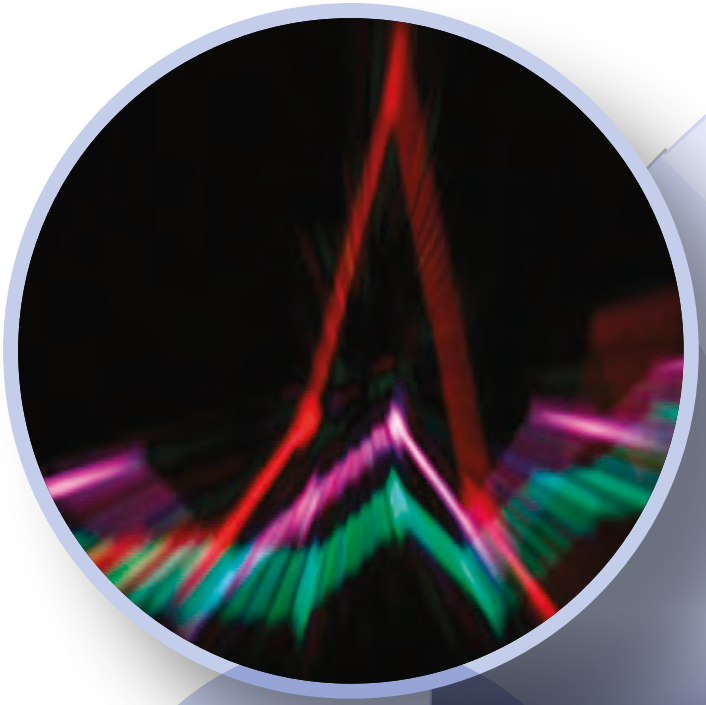
SP ENERGY NETWORKS

Flexible Networks for a Low Carbon Future



Project Cost Benefit Analysis

- Voltage Optimisation

September 2015

Part A – Costs of the trial and future roll-out

1. Introduction

This document provides cost versus benefit analysis of the deployment Voltage Optimisation techniques to 11kV or LV networks. The document aims to quantify the cost per kVA of capacity gain by applying an “alternative” or new technology solution against the cost per kVA of the traditional business as usual reinforcement solution.

2. Planned Innovation and Benefits

The objective of this project element was to evaluate the network capacity benefit that could be gained if the network voltage was reduced to an optimum level, to provide a load reduction of network demand and create additional headroom for generation capacity. The benefit target for this work package was 2% of the capacity within the trial sites.

3. Activities of the intervention

- Following deployment of enhanced network monitoring, undertake system voltage reductions.
- Analyse the effects of voltage changes from the monitoring data.
- Consideration of advantages/disadvantages for future voltage management policy.
- Identify the generation capacity gain created through changing the network voltage.

4. Trial Project Cost and Future Roll out cost

The budget for this work was included in the £2,212K for work package 1.2 enhanced substation monitoring.

Table 1 below is a summary of the expenditure for voltage optimisation trial and future deployment.

Activity	Trial cost (£)	Repeated Method Cost (£)	Benefit (kVA)
Monitoring of network node voltages	25000	8000	
Analysis of voltage scope	10000	4000	
Changes to voltage control systems	1000	8000	
Evaluation of voltage changes	8500	5000	
Engineering & project management	12000	6000	
Totals	56500	31000	289.5
Cost / Benefit Ratio (£ / kVA)		107.08	

Table 1

Monitoring of network node voltages – This provides for installing voltage data recording at specific nodes on the LV network prior to varying the system voltage. This does not include

for the wide scale substation monitoring systems which were needed to provide a full picture of the network load/voltage conditions, this was provided under the enhanced secondary substation monitoring work package.

Analysis of voltage scope – This includes for the analysis of the voltage profiles across the network monitoring points to determine the optimal voltage change available whilst maintaining supplies within statutory limits.

Changes to voltage control systems – This includes for changing the system voltage at either primary transformer AVC set points or secondary transformer tap settings.

Evaluation of voltage changes –This allows for the analysis of the system voltages and margins post the optimised settings being trialled.

Engineering & project management – This covers the practical aspect of delivery of the voltage monitoring equipment, data analysis and system changes.

Part B – Financial Assessment

Reinforcement Base Cost at LV

A generic base cost of £150/kVA has been estimated for LV reinforcement.

In order to allow for the potential amount of capacity released by this project to be provided by conventional reinforcement, 358kVA of capacity would need to be provided. Using the pro-rata base cost of £150/kVA for additional LV capacity, the base cost of network reinforcement is;

PV Generation Capacity created 358kVA @ £150/kVA = £53,700

Carbon Saving:

For this trial it is estimated a saving of 200,000kWh can be realised through the reduced energy consumed by the customers
Cost of Carbon = Energy x Conversion Factor x Value of Carbon

Using the equation above;
Energy = 200,000kWh
Conversion Factor = 0.45211 kgCO_2e/kWh (average over RIIO ED1 8 year period to 2023)
Value of Carbon = £14.03/tCO_2e (average over RIIO ED1 8 year period to 2023)
The Cost of Carbon/year = 200,000kWh x 0.45211 ÷ 1000 x 14.03 = £1,269
Carbon Saving over 10 years = a saving of £12,686
The Benefits rating of the project as per Table 1 is calculated at 4 as the project will avoid >£10,000 in CO_2.
Saving: £12,686

Benefit rating: 4 (significant)

Social and Environmental Benefit

The element of the project provides for energy saving for customer loads which use less power with a lower voltage input and thereby operate at a reduced power (the overall power saving is nullified for thermostatically controlled equipment or non-linear loads). It also provides for additional SSEG to be connected which would otherwise create an overvoltage situation.
Customer energy savings = 50,000kWh (load) + 150,000kWh (generation) = ~200,000kWh x £0.137/kWh = £27,400pa (or £274,000 over 10years)

The above only accounts for the reduced load energy savings and the renewable generation energy saving and does not include the customer investment for the SSEG (probably solar PV). The investment for renewable SSEG (e.g. solar PV) is typically offset via the Feed in Tariff. Additional SSEG capability (Feed in Tariff for 80 typical domestic installations) = 150,000kWh, @14p/kWh = £21,000 (or £210,000 over 10years)

Benefit rating: 4 (significant)

Financial Benefit:

The project identified the voltage range which maintained the voltage within the DNO's statutory obligations.

Base Cost: £53,700
Method Cost: £31,000
Non-Network Derived Benefits:
Carbon + Social; £12,686+ £27,400 = £40,086
Method Cost – Non Network Derived Benefits;
£31,000 - £40,086 = -£9,086
Financial Benefit = Base Cost – Method Cost
Financial Benefit = £53,700 – (-£9,086)
Financial Benefit = £62,786

Benefit rating: 3 (medium)

Safety Benefit:

None envisaged standard health and safety processes will be applied and any new learning gained from the project will be shared.

Benefit rating: 0 (nil)

Network Reliability Benefit:

The project has no measureable reliability benefit to the network.

Benefit rating: 0 (nil)

5. Benefit Scorecard

Grading of Benefit	Financial Benefit	Safety Benefit Per Reported Case	Social and Environmental Benefit	Network Reliability Benefit	Carbon Saving
High (5)	Major £1M+	Lead to the reduction of fatalities >£1m	Managed realignment (significant) –High incurred costs and environmental benefit/value > £50k	Leads to significant and permanent improvement in Regulatory performance targets >£100k	Major >£30k £/tCO2e
Significant (4)	Significant £100k-£1M	Significant improvement to public safety £100k-£1m	Managed realignment (minor) –Minor to medium incurred costs and environmental benefit/value > £25k	Leads to sustainable improvement in Regulatory performance targets >£50k	Significant >£10k £/tCO2e

Medium (3)	Medium £10k-£100k	Reduction of reportable injuries >£20k	Improve (significant) Significantly improve existing processes and systems to adapt the existing environmental characteristics > £10k	Leads to improvement in performance >£10k	Medium >£5k £/tCO2e
Minor (2)	Small £1k-£10k	Lead to the reduction of absence due to ill health >£11k	Improve (minor); Improve existing processes and systems to adapt the existing environmental situation > £1k	Contributes to improvement in performance £1k	Minor >1k £/tCO2e
Low (1)	Low £0-£1k	Avoidance of minor injury >£0.33k	Do minimum; This is a continuation of existing processes and maintenance, delaying but not avoiding or improving < £1k	Small but measurable improvement <£1k	Low <£1k £/tCO2e
Nil (0)	None or Negative	No Tangible Benefit	No Tangible Benefit	No Tangible Benefit	No Tangible Benefit

	Financial Benefit	Safety Benefit Per Reported Case	Social and Environmental Benefit	Network Reliability Benefit	Carbon Saving
Benefit Rating	3	0	4	0	4
Total	**11**				