

# Flexible Networks for a Low Carbon Future



**Project Cost  
Benefit Analysis**  
- Voltage Regulators  
September 2015

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

### 1. Introduction

This document provides cost versus benefit analysis of the deployment of 11kV Voltage regulators. The document aims to quantify the cost per kVA of capacity gain by applying a “smart” 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 work package was to deploy voltage regulators as an enabling technology for the implementation of an automated flexible network. The voltage regulators would enable the movement of load to parts of the network that would sustain voltage problems without the use of the voltage regulator to correct the situation. Therefore the voltage regulator facilitates the utilisation of capacity which could not be used normally without the traditional solution of reinforcement.

### 3. Activities of the Work Package

The elements of the work undertaken for this technology trial are listed below:

- Analysis of existing network conditions and identification of voltage issues and solution.
- Installation of voltage regulator sets and control equipment.
- Review network performance and inter-operation of voltage regulators.

### 4. Work package Outturn against budget (trial Method Cost)

The original submission budget for this work package was £608K.

Table 1 below is a summary of the overall work package 2.4 expenditure and lists the original budget against the actual spend for the trial.

Activity	Budget (£k)	Actual (£k)	Variance (£k)	Commentary
Labour	165	117	-48	Contractors used instead of internal labour
Equipment	240	128	-112	AVR's in Wrexham and Whitchurch not required
Contractors	77	67	-10	Contractors used instead of internal labour
IT				
Travel/Exp's				
Contingency & Others	127	97	-30	Contingency funds not required.
Payments to users	-	-	-	
<b>Totals</b>	<b>608</b>	<b>409</b>	<b>-199</b>	

**Table 1**

Labour – The internal labour costs were significantly lower than budget, due to not being able to release staff from the businesses with the required skills to the project for the 3+years.

Equipment – These costs were significantly lower than budget, as the original concept in the submission was that voltage regulators would be required at each of the three trial sites. Only the St Andrews trial site required a voltage regulator.

Contractors – This is explained above in the labour category.

Contingency & Others –The contingency budget was not required for this work package.

### 5. Future Roll out cost of Voltage Regulators

The table 2 below shows a breakdown of the Trial Project Costs versus Repeated Method Cost for deployment of the Voltage Regulators, so as to allow evaluation of the cost/benefit. The trial cost shows the cost of undertaking the trial of the Voltage Regulators. The repeated method costs illustrate the costs of further deployment to another site. The benefit column shows the capacity gained through the deployment of Voltage Regulators and the Cost/Benefit ratio shows the cost of each kVA of headroom benefit.

Activity	Trial cost (£)	Repeated Method Cost (£)	Benefit (kVA )
Network modelling/analysis	20000	5000	
Site & radio surveys	5000	1000	
Voltage Regulators	93000	85000	
VR Pre-commissioning	5000	1200	
Associated network apparatus	22000	10000	
Land consents	3000	1500	
Apparatus/Equipment installation	12000	7500	
Telecontrol configurations	3000	1000	
PNDC VR performance testing	98000	0	
Engineering & project management	147600	10000	
<b>Totals</b>	408600	122200	1400
<b>Cost/Benefit Ratio (£/kVA)</b>		£87	

Table 2

Network modelling/analysis – This is required to evaluate and identify the issue, the feasibility of the voltage regulator solution and if the cost is worthwhile against the benefit.

Site & Radio surveys – This is necessary to determine if the location is suitable to establish the necessary communications. E.g. topography, range and number of repeater stations needed.

Voltage regulators – The voltage regulator tanks and controllers.

VR Pre-commissioning – Before site installation the equipment is programmed and configured in a workshop in controlled conditions.

Associated network apparatus – This includes for SCADA, pole mounted switches and isolators, for telecontrol operation, by-pass, split point moving and isolation.

Land consents – This allows for the necessary consents to be obtained to install the new equipment on private land.

Apparatus/Equipment installation – This is for the installation of the voltage regulators, controllers and associated network apparatus.

Telecontrol configurations – This is for the setup and commissioning of the SCADA control and alarm functionality into the network management system.

PNDC VR performance testing – This was for the trial testing of the voltage regulator operational performance tests carried out on the PNDC network. This would not need to be repeated.

Engineering & project management – This covers the practical aspect of delivery of a voltage regulator set.

## Part B – Financial Assessment

### Reinforcement Base Cost at 11kV

A generic base cost of £225/kVA has been estimated for 11kV reinforcement (additional 11kV cabling and secondary transformers).

In order to allow for the potential amount of capacity released by this project to be provided by conventional reinforcement, 1400kVA of capacity would need to be provided. Using the pro-rata base cost of £225/kVA for additional 11kV capacity, the base cost of network reinforcement is;

$$\text{Capacity} = 1400\text{kVA} @ \text{£}225/\text{kVA} = \text{£}315,000$$

### Carbon Saving:

No carbon savings can directly be attributed to this project.

Benefit rating: 0 (nil)

### Social and Environmental Benefit

The speed of deploying the voltage regulator can often be much quicker than traditional reinforcement works of a particular network which is at capacity, thereby allowing an accelerated connection of low carbon technologies.

Benefit rating: 2 (minor)

### Financial Benefit:

Base Cost: £315,000

Method Cost: £122,200

Financial Benefit = Base Cost – Method Cost

Financial Benefit = £315,000 – £122,200

Financial Benefit = £192,800

Benefit rating: 4 (significant)

### 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)

## 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 £/tCO <sub>2</sub> e
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 £/tCO <sub>2</sub> e
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 £/tCO <sub>2</sub> e
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 £/tCO <sub>2</sub> e
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 £/tCO <sub>2</sub> e
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
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Benefit Rating	4	0	2	0	0
<b>Total</b>	<b>6</b>				