional voltage monitoring, mainly for the 11kV network, a cost benefit analysis will be completed on the first primary installation during the trials phase to determine the optimum level of 11kV network monitoring required. This will involve installing monitors at all remote locations and then scaling back until the confidence of the SVO algorithm begins to move outside of acceptable limits. This level of monitoring will then be applied to the remaining substations.

Transformer Tap Position

In order to prevent potential voltage issues occurring at substations not included in the SVO trial, it has been determined that the SVO algorithm will ensure that no transformer will be forced to operate on its three most extreme tap positions in either direction. This rule will apply to both the transformers with SVO installed and any downstream transformers with an OLTC. This requires the position of the each tap changer to be available in WPD's NMS. Historically, this data has not been available in the NMS and therefore may or may not be available at substations affected by the SVO trial.

Analysis of the network is currently underway to identify all the substations linked to an SVO substation and to determine the availability and accuracy of data currently available. Where the data is not available, a least cost design solution is being developed to make the information available, where possible, using existing installed equipment.

2.5 Flexible Power Link

2.5.1 Introduction

The Flexible Power Link (FPL) Method aims to overcome voltage and thermal issues associated with paralleling different network groups by coupling them together using back-to-back AC-DC converters. Implementation of the FPL Method will increase the level of flexibility in the network by transferring excess power from one network group to another.

The FPL Method involves the following stages:

- Specification of the FPL;
- Procurement of the FPL;
- Determine substation location for FPL installation;
- Design of the FPL network connection;
- Design review of the chosen FPL technology;
- Tender documentation for the installation of the FPL and associated works;
- Production of policy documentation for the operation, control, inspection and maintenance of the FPL;
- Assembly and testing of the FPL;
- Installation and commissioning of the FPL; and
- Trial period of the FPL including knowledge capture and dissemination of the method.

2.5.2 Progress Overview

Over the six month period since the submission of the last progress report, work has focussed on determining the substation location where the FPL will be installed and the methods for integrating into the network. This information formed the basis of Successful Delivery Reward Criteria (SDRC) 3 – "Detailed Design of the Flexible Power Link Method". This progress report provides an overview of the various elements covered in SDRC3.

Procurement of the FPL technology is nearly finalised, whereby the discussions with chosen supplier are on-going prior to finalising the Contract. The FPL supplier has been provided further technical detail including, detailed harmonic data, transformer operation limits and network vector group detail in order to further refine their product offering and ensure that the testing requirements of the device, for successful integration to site, are agreed prior to contract signature.

2.5.3 FPL Philosophy

The FPL is designed to enable active power transfer between two network groups whilst providing reactive power to support the network voltage. The Network Equilibrium trial area contains a variety of Bulk Supply Points (BSPs) some of which are generation dominated (mainly due to renewables) and some which are demand dominated. To gain the most benefit from the FPL technology it is proposed that it shall be connected on the 33kV network across a Normal Open Point (NOP) between a demand dominated BSP and a generation dominated BSP. Ordinarily these BSPs could be connected together by closing the NOP, however, in the trial area neighbouring BSPs are often fed from different Grid Supply Points (GSPs). Paralleling two GSPs through the 33kV distribution network is likely to result in adverse power flows, high fault levels and voltage infringements. These issues can be overcome by using the FPL to connect the separate network groups together as shown in Figure 2-9.

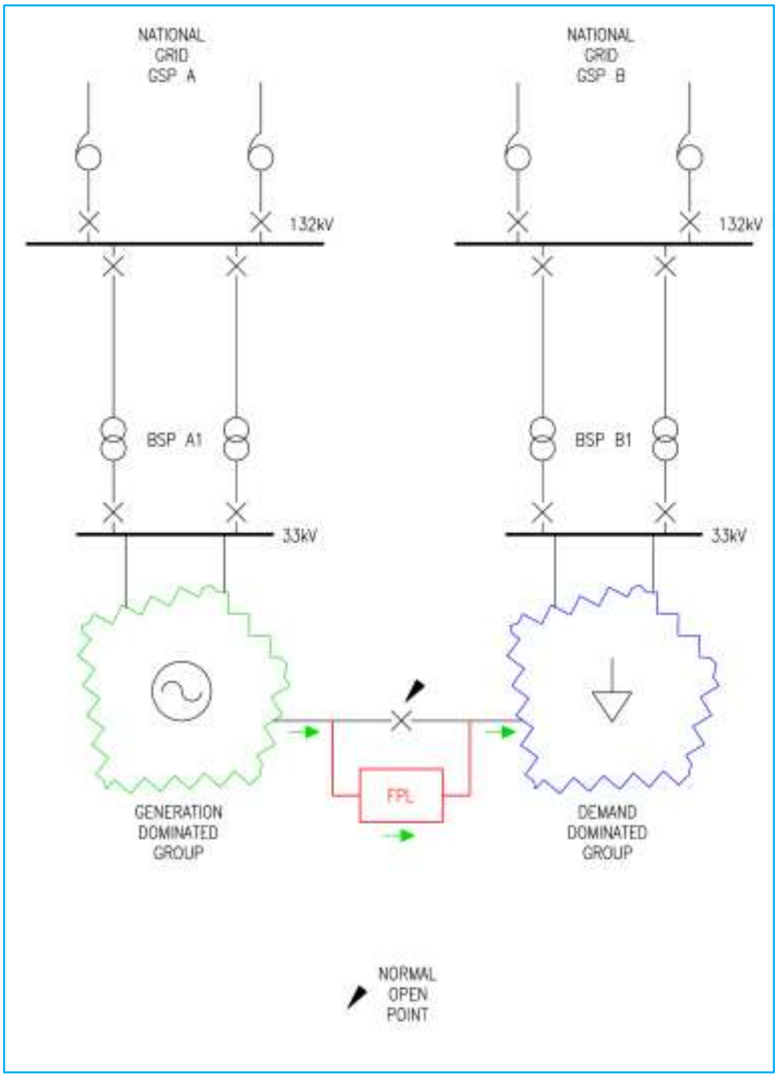


Figure 2-9: FPL installation between network groups

2.5.4 FPL System Integration

Any new equipment installed must not adversely impact the continuity of supply or operation of the existing network. During this reporting period three connection options were produced that allow integration of the FPL technology onto the 33kV network. The options allow the FPL to be electrically disconnected from the network, with the network returned to the current operational arrangement as and when required. The options are as follows:

Option 1 – Within a Normally Open 33kV Interconnector

For this option a new five panel switchboard is required to connect the FPL. The original arrangement is shown in Figure 2-10 and the proposed new arrangement is shown in Figure 2-11. Two circuit breakers are used to connect the FPL, two for the incoming 33kV connections and a bus-section circuit breaker which becomes the new NOP.

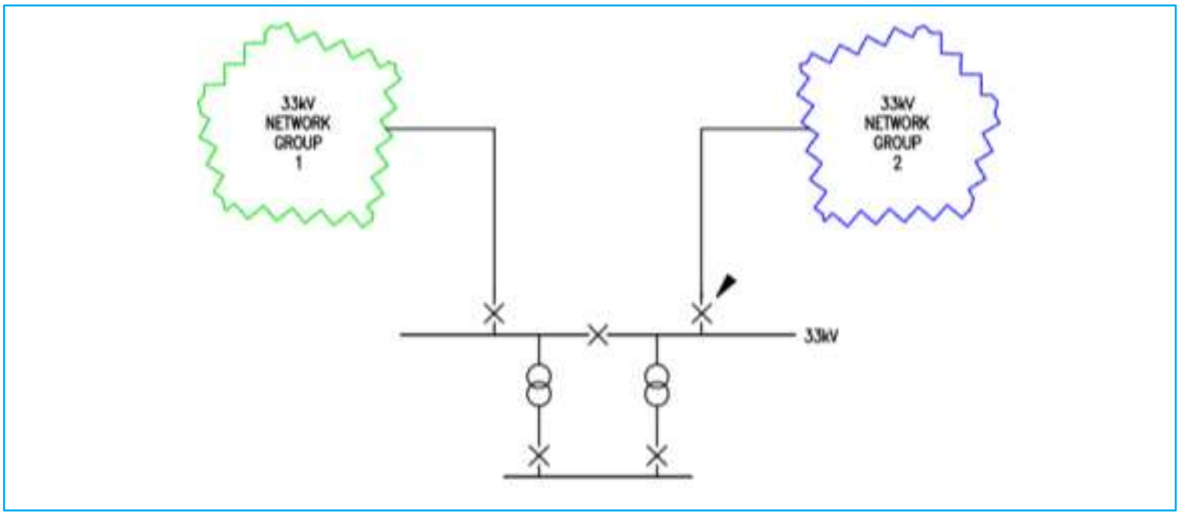


Figure 2-10: Option 1 - Existing Network Arrangement

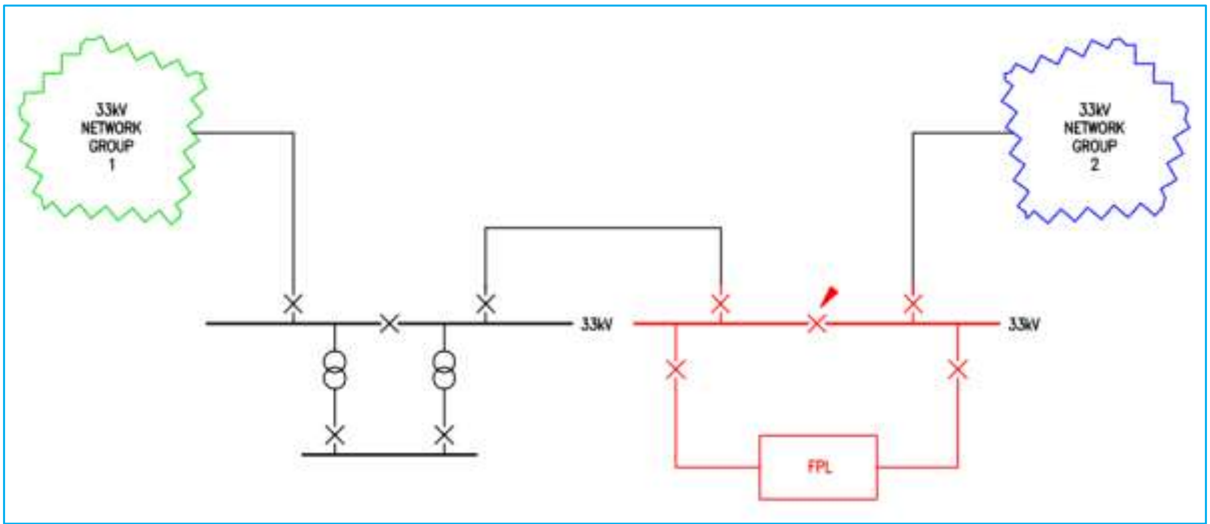


Figure 2-11: Option 1 - Proposed Network Arrangement

Option 2 – Across a Bus-Section

This option considers a switching station with a normally open bus-section. The FPL would connect across the bus-section and would require an additional two circuit breakers to facilitate this connection. The existing arrangement is shown in Figure 2-12 and the proposed arrangement is shown in Figure 2-13 below. This solution could be realised by extending the existing switchyard or replacing all the existing equipment with a new indoor solution.

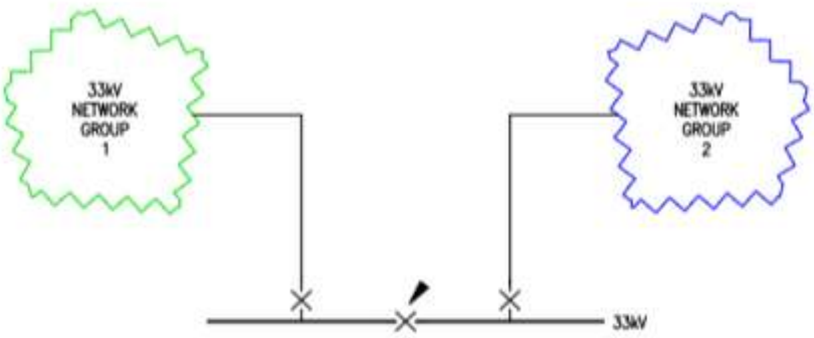


Figure 2-12: Option 2 - Existing Network Arrangement

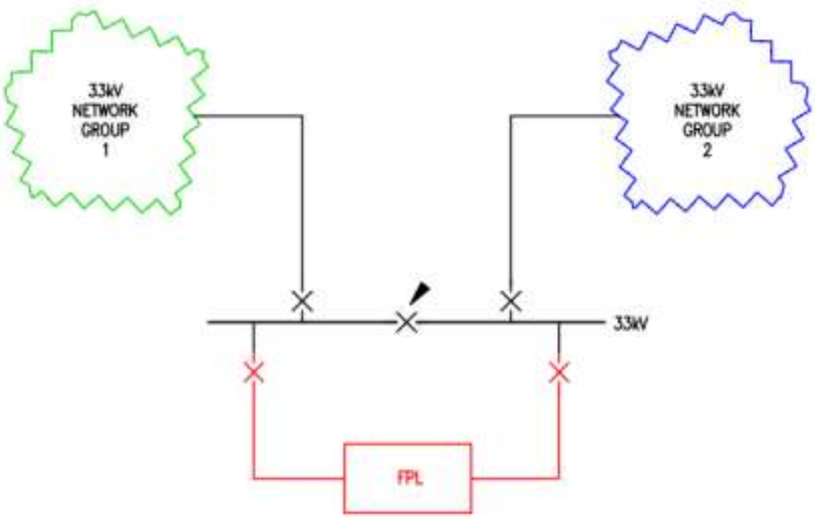


Figure 2-13: Option 2 - Across Existing Bus-Section Circuit Breaker

Option 3 – Network Mesh

This option considers a switching station that connects three network groups. The existing arrangement is shown in Figure 2-14. The FPL would be connected as per the arrangement shown in Figure 2-15 and require a new seven panel switchboard. This configuration would allow the FPL to transfer power to/from any combination of network groups.

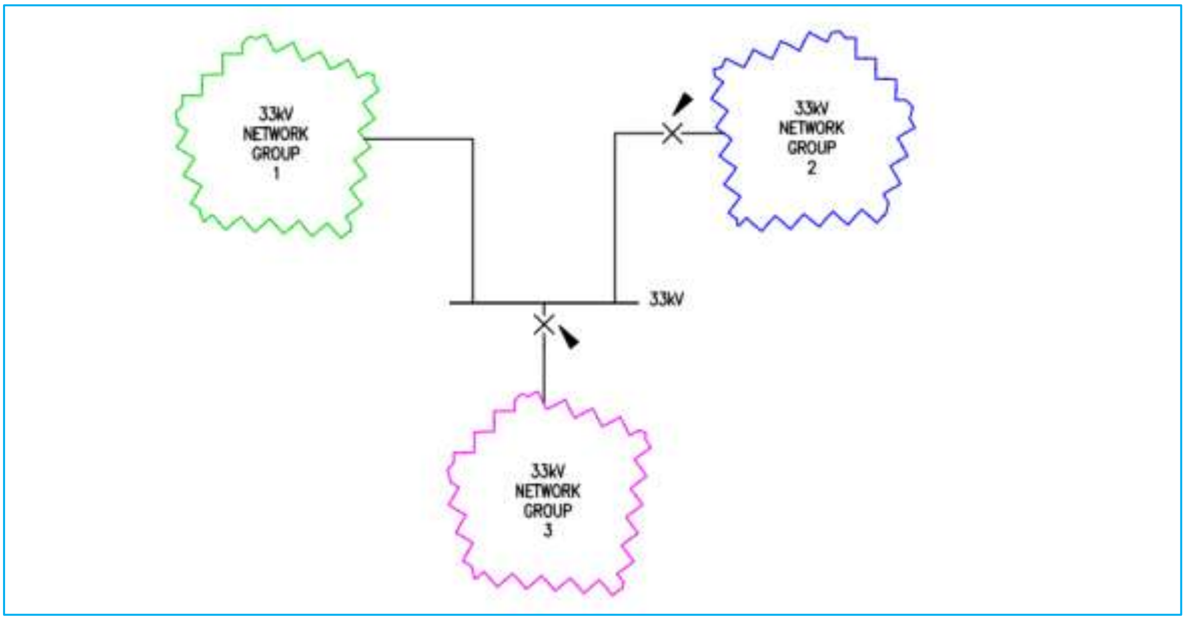


Figure 2-14: Option 3 - Existing Network Arrangement

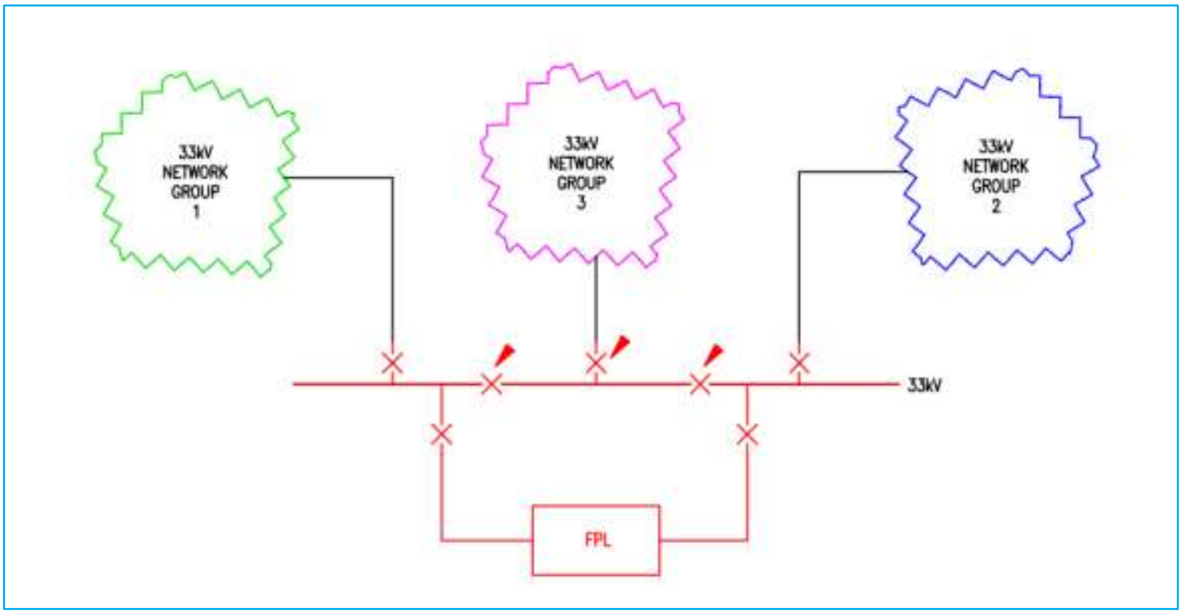


Figure 2-15: Option 3 - Proposed Network Arrangement

2.5.5 Network Protection

The 33kV system in the trial area consists of mainly OHL circuits using distance protection schemes. The FPL installation will require modification of the existing distance schemes to ensure that the incoming 33kV OHLs are protected. The modifications are required because the FPL can push or pull real and reactive power in both directions. This changes the effective impedance of the line as seen by the distance relay elements. Careful calculation of the new distance scheme settings will be required to ensure that the relay does not over or under reach during FPL operation.

An alternative protection methodology would be to utilise a current differential unit protection scheme on each feeder connection to the FPL site. This would require a current differential relay at each end of the feeder along with fibre optic links for communication between the local and remote relays.

2.5.6 FPL Protection Options

During this reporting period work has been undertaken to understand the options for the protection of the FPL. A traditional unit protection scheme is not viable for the protection of the FPL due to its design and operation i.e. differing power flows on either side of the device. In this case the following options would be available for the protection of the FPL:

- Overcurrent and Earth Fault (OCEF) – This scheme would apply an Inverse Definite Minimum Time (IDMT) characteristic to disconnect the FPL for faults. The operation time of the protection would be determined by the magnitude of the fault current, with the time reduced for increasing magnitudes of fault current.

- High Set Overcurrent (HSOC) – This scheme allows instantaneous disconnection of the FPL when the fault current exceeds a threshold setting (approx. 125% - 150% of the rated continuous current of the FPL).

- Loss of Mains Protection – This scheme monitors CT and VT inputs to establish if the network surrounding the device has healthy voltage and frequency. The scheme operates if the voltage drops or a rate of change of frequency occurs.

All protection options will operate both FPL feeder circuit breakers to isolate the device from the network.

2.5.7 Substation Selection

One of the key decisions taken during this reporting period was determining the optimum location of the FPL. The site was selected following the implementation of the substation selection process. The process involved the following steps:

Initial Selection of Candidate Sites

The initial selection of sites was carried out by determining the number of NOPs that are within Network Equilibrium's designated project area and would also connect different GSPs on the 33kV network if they were closed. Each possible FPL integration site and the BSPs that would be connected are detailed in Table 2-6.

Table 2-6: Initial FPL Site Locations

BSPs	Current Normal Open Point	Proposed FPL Location
Barnstaple – Taunton	South Molton	South Molton
		Exebridge
		Quartley Switching Station
Bridgwater – Woodcote	ABSD middle of Feeder	ABSD middle of Feeder
Tiverton – Taunton	Tiverton Moorhayes	Quartley Switching Station
		Tiverton Moorhayes
	Burlescombe	Burlescombe
Exeter City – Tawton	Winslakefoot Switching Station	Winslakefoot Switching Station
Exeter City – Barnstaple	Lapford	Lapford

Shortlist of Candidate Sites

A shortlist of candidate sites was generated from the initial list. This was done by undertaking a desktop study to determine the power transfer capability of the BSP interconnection and the physical size of each substation. The Bridgewater – Woodcote and Exeter – Barnstaple connections were discounted because of the low power transfer capability. Further analysis of the space available at each of the sites also ruled out Burlescombe and South Molton.

The shortlist of candidate sites is shown below in Table 2-7.

Table 2-7: Final FPL Site Locations

Site	BSPs to be Connected
Exebridge Substation	Barnstaple – Taunton
Quartley Switching Station	Barnstaple – Taunton; or Tiverton – Taunton
Tiverton Moorhayes Substation	Tiverton – Taunton
Winslakefoot Switching Station	Exeter City – Tawton

Selection Criteria

A number of additional criteria were applied to the shortlisted sites. These were as follows:

- Availability of Space: What space is currently available and what space could be made available via changes to the existing equipment arrangement;
- Network Connection: How can the connection of the FPL be realised? Can the existing equipment be utilised and if not, how extensive are the works;
- Substation Access: Is there suitable access and space within the substation for manoeuvring and offloading of equipment? Are there any obstructions on potential delivery routes; and
- Customer Impact: What customers may be affected by the closure of the NOP?

A weighting was assigned to each of the selection criteria so that an overall score could be calculated for each of the shortlisted sites.

Table 2-8: Site Selection Weightings

Area	Weighting
Availability of space	50%
Network Connection	30%
Substation Access	10%
Customer Impact	10%

Final Decision

The substations were ranked based on the scores shown in the Table 2-9 below.

Table 2-9: Overall Scores for each Shortlisted Candidate Site

Site	Score (%)
Exebridge Substation	86.7
Tiverton Moorhayes Substation	62.5
Winslakefoot Switching Station	55
Quartley Switching Station	40.8

Exebridge 33/11kV substation was found to have the best overall score and this site has been selected for the installation of the FPL.

2.5.8 Exebridge 33/11kV Substation

Significant work has been undertaken to determine the works that are required to facilitate the connection of the FPL at Exebridge.

Existing Site

Exebridge 33/11kV substation is fed from Taunton Main BSP and is a part of the Bridgewater-Seabank-Taunton interconnected 33kV network group. The 33kV network at Exebridge is normally supplied from Taunton via Quartley switching station. The alternative 33kV supply to Exebridge is from Barnstaple BSP. This alternative connection can be energised by closing the NOP at South Molton 33/11kV substation (Barnstable side). The SLD of Exebridge substation prior to the installation of the FPL is shown in Figure 2-16.

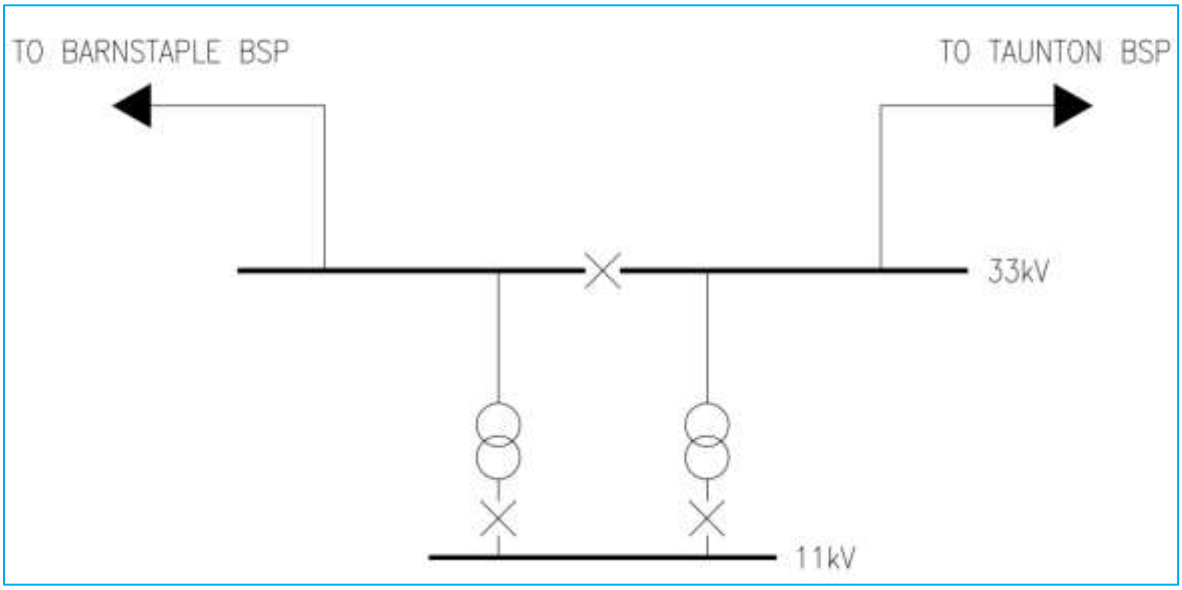


Figure 2-16: Exebridge 33/11kV Single Line Diagram Prior to FPL Installation

The 33kV compound is made up of a six bay Air Insulated Switchboard (AIS) with a single 33kV bus-section circuit breaker. Of the six bays, two are utilised by the incoming 33kV overhead line supplies and two by connections to 33/11kV Primary Transformers. The remaining bays are currently spare.

Proposed Connection

Due to Exebridge having transformers either side of the existing bus section, the FPL had to be located on the OHL circuit from Exebridge to South Molton. Therefore Option 1 “Within a normally open 33kV interconnector” was chosen for connection of the FPL. The proposed connection for the FPL at Exebridge substation is shown in Figure 2-17.

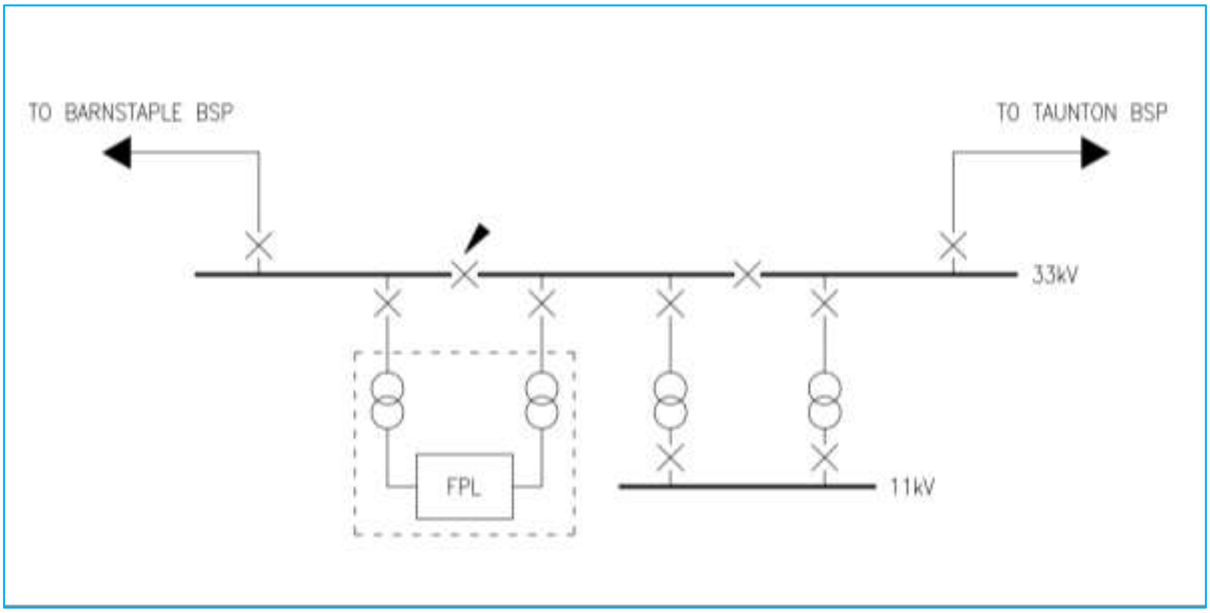


Figure 2-17: Exebridge 33/11kV Single Line Diagram following FPL Installation

Equipment Requirements

In order to integrate the FPL into the Exebridge site a new indoor 8-panel 33kV switchboard will be installed as shown in a Figure 2-17 and will be housed in a containerised solution. The switchboard includes circuit breakers to allow migration of the primary substation feeder circuits and the OHL circuits from Exebridge to Taunton/Barnstaple. The requirements for the new circuit breakers are listed in Table 2-10 below:

Table 2-10: New circuit breaker requirements

CB Type	36DA/ID	36TA3	36BA/ID	36MA1/ID
Number of Panels	2	2	2	2
Function	Primary substation outgoing feeder with distance protection	Primary substation outgoing T/F feeder with local intertripping	Primary substation bus section	Primary substation outgoing metering circuit breaker for FPL connection
Rated Voltage	36kV	36kV	36kV	36kV
Number of Phases	3	3	3	3
CB Rating (cont.)	1250A	1250A	1250A	1250A
Rated short-time withstand	25kA	25kA	25kA	25kA
Cable box	3 x 1c (up to 400mm^2) & 3 x 1ph surge arresters	3 x 1c (up to 400mm^2) & 3 x 1ph surge arresters	3 x 1c (up to 400mm^2) & 3 x 1ph surge arresters	3 x 1c (up to 400mm^2) & 3 x 1ph surge arresters
Cable entry	Bottom	Bottom	-	Bottom

Figure 2-18- Proposed location of FPL

Protection

Protection on all panels except the FPL feeders will be as per standard WPD protection philosophy. This is currently distance protection on the two OHL feeders, HV restricted earth fault protection on the two transformer feeders and overcurrent on the bus section breakers. The new 33kV switchboard will also come equipped with high impedance busbar protection as per current WPD standards.

The FPL switchgear panels will utilise all three protection options specified in Section 2.5.6:

1. High set overcurrent;
2. Loss of mains protection; and
3. Backup overcurrent earth fault protection.

The existing distance protection at the 33kV remote ends (incoming feed from Quartley/Taunton and the outgoing feed to South Molton/Barnstaple) will require modification due to the integration of the FPL device.

Auxiliary Systems

The new containerised switch house will require new LVAC, 110V DC and 48V DC supplies. The LVAC supply will be provided from two new ground mounted 11kV/415V transformers within the substation boundary. The new LVAC distribution board will have auto changeover functionality between dual redundant LV Supplies.

The new LVAC will supply new 110V and 48V battery chargers which will be located in the new switch house. Standing and momentary 110V and 48V DC loads on the new switchgear (including protection) will be determined by the switchgear manufacturer.

The LVAC supplies will be metered as per existing WPD standards. The metering panel will be installed adjacent to the new 33kV switch house.

Telecommunications

All control and indication signals from the new equipment shall be integrated into a new D400 RTU to be installed in the new switch house.

A full I/O list and multi-core schedule shall be developed to include:

- Standard I/O and telecontrol for 33kV switchgear and protection relays;
- Standard I/O for auxiliary systems (LVAC, 110V DC and 48V DC); and
- FPL specific I/O and telecontrol (manufacturer to advise).

Surf Telecom shall be responsible for integration of the new equipment into the existing SCADA system.

The D400 will also have the capability to interface with the FPL control system over DNP3. This connection is utilised for the issue of P and Q set points to the FPL from the Siemens Spectrum 5 unit. The DNP3 connection will also allow FPL control system data to be communicated to the manufacturer if this is required as part of the Contract.

33kV Compound Modifications

To integrate the new FPL and the associated containerised switch house at Exebridge a number of modifications are required to the existing substation. These are as follows:

- Decommissioning and removal of the existing 33kV AIS busbars and circuit breaker;
- Migrate the OHL to South Molton and the 33/11kV Transformer No. 2 feeder circuits;
- Migrate the OHL to Taunton and the 33/11kV Transformer No. 1 feeder circuits; and
- Install foundation structures and cable routes for the FPL and its auxiliary equipment.

Figure 2-19 shows a layout of the existing site at Exebridge. The proposed layout showing the position of the new equipment is shown in Figure 2-20.

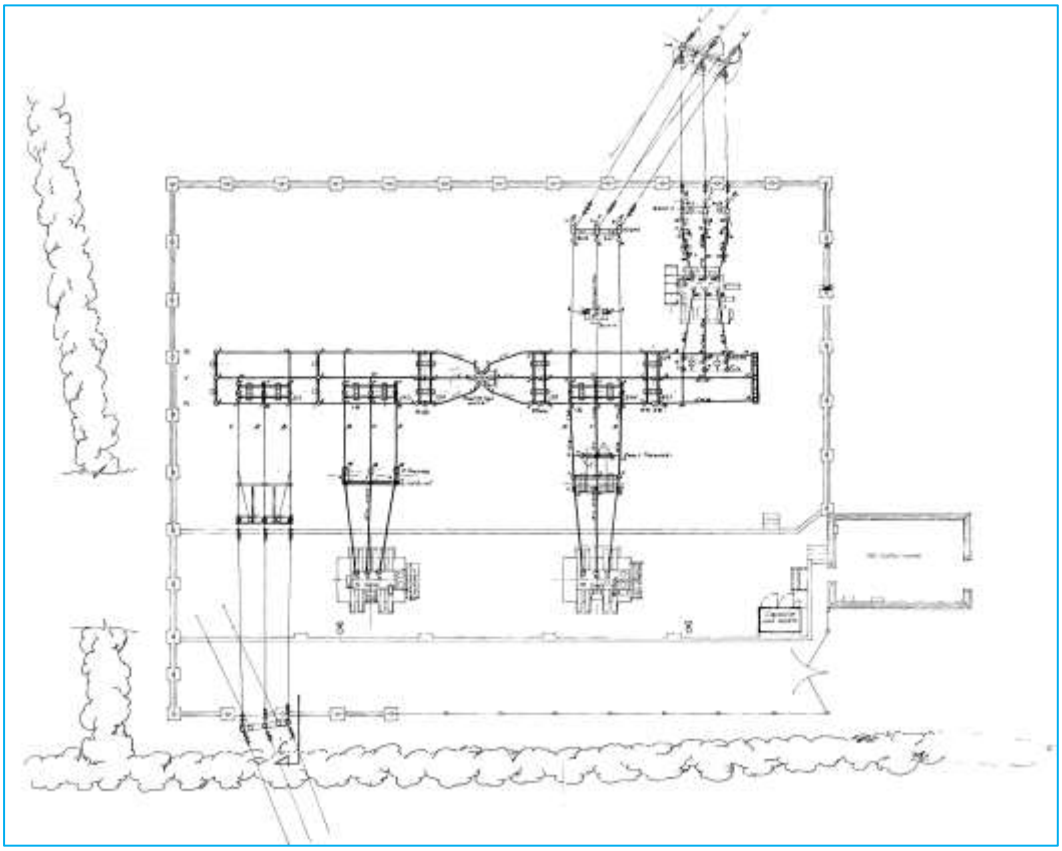


Figure 2-19: Existing Exebridge Site Layout

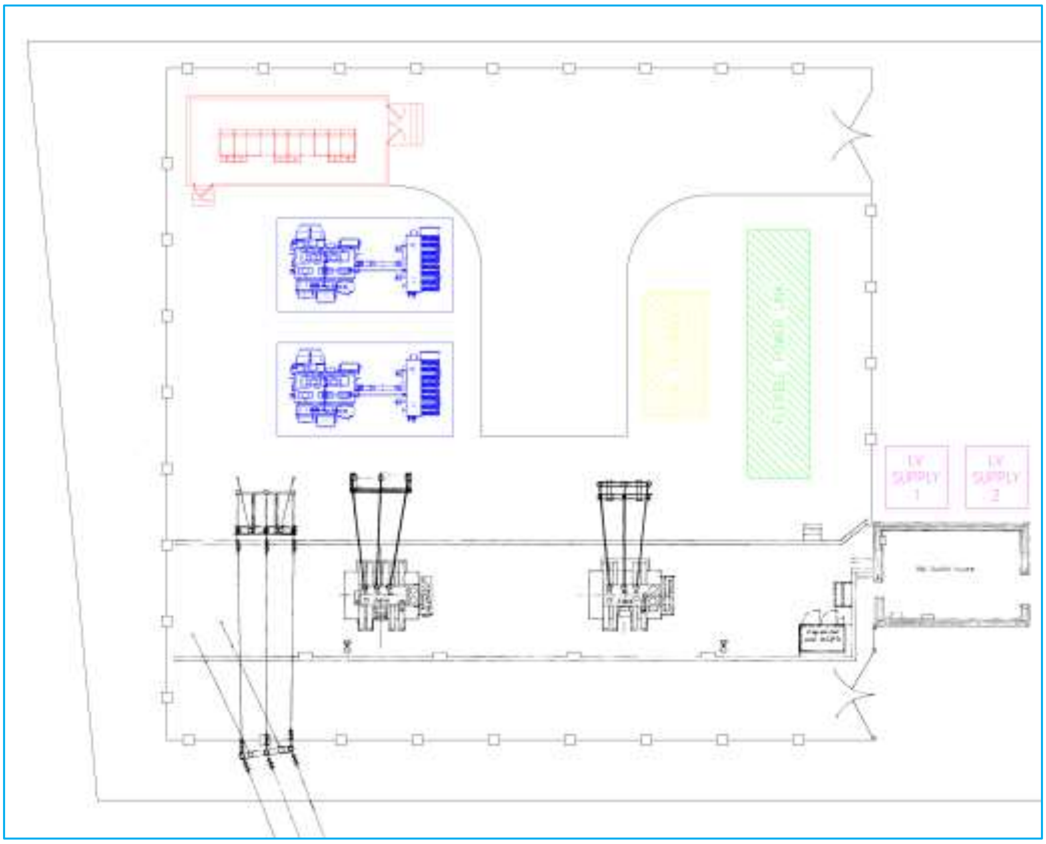


Figure 2-20: Proposed FPL and Switch House Layout for Exebridge

2.5.9 Harmonics

A key consideration associated with the connection of a power electronic switching device is the harmonic output of the device. The FPL utilises banks of power electronic switches operating at a high frequency to convert power from AC-DC and DC to AC. This process leads to harmonic content being produced on the incoming AC network and also inserted in the output AC current waveform.

In this reporting period detailed background harmonic network data has been collected and analysed for the Network Equilibrium project area. A power system study has been undertaken to calculate the harmonic content present on the network with the FPL connected at Exebridge substation. This analysis has shown that filters will be required on both sides of the FPL device to keep the harmonic content within the planning limits. The filters are to be provided by the FPL manufacturer.

The planning limits for network harmonic content are defined in the Energy Network's Association's (ENA) Engineering Recommendation G5/4-1.

3 Business Case Update

There is no change to the business case. The business case to further facilitate the connection of low carbon loads and generation in the project area, on both the 11kV and 33kV are still applicable.

4 Progress against Budget

	Total Budget	Expected Spend to Date May 2016	Actual Expenditure to date	Variance £	Variance %
Labour	**1262**	**305**	**287**	**-18**	**-6%**
WPD Project Management & Programme office	510	195	184	-11	-6%
Project Kick Off & Partner / Supplier Selection	33	33	33	0	0%
Detailed design & modelling	101	75	68	-7	-9%
Installation of Equipment - 11kV & 33kV	390	0	0	0	0%
FPL Technologies - Substation Installation 33kV	141	0	0	0	0%
Capture, analyse & verify data for EVA, SVO & FPL	58	0	0	0	0%
Dissemination of lessons learnt	29	2	2	0	-1%
Equipment	**6691**	**2**	**2**	**0**	**0%**
Project Kick Off & Partner / Supplier Selection	2	2	2	0	0%
Procurement of SVO Equipment	1540	0	0	0	0%
Procurement of FPL Technologies 33kV	4550	0	0	0	0%
FPL Technologies - Substation equipment 33kV	599	0	0	0	0%
Contractors	**3339**	**378**	**380**	**2**	**1%**
Detailed design & modelling	804	340	345	5	2%
Delivery of SVO Technique - 11kV & 33kV	392	0	0	0	0%
Installation of Equipment - 11kV & 33kV	850	0	0	0	0%
Implementation of Solution	46	18	16	-1	-9%
Implementation of Solution	139	0	0	0	0%
FPL Technologies - Substation Installation 33kV	540	0	0	0	0%
Capture, analyse & verify data for EVA, SVO & FPL	445	0	0	0	0%
Dissemination of lessons learnt	123	20	19	-1	-7%

IT	**396**	**35**	**35**	**0**	**-1%**
1. WPD - Advanced Network Modelling and Data Recovery	130	20	19	-1	-6%
1. WPD - Procurement of SVO Equipment	60	0	0	0	0%
Installation of Equipment - 11kV & 33kV	60	0	0	0	0%
6. WPD - Implementation of Solution	46	15	16	1	7%
FPL Technologies - Substation Installation 33kV	100	0	0	0	0%
Travel & Expenses	**159**	**40**	**36**	**-4**	**-9%**
Travel & Expenses	**159**	**40**	**36**	**-4**	**-9%**
Contingency	**1190**	**0**	**0**	**0**	**0%**
Contingency	**1190**	**0**	**0**	**0**	**0%**
Other	**53**	**4**	**3**	**0**	**-4%**
Other	**53**	**4**	**3**	**0**	**-4%**
TOTAL	**13091**	**763**	**743**	**-20**	**-3%**

5 Successful Delivery Reward Criteria (SDRC)

During this third reporting period three SDRCs were completed:

- SDRC-1 – Detailed design of the Enhanced Voltage Assessment (EVA) Method;
- SDRC-2 – Detailed design of the System Voltage Optimisation (SVO) Method; and
- SDRC-3 – Detailed design of the Flexible Power Link (FPL) Method.

All three completed SDRCs are available on WPD's innovation website.

5.1 Future SDRCs

Table 5-1 captures the remaining SDRCs for completion during the project life cycle.

Table 5-1 - SDRCs to be completed

SDRC	Status	Due Date	Comments
4 - Trialling and demonstrating the EVA Method	Green	27/01/2017	On track
5 - Trialling and demonstrating the SVO Method	Green	20/04/2018	On track
6 - Trialling and demonstrating the FPL Method	Green	05/10/2018	On track
7 - Trialling and demonstrating the integration of the EVA, SVO and FPL Methods	Green	28/12/2018	On track
8 - Knowledge capture and dissemination	Green	12/04/2019	On track

Status Key:	
Red	Major issues – unlikely to be completed by due date
Amber	Minor issues – expected to be completed by due date
Green	On track – expected to be completed by due date

6 Learning Outcomes

Learning outcomes have been detailed in all three SDRCs submitted and approved to date (SDRC1-3).

SDRC-1, Detailed Design of the Enhanced Voltage Assessment Method, provided valuable learning on the Voltage Limits Assessment work package and the design of the Advanced Planning Tool. The various activities completed as part of VLA such as the stakeholder engagement, equipment specification investigations, literature reviews and system studies offered new learning on the rationale behind the UK statutory voltage limits and step change limits and the possibility of their amendment. The design of the Advance Planning Tool generated knowledge on the statistical analysis required for the creation of forecast and typical generation and demand profiles.

Significant learning has been generated through the production of SDRCs 2 and 3, specifically relating to the detailed design of the SVO and FPL methods. Key learning regarding the on-site activities required, focussing on the necessary relay changes required for the successful operation of the SVO method and the site design and protection philosophy to be employed to enable the 33kV FPL to successfully operate.

7 Intellectual Property Rights

A complete list of all background IPR from all project partners has been compiled. The IP register is reviewed on a quarterly basis.

No relevant foreground IP has been identified and recorded in this reporting period.

8 Risk Management

Our risk management objectives are to:

- Ensure that risk management is clearly and consistently integrated into the project management activities and evidenced through the project documentation;
- Comply with WPDs risk management processes and any governance requirements as specified by Ofgem; and
- Anticipate and respond to changing project requirements.

These objectives will be achieved by:

- ✓ Defining the roles, responsibilities and reporting lines within the Project Delivery Team for risk management
- ✓ Including risk management issues when writing reports and considering decisions
- ✓ Maintaining a risk register
- ✓ Communicating risks and ensuring suitable training and supervision is provided
- ✓ Preparing mitigation action plans
- ✓ Preparing contingency action plans
- ✓ Monitoring and updating of risks and the risk controls.

8.1 Current Risks

The Network Equilibrium risk register is a live document and is updated regularly. There are currently 53 live project related risks. Mitigation action plans are identified when raising a risk and the appropriate steps then taken to ensure risks do not become issues wherever possible. In Table 8-1, we give details of our top five current risks by category. For each of these risks, a mitigation action plan has been identified and the progress of these are tracked and reported.

Table 8-1 - Top five current risks (by rating)

Details of the Risk	Risk Rating	Mitigation Action Plan	Progress
Development of SVO/FPL control system is delayed due to Siemens developing both FPL control system and SVO.	Major	Ensuring appropriate resource is provided for each of the elements of Siemens development activities	Two separate streams of work have been identified with key engineering teams provided
Project cost of high cost items are significantly higher than expected	Major	Ensure the requirements of each high cost item is understood and ensure competitive tenders are carried out	All key items have been tendered. Risks remain about cost growth based on developing requirements throughout the project
Terms and conditions cannot be agreed with suppliers	Major	Clear provision of acceptable terms and conditions to be provided at the contract tender stage	Current issues with the FPL manufacturer in terms of ensuring the terms of the contract can be agreed
Network topology data cannot be incorporated within the SVO	Major	Early engagement with SVO supplier to ensure an agreed format can be identified	Discussions are currently in place to understand the topology data requirements as well as in-depth data gathering activities
Technologies/Solutions do not deliver the anticipated network benefits by unlocking capacity	Moderate	Provision of technical requirements provided to each supplier with clear project specific requirements	Work is being undertaken as part of SDRC-4 to model the expected capacity benefits

Table 8-2 provides a snapshot of the risk register, detailed graphically, to provide an on-going understanding of the projects' risks.

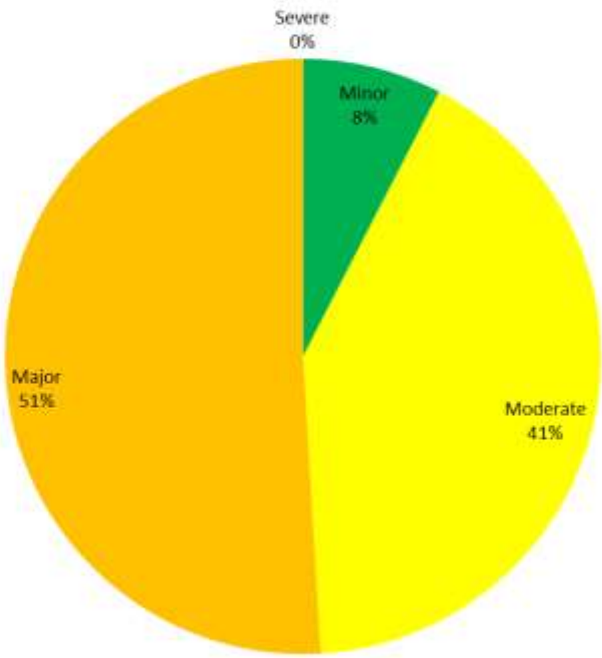
Table 8-2 - Graphical view of Risk Register

Likelihood = Probability x Proximity						
	Certain/Imminent (21-25)	0	0	0	0	0
	More likely to occur than not/Likely to be near future (16-20)	0	0	0	0	0
	50/50 chance of occuring/ Mid to short term (11-15)	0	1	4	7	0
	Less likely to occur/Mid to long term (6-10)	1	0	14	13	3
	Very unlikely to occur/Far in the future (1-5)	0	1	2	5	2
		1. Insignificant changes, re-planning may be required	2. Small Delay, small increased cost but absorbable	3. Delay, increased cost in excess of tolerance	4. Substantial Delay, key deliverables not met, significant increase in time/cost	5. Inability to deliver, business case/objective not viable
		Impact				

	Minor	Moderate	Major	Severe	
Legend	4	22	27	0	**No of instances**
Total	53				No of live risks

Table 8-3 provides an overview of the risks by category, minor, moderate, major and severe. This information is used to understand the complete risk level of FlexDGrid.

Table 8-3 - Percentage of Risk by category



8.2 Update for risks previously identified

Descriptions of the most significant risks, identified in the previous six monthly progress report are provided in Table 8-4 with updates on their current risk status.

Table 8-4 - Risks identified in the previous progress report

Details of the Risk	Previous Risk Rating	Current Risk Rating	Mitigation Action Plan	Progress
Project cost of high cost items are significantly higher than expected	Major	Moderate	Ensure that all new technology items are competitively tendered and other high cost items are procured using WPD's standard process	The SVO contract is signed and the FPL cost is well understood
Land acquisition and planning permission delays the installation of the Flexible Power Link	Major	Moderate	Early engagement with the Wayleaves team, selecting multiple sites where the risk is reduced and selecting a main and back-up site	The site for FPL has been selected and the associated wayleaves activities are well underway
Selected sites for technology installations become unavailable	Major	Moderate	Redundant sites will be identified and designed so that technologies can be included in these if required	Three FPL sites were identified and 22 SVO installation sites
FPL's are larger than originally Identified and are not suitable for installation	Major	Moderate	Maximum dimensions provided by manufacturers has been used to select suitable sites	The FPL dimensions are understood and is suitable for installation in the chosen substation
Integration of SVO algorithm in to existing WPD systems is unachievable	Major	Major	Ensure that in the tender it is explicit that the SVO algorithm must interface to WPD's existing system, NMS manager engaged pre ITT to ensure they are happy with the ITT to offer suggestions to alleviate issues	SVO contract has been signed and initial work to develop the system is underway, however, to date no integration activities have been carried out

Descriptions of the most prominent risks, identified at the project bid phase, are provided in Table 8-5 with updates on their current risk status.

Table 8-5 - Risks identified at the Bid Phase

Risk	Previous Risk Rating	Current Risk Rating	Comments
Project team does not have the knowledge required to deliver the project	Major	Minor	A Technical Lead role has now been appointed for the project and a contract has been signed with WSP|PB to provide specialist engineering resource to successfully deliver the project
No SVO available from the contracted supplier	Major	Closed	The SVO system procurement activity is now complete
Project cost of high cost items are significantly higher than expected	Major	Major	Key deliverables and technologies are now well understood along with their costs. Constant monitoring of costs against progress and budget with continue throughout the project
No FPL available from the contracted supplier	Major	Moderate	An FPL supplier has been identified and is pro-actively working towards contract signature
Selected sites for technology installations become unavailable	Major	Moderate	Significant design work has now been completed and the site owners have been involved to ensure their suitability and availability

9 Consistency with Full Submission

During this reporting period a core team of both WPD and WSP|PB engineers has been formed, which has and will continue to ensure that there will be consistency and robust capturing of learning moving forwards. This has ensured that the information provided at the full submission stage is still consistent with the work being undertaken in the project phase.

The scale of the project has remained consistent for all three methods:

- **EVA** – Develop and demonstrate an Advanced Planning and Operational tool for 33kV and 11kV networks;
- **SVO** – Install and trial advanced voltage control schemes at 16 substations; and
- **FPL** – Install and trial a Flexible Power Link at a 33kV substation.

10 Accuracy Assurance Statement

This report has been prepared by the Equilibrium Project Manager (Jonathan Berry), reviewed by the Future Networks Manager (Roger Hey), recommended by the Network Strategy and Innovation Manager (Nigel Turvey) and approved by the Operations Director (Philip Swift).

All efforts have been made to ensure that the information contained within this report is accurate. WPD confirms that this report has been produced, reviewed and approved following our quality assurance process for external documents and reports.