WESTERN POWER DISTRIBUTION

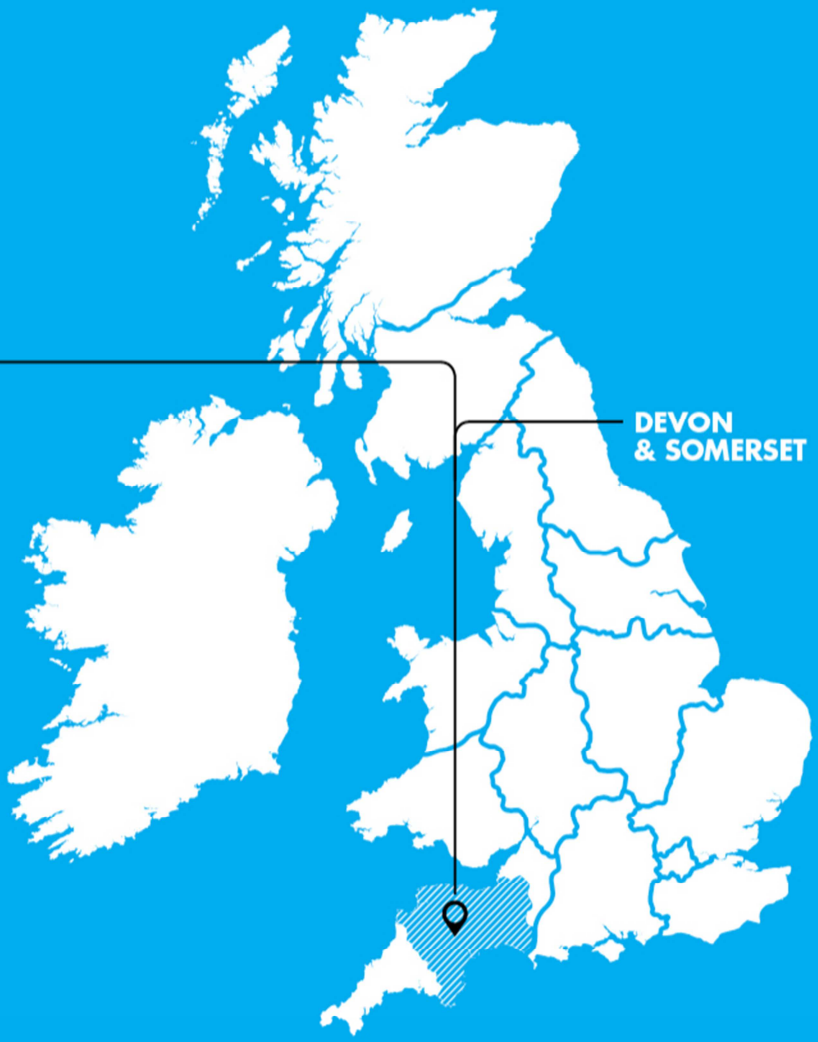
NETWORK EQUILIBRIUM

BALANCING GENERATION AND DEMAND

PROJECT PROGRESS REPORT

REPORTING PERIOD:

December 2014 – May 2015



LCN Fund
Low Carbon Networks

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Contents

Glossary

Term	Definition
AVC	Automatic Voltage Control
DG	Distributed Generation
DMS	Distribution Network Management
FPL	Flexible Power Link
ITT	Invited to Tender
PQQ	Pre-Qualification Questionnaires
SDRC	Successful Delivery Reward Criteria
SVO	System Voltage Optimisation
TSDS	Timed Series Data Store

1 Executive Summary

The Network Equilibrium project is funded through Ofgem's Low Carbon networks Second Tier funding mechanism. Network Equilibrium commenced in March 2015 and will be complete by 14th June 2019. Network Equilibrium is balancing network voltages and power flows across the South West.

This report details progress of Network Equilibrium, focusing on the start of the project, December 2014 to May 2015.

1.1 Business Case

Network Equilibrium will demonstrate how the project methods Advanced Planning Tool, System Voltage Optimisation and Flexible Power Link will unlock additional capacity within distribution networks more cost effectively than the conventional methods.

As of May 2015, the project Business Case has not altered.

1.2 Project Progress

This is the first reporting period for Network Equilibrium. During this reporting period (December 2014 – May 2015) Network Equilibrium project started in March 2015 and is following the project plan. The project is in the mobilisation phase, the principal project manager has been appointed.

1.3 Project Delivery Structure

1.3.1 Project Review Group

The Network Equilibrium Project Review Group was appointed and met once after the award of Network Equilibrium and before the project started. The project board members were all stakeholders in the Network Equilibrium bid.

1.3.2 Resourcing

In March 2015, the project recruited a person to run the programme office and lead the project Knowledge Capture and Dissemination activities. The project is in the process of recruiting two additional positions to support the delivery of the project.

The project has contracted Nortech Ltd to support and provide specialist advice to Western Power Distribution with the Network Equilibrium procurement activities.

1.3.3 Collaboration Partners

At the current stage of the project, no collaboration partners have been identified.

1.4 Procurement

The procurement process has commenced, four, Pre-Qualification Questionnaires (PQQ) were uploaded to the Achilles Vender Database and announced on the ENA Smarter Grids collaboration portal at the same time.

The responses to each PQQ's have been assessed with the highest scoring organisations select and invited to tender. An Invitation to Tenders (ITT) has been sent out for an

Advanced Planning Tool, Voltage Limits Assessment, System Voltage Optimisation (SVO) and Flexible Power Link (FPL).

The responses to the Advanced Planning Tool and Voltage Limits Assessment tenders have been assessed and a number of organisations have been invited to Post Tender Negotiations.

1.5 Installation

The project is in the mobilisation phase and will not proceed to installation until January 2016.

1.6 Project Risks

The Project Manager takes a proactive role in ensuring effective risk management for Network Equilibrium. He 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 has changed, and report significant changes which adjust risk priorities and deliver assurance of the effectiveness of control.

Contained within Section 8 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 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.

During this reporting period we have identified the most relevant learning opportunities and approached UKPN to discuss Flexible Plug and Play. We have shared our early learning from Network Equilibrium through a meeting with Scottish Power Distribution's Future Networks Team and captured as much learning from the Northern Power Grid CLNR project team and discussed the project scope in detail.

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.

Table 1-1 - Contribution to knowledge sharing events hosted by other organisations

Event Title	Date	Host	Contribution
Sharing the insights of Flexible Plug and Play - UKPN	05/03/2015	UKPN	Attendee
CLASS webinar	26/03/2015	ENW	Attendee
System Operability Framework (SOF) Industry Workshop	09/04/2015	National Grid	Attendee
Modular Approach to Substation Construction for the Network Operator - SSE	21/04/2015	SSE	Attendee

2 Project Managers Report

2.1 Project Background

The Network Equilibrium project was awarded £11.5m through Ofgem's Low Carbon Networks Second Tier funding mechanism. The project commenced in March 2015 and will be complete by 14th June 2019. Network Equilibrium is balancing voltages and power flows across the South West.

Network Equilibrium consists of an analytical study (**Voltage Limits Assessment**) and the designing and demonstrating three resilient methods (**Advanced Planning Tool, System Voltage Optimisation and Flexible Power Link**) for managing power flows and controlling voltages across the trial area, approximately a third of WPD's South West distribution network.

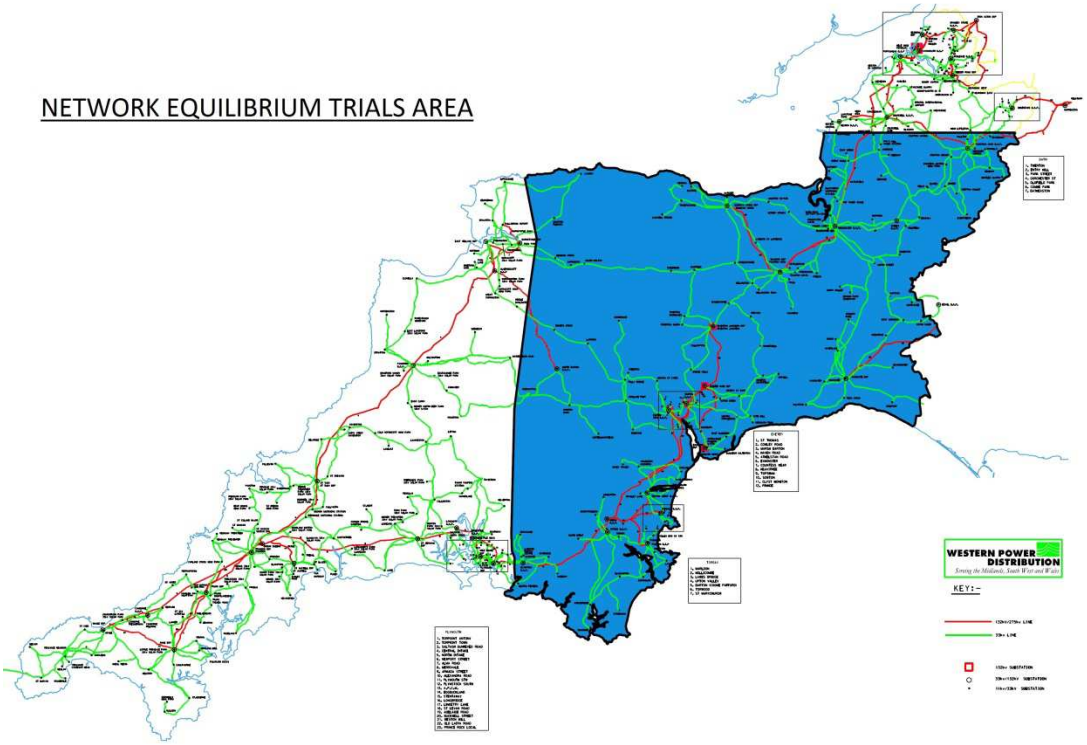


Figure 1 - Network Equilibrium Trial area across Somerset and Devon

2.1.1 EVA – Part 1, Method One – Advanced Planning Tool

Network Equilibrium will work with a supplier to deliver a scripted power system analysis tool, using historical demand and generation profile data for steady state evaluation of the 132kV, 33kV and truncated 11kV networks.

The tool will create a number of profiles for substation loads and generator exports using available historical data, weather corrected forecast profiles for demand and generators using available historical data or historical profiles. Historical and forecast profiles created by the tool will be stored in a TSDS (Time Series Data Store).

The tool will be used by Primary System Design Engineers, Operations Support Engineers and Control Engineers for proactive and reactive network modelling using profile data. This will give better information on the expected power flows and voltage profiles under both normal and abnormal network operations.

The tool will incorporate the South West 132kV network, the associated 33kV and truncated 11kV network in the trial area. The tool will also be used to evaluate and configure smart solutions including SVO, FPL, Statcoms and generation operating in reactive power control modes. The tool will quantify the available headroom, on their 11kV and 33kV networks under normal and abnormal conditions with and without the smart solutions being applied.

2.1.2 EVA – Part 2, Analytical Study – Voltage Limits Assessment

The project will conduct a theoretical investigation into whether steady state statutory voltage limits (±6%) and step change limits for the 11kV and 33kV networks could and should be amended. The study will assess the rationale for the current standards, assess if the validity of the original assumptions remains, assess if any DNO or customer equipment could limit the future amendments to voltage limits, if there is any commercial, safety or customer reasons which could limit future amendments to limits and based on the analysis, create a recommendation for future amendments to voltage limits.

It is expected that this project will create a definitive recommendation stating how the ESQCR statutory limits could be amended, how the P28 step change limits could be amended and if there any limitations which could prevent voltage limits from being changed, the further actions that would need to be taken. This is expected to be disseminated both in a report and presentation format.

2.1.3 Method Two – System Voltage Optimisation (SVO)

Network Equilibrium will work with a supplier to create an analysis and a control system and integrate this with WPD's existing centralised DMS (Distribution Network Management system) PowerOn, this has been called System Voltage Optimisation (SVO). SVO will assess the voltage impact of DG (Distributed Generation) and network demands on selected 11kV and 33kV networks, evaluate the real time and forecasted power flows available from a TSDS and the subsequent voltage profiles across the SVO substations taking into account current and plausible abnormal network running arrangements. Using this information, if a more optimum target voltage setting can be applied, it will be sent to modern microprocessor AVC (Automatic Voltage Control) relays through the existing DMS using the existing SCADA network, optimising the network voltage profiles over the substations that SVO is applied.

The SVO system must be able to compute more optimal voltage set-points for the AVC relays, on a number of substations in the trials area. The method must be robust, accounting for failures of communications channels, SVO algorithms and the DMS systems.

2.1.4 Method Three – Flexible Power Links (FPL)

Network Equilibrium requires a supplier to provide and install a back to back power electronic convertor (AC-DC-AC) which will allow power transfers across two different 33kV networks which cannot currently be connected due to a number of issues including

circulating currents, protection grading or fault level constraints. This has been called a Flexible Power Link.

The project will install and trial one 20MVA link between two 33kV networks, ideally between two different grid groups that cannot be paralleled due to circulating current issues. The FPL will allow controlled transfers of both real and reactive power flows between the two networks. The FPL will be used in conjunction with the SVO to influence the local voltage profiles, it will also control power flows between the two different BSP networks, unlocking additional capacity under both normal and abnormal network conditions.

2.2 Project Progress

Table 2-1 - Progress to date - Key Outputs and Milestones

Type	Description	Due Date	Status	Completion Date
KPI	Project Start	01/03/2015	Completed	01/03/2015
Document	Create Customer Communications and Data Protection Plan	30/06/2015	Completed	08/06/2015
Report	6 Monthly Project Report to Ofgem	June 15/16/17/18	Ongoing	
Report	Interim Major Projects Report	Sept 15/16/17/18	Not Started	
Report	6 Monthly Project Report to Ofgem	Dec 15/16/17/18	Not Started	
Report	Interim Major Projects Report	Feb 16/17/18/19	Not Started	
KPI	Workshop 1 - Amending 11kV and 33kV voltage limits	09/11/2015	Not Started	
SDRC	Delivery of a report on the detailed design of the Enhanced Voltage Assessment (EVA) Method	29/01/2016	Not Started	
SDRC	Detailed design of the System Voltage Optimisation (SVO) Method	26/02/2016	Not Started	
SDRC	Detailed design of the Flexible Power Link (FPL) Method	25/03/2016	Not Started	
KPI	Workshop 2 - Unlocking capacity using amended voltage limits	17/06/2016	Not Started	
KPI	Workshop 3 - How to implement enhanced planning tools for planning & operational purposes	09/09/2016	Not Started	
SDRC	Trialling and demonstrating the EVA Method	27/01/2017	Not Started	
KPI	Workshop 4 - Unlocking capacity using enhanced planning tools	24/02/2017	Not Started	
KPI	Workshop 5 - How to implement SVO at a system level	03/10/2017	Not Started	
KPI	Workshop 6 - Maintaining customer connections using enhanced operations tools	30/03/2018	Not Started	
SDRC	Trialling and demonstrating the SVO Method	20/04/2018	Not Started	
KPI	Workshop 8 - How to implement FPLs	20/04/2018	Not Started	
KPI	Workshop 7 - Ability to unlock capacity using SVO	04/09/2018	Not Started	

SDRC	Trialling and demonstrating the FPL method	05/10/2018	Not Started	
KPI	Workshop 9 - Ability to unlock capacity using FPLs	05/10/2018	Not Started	
SDRC	Trialling and demonstrating the integration of the EVA, SVO and FPL methods	28/12/2018	Not Started	
KPI	Workshop 10 - Implementing and unlocking capacity (generation & demand) as a combined project	15/02/2019	Not Started	
SDRC	Knowledge capture and dissemination	12/04/2019	Not Started	
KPI	Project End Date	14/06/2019	N/A	
Report	Project Closedown Report	Sep-19	N/A	

2.2.1 Progress against Project Start

During the first reporting period Dec 2014 – May 2015 Network Equilibrium has progressed through the design stage and into mobilisation. All Key Performance indicators are on track. The Principle project manager has been appointed along with a person to run the programme office and lead the project Knowledge Capture and Dissemination activities. The project is in the process of recruiting two additional positions to support the delivery of the project. The Network Equilibrium project office has been established at WPD's Pegasus office.

Tenders have been received for the SVO and FPL and once fully assessed will move quickly into to contract negotiations.

2.2.2 Progress against Customer Communications and Data Protection Plan

The customer communication and Data protection Plan is completed and has been submitted to Ofgem. Network Equilibrium has no direct interaction with customers, and as such there are no planned installations directly in customers' properties. There are no planned interruptions for installing equipment on WPD's network; however the installation work carries some minimal risks of causing customer interruptions due to a network fault. This risk has been is mitigated as part of WPD's standard return to service plan for any construction work being carried out. As part of EVA part 2 a questionnaire will be sent to DG customers requesting their opinions on potential changes to the voltage limits and if a change would have any material effect on equipment used by them. No sensitive information will be collected and the questionnaire is voluntary.

3 Business Case Update

Network Equilibrium will demonstrate how the project methods Advanced Planning Tool, System Voltage Optimisation and Flexible Power Link will unlock additional capacity within distribution networks more cost effectively than the conventional methods.

3.1.1 Network Equilibrium Post Trial method Costs

Method	Base Case Costs	Equilibrium Post-Trial costs	Financial benefit by 2030
Advanced Planning Tool	£10.2m	£0.3m	**£9.9m**
System Voltage Optimisation	£28.9m	£3.0m	**£25.9m**
Flexible Power Link	£15.0m	£5.6m	**£9.4m**

3.1.2 Network Equilibrium Post Trial capacity released

The Advanced Planning Tool Method could release up to **81 MW** of capacity for DG connections in the Trial area. This capacity could be released at least **24 months more quickly** than the most efficient method currently in operation on the GB distribution system.

The System Voltage Optimisation (SVO) Method could release up to **195 MW** of capacity for DG connections in the Trial area. This capacity could be released at least **18 months more quickly** than the most efficient method currently in operation on the GB distribution system.

The Flexible Power Link (FPL) Method could release up to **36 MW** of capacity for DG connections based in the Trials area. This capacity could be released at least **12 months more quickly** than the most efficient method currently in operation on the GB distribution system.

As of April 2015, the majority of new DG connections within the South West are subject to a 3-6 year delay whilst a 132kV thermal restriction between Bridgwater and Seabank is alleviated. This restriction does not change the business case of the project due to the nested constraints at both 11kV and 33kV restricting further connections to these networks across the trials areas. The business case will continue to be evaluated throughout the project.

4 Progress against Budget

The project is being delivered within the expected timescales and within the allowable budget.

Table 4-1 - Progress against budget

	Total Budget £k	Expected spend to date May 2014 £K	Actual Spend to date £k	Variance £k over period	Variance % over period
Labour	**1262**	**31**	**24**	**-8**	**-25%**
WPD Project Management & Programme office	510	20	19	-1	-5%
Project Kick Off & Partner / Supplier Selection	33	12	5	-7	-58%
Detailed design & modelling	101	0	0	0	0%
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	0	0	0	0%
Equipment	**6691**	**0**	**0**	**0**	**0%**
Project Kick Off & Partner / Supplier Selection	2	0	0	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**	**0**	**0**	**0**	**0%**
Detailed design & modelling	804	0	0	0	0%
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	0	0	0	0%
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	0	0	0	0%
IT	**396**	**0**	**0**	**0**	**0%**
1. WPD - Advanced Network Modelling and Data Recovery	130	0	0	0	0%
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	0	0	0	0%
FPL Technologies - Substation Installation 33kV	100	0	0	0	0%

IPR Costs	0	0	0	0	0%
Travel & Expenses	159	0	0	0	0%
Contingency	1190	0	0	0	0%
Decommissioning	0	0	0	0	0%
Other	53	0	0	0	0%
Total	13091	31	24	-8	-25%

5 Successful Delivery Reward Criteria (SDRC)

The project was not due to complete any SDRC's within this reporting period.

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
Detailed design of the Enhanced Voltage Assessment (EVA) Method	Green	29/01/2016	This EVA method, both Advanced Planning tool and Voltage Limits Assessment, are currently being tendered and the project remains on track to deliver against this SDRC
Detailed design of the System Voltage Optimisation (SVO) Method	Green	26/02/2016	The SVO is currently being tendered and the project remains on track to deliver against this SDRC
Detailed design of the Flexible Power Link (FPL) Method;	Green	25/03/2016	The FPL is currently being tendered and the project remains on track to deliver against this SDRC
Trialling and demonstrating the EVA Method;	Green	27/01/2017	The project remains on track to deliver against this SDRC
Trialling and demonstrating the SVO Method;	Green	20/04/2018	The project remains on track to deliver against this SDRC
Trialling and demonstrating the FPL Method;	Green	5/10/2018	The project remains on track to deliver against this SDRC
Trialling and demonstrating the integration of the EVA, SVO and FPL Methods	Green	28/12/2018	The project remains on track to deliver against this SDRC
Knowledge capture and dissemination;	Green	12/04/2019	The Knowledge Capture activities have already commenced

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

At this stage of the project, no formal learning outcomes have been published.

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
- ✓ regular 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 33 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)

Risk	Risk Rating	Mitigation Action Plan	Progress
Suitable project team cannot be recruited	Severe	1. As a temporary measure, use a specialist procurement organisation to support the project mobilisation. 2. Work with the recruitment company to further hone the job description 3. Engagement with senior stakeholders to look for alternative options to create a project team, 4. Use contractors for an extended period / the entire project.	Mitigation action plan 1, 2 & 3 have been enacted. If no suitable alternative options were available as of 1/07/2015, the project team will tender for contractors to support the entire project.
Project cost of high cost items are significantly higher than expected	Major	During bid process RFIs were issued to understand the cost of these items Use the lessons learnt from BAU and other LCNF projects where appropriate	This risk still applies until after the project can procure the key goods and services.
FPL manufacturers have underestimated the costs in the RFIs	Major	A suitable cost for the devices is used in the bid, i.e. not the cheapest Clear scope, include stop / go after ITT process if costs are unreasonable.	The FPL procurement activity is ongoing with 14 confirming they can meet the project scope at the PQQ stage.
Selected sites for technology installations become unavailable	Major	Redundant sites will be identified and designed so that technologies can be included in these if required	This risk applies until the site selection is complete. The project continues to work with the local delivery teams to identify appropriate demonstration sites.
No SVO available from the contracted supplier	Major	Issue a RFI to the industry to ensure multiple SVO solutions exist Engage with key experts to ensure the requirements are achievable	The SVO procurement activity is ongoing with 14 confirming they can meet the project scope at the PQQ stage. 7 companies have been invited to tender their solutions

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

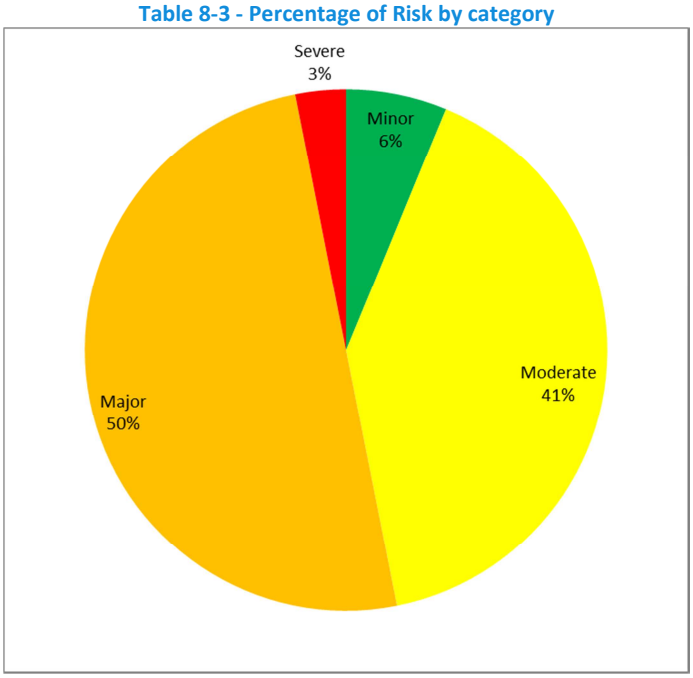
Table 8-2 - Graphical view of Risk Register

Likelihood = Probability x Proximity	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
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	1	0
50/50 chance of occuring/ Mid to short term (11-15)	0	2	1	2	0
Less likely to occur/Mid to long term (6-10)	0	1	7	9	4
Very unlikely to occur/Far in the future (1-5)	0	0	1	3	1
	Impact				

	Minor	Moderate	Major	Severe	
Legend	2	13	16	1	**No of instances**
Total	32				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 Network Equilibrium

Table 8-3 - Percentage of Risk by category



8.2 Update for risks previously identified

Descriptions of the most prominent risks, identified at the project bid phase, are provided in Table 8-4 with updates on their current risk status.

Table 8-4 – Top five risks identified at the project bid phase

Risk	Previous Risk Rating	Current Risk Rating	Comments
Project team does not have the knowledge required to deliver the project	Major	Major	The bid manager has been appointed as the project manager. The procurement activity has already progressed to identify the key companies to support Network Equilibrium. This will remain a major risk until the key procurement activates and internal roles have been filled.
No SVO available from the contracted supplier	Major	Major	The SVO procurement activity is ongoing with 14 confirming they can meet the project scope at the PQQ stage. 7 companies have been invited to tender their solutions.
Project cost of high cost items are significantly higher than expected	Major	Major	This risk still applies until after the project can procure the key goods and services.
No FPL available from the contracted supplier	Major	Major	The FPL procurement activity is ongoing with 12 confirming they can meet the project scope at the PQQ stage.
Selected sites for technology installations become unavailable	Major	Moderate	This risk applies until the site selection is complete. The project continues to work with the local delivery teams to identify appropriate demonstration sites.

9 Consistency with Full Submission

The project is being delivered in consistency with the Full Submission and no material changes have taken place.

Going forwards in all dissemination activities, the project methods will be referred to as:

EVA - Part 1 – Advanced Planning Tool (APT)
EVA – Part 2 – Voltage Limits Assessment (VLA)
SVO - System Voltage Optimisation (SVO)
FPL - Flexible Power Link (FPL)

10 Accuracy Assurance Statement

This report has been prepared by the Network Equilibrium Project Manager (Philip Bale), reviewed by the Future Networks Team Manager (Roger Hey), recommended by the Policy Manager (Paul Jewell) 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.