OFGEM

AQUILA

DPCR4 – FBPQ ANALYSIS AND CAPEX PROJECTIONS

OCTOBER 2004

LIST OF REVISIONS

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Final	28/10/04	All	Revision of model and allowance levels following DNO meetings with Ofgem and Ofgem September 2004 paper.			

CONTENTS

LIST OF ABBREVIATIONS

capex	Capital expenditure
CHL	Customer hours lost
CI	Customer interruptions per 100 customers
CML	Customer minutes lost per connected customer
Consac	A type of concentric LV mains cable
DNO	Distribution Network Operator
DPCR	Distribution Price Control Review
DTI	Department of Trade and Industry
EATS	Electricity Association Technical Specification
EHV	Extra High Voltage (i.e. > 22kV)
ESQCR	Electricity Safety, Quality and Continuity Regulations 2002
FBPQ	Forecast Business Plan Questionnaire
GDP	Gross Domestic Product
GVA	Gross Value Added
GWh	Gigawatthour (a unit of energy)
HBPQ	Historic Business Plan Questionnaire
HV	High Voltage (i.e. between 1kV and 22kV)
km	kilometre
kV	kilovolt
LV	Low voltage (i.e. less than 1kV and here 230/400V)
m	Million
MEAV	Modern Equivalent Asset Value
MPRS	Meter Point Registration System
OHL	Overhead line
PB	Parsons Brinckerhoff
QoS	Quality of supply (reliability/interruption performance)
SSAP	Standard accountancy practice

FOREWORD

This report sets out the views of PB Power on the capital expenditure in the DNO's FBPQ submission to Ofgem for DPCR4. It supersedes the earlier (June 2004) report and changes reflect the outcome of the meeting with the DNO in August 2004.

The comments in the report are based on the information provided by the DNO concerned as part of the FBPQ submission to Ofgem, subsequent meetings and information exchanges between Ofgem, ourselves and all the DNOs. The volume of information submitted in support of the business plans has been substantial in both narrative and numerical form and, together with subsequent meetings and clarifications, has provided an insight to the rational for expenditure variation compared to that in DPCR3.

We have however reviewed the expenditure and drivers of the DPCR4 Base Case Scenario only, with a limited overview of the Ofgem Scenario/Sensitivity and the DNO Alternative Case. In particular, we have taken note that Ofgem's requirement that capital expenditure included in the Base Case Scenario should be only that necessary to maintain the distribution system at its existing performance level in respect of quality of supply. It follows in our view that the level of network risk experienced during DPCR3 should also be held constant during the forthcoming review period. Where DNOs have included expenditure that may not fit with those objectives then such expenditure is not deemed to be appropriate to the Base Case Scenario and has therefore been excluded from our considerations, except as part of the process of identifying such expenditure. This approach does not imply that we do not believe that the non-Base Case expenditure identified is inappropriate or unjustified; in fact in some instances we have observed that non-Base Case expenditure may be prudent. This approach of limiting consideration to only the Base Case Scenario seeks to ensure that all DNOs are considered on an equitable basis with any further consideration as to treatment of special cases resting between Ofgem and the DNO concerned.

Our approach to the modelling of both load-related and non-load related expenditure has been developed on principles agreed by Ofgem and discussed with the DNOs. The models have been populated with data submitted to Ofgem by the DNOs. The output from the models therefore reflects the input data comprising individual DNO data, practices and from these aggregate DNO data which has been used to create 'industry-level' data. The principle that has been applied is that the output of the models should reflect a general industry view against which each DNO's submission can be compared. In respect of the modelling of non-load related expenditure, no material age dispersion across DNOs has been observed for the main asset classes. Consequently any major difference between DNO submission and model output is likely to reflect a difference with general industry practice in terms of replacement or refurbishment policy and unit costs. Information provided by a DNO has been assumed to be correct although concerns on unsupported changes to the asset age profiles of certain DNOs have been raised with Ofgem.

In forming a "PB Power" opinion of the proposed allowance, we have observed the approach set out above. Our modelling has been used as a guide and, where expenditure differing from that indicated by the model has been justified and is in keeping with Base Case Scenario, we have duly taken account of such differences.

We would also like to take the opportunity of expressing our appreciation of the time taken and courtesy extended by the staffs of Ofgem and the DNOs during meetings and in responding to our queries.

EXECUTIVE SUMMARY

The following table summarises the Aquila's adjusted DPCR3 projection, adjusted DPCR4 forecast, PB Power's modelling results and opinion of proposed expenditure.

Expenditure Category	Adjusted DPCR3 Projection (£m)	Adjusted DPCR4 Forecast (£m)	Model Output (£m)	PB Power Opinion (£m)	PB Power Comments
Load Related Expenditure - Gross	235.8	261.8	230.1	246.0	The proposed expenditure is based on the forecast but would exclude expenditure to reduce the network risk to a level below DPCR3 as well as expenditure on an unsupported scheme.
Customer Contributions	(130.8)	(141.1)		(141.1)	
LRE Net	**105.0**	**120.7**		**104.9**	
Asset Replacement – non fault	209.2	358.5	335.7	319.2	The proposed expenditure is based on the forecast less ESQCR expenditure and takes account of reductions in respect of replacement of LV bare conductor lines and services and LV Consac cable.
Other	127.6	127.8		125.0	£125m comprises diversions (£20.0m), SCADA (£0.3m), metering (£40.8m) and fault capex (£63.9m).
NLRE Total	**337**	**486.2**		**444.1**	
Non Operational	11.0	0.0		0.0	Not reviewed.
DNO Total	**453.0**	**606.9**		**549.1**	
DNO Total				***444.4***	*As Ofgem Sep 04 paper, excl. meters, faults and ESQCR compliance*

Base case submission

PB Power's review is of the Base Case capex forecasts excluding diversions, metering, fault capex and non-operational capex. Fault expenditure is considered separately. Where appropriate the forecasts and DPCR3 projections have been adjusted for the funding of the pension deficit, capitalised overheads, inter-company margins and lane rentals in line with figures provided by the DNOs in their submissions and summarised by Ofgem. Where companies have indicated a loss of new connections market share, PB Power has also made adjustments to gross load related expenditure to reflect the total connections market.

The Aquila forecast has been adjusted for funding a pension deficit, capitalised overheads and lane rentals.

Our principal findings are summarised below.

Load related expenditure

- Aquila has identified that the one of the main contributors to the increase in forecast expenditure is driven by some 18 additional primary schemes, intended to lower the level of risk on the network. It is estimated that these schemes may have increased the level of forecast expenditure by £9m to £18m,

- The majority of schemes reviewed have yet to go through detailed design. This means that phase, scope and price risk exists.

Non-load related expenditure

- The level of non-load replacement capital expenditure forecast for DPCR4 is in excess of that forecast to be incurred in DPCR3.

- The company has proposed a refurbishment programme for the small conductor HV overhead line network. This will provide improvement to QoS measures as indicated by the company in its QoS submission.

- The company has forecast in the order of £14m for replacement of the LV bare conductor overhead line network and services. The need for replacement is not consistent with Base Case guidelines and in that regard is deemed inappropriate. However, from an asset management perspective the decision to commence an increased replacement programme now may be considered prudent practice.

- The company has forecast replacement expenditure driven by LV Consac cable of £31m whereas, based on typical activity elsewhere in the industry, we would consider £20m to be appropriate. The forecast expenditure represents an increase over DPCR3 allowance levels and is not in keeping with that of other DNOs with LV Consac issues.

- Site-specific non-load replacement schemes also raise issues associated with price phasing and scope risk.

- The company has made an allowance in its forecast of £22m for wayleave terminations. This is in excess of that projected for DPRC3. It is also counter to Ofgem's Base Case guidelines. Insufficient data has been submitted to support the need for such an increase.

We would also make the following general comments:

- PB Power's non-load related modelling is based on the asset lives provided by DNOs. Subsequent refinements have been made to this modelling to reflect PB Power's view of efficient DNO policies and practice.

- There is some concern about the comparability of data between DNOs due to different policies applied by DNOs, particularly the boundary between fault and non-fault replacement and capitalisation of overheads.

- The data presented in this appendix includes comparisons between DPCR3 allowances, DPCR3 projections and DPCR4 forecasts. Care needs to be taken in reviewing these figures in respect of the following:

  - The DPCR3 allowance included £2.30 per customer per year (1997/98 prices) capex for quality of supply[1], which is not separately identified in the DPCR3 projections and is not included in the Base Case DPCR4 forecast.

Quality of supply scenarios

- The Quality of Supply submission indicates a relatively high expenditure level. This is primarily driven by replacement of small section conductor in the QoS scenario. That particular initiative has a relatively low cost/benefit ratio. This initiative could well be included in the non-load related expenditure classification. The scalability of the initiatives, with the exception of the overhead line option, does permit sensitivities to be easily considered based on incremental change to the main initiatives.

DNO alternative case

- The DNO Alternative Scenario in total is forecast to require an investment of £766.5m. This includes QoS improvements as well as increase in network resilience through under-grounding. An additional expenditure item associated with replacement driven by environmental need has also been identified. The investment required on this item is £18.5m the majority of which is replacement of oil filled cable. Nothing has been submitted in this scenario for investment due to distributed generation.

[1] Ofgem DPCR 3 Final Proposals Paper December 1999 para 3.14 page 28

PB Power view on load related and non-load related expenditure allowances

Load related expenditure

In our view the allowed expenditure would be about midway between the model output and the DPCR4 forecast, i.e. at £246m. Our view is based on the forecast but reflects that expenditure to reduce the network risk to a level below DPCR3 and expenditure on an unsupported scheme should be excluded.

Non -load related expenditure

In PB Power's opinion, the allowed non-load related expenditure corresponding to the model output should be £319.0m. The proposed expenditure is based on the forecast less ESQCR expenditure (£17.6m) and takes account of reductions in respect of replacement of LV bare conductor lines and services (£13.8m) and LV Consac cable (£10m). The proposed expenditure on replacement of substation plant is however considered to be acceptable.

Conclusion

The above considerations would indicate that a net capital expenditure of £549.1m would be appropriate.

1. INTRODUCTION

The Office of Gas and Electricity Markets (Ofgem) appointed PB Power to provide support for the 2005 Distribution Price Control Review (DPCR4) covering aspects of capital expenditure and repairs and maintenance forecasting, excluding distributed generation which is covered by a separate review. The project is in two parts.

- Part 1, covered the systems, processes, assumptions, asset risk management and data used by Distribution Network Operators (DNOs) to forecast capital expenditure and an analysis of variances and efficiency gains in the HBPQ period.

- This Part 2 report provides an analysis of forecast expenditure for the five year period to 31 March 2010 and builds on information obtained in Part 1 of the project.

Ofgem published the Forecast Business Plan Questionnaire (FBPQ) in October 2003, prior to appointing PB Power. Each DNO was requested to provide forecasts of future capital expenditure requirements against 3 scenarios: the Base Case Scenario; the Ofgem Scenarios/Sensitivities; and the DNO Alternative scenario.

The Base Case is intended to reflect the forecast investment requirement that would maintain existing network quality of supply performance and network fault rates together with the same level of network resilience for the period to 2020.

The Ofgem Scenarios/Sensitivities set out network performance improvement targets for 2010 and 2020 with sensitivities of ± 2% and ± 5% of the 2010 targets. The targets are based on Ofgem's view depending on the nature of each of the DNO networks.

The DNO Alternative Scenario is intended to reflect the DNO view of the efficient level of capital expenditure required to meet the outputs they consider appropriate for their area of supply.

The PB Power review of the DNO forecasts was undertaken as follows:

a. Further questions and visits to companies to inform a review of each DNO capital expenditure forecast to give a bottom up view of the assumptions, risk assessments and justifications put forward by DNOs for their Base Case forecast, and a high level review of the Ofgem and DNO scenarios.

b. For the Base Case load-related expenditure, a benchmarked comparison of the each DNO's forecast with a PB Power forecast using a PB Power model based on the methodology set out in Appendix D.

c. For the Base Case non-load related expenditure, a comparison of the DNO forecast with the output of a PB Power model forecast using industry average weighted asset replacement profiles and PB Power's unit costs.

d. From consideration of the above we have formed a "PB Power Opinion" of the proposed allowance.

As indicated above Ofgem provided criteria for the Base Case forecasts. The DNOs forecasts are based on different assumptions included in the DNO FBPQ submissions. As instructed by Ofgem, adjustments have been made to the DNO forecasts to take account of differing treatments of pension funding deficits, capitalised overheads, intercompany margins and lane rentals. Where appropriate the load-related expenditure, as submitted has been grossed up to take the cost of all connections into account including where these may have been provided by third parties.

In our review of asset replacement expenditure, only non-fault expenditure has been considered. Other items in non-load related expenditure namely diversions, SCADA, metering and fault capital expenditure have been treated as a pass-through. No assessment has been made of non-operational capital expenditure.

Adjustments to DPCR4 forecast

In the FPBQ submissions, allowances may have been made by DNOs for items including third party connections, pension funding deficit, capitalised overheads, inter-company margins and lane rentals. In order to bring the forecasts of capital expenditure onto a common basis, Ofgem has been in discussion with all DNOs as to the level of those adjustments and has arrived at an "Adjusted DPCR4 Forecast" as is indicated in tables in the report.

Such adjustments have been made after PB Power had completed a detailed review of the FPBQ submissions. Therefore certain numbers relating to capital expenditure items in the general text of the report refer to the original unadjusted numbers as presented by the DNOs. Such numbers have not been adjusted retrospectively.

However, for avoidance of doubt, all modelled outputs relying on DPCR4 submission (forecast) values have been based on the "Adjusted DPCR4 Forecast" values and not necessarily those values as originally submitted.

2. DNO SUBMISSION

2.1 Base case

2.1.1 General

Aquila's approach to forecasting the capital expenditure projections has, in general, been to define the volume of activity associated with non-load replacement based on maintaining a constant fault rate consistent with Ofgem's Base Case directions.

The Base Case submission makes no additional expenditure allowance for quality of supply or resilience. Aquila has included within the Base Case capital expenditure necessary to deal with ESQCR issues.

Aquila has also included lane rentals within the submission for non-load related expenditure. Additional cost for lane rentals has also been identified in load-related expenditure although Aquila has taken the decision not to include this element in the submission on the basis that it would be fully recoverable from customer contributions. We have adjusted both the load and non-load related expenditure forecasts to exclude lane rental expenditure.

Aquila has made no allowance for loss of market share of the connections market. It has also provided customer contributions based on DPCR3 charging structure.

The following table presents the revised DPCR4 forecast expenditure together with the corresponding DPCR3 allowance and projection.

Table 2.1 - Base Case Capex Projections (£m at 2003/03 prices)

Item	DPCR3 Allowance	Adjusted DPCR 3 Projection	DPCR 4 Forecast	DPCR4 Corrections	Revised DPCR4 Forecast
Gross Load Related	**197.1**	**235.8**	**276.9**	**0.0**	**276.9**
Non Load Related	**332.7**	**337.0**	**510.1**	**0.0**	**510.1**
Gross Capex less Non Op Capex	***529.8***	**572.7**	***787.0***	***0.0***	***787.0***
Non Op Capex (Not Assessed)	16.8	11.0	0.0	0.0	0.0
Total Gross Capex	**546.6**	**583.7**	**787.0**	**0.0**	**787.0**
Contributions	-79.4	-130.8	-149.2	0.0	-149.2
Net Load Related	**117.8**	**105.0**	**127.7**	**0.0**	**127.7**
Total Net Capex	**467.3**	**453.0**	**637.8**	**0.0**	**637.8**
Non Load Related Summary					
Replacement	283.4		328.8	0.0	328.8
ESQCR			18.5	0.0	18.5
Heath & Safety			31.5	0.0	31.5
Environment			0.3	0.0	0.3
Sub Total - Model Comparison	**283.4**	**209.2**	**379.1**	**0.0**	**379.1**
Diversions	16.8	17.1	24.1	0.0	24.1
SCADA		4.8	0.3	0.0	0.3
Sub Total	***300.2***	***231.2***	***403.5***	***0.0***	***403.5***
Metering (Not Assessed)	32.5	40.2	41.1	0.0	41.1
Sub Total	***332.7***	***271.4***	***444.6***	***0.0***	***444.6***
Fault Capex (Not Assessed)		65.5	65.5	0.0	65.5
Non Load Related Total	**332.7**	**337.0**	**510.1**	**0.0**	**510.1**

The forecast has been adjusted for:

- gross market LRE adjustment, to take account of customer connection expenditure by third parties
- pension funding deficit
- capitalised overheads
- inter-company margin and
- lane rentals.

The adjusted DPCR4 forecast is presented in the table below.

Table 2.2 – Adjusted DPCR4 Base Case Capex Projection (£m at 2003/03 prices)

	Adjustment to DPCR4 Forecast					
Item	Gross Market LRE Adjustment	Pension Funding Deficit	Capitalised Overhead	Inter-company Margin	Lane Rentals Adjustment	**Adjusted DPCR4 Forecast**
Gross Load Related	0.0	-5.6	-7.9	0.0	-1.6	**261.8**
Non Load Related		-9.4	-11.6	0.0	-2.9	**486.2**
Gross Capex less Non Op Capex	***0.0***	***-15.0***	***-19.5***	***0.0***	***-4.5***	**748.0**
Non Op Capex (Not Assessed)						**-**
Total Gross Capex	**0.0**	**-15.0**	**-19.5**	**0.0**	**-4.5**	**748.0**
Contributions	0.0	3.0	4.3	0.0	0.9	-141.1
Net Load Related	**0.0**	**-2.6**	**-3.7**	**0.0**	**-0.7**	**120.7**
Total Net Capex	**0.0**	**-12.0**	**-15.2**	**0.0**	**-3.6**	**606.9**
Non Load Related Summary						
Replacement		-6.6	-9.4	0.0	-1.9	310.9
ESQCR		-0.4	-0.5	0.0	-0.1	17.5
Heath & Safety		-0.6	-0.9	0.0	-0.2	29.8
Environment		0.0	0.0	0.0	0.0	0.3
Sub Total - Model Comparison		**-7.6**	**-10.9**	**0.0**	**-2.2**	**358.5**
Diversions		-0.5	-0.7	0.0	-0.1	22.8
SCADA		0.0	0.0	0.0	0.0	0.3
Sub Total		***-8.1***	***-11.6***	***0.0***	***-2.3***	***381.5***
Metering (Not Assessed)		-0.0	-0.0	0.0	-0.2	40.8
Sub Total		***-8.1***	***-11.6***	***0.0***	***-2.5***	***422.4***
Fault Capex (Not Assessed)		-1.3	-0.0	0.0	-0.4	63.9
Non Load Related Total		**-9.4**	**-11.6**	**0.0**	**-2.9**	**486.2**
Total Adjustments	**0.0**	**-15.0**	**-19.5**	**0.0**	**-4.5**	**-39.0**

2.1.2 Load related capital expenditure

2.1.1.1 Network reinforcement

Aquila has based its load related investment programme on historic growth in demand and customer numbers. These projections are supported by data from a number of sources including regional gross value added, housing starts, historical trend analysis by sector and regional information from energy business centres. The customer and unit projections appear justified.

The company has identified the major grid and primary network load related investment schemes throughout the forecast period. Together these schemes represents an increases on historic levels of expenditure due to the need to conform to P2/5 security standards as well as the need to address overstressed switchgear. The number of substations proposed to be replaced is greater than that required to maintain DPCR3 risk levels. We are advised that this additional investment affects 18 substation sites.

The level of grid and primary network investment is forecast to be £57m compared to an overall £63m required for network reinforcement. This has resulted in a work schedule that is predominantly site-specific as opposed to a more general programme of work arrangement. The site-specific nature of the schedule provides greater transparency but creates increased price, scope and phasing risk.

2.1.1.2 New connections forecast expenditure

The level of capital expenditure set against new connections once adjusted for pensions is consistent with that in DPCR3 as would be expected. The level of customer contributions is consistent with DPCR3 percentages and supports Aquila's statement of no change to customer contribution levels.

2.1.1.3 Load related scheme papers

Aquila has provided High-Level 'Need Statements' for a selection of primary schemes where plant and equipment are identified for replacement under both P2/5 (security of supply) and switchgear fault level criteria. These scheme papers are at 'Investment Need' level and still require firm scheme details and prices. Based on the information provided the level of detail supports, at high-level, the need for investment. The timing of the schemes is front-end biased and as such provides increased confidence that sufficient firm information should exist to enable greater certainty that the schemes will progress. No detailed assessment of the individual site-specific forecast expenditure level has been made. Schemes related to replacement due to fault levels have been reviewed and in all cases the percentage of the switchgear fault rating at which the decision to replace was based is appropriate; typically this percentage is at 98% to 99%. Schemes driven by fault level also appear to be justified. Of those schemes reviewed that are intended to deal with P2/5 issues it is believed that one scheme may be deferred or replaced by an alternative arrangement. This single scheme, Nechells, is forecast at £7.6m and programmed for completion during 2008/09.

2.1.3 Comments and issues associated with the load related expenditure forecast

- Aquila has estimated future expenditure requirements on the assumption that a number of substations would exceed firm capacity in the future in line with a 1% increase in demand growth. Load projections are based on load growth trends using historical data and online demand information from primary network substations. In addition, known changes advised by regional engineering business centres are considered. These two factors are not mutually exclusive and act to ensure that the forecast is robust. The use of demand growth projections at a substation site level to assess firm capacity issues, post load transfer capabilities, is thought to be appropriate.

- The level of reinforcement proposed by Aquila is believed to be in excess of that necessary to comply with Base Case guidelines in terms of maintaining constant fault and performance levels that we have interpreted as network risk. This reluctance to continue with a constant DCPR3 risk level is linked by the company to its capital expenditure limit and hence the company has managed the network during DPCR3 in keeping with its net expenditure allowance. In that regard continued operation at such a level might not be possible in the longer term. Given that the site-specific schemes reviewed passed technical review then it may be inferred that the technical need for the additional schemes would likewise be technically supported. However this view is subject to the results of our top-down modelling as described later in the report.

- The planning approach to reinforcement investment associated with the replacement of switchgear is based on the switchgear duty being on excess of 98% of the nameplate rating. This is an acceptable value. Inspection of larger site-specific schemes has tended to indicate fault levels at 98% to 100% of the switchgear rating. Therefore, schemes that are driven by fault duty are regarded as acceptable.

- The rate of growth of customer numbers is lower than historical trend and national average customer growth rates. The level of primary expenditure proposed, may mask the significance of this in terms of reduced general reinforcement expenditure.

- A front-end biased reinforcement programme provides greater confidence in terms of information certainty and therefore greater probability that the schemes identified will actually proceed. Although the programme is in excess of that delivered in DPCR3 by on average £3m per annum, the latter part of DPCR3 does tend to support that an activity level at the level proposed for DPCR4 is deliverable.

- The level of customer contributions has been kept constant during the DPCR4 period. This level is commensurate with that observed during DPCR3. As such, concerns with regard to possible differences between forecast and actual are limited.

- Aquila has provided a number of Need Statements for review pertaining to specific reinforcement schemes. These proposals are by necessity at concept and budget price stage. This may result in variance in both the price and scheme detail once the project is delivered. Moreover, the risk of rephasing is greater. The fact that the company's reinforcement forecast is heavily biased towards site-specific schemes greatly increases that risk. The scheme detail provided has been reviewed and overall is found to be acceptable with the exception of Nechells reinforcement, which appears to have a low probability of proceeding. That scheme is forecast to be £7.6m.

- Of the 48 identified schemes within the DPCR3 programme 50 percent are due to proceed during the review period with a further 10 percent being identified during the period and reprioritised ahead of those previously expected to be undertaken. The remaining 40 percent failed to proceed. This assessment indicates the dynamics of the network planning process and is not unusual for site-specific schemes. Based on our review of the schemes selected by us then, in general, the probability of forecast being delivered appears high. While this issue addresses volume no account has been taken of the accuracy of the budget price or change to scope issues that will exist. Typically price variance attributed to budget price tolerance is expected to be in the order of +/- 20%. The top down load-related modelling exercise captures this price risk issue. Therefore no further adjustment is necessary.

The primary programme submitted is believed to be deliverable from a resource perspective. Aquila's ability to deliver close to DPCR3 allowance supports a favourable consideration of the load-related submission.

2.1.4 Non load related capital expenditure

Aquila has derived both primary and secondary network long-term replacement from an asset replacement model. The mean lives allocated to the main asset classes are in excess of industry averages presented by the company. In general, the forecast volume is not considered an issue. Primary network assets are forecast for long-term planning purpose using the model but for short-term, DPCR4 timescale, condition reports influence prioritisation and targeting of investment. Condition reports and historical replacement rates also drive short-term secondary asset replacement activity.

In terms of secondary network replacement activity three main issues have been identified:

- replacement of small conductor HV overhead line; this replacement activity is forecast to increase during DPCR4 and Aquila plans to remove almost all of the small section conductor overhead line by the end of DPCR4replacement of LV Consac cable is forecast to increase in line with DPCR3 fault trend line extrapolation and DPCR3 replacement activity and

- commencement of an accelerated replacement of LV bare overhead mains and services.

In terms of Consac replacement Aquila does not address cable-joint problems as is the approach of other DNOs. Rather a reactive policy of cable length replacement is undertaken instead.

Aquila has provided details of its major replacement schemes and programmes of work for HV and LV assets. Aquila does operate systems to calculate the quality of supply benefits from its investments and has indicated that quality of supply improvements that may arise as a consequence of the proposed replacement investment are not material. However, consideration needs to be taken of Aquila's Quality of Supply submission where small section reconductoring has been proffered as a Quality of Supply initiative. Therefore, given the size of the programme proposed in the Base Case it is likely that a degree of betterment will be realised by the company.

Aquila has made provision for issues associated with ESQCR regulations. The forecast at present may overlap with the company's overhead line refurbishment/replacement programme in certain areas. The main contributor to the ESQCR forecast of £18.5m is associated with Regulation 18; overhead line height; that activity is forecast to be £11.5m during DPCR4.

Aquila has identified that within the Base Case £22m is forecast for asset replacement associated with wayleave termination. This is in excess of that projected to be incurred during DPCR3, although note is taken of the extraordinary Birmingham Metro development and associated diversion cost of £1.3m.

2.1.5 Comments and issues associated with the non-load related expenditure forecast

- Aquila's asset replacement expenditure has been forecast using a mix of modelled forecast replacement levels and condition reports. The model parameters (asset ages) used are, according to Aquila, in excess of other industry asset replacement parameters, the consequence being that the modelled replacement volume for Aquila is likely to be lower in comparison with general industry activity levels.

- The secondary asset replacement activity identified has been reviewed and the rational provided by Aquila based either on condition, safety or performance, in general, supports the need for replacement. Overall the secondary programme does not raise many concerns, with the exception of LV bare conductor line and service replacement and forecast LV Consac activity.

- There are asset types where non like-for-like replacement is proposed, in particular, LV street pillars. This is an area where the decision to enhance or change the existing arrangement rests with Aquila.

- The case for continued remedial work on replacement of HV overhead line constructed to BS1320 has been made. However, it is recognised that network performance is also likely to be delivered by this replacement programme. Replacement of LV bare conductor line although not in keeping with the Base Case objectives appears a prudent asset management decision. However lack of data showing increasing fault rates[1] or deterioration in network resilience attributed to that asset type at existing activity level limits justification of the forecast. The same is also true of overhead LV service replacement. Together these LV bare conductor line activities increase capital expenditure by approximately £13m over DPCR4 period.

- Issues do exist with the forecast level of LV Consac cable replacement. The previous allowance in DPCR3 for this activity is projected to be spent in full by the end of DPCR3. However the case for increased investment in replacing LV Consac cables is based on the short-term information and, when this investment level is viewed in the context of other DNOs forecasts, justification to invest £31m appears limited.

[1] Ofgem 2002/03 Electricity Distribution Quality of Service Report, dated July 2004, page 15 refers.

- The primary programme is £21.2m in excess of DPCR3. This has been driven by a number of large projects. The review of the major schemes indicates that technical need does exist and given their timing and joint-development with NGT should result in the scheme proceeding to programme.

2.2 Quality of supply scenarios

Aquila has indicated that:

> *In order to achieve the benchmark performance for 2020, set by Ofgem in the guidance to this scenario, Aquila is required to reduce the number of unplanned Customer Interruptions (CI) by over 7% and unplanned Customer Minutes Lost (CML) by more than 11% by 2010, in comparison to the average performance experienced in the last two years'*

Table 2.3 below identifies the QoS targets proposed by Aquila for 2010.

Table 2.3 - Total QoS measures for Quality of Supply Scenario

	02/03 actual		01/02 & 02/03 ave		2010 Scenario		2020 Scenario		(ave/2010)%	
	CI	**CML**	**CI**	**CML**	**CI**	**CML**	**CI**	**CML**	**CI**	**CML**
Aquila	95.4	87.7	106	97.9	98.4	86.6	85.4	70.4	7.7%	10.9%

Aquila's approach to QoS assessment appears comprehensive and provides appropriate support for the initiatives proposed.

Overall assessment of the initiatives presented requires further analysis at industry level based on an agreed value for quality improvement.

2.2.1 Quality of supply – improvement scenario

The initiatives proposed are mainly based upon:

- reconfiguration of longer HV circuits;
- completion of the small section HV overhead line reconductoring programme; and
- remote control devices in mixed and urban circuits.

These three initiatives account for £34m of the proposed £40.7m capital programme. The contribution from each activity is; small section reconductoring £16m; network reconfiguration £14m and urban remote control £4.5m. The CI and CML improvement provided by these initiatives are reported to deliver improvements of 5.0 CI and 6.4 CML. The main contributor to this improvement is delivered through network reconfiguration.

Aquila has through a combination of Base Case and QoS submissions proposed replacement of the small section conductor overhead line by the end of DPCR4. Delivery of the 20% through the QoS scenario as opposed to replacement in Base Case requires further consideration.

2.2.2 Quality of supply – sensitivities

Aquila has approached the +/-2% scenario based on increment or decrement of the initiatives identified in the main QoS improvement scenario. The additional cost for a +2% improvement in CI is forecast to be an additional £8.1m. This is delivered through under-grounding short sections of mixed under-grounding – overhead circuits.

The 5% improvement in CML is delivered through additional ground mounted protection and urban remote control schemes. The additional cost is £19.2m.

Aquila has forecast an almost symmetrical reduction in forecast capital expenditure associated with a 2% CI and 5% CML reduction compared to the capital expenditure increase for a 2% and 5% improvement. In each scenario network reconfiguration has been identified as the initiative that would be curtailed.

2.2.3 Accelerated line upgrade

Aquila has recognized the subjectivity of identifying overhead lines that are prone to weather related damage. It has also noted the minimal improvement in QoS that results from under-grounding. On that basis, the 357km proposed would provide a CI improvement in the order of 0.5. The preferred option to achieve this resilience improvement is overhead line construction to EATS 43-40. This is presented in the QoS improvement and provides equal CI and CML improvement of approximately 0.8. This appears a sensible alternative proposal.

2.2.4 Under-grounding existing overhead line (network resilience)

Aquila has forecast capital expenditure of £61.5m as necessary to improve network resilience through under-grounding measures. It has focused this investment on the HV overhead line network given that this is provides more immediate benefit. The unit cost level appears high and may need to be reviewed.

2.2.5 Under-grounding existing overhead line (amenity value)

Aquila has estimated minimal amenity capital expenditure forecast of £6.4m. The company has indicated that investment in this area would not provide worthwhile customer benefit.

2.2.6 Comments and issues associated with quality of supply scenarios

The main issues and comments with regard to each separate scenario within the DNO alternative scenario are set out below:

- Aquila has indicated that it can deliver QoS improvement target by 2010 through a capital expenditure programme of £40.7m. This appears higher than the average DNO, although further industry level assessment is required. This expenditure level in part reflects the additional expenditure forecast because of overhead line small section conductor replacement. This initiative provides a low cost: benefit ratio but is part of Aquila's overall strategy to replace this asset type by a more robust construction. An element of this replacement could be undertaken in DPCR5 as part of non-load replacement with more cost effective QoS initiatives realized in this period. This view tends to be supported by the ease with which Aquila appears to be able to roll-out incremental improvement in other more cost effective quality of supply initiatives.

- The approach taken by Aquila to QoS initiatives and scenario assessment appears robust and based on detailed understanding of the network. The scenarios proposed appear to reflect the optimum cost: benefit solution for delivery of each sensitivity.

- 2% improvement in CI initiative appears a relatively expensive option compared to other QoS initiatives. However, it clearly indicates that saving can be realized through application of this initiative with benefit to CI and CML performance at the expense of overhead line small section reconductoring.

- The 5% improvement in CML appears a relatively low cost option the decrease in cost: benefit ratio and single CML improvement suggests that the initiative may now reaching its limit in terms of application.

- The symmetrical reduction in forecast capital expenditure associated with a 2% CI and 5% CML reduction appears odd given the generally non-linear nature of the cost: benefit ration of the various QoS initiatives. This reduction also tends to be at variance with other DNOs.

- The accelerated overhead line upgrade is promoted in preference to under-grounding option based on more immediate quality of supply improvements for equal sum invested. This argument is appropriate and is consistent with the message contained throughout the submission that aims to target overhead line issues through refurbishment or upgrade as opposed to under-grounding. While this appears a good asset management approach further consideration needs to be taken as to the most cost effective means of delivering that enhanced resilience goal, be that through replacement or remedial work as adopted by other DNOs.

- Aquila has identified £61.5m for resilience under-ground. This is targeted on HV overhead lines and to a lesser extent LV overhead lines. Focused replacement of HV overhead lines is appropriate in terms of increasing overall network resilience for a greater number of customers. Incidence of storm damage data has also been used to support that targeting exercise. This appears appropriate. The unit cost for LV is consistent with that supplied as part of the Base Case. However, HV is inflated without any justification. Based on PB unit costs the expenditure forecast would be £51.9m.

- It would appear preferable based on data submitted by Aquila as part of its QoS scenario to target investment not at under-grounding but at refurbishment of the small section conductor overhead. This would be at a cost of £16m and provide improved CI and CML measurements.

- A forecast of under grounding in AONB and National Parks has been estimated to be in the order of £620m. However Aquila has indicated their unwillingness to support this investment on the basis that it provides minimal customer improvement. It has also indicated that an Amenity programme could be developed to address specific locational issues associated with 'special areas'. Aquila has proposed a programme that would deliver targeted amenity value. The cost of this targeted programme is £6.5m. Little detail is available to support this programme. The company has indicated throughout the submission that under-grounding would not yield significant network improvement when this option is married to under-grounding in NP or AONB areas the company recognizes that the economics of the proposal do not stand scrutiny.

2.3 DNO alternative case

Aquila has indicated that a further £6m is included in the DNO Alternative case over and above the Base Case for wayleave terminations. In total the wayleave forecast expenditure is £28m. Overall the level of capital expenditure incurred by Aquila due to wayleave terminations is in excess of the average observed across the industry. The level of increase above DPCR3 requires additional supporting information.

A forecast of £18m has been made for environmental improvements. This is primarily focused on fluid filled cable leakage control and transformer losses as well as previously mentioned provision for amenity improvements. Those activities which are additional to amenity improvement scenario sum to £11.8m. The oil leakage expenditure is almost entirely driven by cable replacement which sums to £9.4m. The volume proposed is a low percentage of the total asset class population.

Environmental improvement based on additional capital expenditure associated with low loss transformers fails to recognise regulatory benefit. Therefore the £1.9m allocated to this investment may after allowance for benefit through regulatory incentive is likely to be in the order of £0.7m.

Expenditure on distributed generation has not been included in this alternative business case.

3. PB POWER MODELLING AND COMPARISONS

3.1 Introduction

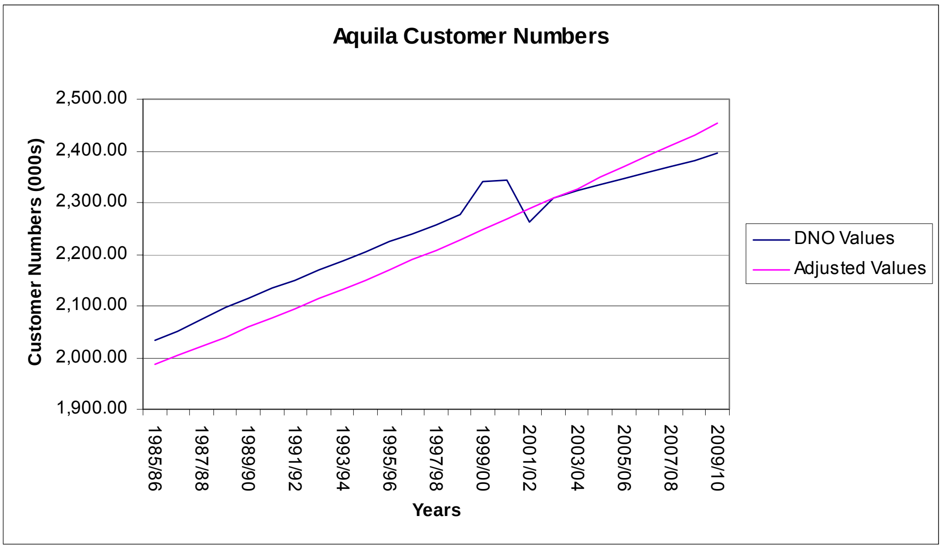
PB Power has carried out modelling of forecast expenditure using both DNO data and PB Power data with a view to understanding better how DNOs have arrived at forecast expenditure and with a view to informing Ofgem of issues that may be considered in arriving at allowances for DPCR4. It is not intended that the models themselves should be used to predict an allowance.

Detailed descriptions of the models are provided in Appendices D, E and F and the following sections discuss the validation and adjustment of the input variables and the model outputs.

3.2 Load related expenditure

3.2.1 Model inputs

Aquila customer numbers appear to have a significant decline between 1998/99 and 2002/03; this has been considered as a stepped reduction. To remove this PB Power has applied a growth rate of 0.88% working back from 2002/03. The growth rate has been calculated as the average growth between 1986/87 and 1998/99. Also Aquila's forecast of customer number growth is lower than its historic average and therefore for modelling purposes has been increase to represent past growth.



A review of the DNO HV & LV load forecast has been carried out as part of the Load Related Expenditure modelling. No adjustments have been made to the Aquila forecast of units distributed and so Aquila's data has been used in the model.

3.2.2 Model outputs

The following table sets out the model output compared to the actual DPCR2 expenditure, the actual and forecast DPCR3 expenditure and the DPCR4 submission.

Table 3.1 - Load-Related Expenditure Model Outputs

LRE DPCR2 (excluding generation)	LRE DPCR3 (excluding generation)	Submitted LRE Gross DPCR4 (excluding generation)	Model Output LRE for DPCR4
(£m)	(£m)	(£m)	(£m)
273	236	262	**230**

3.2.3 Load related expenditure modelling comments

Aquila's forecast expenditure is higher than both DPCR3 projected outturn and the output of our load related model. The output of the model indicates that Aquila's forecast is high relative to the forecast increase in units distributed.

We have commented earlier that Aquila's forecast reinforcement expenditure is in excess of that required to comply with Base Case guidelines and that a particular single scheme (Nechells) may be deferred beyond DPCR4.

PB Power has based its view on the level of the load-related expenditure allowance using information supplied by Aquila both in the submission and at meetings with the company. The modelled output has also informed our view and indicates that the level of allowance for DPCR4 gross load-related expenditure should be set at £230.1m. However the model is a guide and, based on the DPCR3 allowance and projection, it would appear inappropriate from a technical perspective to recommend an allowance that is less than the net DPCR3 projection.

Accordingly the proposed allowance level of £246m for DPCR4 gross load-related expenditure has been derived after allowing for adjustment to the site-specific schemes tendered by Aquila and for reduction in the forecast expenditure to correct for a change in the company's risk position.

3.3 Non-load related expenditure

3.3.1 Model inputs

No specific model input adjustments were made for Aquila.

With minor exceptions, assets were modelled on an age based replacement profile basis.

3.3.2 Model outputs

Table 3.2 below provides a comparison between the DNO submission and the model output for the main asset classes.

Table 3.2 - Comparison of NLRE Model Outputs with DNO Submission (£m)

Submission	FBPQ Table 26	Adjusted submission	Combined	Adjusted submission	Model output	Bench-marked output	PB Power Opinion
Lines	129.4	123.0	Lines & services	146.0	131.6	141.7	
Cables	57.4	54.6	Cables & services	61.5	49.2	41.2	
Transformers	19.2	18.2	Substations	152.9	180.8	152.9	
Switchgear	108.0	102.6	Part Submission Total	360.4	361.5	335.7	
Services and Lines	31.5	29.9					
SMC	0.0	0.0					
Other Substations	33.7	32.0					
Other Not Modeled	0.0	0.0	Other Not Modeled	0.0		0.0	
Total	379.1	360.4	Total	360.4		335.7	319.2

3.3.3 Non-load related expenditure modelling comments

The model generates a lower overall non-load related allowance than the company's submission. However once adjustments to the submission are made for ESQCR (£17.6m), an accelerated programme to replace LV bare conductor lines and services (£14.0m) and the high level of replacement of LV Consac cable (£10m), then the modelled output supports that adjusted position. The adjustments also reflect those asset classes that are constrained by the benchmarked modelled output, in particular, lines and services, cables and services. No constraint on substation expenditure occurs and therefore the company's submission is reflected in the modelled output in full. Within the cables and services asset class LV cable accounts for the majority of the difference between the modelled output and submission this variance is driven by both price and volume. This reflects the higher than–industry-average forecast level of replacement of LV Consac cable.

In PB Power's opinion, the allowed non-load related expenditure corresponding to the model output should be £319.0m. This amount excludes ESQCR expenditure, diversions, metering and fault capital expenditure. Furthermore ESQCR expenditure has been excluded from the overall total as this matter is being considered separately.

3.4 PB Power's opinion of allowances

Our findings are summarised in the table below.

Table 3.3 – PB Power's Opinion of Allowances (£m)

Item	Adjusted DPCR 3 Projection	Adjusted DPCR4 Forecast	Model Output, benchmarked	PB Power Opinion
Gross Load Related	**235.8**	**261.8**	**230.1**	**246.0**
Non Load Related	**337.0**	**486.2**		**444.1**
Gross Capex less Non Op Capex	**572.7**	**748.0**		**690.1**
Non Op Capex (Not Assessed)	11.0	**-**		0.0
Total Gross Capex	**583.7**	**748.0**		**690.1**
Contributions	-130.8	-141.8		-141.1
Net Load Related	**105.0**	**120.7**		**104.9**
Total Net Capex	**453.0**	**606.9**		**549.1**
Non Load Related Summary				
Replacement		310.9	**335.7**	
ESQCR		17.5		
Heath & Safety		29.8		
Environment		0.3		
Sub Total - Model Comparison	**209.2**	**358.5**		**319.2**
Diversions	17.1	22.8		20.0
SCADA	4.8	0.3		0.3
Sub Total	***231.2***	***381.5***		***339.5***
Metering (Not Assessed)	40.2	40.8		40.8
Sub Total	**271.4**	***422.4***		**380.3**
Fault Capex (Not Assessed)	65.5	63.9		63.9
Non Load Related Total	**337.0**	**486.2**		**444.1**

Notes:

- Non operational capital expenditure has not been assessed
- Non-load related expenditure modelling covers all non-load related headings except diversions, metering, fault capex and SCADA
- Metering and fault capex are passed through
- Diversions are passed through, where compliant, with the Base Case the same as for DPCR3
- SCADA is separately assessed but not included in the modelling
- PB Power's asset replacement model output and Opinion are based on retirement profile modelling and exclude any additional expenditure that may arise under ESQCR legislation.

APPENDIX A

BASE CASE SUBMISSION

APPENDIX A – BASE CASE SUBMISSION

Aquila has stated that the Base Case submission is predicated on maintaining the fault rate performance constant at 2002/03 levels with no additional expenditure being incurred on Quality of Supply initiatives or major operational changes. The Base Case Projected Capital Expenditure follows the Ofgem FBPQ guidelines and is summarised as follows:

A.1 Actual and forecast capital expenditure projection for DPCR3

In the table below we present the actual and forecast capital expenditure projection for DPCR3. The net load-related expenditure for the period is £120.4m and overall gross capital expenditure £617.1m.

Table A.1 - Actual and Forecast Capital Expenditure Projection for DPCR3
(£m at 2003/2003 prices)

	← Actual →			Forecast		Total
	2000/01	2001/02	2002/03	2003/04	2004/05	
Capital Expenditure						
Load Related	38.4	50.9	57.5	57.6	54.3	258.7
Capital Contributions	(19.5)	(23.4)	(32.2)	(32.3)	(30.9)	(138.3)
Non Load Related	55.5	65.3	72.3	74.4	79.9	347.4
Non-operational capex	7.0	4.0				11.0
Total Capital Expenditure	80.9	96.9	97.6	99.7	103.3	478.4

A.2 Base case capital expenditure forecast for DPCR4

The Base Case Capital Expenditure Forecast for DPCR4 follows the Ofgem FBPQ guidelines and is summarised as follows:

Table A.2 - Base Case Capital Expenditure Forecast for DPCR4
(£m at 2003/2003 prices)

	← Forecast →					Total
	2005/06	2006/07	2007/08	2008/09	2009/10	
Capital Expenditure						
Load Related	58.1	57.8	55.5	53.6	51.9	276.9
Capital Contributions	(30.4)	(30.5)	(30.5)	(29.0)	(28.8)	(149.2)
Non Load Related	98.3	102.3	102.0	104.6	102.9	510.1
Non-operational capex						
Total Capital Expenditure	126.0	129.6	127.0	129.2	126.0	637.8

Note that the above figures presented in both tables are without normalisation.

Aquila's approach to forecasting the capex projections is broadly consistent with that requested by Ofgem such that only the minimum expenditure necessary to maintain existing performance standards. As such the Base Case does not include expenditure necessary to connect distributed generation, improvements in Quality of Supply, amenity or additional under-grounding of overhead lines.

Although Aquila's approach has been to comply with the objectives set for the Base Case submission, that submission has sought to address longer-term network risks based on a broad based risk management approach. Such an approach has sought to limit network and business risk through two main vehicles:

i. to reduce the current level of network risk associated with the number of substations that are currently operating above their firm capacity, therefore requiring load transfers under outage conditions; and

ii. to reduce the risks associated with managing asset replacement in the future assuming that this need will materialise in accordance with Aquila's current replacement age profiling expectations.

Aquila has also made allowance within its submission for certain issues not driven explicitly by either reinforcement or replacement need. These external expenditure influences, such as ESQCR, have contributed to an increase in the expenditure allowance sought by Aquila. Assessment of additional expenditure activities, such as ESQCR and lane rental, will form the basis for a separate assessment.

Gross load related expenditure is relatively stable over the two price review periods with the expenditure level in DPCR4 reflecting similar expenditure levels to that during the mid to latter part of DPCR3. In certain areas Aquila has deviated from the requirements set out in the Base Case by increasing expenditure resulting in an improvement to the network and management thereof. This reduction in risk has therefore been over and above that associated with maintaining performance or fault rate constant throughout the DPCR4 period.

A.3 Base case

The Base Case submission for each main expenditure class disaggregated by network type and activity has been identified by Aquila and is reproduced below in table A.3.1 below:

Table A.3.1 -Expenditure class by sub-asset or activity

(£m)

Cost Element	**Forecast cost**					
						DPCR4
	2005/6	**2006/7**	**2007/8**	**2008/9**	**2009/10**	**Total**
New connections						
New connections	30.4	30.5	30.5	29	28.9	**149.3**
Reinforcement	11.9	12.3	11.8	11.5	11.2	**58.7**
Generation	0.5	0.4	0.4	0.4	0.4	**2.1**
Customer Contributions	-30.4	-30.5	-30.5	-29	-28.9	**-149.3**
New connections total	**12.4**	**12.8**	**12.2**	**11.9**	**11.6**	**60.9**
Reinforcement						
Primary network	13.3	12.6	10.6	10.6	9.5	**56.7**
Secondary network	1.2	1.2	1.4	1.3	1.3	**6.4**
Reinforcement total	**14.6**	**13.9**	**12**	**11.9**	**10.8**	**63.1**
Replacement						
Primary Network	31.8	29.1	24.3	26	21.7	**132.8**
Secondary Network	53.9	60.4	64.9	65.9	68.3	**313.2**
Replacement total	**85.6**	**89.5**	**89.2**	**91.8**	**89.9**	**446.3**
Legislative compliance						
ESQC Regulations	4.6	4.6	4.6	4.5	4.5	**22.9**
Legislative compliance total	**4.6**	**4.6**	**4.6**	**4.5**	**4.5**	**22.9**
Metering total	**8.9**	**8.9**	**9**	**9**	**9.2**	**45**
Total cost	**126**	**129.6**	**127**	**129.2**	**126**	**637.8**

Comments on the above are provided in this appendix.

A.3.1 Projections of future load related capex

Table A.3.1.1 provides a disaggregation of the total DPCR4 load related expenditure. This forms the basis of subsequent discussion.

Table A.3.1.1: - Load-related capital expenditure disaggregation (£m)

Cost Element	Forecast cost 2005/6	2006/7	2007/8	2008/9	2009/10	DPCR4 total
New connections						
New connections	30.4	30.5	30.5	29.0	28.9	**149.3**
Reinforcement	11.9	12.3	11.8	11.5	11.2	**58.7**
Generation	0.5	0.4	0.4	0.4	0.4	**2.1**
Customer Contributions	- 30.4	- 30.5	- 30.5	- 29.0	- 28.9	**- 149.3**
New connections total	**12.4**	**12.8**	**12.2**	**11.9**	**11.6**	**60.9**
Reinforcement						
Primary network	13.3	12.6	10.6	10.6	9.5	**56.7**
Secondary network	1.2	1.2	1.4	1.3	1.3	**6.4**
Reinforcement total	**14.6**	**13.9**	**12.0**	**11.9**	**10.8**	**63.1**
Total cost (Gross)	**57.4**	**57.2**	**54.7**	**52.8**	**51.3**	**273.3**
Total cost (Net)	**27.0**	**26.7**	**24.2**	**23.8**	**22.4**	**124.0**

A.3.1.2: Network reinforcement

The demand forecast has been undertaken at a substation level with local economic indicators and known schemes used to inform load growth projections. The assessment of P2/5 compliance has been undertaken through a review of primary substation loading following a circuit outage and load transfer capabilities. As such, projections of reinforcement based on this approach are consistent with expenditure necessary to ensure P2/5 compliance. The only reservation with regard to this approach is that expressed earlier in terms of the lowering in risk acceptance by Aquila. Reinforcement occasioned through fault level issues has been approached at site level for the primary network. Modelling using a proprietary software package has been employed to identify fault level issues taking due regard of asset specific technical characteristics at each substation.

The level of reinforcement expenditure disaggregated between primary and secondary network during DPCR3 and DPCR4 is detailed in tables A.3.1.2 and A.3.1.3.

Table A.3.1.2: - DPCR4 Analysis of reinforcement expenditure by voltage level

Voltage Level	DPCR4 (£m) 2005/6	2006/7	2007/8	2008/9	2009/10	Total
132kV	5.7	7.2	6.7	6.3	6.1	**32.0**
66 & 33kV	7.5	5.6	4.0	4.4	3.4	**24.9**
11kV	0.4	0.4	0.4	0.3	0.3	**1.8**
LV	0.8	0.8	1.0	1.0	1.0	**4.6**
Total	**14.4**	**14.0**	**12.1**	**12.0**	**10.8**	**63.3**

Table A.3.1.3- DPCR3 Analysis of reinforcement expenditure by voltage level

(£m)

Voltage Level	DPCR3 (£m)					
	2000/1	2001/2	2002/3	2003/4	2004/5	Total
Primary	3.9	6.3	9.2	10.1	11.5	**41.0**
Secondary	2.5	3.6	2.7	3.0	1.9	**13.8**
Total	**6.4**	**9.9**	**12.0**	**13.1**	**13.3**	**54.8**

Aquila has forecast that, of the 250 Primary substations that are part of the primary distribution system, around 69 of these substations are forecast to have demands in excess of the plant firm capacity rating. When considered alongside reported change to the load characteristics of the substations, the excess demand acts to constrain the available cyclical loading. This situation further exacerbates the affect of demand overload.

During the DPCR4 period Aquila intends to reduce the number of 'at-risk' substations from 16% (39 sites) to 8% (21 sites).

This expenditure appears not to be in keeping with Ofgem's Base Case assumptions. However, Aquila has indicated that in order to maintain network resilience in terms of continued operational integrity of the network then the requirement to reinforce these substations is a clearly identified need. The network has been adequately managed during DPCR3 and given that the load growth on the network is low then additional expenditure to limit risk is difficult to sustain within the guidelines set for the Base Case. It would appear more appropriate that such expenditure should be allocated to the DNO Alternative scenario and considered within that framework.

Aquila since 1990s embarked upon a system strategy of replacing large sections of the 33kV network with 132kV distribution utilising 132/11kV transformation. While this approach provides economic saving in terms of asset provision and maintenance it is less flexible in terms of accommodating over-firm capacity substations due to lower levels of interconnection and hence constrained load transfer capability. This network configuration has therefore contributed to the primary reinforcement need.

The extent to which 'at-risk' is based on both duration and capacity measurements has not been demonstrated.

Grid and primary network expenditure consists of site-specific schemes. Aquila has indicated that this work comprises of approximately 55 projects and addresses the risk at 18 primary sites including a joint NGT transformation points. Examples of typical projects are:

- Bishops Wood £4.9m reinforcement due to switchgear short-circuit rating limitations. This is also a joint NGT site where opportunity for asset replacement has been taken. Total project cost £7.3m. Programmed commissioning date 2008 – 2009.

- Ironbridge – Halesfield New 132kV Overhead line and transformers £2.2m. Programmed commissioning date 2006.
- Kenswick 66kV substation reinforcement £1.5m. Programmed commissioning date 2010.
- Whitfield 132kV substation reinforcement £2.5m. Programmed commissioning date 2010.

At the interface with NGT, reinforcement is proposed at Bishops Wood. This specific scheme is budgeted at £7.3m in total of which £4.9m is allocated to reinforcement, with the remainder classed as replacement. This is a co-ordinated development with NGT and as such the probability of the scheme proceeding increases. A review of any NGT contracts has not been undertaken. In addition the principle reinforcement need is due to overstressed switchgear that alongside NGT joint development suggests that the probability of proceeding should be regarded as high.

The profile of grid and primary expenditure indicates that the overall work programme is front-end biased with over 50% of the schemes completed in the first two years of the price control and 80% by the close of year three. This profile tends to provide greater certainty that the individual proposals will proceed based on the lead-time associated with schemes of this nature as well as the greater certainty that exists within the data used to support the decision-making process.

The reinforcement of the secondary network is minimal by comparison to that proposed for the primary network. In that regard, given that it is significantly less than that required during DPCR3, no further comment is made.

A.3.1.2New connections forecast expenditure

Aquila has derived a forecast increase in metering points as a proxy for customer numbers. This increase is identified as 0.5 percent compound during the course of DPCR4. This rate of increase is less than that forecast at DPCR3 and also less than average national customer growth rate. Aquila has advised that the basis of the forecast in domestic and non-domestic customer numbers as well as demand is based upon a mix of regional development plans and economic indicators. Forecast expenditure attributable to this business driver is not regarded as an issue.

A.3.2 Projections of future non-load related capex

The amount of non-load related expenditure projected by Aquila for the Base Case Scenario is set out be main expenditure type in table A.3.2.1 below. The main expenditure items are dealt with separately within this section.

Table A.3.2.1 - Forecast Disaggregated Non Load Related Expenditure

Expenditure Classes	Non-Load Related (£m)					
	2006	**2007**	**2008**	**2009**	**2010**	**Total**
Non Fault Replacement	62.5	65.8	65.8	68.6	67.1	**329.7**
Metering	8.1	8.2	8.2	8.3	8.3	**41.0**
Fault Capitalisation	13.2	13.3	13.2	12.9	12.9	**65.5**
Diversions	5.0	5.0	5.0	4.6	4.5	**24.2**
Health and Safety	9.4	9.9	9.9	10.2	10.1	**49.4**
Environmental	0.2	0.2	0.2	-	-	**0.5**
Total	**98.3**	**102.3**	**102.2**	**104.6**	**102.9**	**510.4**

A.3.2.1 Environment, health and safety expenditure

Aquila has identified approximately £50m of capital expenditure required to address specific Environmental, Health and Safety issues. The majority of that forecast expenditure, some £49.4m, is targeted at Health and Safety issues. The environmental expenditure within the Base Case is targeted at maintaining Aquila's existing programme of oil retaining bund walls and pumps. This level of expenditure is not material.

Compliance with ESQCR is included within the health and safety classification and is forecast to require an additional expenditure of £18.5m during DPCR4. The constituent elements of that programme are set out in Table A.3.2.2 below:

Table A.3.2.2 - ESQCR expenditure build up

ESQCR Applicable Regulation	Issue	DPR4 Forecast Expenditure (£m)
Regulation 18	Overhead Line LV Line ordinarily accessibility	13.0
Regulation 18	Overhead Line LV Services ordinarily accessibility	
Regulation 19	HV and LV Safety Signs	1.6
Regulation 20	Overhead Line Stay Wire insulators HV and LV	3.9
Total		18.5

Within non-load related expenditure forecast, a provision has been made for a replacement of overhead services and LV bare conductor replacement programme. It is highly likely that savings may be realised due to replacement of end-of-life assets that are also ESQCR non-compliant. Replacement of stay wires (£3.9m) is another activity where opportunities for saving through the application of a co-ordinated approach addressing the needs of the forecast overhead line programme and ESQCR demands may result in a reduced capital expenditure need.

At present the estimate of the impact attributable to ESQCR is based on a high-level assessment. Savings that may be delivered through a targeted replacement programme for both overhead lines and services are only likely to be identified following further detailed assessment once an agreed programme of works is developed. It is acknowledged that ESQCR may in most instances not be the principal driver and therefore the ability to deliver the replacement programme coincident with avoidance of additional ESQCR expenditure may not always be possible. It is also recognised that following network risk assessments that large elements of the ESQCR expenditure may not be required.

It is our opinion that a combination of risk-assessment and targeted replacement may result in the majority of the overhead line accessibility related expenditure being avoided.

It is recognised that further discussion between DTI and Ofgem and individual DNOs is required in order to determine an agreed position across the industry on this issue

Aquila has not separately identified, other than ESQCR, the remaining expenditure drivers that contribute to the overall Health and Safety allocation. Although it has indicated that the company intends to replace LV network pillars, link boxes and assets that are regarded as operationally restricted, such as HV switchgear; GEC KN and KB oil circuit breakers and Air Break Switch Disconnectors (ABSD). ABSD replacement is recognised to be an industry wide safety issue. The final solution to this issue namely full replacement or modification may result in a saving to that forecast by Aquila, however this is not seen as a material item. LV Pillars are reported as being both an operational and public safety issue. Condition reports on this matter have been compiled by Aquila. The need for replacement does appear to be an issue, although the volume and manner by which the units intend to be replaced is not so certain.

A.3.2.2 Asset replacement

Aquila has submitted increases in its capital expenditure forecast compared to DPCR3 allowance levels. An indication of the level of increase by secondary and primary network is set out in Table A.3.2.3 below:

Table A.3.2.3 - Comparison of asset replacement expenditure DPCR3 and DPCR4

Voltage Level	DPCR3 (£m)					
	2000/1	2001/2	2002/3	2003/4	2004/5	Total
Primary	17.8	25.5	24.4	20.9	23.0	**111.6**
Secondary	27.1	30.4	35.5	43.5	47.7	**184.3**
Total	**44.9**	**55.9**	**59.9**	**64.5**	**70.7**	**295.8**

Voltage Level	DPCR4 (£m)					
	2005/6	2006/7	2007/8	2008/9	2009/10	Total
Primary	31.8	29.0	24.3	26.0	21.7	**132.8**
Secondary*	30.7	36.8	41.5	42.6	45.4	**197.0**
Total	**62.5**	**65.8**	**65.8**	**68.6**	**67.1**	**329.8**

*Secondary expenditure is derived from total non-fault related expenditure set out in the above table less the primary expenditure line.

The following table provides an indication as to the volume of assets, both primary and secondary, that are forecast for replacement during DPCR4. The sample listing below indicates that, in general, the modelled output undertaken by Aquila contributes to the forecast programme with certain key exceptions:

- 11kV Overhead ABSDs
- 11kV Overhead line replacement/refurbishment
- 132kV gas circuit breakers
- 132kV Overhead line
- 33kV isolators

In the case of those assets identified above the modelling does not form the main part of the asset replacement assessment but rather replacement is driven by more immediate issues associated with safety, performance or asset specific condition reports.

Table A.3.2.4 - Volume replacement activity for Primary Network Assets

Asset	Aquila modelled volumes	Aquila proposal volumes	Units
Transformers			
11kV pole mounted	1,030	1,030	units
33kV ground mounted transformers	7	-	units
Switchgear			
11kV overhead ABSD	620	2,670	units
11kV switches (excluding RMU & CB)	2,670	2,670	units
LV link boxes	2,750	2,750	units
132kV gas circuit breakers	-	32	units
33kV isolators	100	7	units
Overhead lines			
11kV bare conductor	1,920	2,580	km
11kV refurbishment	5,420	3,700	km
LV services – covered conductor	940	230	km
132kV refurbishment	Not modelled	222	km
66kV double circuit	55	-	km
Underground cables			
LV mains – PILC	-	-	km
LV mains – Consac	260	260	km
LV services – PILC	-	-	km
132kV underground cable	14	20	km

A.3.2.2.1 Forecasting methodology

Aquila has explain in the submission that the asset replacement programme of work is intended to address condition, safety, environmental, and future age profile concerns by a risk-managed approach to targeting, prioritising, and optimisation of timing of replacement. This approach is addressed in two ways.

1. An asset replacement model based on condition inspection and monitoring data is used to inform life expectancy of the modelled assets. This approach is also informed by operational restrictions and performance reports. Such modelling tends to be long term in nature and more readily focused on large volume assets. Primary assets although modelled for longer-term replacement profiling are more accurately addressed due to the lower volume on an asset-by-asset basis.

2. Short-term forecasting: defined as a one to five year forecast horizon is developed on a more specific basis using recent and historical condition information to prioritise and target replacement activity. This applies to both primary and secondary assets. This short-term horizon acts to avoid double counting between load related and non-load related expenditure demands. This is particularly appropriate to scheme specific replacement as indicated by the Bishops Wood proposal.

The asset modelling both long and short-term is considered across all asset classes.

A review of the material differences between life expectancies adopted by Aquila and those of an independent UK study is shown in Table A.3.2.5. This information is provided by Aquila to support their argument that the modelled asset lives, for secondary and primary networks, used by the company are, in general, in excess of those adopted by the industry. On average the increase in asset class modelling parameters is in the order of 10% to 20%. The replacement volumes where matched to condition reporting do provide a robust basis for long-term forecast replacement.

Table A.3.2.5 - Material asset life detail between Aquila and UK independent study

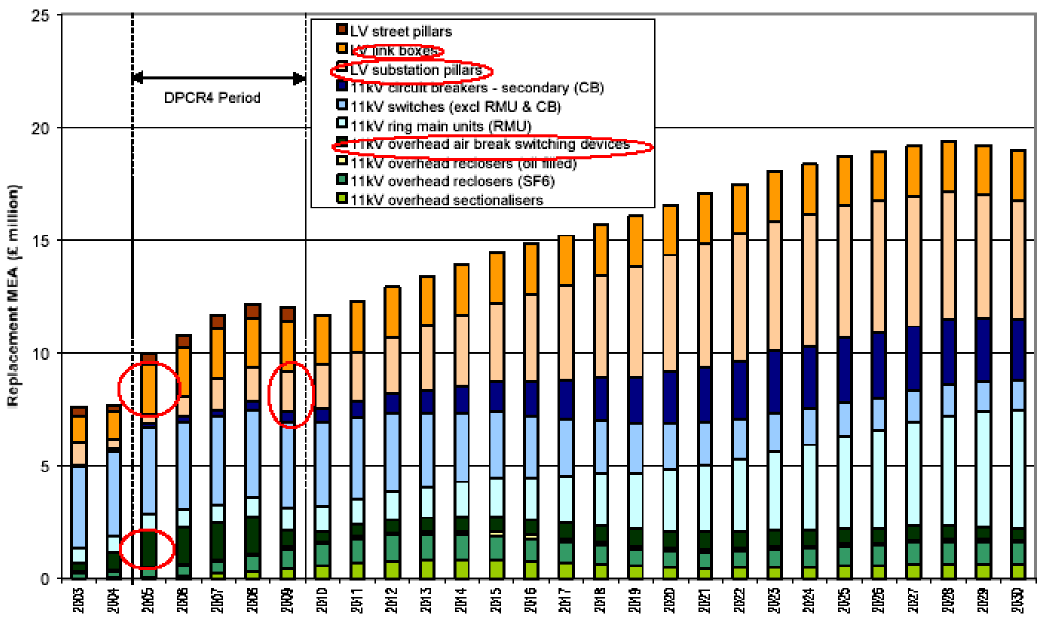
Asset	UK study		Aquila	
	Mean replacement age	Standard deviation	Mean replacement age	Standard deviation
Transformers				
11kV ground mounted transformers	54.0	8.6	70.0	8.4
132kV power transformers	60.0	10.0	55.0	7.4
66kV power transformers	51.0	8.1	60.0	7.4
Switchgear				
11kV circuit breaker (indoors)	51.0	5.0	60.0	7.7
SF_6 switch (outdoors)	45.0	5.0	40.0	6.3
132kV circuit breakers (outdoor)	51.0	5.0	45.0	6.7
33kV circuit breakers (outdoor)	44.0	5.0	60.0	6.7
Overhead lines				
LV mains bare conductor	47.0	10.3	75.0	8.1
LV mains covered conductor	48.0	11.6	75.0	8.1
132kV double circuit	50.0	11.3	60.0	7.7
Underground cable				
LV mains plastic	60.0	19.1	80.0	8.9
66kV underground cable	66.0	16.4	60.0	7.7
33kV underground cable	67.0	15.8	80.0	8.9

Where information that could be used to determine asset lives is not available then replacement modelling has been approached using historical replacement rates with expected life curves adjusted to match the actual replacement levels. This approach has been applied to the replacement rate for network link boxes. This particular asset has been modelled based on an inspection rate of 30%. As a consequence of the inspection and risk assessment a replacement rate equal to 10% of the asset population has been forecast. This approach of adjusting the parameters of the curve to match historical practice for long term profiling would appear an acceptable way forward. The use of shorter-term target and prioritisation of assets based on condition and performance reporting when reconciled to longer-term replacement modelling appears a robust approach.

A.3.2.2.2 Work programmes

In order to identify the main work programme in the context of total activity on the secondary and primary network the model outputs provided by Aquila in their submission are included in this report. These graphical representations of activity are set out in figures A3.2.1 and A3.2.2 below and provide a useful vehicle by which changes in the replacement programme may be readily identified.

Figure A.3.2.1 - Forecast activity for plant on the secondary network (extract from Aquila FBPQ)



The activities circled above represent those areas that are forecast to increase significantly compared to DCPR3. This includes the following asset replacement:

- LV Link Boxes
- LV Substation Pillars
- LV Overhead Air Break Switch Devices

Although not circled the asset replacement activity associated with:

- 11kV switches excluding Ring Main Units and Circuit Breakers is a large volume activity and as such warrants consideration.

LV Link boxes are forecast based on condition inspection reports. As may be noted a stepped increase in DPCR4 compared to DPCR3 does exist. This is attributed by Aquila to increased asset management activity identifying a safety related issue. As such, Aquila has sought to invest £10m in replacement over the period DPCR4. Condition reports on LV Link boxes have indicated that of those inspected 18 percent are in a high-risk state. It is therefore proposed to replace 10% of the asset population in DPCR4. This data forms the basis of the volume forecast. The replacement rate for link boxes is at odds with the industry replacement rate, but is consistent with Aquila's DPCR3 volumes. This difference between industry and company is difficult to reconcile. However, specific asset replacement policy is the responsibility of the company and hence the variance observed may well reflect a different investment focus.

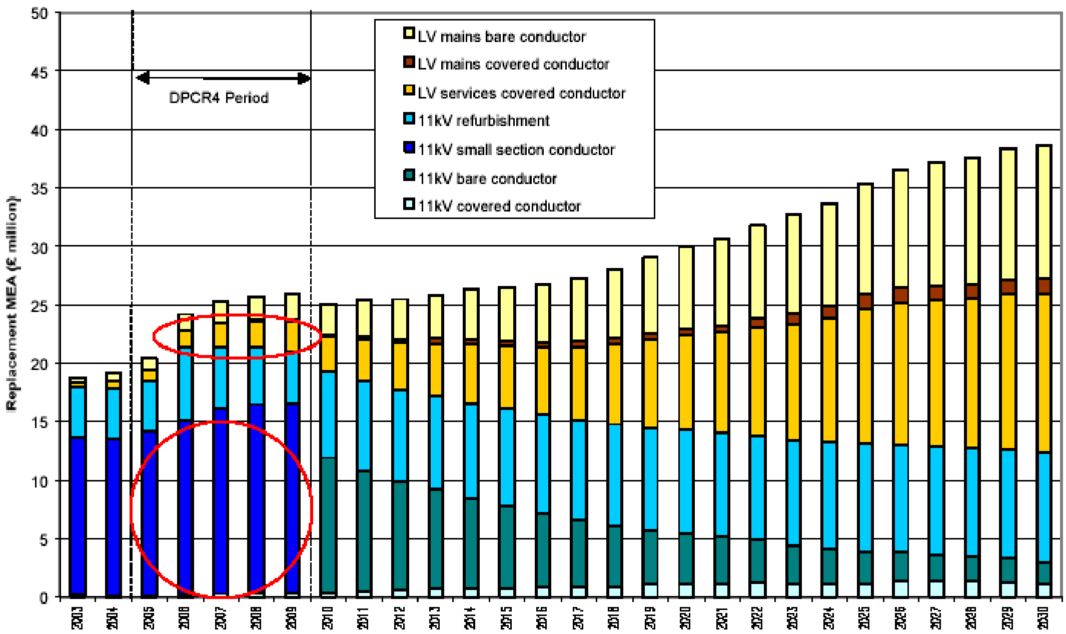
The forecasting of street pillars is similar to that of LV network link boxes. The asset condition reports provided by Aquila support based on safety grounds this replacement. Aquila has ramped up this investment and made provision to replace this asset type with underground network link boxes. This asset is a non like-for-like replacement and more expensive. The argument proposed for this replacement type is based on increase network security. This non like-for-like replacement decision is arguably an enhancement over Base Case however the level of investment deemed appropriate for a particular asset is an individual company decision.

LV Overhead Air Break Switch Devices (ABSDs) are forecast for replacement on safety grounds due to operational restriction. Aquila has advised that it intends to replace all ABSDs in that regard consideration as to what level of replacement is undertaken and the degree to which replacement provides betterment with regard to improvements in system automation may be an issue.

Aquila's asset life parameters for 11kV switches are reported as being in excess of industry level as indicated through the independent UK data provided. The modelled replacement proposed is consistent with Aquila's historical practice and asset condition information. In that regard the replacement volume proposed supported by condition information appears acceptable.

Overhead lines

Figure A.3.2.2 - Forecast activity for overhead line on the secondary network (extract from Aquila FBPQ)



The secondary overhead line programme indicates a stepped increase in DPCR4. This increase is due to work programmes associated with:

- Commencement of LV mains bare conductor replacement
- LV covered conductor
- 11kV bare conductor
- 11kV refurbishment

Aquila has since 1993 conducted a proactive replacement programme aimed at removing small section conductor HV overhead lines from the network. This is consistent with the Baldock Report[1] recommendations with regard to BS1320 construction. It is forecast that this replacement programme will be ramped up during DPCR4 such that all of the overhead line network constructed to BS1320 would be replaced by a more robust construction. This activity will increase network resilience and in that regard influence Quality of Supply measures. However, it is appropriate to note that this investment is not IIP driven but rather network resilience focused. It is recognised that the network is less robust due to this installation type and Aquila has indicated this weakness through reference to storm damage records. Over the DPCR4 period this increased activity is in the order of £7m. This

[1] Baldock Report: Review of Technical Standards for Overhead Lines.

construction is inherently both less reliable and less resistant to storm damage than heavier construction types. Aquila has included within the submission for replacement of this asset type however other DNOs have considered different forms of remedial action to deliver similar network resilience improvements which have proved cost effective. Given that investment proposed is replacement driven then opportunity for saving may exist.

Aquila has indicated that it intends to start replacement of the LV bare conductor overhead line network. This decision appears to be based not on an increase in fault trend or need to maintain network resilience but rather a mix of condition reports and reference to the mean life attributed by Aquila to this asset type compared to that determined by other studies. As indicated in Table A.3.2.4 the average UK mean life is in the order of 48 years. The mean life calculated by Aquila based on current replacement practice is in the order of 75 years. While some degree and form of replacement or refurbishment activity is required the case for a stepped increase in activity of approximately £8m at this review is difficult to support given the submission guidelines issued by Ofgem.

Aquila has forecast to replace 50km of LV services. This replacement is to be undertaken at the same time as LV mains replacement. The replacement need is not based on an increase in fault activity or maintenance of network resilience. The rate of replacement does not appear excessive when compared to the total volume of the asset type some 11,000km. Using UK mean lives and historical replacement rates Aquila indicates that replacement activity for this asset has been low and that this stepped increase in activity is a result of a need to catch-up on previous low replacement rates. However, this is an improvement to the network over and above the Base Case. Aquila has also tied this programme to its LV mains programme and in that regard any shift in replacement activity of that asset may adversely impact on LV service expenditure.

Although replacement is not fault driven it would appear that the previous replacement rate is lower than other industry operators. However, this proposal is difficult to reconcile with the Base Case guidelines and as such appears unsupported on that basis.

The forecast of 11kV refurbishment is set at historical levels of activity and consistent with standard practice for refurbishment of the overhead line network. In that regard, this is considered an appropriate expenditure level.

Underground cables. Cable replacement is dominated by expenditure on Consac replacement. Aquila has forecast an intended replacement of 260km of cable at a cost of approximately £31m. This is supported by an increase in short-term fault trend data. Aquila has indicated that targeted and prioritised replacement of fault cable is the current policy and in that regard proactive Consac cable replacement is not undertaken. The allowance for LV Consac replacement during DPCR3 is projected to be spent by Aquila. Some companies have approached the issue of Consac differently and significant saving in expenditure has been realised by those companies. Aquila has indicated that such an approach is not in keeping with the manner by which it believes the network should be developed. At present the level of investment forecast by the company to address this particular issue is at odds with industry-level investment and hence a level of £31m appears unsupported. Based on industry activity a level of expenditure in the order of £20m appears to be more justified.

It is noted that Aquila claim that the allowance provided has been invested prudently and avoided a proactive cable replacement programme.

Other cable replacement programmes are to be undertaken on a reactive basis. Such an approach is consistent with industry practice and is not regarded as an issue.

Replacement of primary assets. Primary asset replacement is forecast to be £132.8m or 29% of the total replacement forecast. As discussed for load related expenditure this type of investment is scheme specific. Aquila has provided a list of schemes that contribute towards the primary expenditure forecast. Primary schemes are more likely to be subject to price and scope change, or rephasing issues due to changes in the network as more up to date information becomes available closer to the time of investment.

The phasing of the primary expenditure is set out in table A.3.2.6 below. The table also indicates the main primary schemes included in the forecast.

Table A.3.2.6 - Primary Replacement Expenditure and Known Large Projects

	2005/6	2006/7	2007/8	2008/9	2009/10	Total
Primary costs	27.0	24.8	20.7	23.0	19.0	**114.5**
Primary Overheads	4.8	4.3	3.6	3.0	2.7	**18.4**
Total	**31.8**	**29.1**	**24.3**	**26.0**	**21.7**	**132.9**

Aquila has provided high-level 'Need Statements' for a selection of primary schemes. Comments on these Need Statements is, where necessary, detailed below:

- Bishops Wood: This scheme raises concern given both the technical parameters indicated and timing of the proposed replacement in 2008. Specific condition reports have not been provided so no view on this issue can be formed. Condition assessment forecasts and comments undertaken by NGT have been tabled in support of this proposal. This scheme is however part of a joint asset replacement and reinforcement proposal. The reinforcement element proposed to allow replacement of overstressed switchgear and joint development has been commented upon earlier with the conclusion that this scheme should be considered as having a high probability of proceeding. The total scheme cost is £5.9m.

- Boughton Road 132kV: This development is part of the longer-term network reconfiguration embarked upon by Aquila in 1990. The assets are reported as inadequate. No condition report has been provided to support replacement of the 33kV assets in question. Hams Hall is reported as an essential part of the 132kV reconfiguration and as such facilitates replacement or removal of redundant assets elsewhere. The commencement date of 2008 is mid-review in that regard the risk that the scheme may be overtaken by work elsewhere on the network reduces. The total scheme cost is £10.2m.

- Busstleholme 132kV: The Need Statement supports the need for investment although this could arguably be attributed to reinforcement given the expenditure driver is demand growth and short circuit capability of the assets. This is a joint NGT site with a joint commencement date of 2007 and cost of £7.8m. The risk of deferment is also linked to NGT decision to proceed. High probability of proceeding is anticipated.

- Nechells East 132kV: This is jointly owned site where the replacement of NGT assets has been advised through condition assessment. The scheme is tied into 132kV reconfiguration and replacement both under condition and fault levels. The commencement date of 2007 is early-review in that regard the risk that the scheme may be overtaken by work elsewhere on the network is reduced. The risk of the scheme not proceeding is tied to achieving consents associated with installation of cable to the Hams Hall system. If consents can be secured then Aquila has advised that this scheme will no longer be required. While the cable route described is involved negotiations with local authorities, NRA and SRA may well provide consent required. In that regard this scheme is considered to be have a low probability of proceeding. The forecast capital cost of £7.8m may well be avoided.

- Rugeley 132kV: This is jointly owned site where the replacement of NGT assets has been advised through condition assessment. Replacement based on condition assessment is proposed. The commencement date is 2007 at a cost of £4.7m. The risk of deferment is also linked to NGT decision to proceed. A high probability of proceeding is anticipated.

- Banbury 132kV and 11kV: Transformer replacement is proposed to accommodate demand growth. In addition modification to the 11kV assets is required. The commissioning date is 2006 at a cost of £1.5m. This scheme is allocated to replacement but appears may be more appropriately allocated to reinforcement. The risk to the scheme not proceeding is demand growth. However sufficient information should exist now to make this scheme a high probability to proceed.

APPENDIX B

QUALITY OF SUPPLY SCENARIOS

APPENDIX B – QUALITY OF SUPPLY SCENARIOS

B.1 Network performance improvements

In order to achieve the benchmark performance for 2020, set by Ofgem in the guidance to this scenario, Aquila is required to reduce the number of unplanned Customer Interruptions (CI) by over 7% and unplanned Customer Minutes Lost (CML) by more than 11% by 2010, in comparison to the average performance experienced in the last two years

Aquila has assumed that the starting position is the two-year average of 2001/2 and 2002/3 CI and CML performance excluding the October 2002 storm, as used by Ofgem in calculation of the benchmark

Aquila's approach to reviewing the QoS targets and areas for investment is based on analysis of the performance of major elements of the network in terms of CML, CI measurement. That analysis has sought to identify optimum voltage tranche for investment that would yield greatest QoS benefit within the context of other investments being undertaken. This top-down strategy has further identified using Ofgem IIP information issues that may contribute to Aquila QoS performance vis-à-vis other UK DNOs. The investment strategy has therefore led to a number of QoS improvement initiatives being identified based on Aquila's strategy of:

> *'clearly identified approach to the delivery of network service improvements that addresses the causes of interruptions, the number of customers affected and the duration of incidents'*

The initiatives will be based upon:

- reconfiguration of longer HV circuits
- HV network investment to address;
  - rural overhead line spur protection;
  - increased rural remote control coverage;
  - remote control devices in mixed and urban circuits;
  - under-grounding of a limited number of HV overhead line circuits and
  - completion of the small section HV overhead line reconductoring programme.

Aquila has made little comment on achieving the 2020 targets. Any concern that may exist would rest on the ability to extend current network performance improvement strategies based on existing initiatives especially automation and remote control which by 2010 appears to be reaching a fully utilized position.

The programmes of work proposed by Aquila to bring about the network transformation are set out in table B.1

Table B.1 - Proposed programmes of work and associated capital expenditure

	Work volume		Cost		Capital expenditure savings (£ million)	Benefit	
	Amount	Unit	Unit cost (£000)	Cost (£ million)		CI	CML
Network reconfiguration	72.0	circuit	192.5	14.0	-	4.2	3.8
Rural spur protection	95.0	each	3.2	0.3	-	0.8	0.4
Rural remote control	75.0	each	11.0	0.8	-	0.2	0.4
Ground mounted remote control on mixed circuits	175.0	circuit	18.7	3.3	0.2	-	1.8
Urban remote control	235.0	circuit	18.7	4.5	0.3	-	1.8
Ground mounted protection stage on long underground circuits	79.0	each	19.8	1.6	0.3	0.7	0.5
Small section reconductoring	670.0	km	24.2	16.2	-	0.8	0.9
Total				**40.7**	**0.8**	**6.7**	**9.6**

The capital expenditure level of £40.7m is higher than average. This reflects the additional expenditure forecast because of overhead line small section conductor replacement. This initiative provides a low cost: benefit ratio but is part of Aquila's overall strategy to replace this asset type by a more robust construction. Replacement of this asset could be undertaken in DPCR5 as part of non-load replacement with more cost effective QoS initiatives realized in this period. This tends to be evident by the incremental expenditure associated with the improvement scenarios.

The volume of activity proposed for each initiative set out above is, with the exception of rural spur protection, which shows a step down in activity, consistent with programmes of work programme forecast for the 2003 – 2005 period. The programme is also front-end biased with activity reducing towards 2008 – 2010 period. A brief review of each scheme proposed is identified in more detail below:

- Network Reconfiguration: Aquila has identified that longer mixed circuits with more than 2,500 customers connected are associated with poor CI, CML performance. It is therefore proposing to separate underground and overhead sections and thereby limit the impact of overhead faults. This will be achieved through installation of additional 11kV circuit breaker at primary substations and on average 1.5km of associated cable.

This solution has long and short-term benefits in terms of performance it application is however limited and expensive.

- Rural spur protection: This is an extension of an existing programme. The previous programme was based on installation of overhead line reclosers and automatic circuit sectionalizing. The programme is to be rolled-out to suitable spur lines.

This appears a cost effective proposal that delivers QoS and network resilience benefit. However, its application now appears to be becoming exhausted.

- Rural remote control: This is an extension of an existing programme. The previous programme was based on remote controlled overhead line reclosers with graded protection and controlled switching of circuit open points. The programme is to be rolled-out to other suitable lines.

This is a cost effective proposal that delivers QoS benefit. However, its application now appears to be becoming exhausted.

- Ground mounted and urban remote control: This initiative is based on retrofit of remote control devices to existing plant. This initiative is tied to network reconfiguration. It also requires replacement of plant not capable of accepting retrofit devices. In that regard assets that are coincident for replacement will be installed with enhanced technical capabilities.

This is a relatively expensive option that provides QoS and a degree of network resilience benefit.

- Ground Mounted protection on underground cable: The aim of this will be to provide greater sectionalisation of the network through the installation of mid-point circuit breakers.

This is option is limited in application and relatively expensive.

- Small section reconductoring programme: This is consistent with the programme set out in the Base Case. Within the QoS scenario the remaining 20% of overhead line constructed to this specification will be replaced. Construction to a higher specification 50mm AAAC is reported as delivering a substantial reduction in faults per km; typically an improvement of 16.5 faults/km to 5.4 faults/km.

This is a cost effective investment on the basis that it delivers both QoS and network resilience benefit.

Aquila has approached the +/-2% scenario based on increment or decrement of the initiatives identified in the main QoS improvement scenario. The additional cost for a +2% improvement in CI is forecast to be an additional £8.1m. This is delivered through under-grounding short sections of mixed under-grounding – overhead circuits.

This is a relatively expensive option compared to other QoS initiatives. However, it clearly indicates that saving can be realized through application of this initiative with benefit to CI and CML performance at the expense of overhead line small section reconductoring.

The 5% improvement in CML is delivered through additional ground mounted protection and urban remote control schemes. The additional cost is £19.2m. While this is a relatively low cost option the decrease in cost: benefit ratio suggests that the initiative is now reaching its limit in terms of application.

Aquila has forecast an almost symmetrical reduction in forecast capital expenditure associated with a 2% CI and 5% CML reduction compared to the capital expenditure increase for a 2% and 5% improvement. Greater saving would be expected given the generally non-linear nature of the cost: benefit ration of the various QoS initiatives. This tends to be at odds with other DNOs. In each scenario, network reconfiguration has been identified as the initiative that would be curtailed.

B.2 DNO alternative scenario

B.2.1 Description of the scenario

Aquila has provided capital expenditure forecasts related to a number of individual issues within the DNO Alternative Scenario. These have dealt with:

- Resilience Under-grounding;
- Amenity under-grounding;
- Environmental improvement and
- Distributed Generation.

Each of these issues is more fully dealt with in the following text.

B.2.2 Resilience under-grounding

Aquila has forecast capital expenditure of £61.5m as necessary to improve network resilience through under-grounding measures. It has focused this investment on the HV overhead line network given that this is provides more immediate benefit. Table B.1.1 below identifies the volume of activity and capital cost.

Table B.1.1 - Under-grounding activity and capital cost

	2005/6	2006/7	2007/8	2008/9	2009/10	Total
LV network						
Length of LV line (km)	12.6	18.9	25.2	31.6	37.9	**126.2**
Capital expenditure (£m)	1.7	2.5	3.3	4.2	5.0	**16.7**
HV network						
Length of HV line (km)	35.7	53.6	71.4	89.3	107.1	**357.0**
Capital expenditure (£m)	4.5	6.7	9.0	11.2	13.4	**44.8**
Total (£ million)	**6.2**	**9.2**	**12.3**	**15.4**	**18.4**	**61.5**

Aquila has identified that the above selective under-grounding may also cause difficulties associated based on historical performance of mixed circuits in addition possible wayleave termination issues are also cited. Aquila has identified that 110km of the proposed 357kM are driven by the inability to undertake effective vegetation management. In that regard, £13m could be avoided based on Aquila's own estimate. It would be expected that a percentage of the £13m could be saved through negotiation.

Aquila has recognized the subjectivity of identifying overhead lines that are prone to weather related damage. It has also noted the minimal improvement in QoS that results from under-grounding. On that basis, the 357kM proposed would provide a CI improvement in the order of 0.5. The preferred option to achieve this resilience improvement is overhead line construction to EATS 43-40. This is presented in the QoS improvement and provides equal CI and CML improvement of approximately 0.8.

This overhead line initiative would prove more cost effective than the under-grounding option identified.

B.2.3 Amenity under-grounding

Aquila has proposed a minimal amenity capital expenditure forecast of £6.4m. This is principally aimed at under-grounding in AONB and NP areas that is forecast at £5.8m. The company has indicated that investment in this area would not yield customer improvement and in that regard has forecast a provisional sum of £1.2m per annum. The company has indicated throughout the submission that under-grounding would not yield significant improvement when this option is married to under-grounding in NP or AONB areas the company recognizes that the economics of the proposal do not stand scrutiny.

This approach appears a pragmatic way forward with regard to investment options and measured customer improvement.

B.2.4 Environmental improvement

Aquila has indicated that within the Alternative Scenario allowance has been made for Environmental expenditure. This information is set out in Table B.1.2below

Table B.1.2 - Capital expenditure associated with environmental drivers

Cost element	Capital expenditure (£m)	Operating expenditure (£ m)
Electrical losses	1.9	
Leakage reduction	9.7	
Amenity improvement	6.5	
Distributed Generation (DG)		1.0
Total	**18.1**	**1.0**

The £6.5m included within the above has been discussed previous. This appears as a provision for possible expenditure that is not guaranteed to develop. Given that the amenity allowance has little to do with improvement of the network, in so far as that improvement will provide a material benefit to customers, then the £6.5m appears unsupported.

Electrical losses are forecast to require an additional expenditure of £1.9m. The decision to invest in low loss transformers is a company decision taking due regard of regulatory incentive and corporate policy towards environmental issue. The saving of 10GWh over the full DPCR4 period will provide regulatory benefit of approximately £1.2m[1]. This assessment is provided only as a measure of the additional benefit that may flow to the company through current regulatory incentive. This forecast therefore appears at least £1.2m higher than required. The value of corporate environmental policy has not been considered.

Leakage reduction is driven primarily by replacement of fluid filled 132kV and 33kV cables. This accounts for £9.4m. This expenditure is related to less than 10% of the fluid cables installed provide problems and equates to around 5% of the total population. Oil leakage is modifiable event to the Environmental Agency. Depending on the security of supply role of the cable, oil leakage level and voltage then the Environmental Agency may suspend an instruction to eliminate that risk. The replacement activity proposed is a low percentage of the overall fluid filled cable asset base. Aquila has provided detail to support the need for replacement including asset condition reports. The leakage appears to be driven not by failure of the cable joints but crystallization of the lead. It is therefore felt that a technical need for replacement exists.

[1] This calculation is based on loss benefit reducing linearly over a 10 year period. The value of losses has been taken as 3.0 p/kWh. A discount rate of 6.5% has been adopted to discount back the annual benefit over the DPCR4 period.

B.3 Distributed generation

Aquila has made no separate submission for capital expenditure associated with this issue.

APPENDIX C

DNO ALTERNATIVE SCENARIO

APPENDIX C – DNO ALTERNATIVE SCENARIO

C.1 DNO alternative case

The DNO alternative scenario including Base Case is forecast at £766.5m. This includes additional items such as:

Environmental expenditure	£18.5m
Network resilience	£61.5m
Quality of Supply	£40m

In total a further £120m has been identified by Aquila over the Base Case submission.

APPENDIX D

LOAD RELATED EXPENDITURE MODELLING

APPENDIX D – LOAD RELATED EXPENDITURE MODELLING

The methodology used in the modelling of the companies forecast for load related expenditure is based on 3 discreet steps:

- a review of the main investment drivers, growth in customer numbers and units distributed (GWh) over the period to be reviewed;
- a comparison of LRE outturns and projections using Modern Equivalent Asset (MEA) values of the companies total network assets and, finally,
- a benchmarking of the relative evolution of each company's LRE against the those of the rest of the companies which included a representation of relative efficiencies and provides an implicit 'Industry view' on the evolution of LRE.

These issues are further discussed below and consideration is given to the period over which the analysis was carried out. Flow charts for the process showing the derivation and combination of the MEAV/Customer and MEAV/GWh factors are included in the Appendix.

D1.1 Stage 1: Review of growth in customer numbers and Units distributed (GWh)

Load related expenditure is affected by two main drivers, customer connections and demand growth, which underpin the majority of the companies' expenditure forecast associated with the New Business and Reinforcement categories respectively. The importance of these variables on the LRE has been reflected by the companies, many of which receive regular specialist advice for forecasting main economic trends in their distribution area. These forecasts have been presented as supporting evidence for the companies' own projections. The companies have assessed the impact of the overall trends and other external factors beyond their control upon customer connections and demand growth in their elaboration of the projected LRE for DPCR4.

The first stage of the review process was therefore to examine the historical evolution of customer and demand growth and its comparison with the company expenditure projections for the next control period and to make adjustments for modelling purposes as necessary.

D1.1.1 Analysis of demand growth

The companies were asked to submit outturns and forecasts for regulated distributed units at different voltage levels and peak demand including weather corrected (Average Cold Spell, ACS) peak system demand.

Demand growth can be used as a proxy for the overall level of economic activity, which drives new business spend, and is also an indicator of the need to reinforce the system. The data regarding energy growth is comprehensive since it is associated with the Ofgem formula set for the calculation of the regulated revenue of the companies at the start of the present control. Units distributed are generally considered to be a more robust indicator of growth than Maximum Demand.

EHV units are associated with a small number of large customers and are therefore subject to the volatility associated with the activity of a small number of users that, in turn, may have a distorting effect on the observed variability of the company total distributed units. In order to enable a more consistent comparison, the demand growth of HV/LV units only was adopted as an indicator of demand growth.

In order to form an independent view of future demand growth, a review of the comparability between units distributed and a macro-economic indicator (gross value added, GVA) was carried out for each DNO. This analysis is described fully in Appendix E.

Where trend analysis and the independent GVA based view of forecast growth both showed that DNO forecast GWh growth was either higher or lower than anticipated, then the forecast was adjusted by the minimum necessary to match either the trend analysis or the GVA based forecast.

D1.1.2Analysis of new customers

There are large fluctuations in reported customer numbers due largely to changes in reporting following the opening of the retail market (and introduction of Meter Point Administration Numbers in about 1998) and the improvements in customer connectivity reporting under the Information and Incentives Project (IIP) in about 2002. The net effect of these fluctuations is to cause a step increase or decrease in the total number of customers connected to the network. For modelling purposes, we consider it necessary to remove such step changes to reflect the true growth in customer numbers. Profiling the customer numbers before and after the fluctuations and shifting the pre-fluctuation profile to align with the post fluctuation profile achieved this.

Where trend analysis showed that the forecast growth in customer numbers was out of step with historic growth, customer numbers were adjusted accordingly. This was considered particularly appropriate for load related modelling since investment normally lags growth by two to three years and any change in growth in the later years of the review period should not influence the investment required in the period.

D1.2 Stage 2: Benchmarking of LRE using MEA network values

The companies' networks are a reflection of the particular circumstances affecting their areas of supply. These circumstances include not only physical factors, such as geographical location, customer density etc., but also other effects such as company historical design policies, operating practices etc. All these have been historically been built into the existing network and amount to an average network cost per customer which is then specific to each company. As new customers are connected, it can be expected that the additional cost per new customer, over a reasonable period, should approximate to the Modern Equivalent Asset Value (MEA) of the entire network per existing customer. In so doing, the effects of load density or high location-related costs such as underground networks in congested areas are taken into account.

The proposed MEA method is also robust regarding network design policy since all companies work against a common security standard with variations in LPN and SHEPD for network reinforcement. The companies' submissions indicate that the network design does not vary significantly from the requirements embodied in the Licence Security Standard and hence network MEA provides a consistent basis for comparison of the companies.

The procedure followed in the calculation of MEA builds on the information used in the analysis of Non-Load Related expenditure. As part of the Non-Load Related submission the companies were asked to provide age profiles of all the main network assets and a cost database for all the main categories of equipment. The cost data submitted by all the companies was used to inform our own "PBP Cost Database' in order to arrive at an aggregate DNO view of cost levels. Modern Equivalent Asset (MEA) value of the companies' networks was then obtained by cross-multiplying the cost database and the assets database. The results so obtained for the analyses of the LRE are therefore consistent with the figures used in the analysis of NLRE. In order to eliminate distorting variables from the analysis, Generation expenditure is removed from the analysis.

Future expenditure is therefore assessed on a cost per new customer and GWh added compared to MEAV per existing customer and GWh distributed (referred to as the 'Combined Model'); this not only assesses future expenditure compared to past expenditure on a DNO basis but it allows comparisons between companies to be made.

D1.3 Stage 3: Inter-companies benchmarking of LRE projections

The companies forecast of LRE weighted by their relative MEA per customer as indicated above can be benchmarked among the companies using the "prevalent" industry trend. In the analysis undertaken, the prevalent industry trend has been represented by using the median figure in order to arrive at appropriate factors for all the companies. This benchmarking approach is also consistent with the method adopted in the analysis of NLRE.

The overall trend resulted in MEA value per customer below unity. This indicates than on the whole the companies expect to spend on average during the next control period below what they would have spent historically and is justified on the efficiencies already achieved and forecast into the next period. The lower than unity MEA value per customer also tends to indicate the marginal costs of extending an already mature network. These efficiencies are expected to come from procurement, design and better asset utilisation via greater use of network knowledge relating to demand distribution variations over time, plant loading and system risks. Some companies have planned on reductions in their New Business spend through the loss of a significant proportion of new connections business over the next period which has been duly accounted for in the models in respect of forecast expenditure.

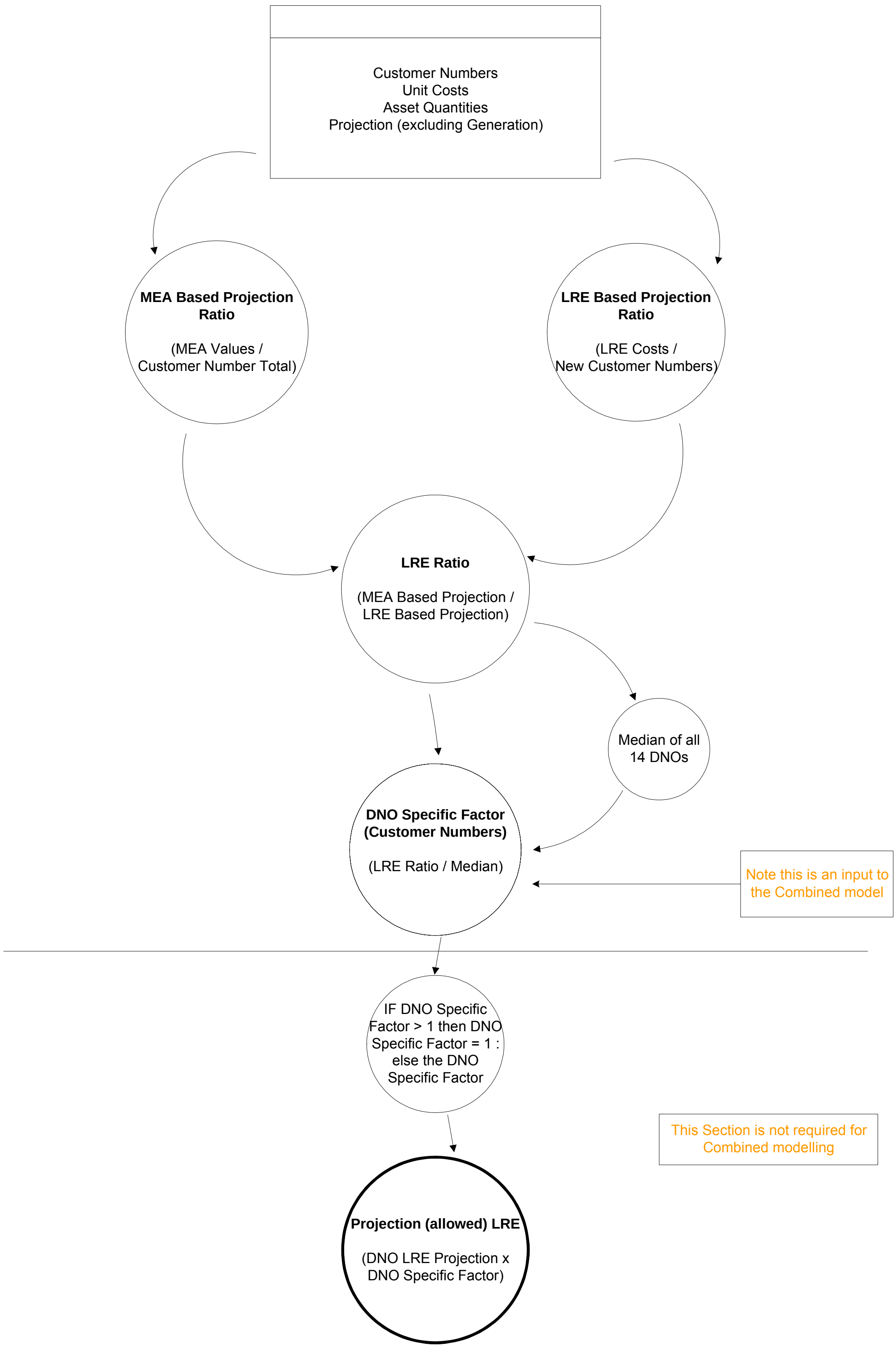
Being benchmarked on a median rather than on an average implies that extremes do not affect the adopted benchmarking position. It also means that the LRE of each company is compared relative to its cost base against the Industry Trend and not in absolute cost terms. This approach recognises therefore the historic cost of distribution within the area of influence of each company and, at the same time, requires the company to drive their costs down in accordance with the prevalent industry trend. In this respect and similarly to the case of Non-Load related expenditure PB Power's view is impartial in that it is the Industry that ultimately sets the trend by which all the companies are measured.

Period of analysis

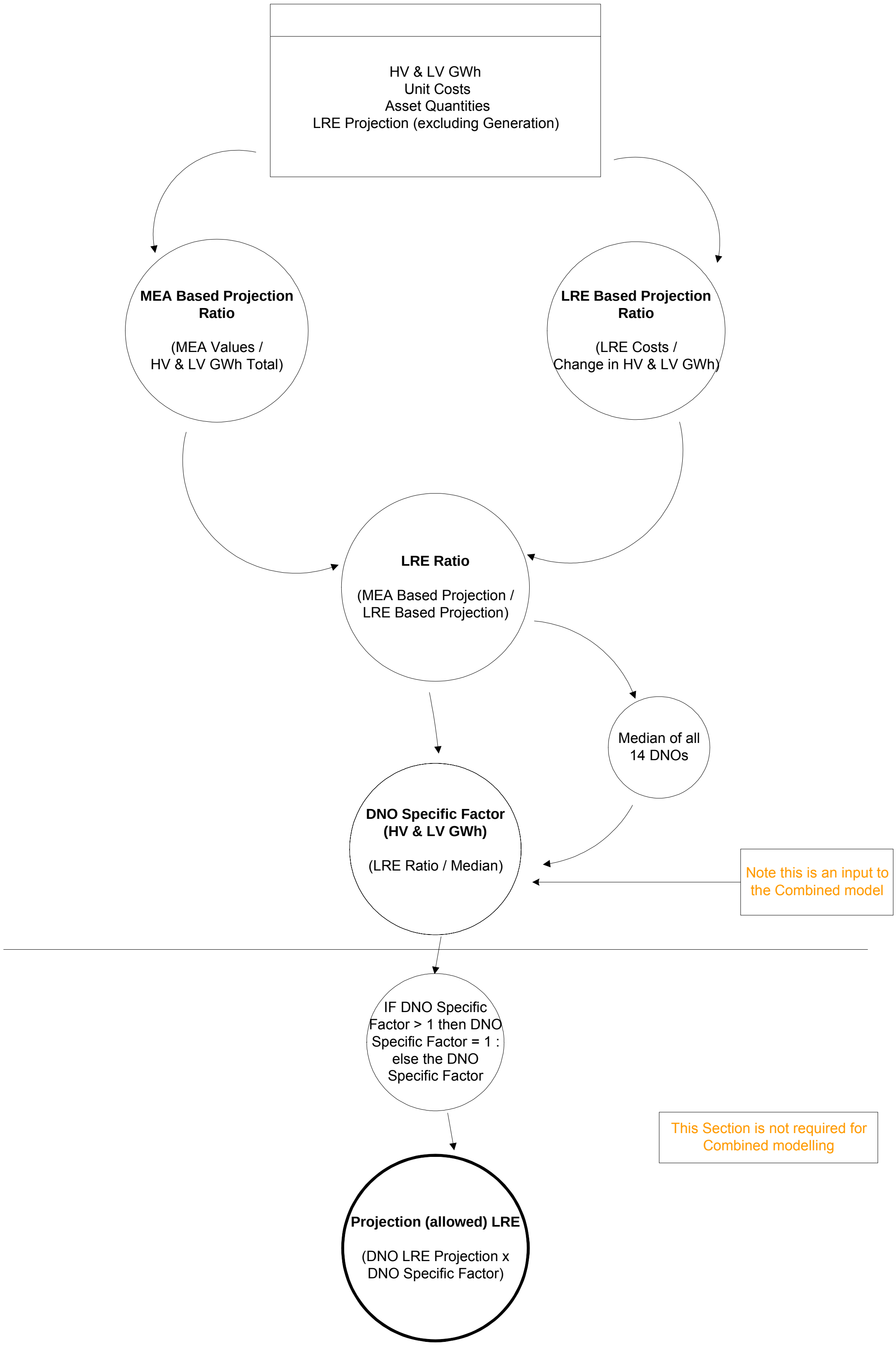
Although each DNO's network is comprised of a large number of smaller networks and that it would be expected that these would have a range of spare capacities depending on local load growth and when individual networks were last reinforced, it is possible that a larger number of the smaller networks would require reinforcement within one regulatory period and fewer in a subsequent period and hence cause a peak in expenditure in one period rather than another.

This issue can be addressed by modelling the expenditure required over a number of review periods and assessing future expenditure requirements by taking into consideration the expenditure already incurred in previous review periods. The modelling carried out in the current review therefore looked at growth and expenditure over DPCR2 and DPCR3 in addition to the forecast growth and expenditure for DPCR4.

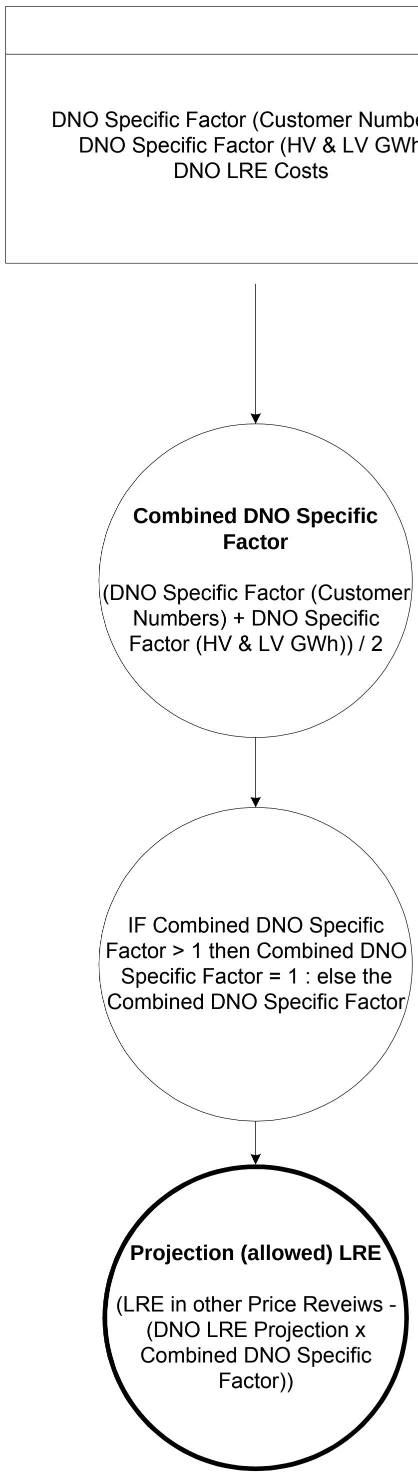
Combined Load Related Expenditure Modelling (Phase 1A Customer Numbers)



Combined Load Related Expenditure Modelling (Phase 1B Load Forecast HV & LV GWh)



Combined Load Related Expenditure Modeling (Phase 2 Customer Numbers & Load Forecast)



APPENDIX E

DEMAND GROWTH ANALYSIS

APPENDIX E - DEMAND GROWTH ANALYSIS

E.1.1 Introduction

The purpose of the review of the load forecasts provided by the DNOs in their HBPQ and FBPQ submissions is to review the consistency of the load forecasts as a comparator for load-related modelling. Three candidate data sets for comparison purposes were provided as part of the key performance indicators (KPIs), namely customer numbers (by voltage), energy or units distributed (GWh, by voltage) and system power demand (MW). A review was subsequently made of the comparability between units distributed and a macro-economic indicator (gross value added, GVA). Only HV and LV units distributed were considered as the trend in EHV units exhibited volatility, often due to changes (reductions) in manufacturing output.

Although strictly power demand should be the direct capacity driver, energy trends are generally considered to provide a more consistent long-term indicator of load growth. System maximum power demand occurs at a single instant and may vary year on year, although maximum demand data is corrected for weather (average cold spell – ACS correction). Energy is however integrated over time and less prone to instantaneous influences. In this case a simple check was also carried out to show that the change in load factor was not a significant issue.

Customer numbers were declared by voltage level, but not by sector (domestic, commercial and industrial) and some of the DNOs stated that since the separation of distribution and supply businesses such (traditional) disaggregation of load data is no longer available to them. (A similar comment has been made by NGC in the 2002 and 2003 editions of its Seven Year Statement.) Consequently a comparison between, say, new housing starts and net increase in LV customer numbers was not possible without disproportionate effort in this instance.

Furthermore discontinuities were found in DNOs' declarations of customer numbers due to changes in reporting following the opening of the retail market (and introduction of MPAN numbers in about 1998) and the improvements in customer connectivity reporting under the Information and Incentives Project (IIP) in about 2002. These discontinuities particularly affected the calculation of net increases in customer numbers. (For analysis purposes a method of deriving a smoothed projection was subsequently derived and is described in the main text of this report.)

As GVA data was more readily available in a form that could be analysed and as units distributed were viewed as a more consistent comparator than customer numbers, the review of load forecasts was confined to a comparison of increases in units distributed with GVA.

E.1.2 Gross value added (GVA)

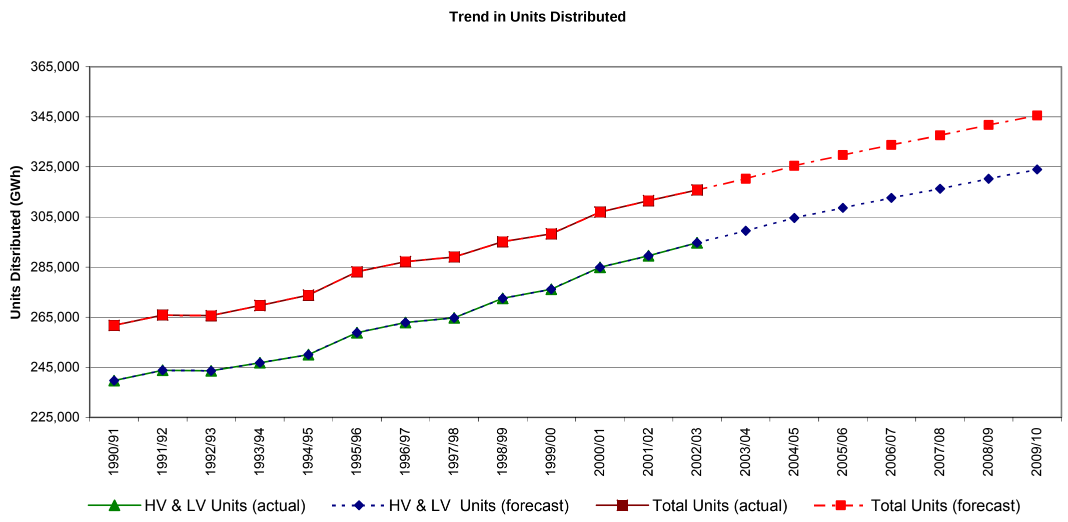
For the purposes of this review, GVA is treated as being synonymous with gross domestic product (GDP). Furthermore Regional Accounts are currently published in terms of GVA1 only. Statistics are published by geographical region in accordance with the Nomenclature of Units for Territorial Statistics (NUTS) classification. NUTS1 covers regions, NUTS2 covers sub-regions and NUTS3 covers unitary authorities or districts. At present NUTS2 data is available for the years 1995 to 2001 and NUTS3 data for 1993 to 1998 only.

In the review NUTS2 headline GVA data on a sub-regional basis was reconfigured to reflect the corresponding GVA per DNO service area. For example the NEDL area GVA was derived as comprising the North East Region and North Yorkshire (part of the Yorkshire and the Humber Region). In other instances where a more detailed disaggregation was required, NUTS3 data was used to indicate the proportioning of GVA by district (for example the disaggregation of Welsh GVA into SP Manweb and WPD South Wales distribution service areas).

As GVAs are published at current basic prices, the GVAs were brought onto a common 2002/03 price basis using the indices in the RP02 "All Items" index.

The trend of energy distributed against time is presented in the chart below.

Trend of energy distributed against time



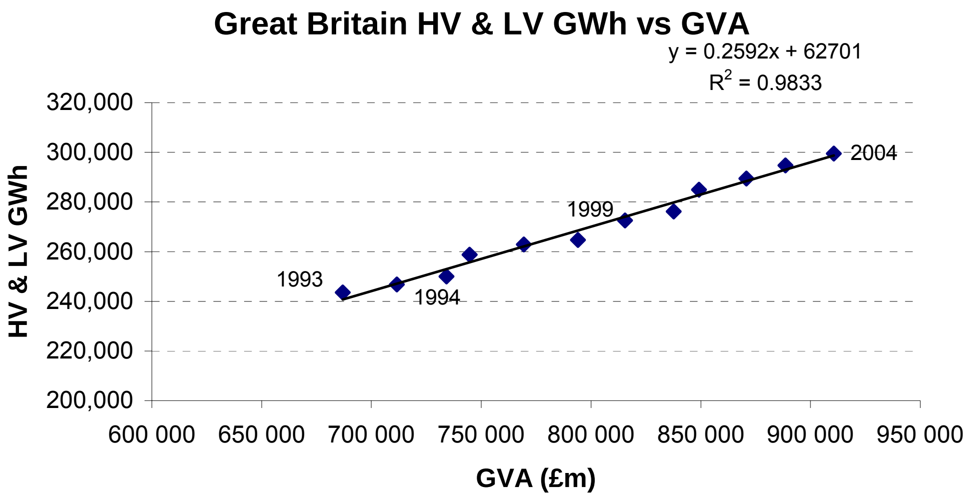
The total regulated units are HV and LV units and the total regulated units include EHV units. Up to and including 2003/03, the units distributed are actual units whereas from 2003/04 onwards these are forecast.

1 Office of National Statistics: Local area and sub-regional gross domestic product, 26 April 2001, www.statistics.gov.uk

The average annual load growth of both total and combined HV and LV units from 2004/5 to 2009/10 is about 1.2 per cent nationally.

E.1.3 Historic trend of units distributed against GVA

The trend of HV and LV units distributed against GVA in Great Britain is presented in the chart below and shows a good correlation[2].



A comparison was also made between the percentage increases in units distributed (%ΔGWh) and (%ΔGVA). The national (Great Britain) average of %ΔGWh/%ΔGVA covering the years 1995/96 to 2001/02 (years of NUTS2 data availability) is about 0.7. Typical corresponding values for DNOs were calculated to be in the range of about 0.5 to 0.9.

E.1.4 GVA growth rates

Growth rates for GVA nationally for the years 2002/03 to and 2003/04 were obtained from ONS GDP statistics. By region a variety of published sources was used, including regional assemblies, regional development agencies and prominent econometric consultants.

For the years 2004/05 onwards, the HM Treasury "Forecasts for the UK Economy" dated February 20043 was used as the forecast for national growth. In a number of cases and, depending on the availability of published data, regional growth trends were estimated from the national trend but with a difference applied depending on the relative positions in 2003/2004.

[2] To align GVA and GWh data, ONS data for 2001 was treated as corresponding to the review year 2001/02 and so on.

[3] www.hm-treasury.gov.uk/media//E7910/ACF11CB.pdf, "Forecasts for the UK Economy", February 2004.

FORECAST UK ANNUAL CHANGE IN GDP (GVA) (%)

2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
1.7	2.1	2.8	2.6	2.5	2.5	2.3	2.3

As might be expected the highest forecast growth rates are in London and the South East. The lowest are in the North East of England and in Scotland. The underlying driver in the forecast growth is the service industry.

E.1.5 Derivation of GVA-based load forecasts

Forecasts of GVAs up to 2009/10 for each DNO service area were obtained by applying the forecast growth rates to the 2001/02 GVA data derived from the NUTS2 sub-regional GVA data referred to earlier.

For each of the years 1995 to 2001 and for each DNO, a plot was made of HV and LV units distributed against corresponding GVA and a linear “least squares fit” regression line applied. For 12 of the DNOs a good correlation (R-squared value > 0.8) was obtained. The remaining two DNOs showed R-squared values of about 0.6 and 0.7 respectively, reflecting year-on-year variations in units distributed.

The regression formulae for GWh versus GVA were applied to the forecast GVAs in order to obtain GVA-based forecasts of units distributed for each DNO. The individual forecasts for DPCR4 were adjusted pro rata so that the overall increase nationally was equal to that forecast by the DNOs.

APPENDIX F

NON-LOAD RELATED EXPENDITURE MODELLING

APPENDIX F – NON-LOAD RELATED CAPEX MODELLING

F.1.1 NLRE asset replacement modelling for DPCR4

The NLRE that is modelled is that concerned with asset replacement and refurbishment, as charged against capital expenditure. The asset replacement modelling procedure and associated assumptions adopted for DPCR4 are described in this Appendix and are consistent with those discussed with DNOs during the course of the review. The input data used is, in the main, based on that provided by DNOs as part of the DPCR4 FBPQ process. Where PB Power has had need to supplement the DNO input data, such as the process of deriving a industry weighted average replacement profiles or use of PB Power's own replacement unit costs, then such actions have been highlighted.

F.1.1.1 Age-based replacement

A modelling technique has been employed for all switchgear, transformer, underground cable, submarine cable and overhead line asset types, with detailed variations as appropriate. This technique is equivalent to the "survivor" type analysis that formed the main input into DPCR3 non-load replacement modelling.

Fundamentally the model requires three input data items for each defined asset category, viz:

i. age profile

ii. retirement profile and

iii. unit cost.

The age profile defines the number of assets still in service and the current age of those assets.

The retirement profile represents the ages at which assets are retired from the system. These profiles are generally expressed as the fraction of assets that would be expected to be retired in each year over a given number of years of operation. For DPCR4 the retirement profiles have been based on Gaussian distributions defined according to the standard deviation and mean life of the asset types represented. As part of the modelling process we have derived industry weighted average replacement profiles for each asset type. These are normal distributions with mean asset lives obtained by weighting each DNO's expected useful life for the asset by the corresponding DNO asset population.

The unit costs are the replacement costs for items new plant and equipment on a per unit basis namely per transformer, per switchgear bay and per kilometre of underground cable. The schedule of PB Power's unit costs is presented in Appendix G.

The asset replacement calculation involves the cross-multiplication of the estimated original population of the assets of a given age with the assumed retirement fraction for assets of the same age. This process is carried out for assets of all ages such that the output of the model represents the total volume of assets to be replaced. The asset volume is then multiplied by the appropriate unit replacement cost to give an estimate of the replacement expenditure for that asset type.

Our modelling of asset replacement and refurbishment concerns non-fault replacement and refurbishment; DNOs have been required to segregate fault and non-fault expenditure and the former may be considered as operating expenditure. Discussion with DNOs has been held on the issue of overlap between assets replaced due to fault and those replaced as a consequence of other asset management drivers. Given that these areas are modelled separately it is important that the risk of double counting is reduced. In terms of transformer replacement it has been decided that, in general, replacement of pole-mounted transformers occur mainly as a result of a fault. Therefore, no pole-mounted transformers have been included in the modelled output of (non-fault) expenditure. The majority of cable replacement tends to be undertaken due to fault. Nevertheless DNOs have classified a certain volume of cable replacement as non-fault replacement. It is this non-fault replacement activity that is considered and hence included in the modelled output

F.1.1.2 Cyclic refurbishment / replacement

We investigated the direct modelling of refurbishment and replacement of overhead lines on a cyclic basis and found that it was not sufficiently robust in volumetric terms to reflect the refurbishment activity over a five-year period (DPCR4). Instead we found that replacement profile approach using an adjusted replacement profile provided an effective modelling approach, particularly in the case of HV and 33kV overhead line assets.

For these lines, in contrast to the single replacement unit cost required for the age-based replacement expenditure projection, the 'adjusted' refurbishment / replacement based model requires a blended unit cost based on an weighted average industry view taking account of the proportions of activity associated with refurbishment and replacement.

F.1.1.3 Assumptions

In order to complete our modelling of asset replacement we have found it necessary to make a number of assumptions. These are outlined below:

F.1.1.3.1 Overhead lines

LV mains and services. We compared the volumes forecast by the model for the five years of DPCR4 with those in the DNO submission and found that there was little difference between the two forecasts. Accordingly our modelling has used the industry weighted replacement profiles and our unit costs.

HV and 33kV overhead lines. The replacement/refurbishment of these lines has been modelled using 'adjusted' weighted industry average replacement profiles, obtained by "back-fitting" the replacement profile in order to match the volumes forecast by the model for the five years of DPCR4 with those in the DNO submission. The back-fitting resulted in adjustments to the mean asset lives, some increasing and others decreasing. The volumes derived from these profiles have been applied to a blended unit cost based on industry refurbishment and replacement activity.

For all assets with a rated voltage of 66 kV and greater (i.e. age-based asset replacement expenditure calculation) the mean life has been assumed to be 70 years. In PB Power's view the industry weighted average calculated for these asset types was considered too low.

The 12-year mean expected asset life declared in the FBPQ submission of one DNO for a number of asset types was considered to be a misinterpretation of the FPBQ as the 12 year life reflects the cyclic refurbishment period and not the mean asset life. That particular DNO's data has therefore been excluded from the industry weighted average replacement profile calculation. The asset types affected include LV mains and services, 6.6 & 11 kV bare and covered conductor, and 33 kV single and double circuit conductor overhead lines.

F.1.1.3.2 Underground cables

In general, the approach taken by the industry with regard to cable replacement is based largely on a reactive policy of undertaking fault repairs and of replacing lengths of cable only when such cable exhibits poor condition. In order to avoid possible over-forecasting of cable replacement volumes and to reflect the non-fault replacement volumes forecast by the DNOs, we have therefore adjusted the industry weighted average replacement profile of each main cable type before proceeding with age-based modelling. In general the resulting average asset lives have been increased. At LV, Consac cable has been modelled separately from the other LV cable types (PILC and Waveform have been combined) with the Consac replacement profile based on a much shorter average asset life than other types. One particular DNO's data on expected useful asset lives of LV, HV and 33kV cables was found to be inconsistent with that of other DNOs and has been excluded from the calculation of the industry average weighted replacement profiles.

F.1.1.3.3 Submarine cable

A 50-year mean life has been assumed for all asset types. One DNO has declared a 15-year mean life. As the DNO concerned has a relatively high forecast of submarine cable replacement its data would have had a significant impact on the industry weighted average asset life. Furthermore, 15 years is not in PB Power's view considered representative of the mean expected life of this asset type.

F.1.1.3.4 Benchmarking of DNO forecasts

Benchmarking of individual DNO submissions against corresponding outputs of the asset replacement model has been undertaken. This process has enabled the forecasts of individual companies to be compared thereby providing greater transparency with regard to asset class activity and highlighting any activity that may be atypical compared with industry norm performance levels. In the benchmarking process assets have been grouped under overhead lines and services, underground cables and services and substations (transformers, switchgear and substation other) enabling the forecast expenditure for each group to be benchmarked against corresponding model output. The output for each DNO by the asset classes of lines and services, cables and services and substations has been benchmarked against a median industry performer.

The approach to benchmarking has considered the DNO submission for asset replacement to include all asset replacement irrespective of the primary classification of causation such as: health and safety, environment or non-fault replacement. Expenditure associated with ESQCR has not been considered in this assessment and instead is expected to be the subject of a separate consideration by Ofgem. Combining the various asset replacement drivers into a single element overcomes differences in allocations between individual DNOs and hence avoids unduly penalising a particular company for internal allocation issues.

Certain asset classes have been combined for each DNO prior to any benchmarking assessment. This has been undertaken where the opportunity for imprecise asset replacement definition, common elements within unit cost and or related work may exist. For instance, certain expenditure items submitted as part of the DNO submission are referenced to substations with no clear attribution to either switchgear or transformer replacement. In order to avoid the risk of unjustified scaling back of companies through lack of a clear definition a generic class of substations has been created. This particular example is defined as all expenditure allocated to switchgear, transformer and other, including protection and civil works. Similarly, overhead line replacement has been combined with overhead service replacement given the likelihood that both activities will be undertaken within the same programme of work.

Certain adjustments to individual DNO submissions to compensate for pension deficit funding, lane rentals, inter-company margin and capitalised overheads have been made by Ofgem and these adjustments are taken into account. In order to determine a disaggregated forecast of capital expenditure that reconciles back to an Ofgem 'adjusted' submission it has been necessary to calculate a ratio between the company's initial submission and the 'adjusted' submission. That ratio has been applied equally to each main asset class. These adjusted and combined generic-asset-classes form the basis from which a comparison to an equivalent asset replacement model output is drawn.

The model output is based on DNO data with regard to asset age profiles and replacement profiles from which industry average weighted replacement profiles have been derived. In that regard, the output from the model is industry-driven in terms of its input parameters. The only information that has been derived directly by PB Power has been asset replacement unit costs. A comparison of MEAVs for all 14 DNOs calculated using (new build) DNO unit costs and PB Power unit costs showed that these MEAVs were within 2 per cent of each other. A disaggregation of corresponding MEAVs by DNO in percentage terms by main asset groups and voltage levels is presented in Appendix G.

In the benchmarking process a comparison is made between the adjusted DNO submission and the corresponding model output for each of the three main asset groups:

- lines and services
- cables and services and
- substations

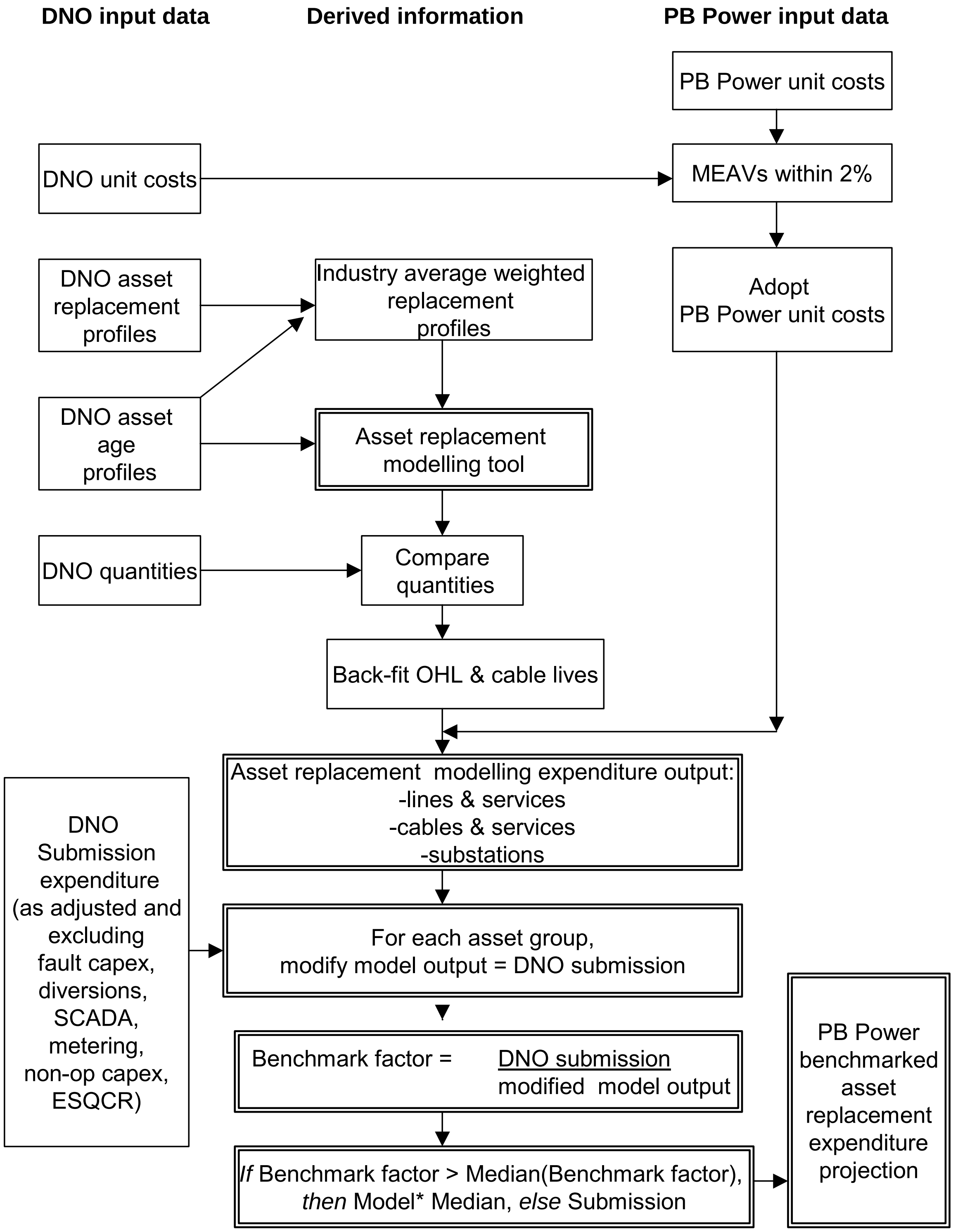
The model output is initially modified so that for each of the asset groups the overall industry (14 DNOs') expenditure predicted by the model is the same as that forecast by the DNOs. (The differences had in any case been small.) For each asset group, benchmark factors of DNO submission/model output are calculated and medians (about unity) obtained. Where the benchmark factor exceeds the median (submission exceeds model output), the resulting benchmarked output is the model output multiplied by the median. Otherwise the benchmarked output is the submission itself. Minor miscellaneous amounts not specifically included within asset groups in the FBPQ submission have been treated as pass-through with minor adjustments.

PB POWER INDUSTRY AVERAGE WEIGHTED REPLACEMENT PROFILES	MEAN LIFE (years)	STANDARD DEVIATION (years)
Overhead lines		
LV lines		
- LV mains Bare conductor	52	13
- LV mains Covered conductor	55	11
- LV services Bare conductor	51	12
- LV services Covered conductor	51	8
HV lines		
- 6.6 & 11 kV Bare conductor	45	11
- 6.6 & 11 kV Covered conductor	33	11
- 20kV Single circuit	51	11
EHV Lines		
- 33kV Single Circuit length	46	11
- 33kV Double Circuit length	69	8
- 66kV Single Circuit length - Towers	46	8
- 66kV Single Circuit length - Poles	55	8
- 66kV Double Circuit length	13	8
132kV		
- 132kV Single Circuit length	66	9
- 132kV Double Circuit length	67	12
Underground cables		
LV cables		
- LV mains (Consac)	54	14
- LV mains (PILC)	103	13
- LV mains (Plastic Waveform)	103	13
- LV services (PILC)	100	10
- LV services (Plastic Concentric)	100	10
HV cables		
- 6.6 & 11kV	85	12
- 20kV	103	16
EHV cables		
- 33kV	76	10
- 66kV	77	11
- 132kV	61	9

PB POWER INDUSTRY AVERAGE WEIGHTED REPLACEMENT PROFILES	MEAN LIFE (years)	STANDARD DEVIATION (years)
Submarine cables		
HV cables		
- 6.6 & 11kV	50	5
EHV cables		
- 33kV	50	5
- 132kV	50	6
Switchgear		
LV network		
- LV pillar	56	11
- LV Link box	90	12
HV network		
- 6.6 & 11kV switches (excluding RMU & CB)	47	8
- 6.6 & 11kV RMU	46	8
- 6.6 & 11kV CB	52	7
- 6.6 & 11kV A/RC & Sect, urban automation	42	8
EHV network		
- 33kV CB (I/D)	53	7
- 33kV CB (O/D)	52	10
- 33kV Isol (I/D)	59	8
- 33kV Isol (O/D)	53	10
- 66kV CB (GIS) (I/D)	53	10
- 66kV CB (GIS) (O/D)	50	6
- 66kV CB - other (I/D)	52	9
- 66kV CB - other (O/D)	49	7
- 66kV Isol (I/D)	55	12
- 66kV Isol (O/D)	58	10
- 132kV CB (GIS) (I/D)	56	6
- 132kV CB (GIS) (O/D)	50	8
- 132kV CB - other (I/D)	48	9
- 132kV CB - other (O/D)	49	10
- 132kV Isol (I/D)	50	7
- 132kV Isol (O/D)	48	9

PB POWER INDUSTRY AVERAGE WEIGHTED REPLACEMENT PROFILES	**MEAN LIFE (years)**	**STANDARD DEVIATION (years)**
Transformers		
HV network		
- 6.6kV PMT	55	15
- 6.6kV GMT	54	14
- 11kV PMT	56	10
- 11kV GMT	58	11
- 20kV PMT	60	9
- 20kV GMT	50	10
EHV network		
- 33kV PMT	55	12
- 33kV GMT	60	10
- 66kV	53	9
- 132kV	55	11

ASSET REPLACEMENT BENCHMARKING FLOWCHART



APPENDIX G

UNIT COSTS AND MODERN EQUIVALENT ASSET VALUE

APPENDIX G – UNIT COSTS AND MODERN EQUIVALENT ASSET VALUE

PB POWER – SCHEDULE OF UNIT COSTS

PB POWER – SCHEDULE OF UNIT COSTS		LRE	NLRE
NB. Unit costs of OHL circuit lengths include costs of supports (poles/towers), except for 66kV and 132kV replacement/refurbishment costs which exclude supports.	Unit	(new build)	(replacement/ refurbishment)
(2002/03 price levels)		(£ 000s)	(£ 000s)
Overhead lines			
LV lines			
- LV mains Bare conductor	km	25.5	25.5
- LV mains Covered conductor	km	27.5	27.5
- LV services Bare conductor	km	20.7	20.7
- LV services Covered conductor	km	23.6	23.6
HV lines			
- 6.6 & 11 kV Bare conductor	km	33.1	20.0
- 6.6 & 11 kV Covered conductor	km	43.2	26.0
- 20kV Single circuit	km	34.9	34.9
EHV Lines			
- 33kV Single Circuit length	km	38.2	38.2
- 33kV Double Circuit length	route km	60.0	60.0
- 66kV Single Circuit length - Towers	km	130.4	71.7
- 66kV Single Circuit length - Poles	km	85.1	46.8
- 66kV Double Circuit length	km	204.9	112.7
132kV			
- 132kV Single Circuit length	route km	168.4	92.6
- 132kV Double Circuit length	route km	332.8	183.1
Underground cables			
LV cables			
- LV mains (Consac)	km	58.8	58.8
- LV mains (PILC)	km	58.8	58.8
- LV mains (Plastic Waveform)	km	58.8	58.8
- LV services (PILC)	km	35.6	35.6
- LV services (Plastic Concentric)	km	35.6	35.6
HV cables			
- 6.6 & 11kV	km	88.7	88.7
- 20kV	km	127.6	127.6
EHV cables			
- 33kV	km	195.8	195.8
- 66kV	km	826.9	826.9
- 132kV	km	1,012.5	1012.5

PB POWER - DATABASE OF UNIT COSTS (continued)		LRE	NLRE
(2002/03 price levels)	Unit	(new build) (£ 000s)	(replacement/ refurbishment) (£ 000s)
Submarine cables (km)			
HV cables			
- 6.6 & 11kV	km	105.8	105.8
EHV cables			
- 33kV	km	496.1	496.1
- 132kV	km	1,277.6	1277.6
Switchgear (units)			
LV network			
- LV pillar	each	4.3	4.3
- LV Link box	each	1.1	1.1
HV network			
- 6.6 & 11kV switches (excluding RMU & CB)	each	7.3	7.3
- 6.6 & 11kV RMU	each	11.3	11.3
- 6.6 & 11kV CB	each	27.8	27.8
- 6.6 & 11kV A/RC & Sect, urban automation	each	11.0	11.0
EHV network			
- 33kV CB (I/D)	each	76.8	76.8
- 33kV CB (O/D)	each	54.0	54.0
- 33kV Isol (I/D)	each	7.6	7.6
- 33kV Isol (O/D)	each	7.6	7.6
- 66kV CB (GIS) (I/D)	each	311.7	311.7
- 66kV CB (GIS) (O/D)	each	311.7	311.7
- 66kV CB - other (I/D)	each	311.7	311.7
- 66kV CB - other (O/D)	each	311.7	311.7
- 66kV Isol (I/D)	each	8.0	8.0
- 66kV Isol (O/D)	each	8.0	8.0
- 132kV CB (GIS) (I/D)	each	1,012.5	1012.5
- 132kV CB (GIS) (O/D)	each	519.6	519.6
- 132kV CB - other (I/D)	each	519.6	519.6
- 132kV CB - other (O/D)	each	519.6	519.6
- 132kV Isol (I/D)	each	13.5	13.5
- 132kV Isol (O/D)	each	13.5	13.5

PB POWER - DATABASE OF UNIT COSTS (continued)		LRE	NLRE
(2002/03 price levels)	**Unit**	(new build) (£ 000s)	(replacement/ refurbishment) (£ 000s)
Transformers (units) - including tap changes and reactors			
HV network			
- 6.6kV PMT	each	3.0	3.0
- 6.6kV GMT	each	10.5	10.5
- 11kV PMT	each	3.0	3.0
- 11kV GMT	each	10.5	10.5
- 20kV PMT	each	3.7	3.7
- 20kV GMT	each	15.7	15.7
EHV network			
- 33kV PMT	each	4.3	4.3
- 33kV GMT	each	317.5	317.5
- 66kV	each	337.8	337.8
- 132kV	each	929.8	929.8

Modern equivalent asset value (MEAV)

On the following page a disaggregation of the MEAVs of the DNOs is presented, from asset quantities declared by the DNOs and from PB Power's unit costs. The total MEAV of all the 14 DNOs is calculated at some £86.6 billion.

MEA SUMMARY		Calculated using PB Power's Unit Costs					
		Trans-formers	**Switchgear**	**Overhead Line**	**Under-ground Cable**	**Services**	**Total**
1	**EHV**	52%	34%	32%	17%	0%	23%
	HV	48%	52%	53%	36%	0%	35%
	LV	0%	14%	14%	47%	100%	42%
	Total	11%	10%	23%	34%	22%	100%
2	**EHV**	63%	51%	39%	28%	0%	34%
	HV	37%	45%	45%	26%	0%	31%
	LV	0%	4%	16%	46%	100%	34%
	Total	11%	14%	19%	45%	10%	100%
3	**EHV**	60%	26%	53%	14%	0%	22%
	HV	40%	60%	36%	32%	0%	29%
	LV	0%	15%	11%	54%	100%	49%
	Total	8%	10%	15%	44%	22%	100%
4	**EHV**	54%	25%	60%	20%	0%	23%
	HV	46%	57%	25%	33%	0%	28%
	LV	0%	18%	15%	47%	100%	49%
	Total	8%	10%	12%	46%	23%	100%
5	**EHV**	54%	23%	51%	17%	0%	26%
	HV	46%	64%	35%	35%	0%	34%
	LV	0%	13%	13%	48%	100%	40%
	Total	10%	9%	20%	49%	12%	100%
6	**EHV**	56%	28%	47%	14%	0%	22%
	HV	44%	62%	40%	36%	0%	33%
	LV	0%	10%	13%	50%	100%	45%
	Total	8%	13%	18%	39%	22%	100%
7	**EHV**	51%	30%	100%	29%	0%	26%
	HV	49%	51%	0%	26%	0%	26%
	LV	0%	19%	0%	44%	100%	48%
	Total	6%	9%	0%	71%	15%	100%
8	**EHV**	55%	31%	50%	24%	0%	28%
	HV	45%	66%	41%	33%	0%	33%
	LV	0%	3%	9%	44%	100%	39%
	Total	7%	12%	18%	47%	17%	100%
9	**EHV**	62%	28%	58%	17%	0%	26%
	HV	38%	68%	33%	30%	0%	32%
	LV	0%	4%	10%	53%	100%	42%
	Total	9%	13%	13%	54%	11%	100%
10	**EHV**	62%	28%	63%	27%	0%	31%
	HV	38%	70%	32%	27%	0%	31%
	LV	0%	3%	5%	46%	100%	38%
	Total	8%	14%	14%	49%	14%	100%
11	**EHV**	54%	45%	36%	14%	0%	24%
	HV	46%	43%	55%	38%	0%	35%
	LV	0%	12%	8%	49%	100%	41%
	Total	11%	12%	21%	34%	21%	100%
12	**EHV**	51%	12%	15%	16%	0%	16%
	HV	49%	73%	68%	35%	0%	40%
	LV	0%	15%	17%	50%	100%	45%
	Total	9%	13%	12%	51%	15%	100%
13	**EHV**	47%	16%	25%	22%	0%	23%
	HV	53%	68%	65%	39%	0%	48%
	LV	0%	16%	10%	39%	100%	29%
	Total	11%	10%	33%	35%	11%	100%
14	**EHV**	56%	23%	57%	25%	0%	31%
	HV	44%	64%	29%	32%	0%	33%
	LV	0%	13%	14%	43%	100%	36%
	Total	10%	14%	19%	46%	11%	100%
All 14 DNOs	**EHV**	56%	28%	46%	21%	0%	26%
	HV	44%	61%	41%	32%	0%	33%
	LV	0%	11%	12%	47%	100%	58%
	Total	9%	12%	16%	48%	16%	100%