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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 Power	Parsons Brinckerhoff Power
QoS	Quality of supply (reliability/interruption performance)
RTU	Remote terminal unit
SCADA	Supervisory control and acquisition of data
SSAP	Standard accountancy practice
SPD	Scottish Power Distribution or SP Distribution plc
SPM	Scottish Power Manweb or SP Manweb plc

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 SPM's adjusted DPCR3 projection, adjusted DPCR4 forecast, PB Power's modelling results and PB Power's 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	**177.2**	**215.4**	**122.6**	**215.1**	SPM's forecast is high as it is based on an increasing cost trend line and a sudden rise in expenditure to meet low capacity headroom. The model output conversely indicates an appreciable reduction that we have not been able to reconcile with the forecast. Low growth and relatively high expenditure may suggest load movement (churn) although this has not been substantiated by SPM. We propose that the DPCR4 gross expenditure be accepted as the DPCR4 forecast.
Customer Contributions	(75.3)	(68.4)		(86.9)	
LRE Net	**101.9**	**147.0**		**128.2**	
Asset Replacement	121.5	**325.6**	**185.8**	**215.8**	The model predicts expenditures lower than the forecast for overhead lines, cables and switchgear, but higher expenditure for transformers. We would consider SPM's policy of replacing 33kV lines and 11kV interconnectoring lines with more resilient construction to be justified as reflected in the increased amount in PB Power's Opinion.
Other	125.5	111.8		110.2	£110.2m comprises £11.6m diversions, £7.1m SCADA, £32.6m metering and £58.9m fault capex.
NLRE Total	**247.4**	**437.4**		**326.0**	
Non Operational	5.0	0.0		0.0	
DNO total	**354.3**	**584.4**		**454.1**	
DNO Total				*362.6*	*As Ofgem Sep 04 paper, excl. meters, faults, non operational and ESQCR*

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 SPM forecast has been subject to adjustments in respect gross market load-related expenditure, capitalised overheads and inter-company margin.

Our principal findings are summarised below.

Load related expenditure

- In our opinion the load-related modelling process we have undertaken provides a sound indicator of investment for the industry. However the information provided by SPM has resulted in a model output that indicates an appreciable reduction in expenditure that we have not been able to reconcile with SPM's forecast.
- SPM has identified problems of lack of spare capacity, particularly for 33/11kV groups. The proposed expenditure on general network reinforcement for the years 2004/05, 2005/06 and 2006/07 however shows a rapid rise above the long-term trend line (which is itself rising). We would question such a rapid increase in expenditure.
- Forecast expenditures on new connections and reinforcement are based on rising trends in annual expenditure but the corresponding growth in customer numbers and units distributed is relatively low. The expenditure trends are also increased by SPM's rebalancing of overheads towards Capex and allocation of corporate costs. These costs have accordingly been deducted before modelling.
- SPM's interconnected network on Merseyside may be more expensive to reinforce than conventional networks although arguably some of this reinforcement may contribute to improved quality of supply.
- The low level of growth on the network together with relatively high expenditure may suggest an underlying level of load movement (churn), but this has not been substantiated by SPM.
- SPM's normalised load-related expenditure is high, as
    - o we calculate that over three price controls (DPCR2, DPCR3 and DPCR4 forecast) SPM's load-related expenditure per additional customer, normalised

by MEAV per total customer, is about 9 per cent higher than the industry median, and

- o SPM's corresponding load-related expenditure per additional unit distributed, normalised by MEAV per total units distributed, is about 35 per cent higher than the industry median.

Non load related expenditure

- SPM is not entirely compliant as a Base Case forecast compared with other DNOs as it has a policy of replacing 33 kV and 11 kV interconnector overhead lines with a higher specification which represents an estimated £25m additional costs for resilience. However SPM's approach is considered by us to be justified in view of recent storm experience.

- SPM's forecast includes switchgear replacement costs which are higher than the model output and SPM states that this is justified by risk assessment.

PB Power view on load-related and non-load related expenditure allowances (base case)

Load related expenditure

SPM's forecast is high as it is based on an increasing cost trend line and a sudden rise in expenditure to meet low capacity headroom. The model output conversely indicates an appreciable reduction in expenditure that we have not been able to reconcile with the forecast. Low growth and relatively high expenditure may suggest load movement (churn) although this has not been substantiated by SPM. We propose that the DPCR4 gross expenditure be as the DPCR4 forecast, namely £215.m.

Non-load related expenditure

The model predicts expenditures lower than the forecast for overhead lines, cables and switchgear, but higher expenditure for transformers. We would consider SPM's policy of replacing 33kV lines and 11kV interconnectoring lines with more resilient construction to be justified as reflected in the increased amount in PB Power's Opinion.

In PB Power's opinion the allowed asset replacement expenditure should be £215.8m, this amount excluding ESQCR related expenditure which is being reviewed separately. Our opinion reflects an increase above model output for cables. With the inclusion of diversions, metering and fault capital expenditure the corresponding overall non-load related expenditure would be £326.0m.

Conclusions

The above considerations would indicate that a total capital expenditure, net of customer contributions, of £454.1m 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. A separate PB Power report covers repairs and maintenance expenditure.

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 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 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 SUBMISSIONS

2.1 Base case

2.1.1 General

The forecast is based on risk assessment techniques and the Base Case has a neutral affect on performance where, as a matter of strategy, SPM has a target for industry average reliability and upper quartile network performance. However SPM has built network resilience into its forecast as its overhead line refurbishment programme is based on rebuilding the network over time to a more robust standard following experience with storms in DPCR3 and SPM's forecast may as a consequence be £25m higher than a strictly Base Case scenario. Since the DPCR4 forecast SPM has provided additional information on the likely costs of compliance with ESQCR estimated at £30m but this is being considerd separately by Ofgem.

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	**198.4**	**177.2**	**188.9**	**-6.4**	**182.5**
Non Load Related	**240.9**	**247.4**	**433.7**	**36.4**	**470.1**
Gross Capex less Non Op Capex	***439.3***	***424.7***	***622.6***	***30.0***	***652.6***
Non Op Capex (Not Assessed)	16.8	5.0	0.0	0.0	0.0
Total Gross Capex	**456.1**	**429.7**	**622.6**	**30.0**	**652.6**
Contributions	-100.6	-75.3	-28.2	4.0	-24.2
Net Load Related	**97.8**	**101.9**	**160.7**	**-2.4**	**158.3**
Total Net Capex	**355.5**	**354.3**	**594.4**	**34.0**	**628.4**
Non Load Related Summary					
Replacement	201.7		298.9	2.8	301.7
ESQCR			0.0	30.0	30.0
Heath & Safety			16.6	0.0	16.6
Environment			2.4	0.0	2.4
Sub Total - Model Comparison	**201.7**	**121.5**	**317.9**	**32.8**	**350.7**
Diversions	16.8	11.6	13.6	0.0	13.6
SCADA		5.0	8.2	0.0	8.2
Sub Total	***218.5***	***138.0***	***339.7***	***32.8***	***372.5***
Metering (Not Assessed)	22.4	23.1	28.4	6.4	34.8
Sub Total	***240.9***	***161.1***	***368.1***	***39.2***	***407.3***
Fault Capex (Not Assessed)		86.3	65.6	-2.8	62.8
Non Load Related Total	**240.9**	**247.4**	**433.7**	**36.4**	**470.1**

Corrections made by SPM to the original forecast include an estimated £30m for work associated with ESQCR, a transfer of metering of £6.4m from load related expenditure to non load related expenditure and classification of £2.8m of fault expenditure as replacement.

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	45.9	0.0	-1.6	-11.4	0.0	**215.4**
Non Load Related		0.0	-3.4	-29.3	0.0	**437.4**
Gross Capex less Non Op Capex	***45.9***	***0.0***	***-5.0***	***-40.7***	***0.0***	**652.8**
Non Op Capex (Not Assessed)						**-**
Total Gross Capex	**45.9**	**0.0**	**-5.0**	**-40.7**	**0.0**	**652.8**
Contributions	-45.9	0.0	0.2	1.5	0.0	-68.4
Net Load Related	**0.0**	**0.0**	**-1.4**	**-9.9**	**0.0**	**147.0**
Total Net Capex	**0.0**	**0.0**	**-4.8**	**-39.2**	**0.0**	**584.4**
Non Load Related Summary						
Replacement		0.0	-2.7	-18.8	0.0	280.2
ESQCR		0.0	-0.3	-1.9	0.0	27.8
Heath & Safety		0.0	-0.1	-1.0	0.0	15.4
Environment		0.0	0.0	-0.1	0.0	2.2
Sub Total - Model Comparison		**0.0**	**-3.2**	**-21.9**	**0.0**	**325.6**
Diversions		0.0	-0.1	-0.8	0.0	12.6
SCADA		0.0	-0.1	-0.5	0.0	7.6
Sub Total		***0.0***	***-3.4***	***-23.2***	***0.0***	***345.9***
Metering (Not Assessed)		0.0	-0.0	-2.2	0.0	32.6
Sub Total		***0.0***	***-3.4***	***-25.4***	***0.0***	***378.5***
Fault Capex (Not Assessed)		0.0	-0.0	-3.9	0.0	58.9
Non Load Related Total		**0.0**	**-3.4**	**-29.3**	**0.0**	**437.4**
Total Adjustments	**45.9**	**0.0**	**-5.0**	**-40.7**	**0.0**	**0.2**

2.1.2 Load related capex

SPM has provided a comprehensive explanation of its forecasting techniques at the HBPQ and FBPQ stage and these are not commented on in this report. SPM has based its load and new connections forecasts on cost trend line analysis which its own and external research shows is an indicator of the gross connections market. However this leads to a rising forecast against low growth in customer numbers and units. The trend line is also affected by the rising costs in DPCR3 due to SPM's rise in Capex due to rebalancing of overheads towards Capex and additional corporate costs. This will have contributed to the rising trend line to give a high forecast.

2.1.2.1 Network reinforcement

SPM experienced unavoidable delays in major projects in DPCR3 and the DPCR4 forecast includes a deferred 132kV project at Lostock – Carrington for which SPM has derogation from Ofgem in respect of the P2/5 security standard. The Liverpool area of SPM has an interconnected system of 33kV/11kV distribution which is efficient and delivers a good quality of supply but reinforcement is relatively expensive as primary groups need to be split up and new cables and substations installed. There is now little capacity headroom in the system and SPM has demonstrated that the total supply capacity is over 90% loaded. 9% of Merseyside primary groups have operated above cyclic ratings in the past year and at 1% load growth this will increase to 17% by the end of DPCR4. Major reinforcement is also now also required in the Central Wales and other areas. The expenditure in DPCR4 is loaded in the early years and it is unlikely that there is significant opportunity for deferment of these schemes although schemes later in the programme may be less definite.

This lack of spare capacity is a cause of major concern to SPM and has implications for the application of commercial policies, resulting in a higher level of system reinforcement to be funded by the DNO.

SPM has provided information on major network reinforcements to relieve overloaded 33kV substations and provided information on major projects planned for the five years of the plan. SPM operates a risk points scoring methodology for prioritising these major projects as shown in Table A-4 in Appendix A and explained the rationale behind four projects. The methodology is considered sound but the timing of individual schemes is difficult to predict and the forecast is considered high.

2.1.2.2 New connections forecast expenditure

Historically new non-domestic connections expenditure in Merseyside has been relatively high due to its development area status and urban renewal. SPM has identified a number of projects of a similar nature going forward where this is set to continue, but we do not consider that there is sufficient evidence to indicate a continuing rising trend. Domestic growth is constant but the forecast shows a rise above the expenditure trend.

2.1.3 Comments and issues associated with the load related expenditure forecast

i. SPM has reached a point in the investment cycle requiring a significant step increase in investment. This could be considered similar to the quality of supply investment of other DNOs as quality of supply is automatically built into the network design of SPM's interconnected network but at certain points in the reinforcement cycle it is expensive to reinforce fo an incremental increase in demand. That time has now been reached in Liverpool.

ii. SPM has based its load and new connections forecasts on cost trend line analysis of total costs which its own and external research shows is an indicator of the gross connections market. However this leads to a rising forecast against low growth in customer numbers and units. The trend line is also affected by the rising costs in DPCR3 and DPCR4 due to SPM's rise in Capex due to rebalancing of overheads towards Capex and additional corporate costs which will tend to give a higher forecast.

iii. Historically new non domestic connections expenditure in Merseyside has been relatively high due to its development area status and urban renewal and projects and SPM has identified a number of projects of a similar nature going forward where this is set to continue, but we do not consider that there is sufficient evidence to indicates a continuing rising trend but rather a steady level of investment.

iv. With low levels of new domestic connections and only marginally overloaded substations the load related programme is extremely sensitive to non domestic development which is volatile. The outturn requirements could be much lower than forecast. A more central case could be considered in line with the outturn for DPCR3 and modelling forecasts. We consider that the requirement for load related investment is likely to continue on current trends. Care needs to be exercised in setting a DPCR4 allowance to ensure that this is defined in terms of the gross market and the various adjustments for pensions, recharges and other adjustments.

2.1.4 Non-load related capex

Overhead lines

SPM has developed overhead line specifications to take account of the effect of weather conditions in severe weather areas and normal weather areas and intends to progressively replace its main 33 kV and 11 kV interconnector lines to the new specifications as follows:

- severe weather area, represents 41% of SPM's HV overhead line network
- normal weather area, represents 59% of SPM's HV overhead line network.

'Storm resilient' overhead lines in severe weather areas are required to withstand a maximum combination of 70mph winds and 40mm diameter ice accretion.

'Low weather areas' are required to withstand 50mph winds and 40mm diameter ice accretion.

All inter-connected 33kV overhead lines would be storm resilient within 20 years in severe weather areas and 30 years in normal weather areas. 11kV inter-connected overhead lines would be made storm resilient within 15 years in severe weather areas and 40 years in normal weather areas. This represents a line strengthening rate of 132km per year in severe weather areas and 74km per year in normal weather areas. In this respect the SPM forecast may be some £5m per year higher than a strictly Base Case scenario. It is noted that the DNO case includes a further 115km of overhead line strengthening.

SPM also indicates that in rural villages, there is a strong case for removing existing open wire overhead lines to enhance safety and reduce environmental impact. In some instances, old construction standards have resulted in inadequate clearances between open wire lines and buildings and other structures. The highest risk locations have been identified and are being rectified on a prioritised, programmed basis. When such lines are due for replacement a modern equivalent LV overhead line construction based upon ABC or undergrounding is being adopted.

SPM includes this safety work on LV overhead lines as work as part of normal risk assessed replacement. SPM has identified work associated with ESQCR of some £30m. SPM's approach is considered to be beyond that required by the Base Case scenario due to the additional resilience and safety related LV overhead line work by around £43m. Nevertheless in view of storm experience the replacement of interconnector lines with a more resilient design is considered to be prudent and could be considered by Ofgem and DTI as a model for other DNOs in that the resilience expenditure is restricted to 33kV and interconnector lines, the timescales are reasonable and for less severe weather areas would only be completed when the lines need to be replaced. Spur lines are not to be strengthened.

Underground cables

SPM has identified certain strategic 33kV and 11kV cables which are deteriorating and have a steeply increasing replacement programme based on identifying specific sections for replacement. Forecast replacements rise from £1m to £9.7m We do not consider the increase to be justified due to the relatively static fault rate. The identification of deteriorating cable from partial discharge studies is not considered to be sufficiently advanced cause for the increase.

Expenditure on replacement of service cables is similar to DPCR3.

Switchgear and transformers

Switchgear expenditure increases slightly in the DPCR4 period compared to DPCR3. This continued level of investment is necessary to manage the risks associated with ongoing disruptive failures, increasing numbers of reported switchgear defects and condition information including; increasing trends in SOPs (Suspension of Operational Practice), DINs (Dangerous Incident Notification) and ORs (Operational Restriction) as reported through the Electricity Association's NEDERS system (National Equipment Defect Reporting Scheme) over recent decades; and condition issues such as Lucy (water ingress and rusting), RA4 (overheating issue) and ABB Sentinel (manufacturing defect) and J & P (rusting) which have, and will continue to, force increased replacement investment over the DPCR3 and DPCR4 periods.

Although SPM is not proposing a programme to address the replacement of oil filled switchgear, SPM has adopted a procurement policy based on the purchase of non-oil filled switchgear.

Transformer replacements are forecast to be similar to DPCR3 although pole transformers are not only replaced on failure but also as a part of overhead refurbishment.

The increase expenditure on protection assets over the DPCR4 period is associated with replacement of particular 33kV unit protection schemes (Hardex pilots and MPR) to address performance and supportability of these systems. It also deals within SPM some particular limitations associated with voltage control and sensitive earth fault protection for 11kV overhead lines.

Expenditure on Telecontrol/ SCADA of £8.2m over the DPCR4 can be attributed to addressing performance and support issues associated with RTU equipment in substations and control room SCADA system.

ESQCR Non load related investment

SPM has identified expenditure associated with ESQCR estimated at £30m of investment mainly for LV overhead line work.

2.1.4.1 Health and safety

Only a small proportion of SPM's investment is specifically allocated to Safety and environment to address certain switchgear issues such as safety and asbestos etc.

2.1.4.2 Diversions

SPM has included amounts for diversions at historic rates in the forecasts reflecting a robust approach to managing wayleave terminations.

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

i. The non-load related expenditure forecast is based on a robust risk assessment process, reconciled to asset replacement modelling and shows a significant rise from around £35m per year in DPCR3 to £60m per year in 2005/06 and £75m per year at the end of DPCR4. SPM's programme includes significant switchgear, protection and control systems replacements associated with the Merseyside interconnected network and the EHV network. However it is accepted that the Merseyside network is significantly different to other DNOs.

ii. SPM's approach to overhead line replacement is considered to be beyond that required by the Base Case scenario due to the additional resilience and safety related LV overhead line work by around £43m. Nevertheless in view of storm experience the replacement of interconnector lines with a more resilient design is considered to be prudent and could be considered by Ofgem and DTI as a model for other DNOs in that the resilience expenditure is restricted to 33kV and interconnector lines, the timescales are reasonable and for less severe weather areas would only be completed when the lines need to be replaced.

iii. SPM uses a form of modelling which has separate algorithms for forecasting replacement and fault expenditure. SPM considers that this tends to allocate more of its expenditure to faults than replacement and that its forecasts of faults and replacement expenditure may not be comparable with other DNOs.

iv. SPM has suffered the serious effects of storms during DPCR3 which has led to a reappraisal of its overhead line design and replacement strategy. SPM has developed an enhanced line design for its severe weather areas, equivalent to the design envisaged for the enhanced line design scenario and plans to replace all interconnector lines over a period of time beyond DPCR4. SPM has many light construction (BS1320 design) installed during rural electrification and which are underdesigned by today's standards. In this respect SPM's Base Case includes line enhancement for its replacement lines but does meet Ofgem's requirement for maintaining existing levels of performance although resilience to storms is enhanced. We would consider SPM's proposals to be reasonable.

v. SPM has included relatively modest amounts for diversionsESQCR and environmental improvements in the Base Case.

vi. SPM has a relatively low level of wayleave terminations and associated compensation and diversions as it takes a strong stance towards termination notices.

vii. Costs are distorted due to rebalancing of overhead, profits on recharges, pension costs etc.

2.1.6 Major schemes submitted

Three largest schemes, SPM 2005/06

- Lostock - Carrington (£8,010k)
- Wrexham 33kV reinforcement (£6,762k)

- 25 MVA connection Castle Cement (£3,256k)

Three largest schemes, SPM 2005/06 and 2006/07

- Legacy – Oswestry Reinforcement (£2,360k)
- Liverpool City Centre Infrastructure Reinforcement (£9,028k)
- St Asaph Refurbishment (£4,900k)

SPM also has two large off shore windfarm connections in 2005/06 at around £7.7m which are not included in the Base Case forecast.

The schemes provide a good level of justification for expenditure and include detailed risk assessments as a part of investment appraisal.

2.2 Quality of supply/sensitivity scenarios

2.2.1 Network performance improvements

The following table sets out the proposed targets for the Ofgem QoS targets.

Table 2.3 - Network Performance Targets 2010 – 2020

	02/03 actual		01/02 & 02/03 ave		2010 Scenario		2020 Scenario		(ave/2010)%	
	CI	CML	CI	CML	CI	CML	CI	CML	CI	CML
SPM	38.3	44.3	41.6	46.0	60.4	48.7	60.4	48.7	69%	69%

Scottish Power has a robust methodology for calculating the impact of investment on quality of supply and has provided a comprehensive summary by circuit type and plans through to DPCR6. SPM has indicated that it does not require further investment to meet its quality of supply targets for 2010 and 2020.

2.2.2 Overhead line upgrade

SPM has included only a modest figure of £16m for overhead line upgrade since its overhead line strategy of line strengthening to meet environmental conditions in the Base Case already includes plans to strengthen overhead lines to the required design criteria.

2.2.3 Resilience and undergrounding

SPM has included £125m for resilience undergrounding.

2.2.4 Amenity undergrounding

Undergrounding in national parks and AONBs and for resilience is considered to be prohibitively expensive and not effective. The DNO alternative case gives preference to reduction in losses for environmental reasons.

2.2.5 Comments and issues associated with the quality of supply scenarios

2.3 DNO alternative scenario

The DNO alternative includes a further 115 km of overhead line strengthening. SPM also includes adoption of low loss transformers for new installations and improvement of security of real time scada and network control systems. The alternative case is costed at £17.4m.

The low forecast reflects the fact that SPM does not need to invest to achieve overall quality of supply targets. However the overall quality of supply performance masks the significant differences between rural areas and the interconnected urban network of SPM. The work on line strengthening will improve the resilience of the rural networks to storms but will not contribute significantly to everyday quality of supply.

3. PB POWER MODELLING AND COMPARISONS

3.1 Introduction

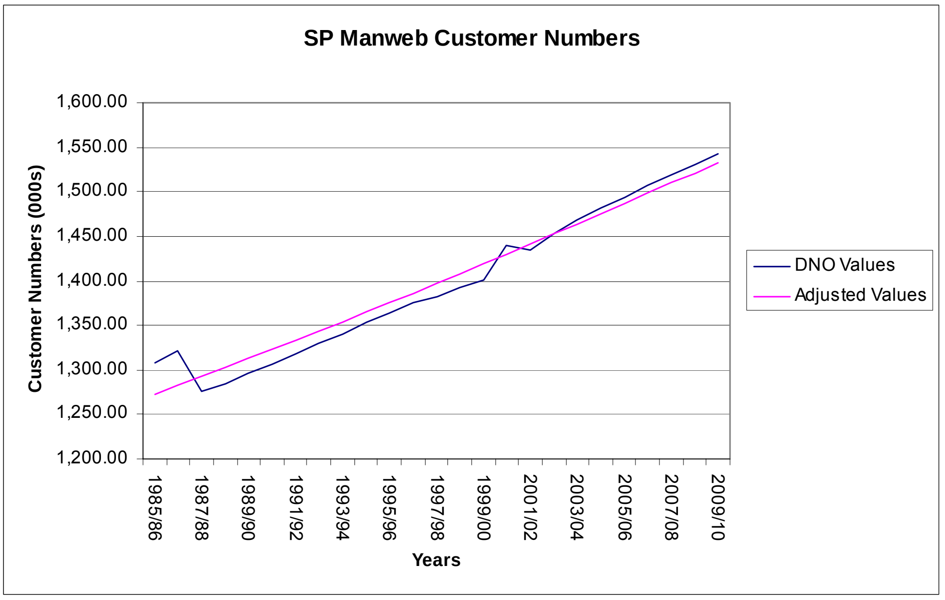
PB Power has carried out modelling of forecast expenditure using both DNO data and PB Power data with a view to understanding better how DNOs have arrived at forecast expenditure and with a view to informing Ofgem of issues that may be considered in arriving at allowances for DPCR4.

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.

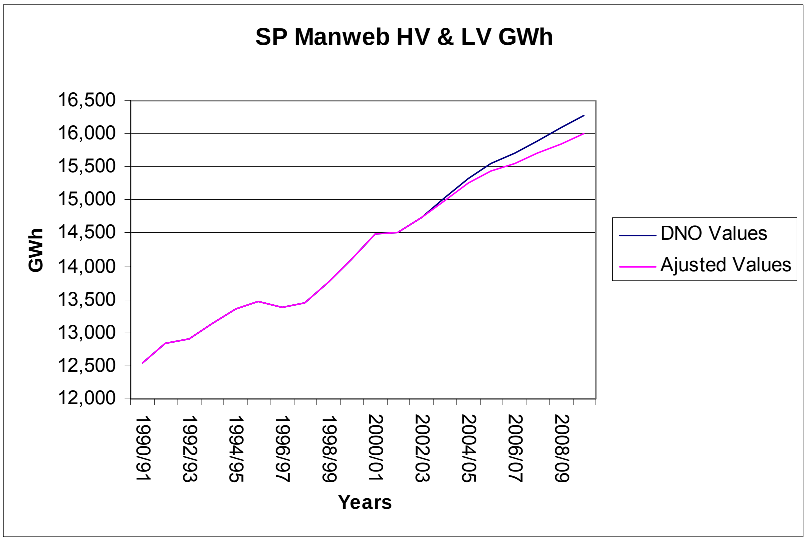
3.2 Load related expenditure

3.2.1 Model inputs

A step change in SP Manweb customer numbers occurs between 1999/00 and 2001/02. To remove this step change an average growth rate of 0.78% has been applied backwards from 2002/03. Also the forecast growth rate from 2003/04 is higher than the historic data, therefore the average growth rate has been applied to the forecast years.



GVA analysis indicated that SP Manweb's load forecast was high. Therefore the values entered into the model have been adjusted to reflect a lower load forecast. The adjustment has taken the form of a 37.8GWh year on year reduction from 2003/04. The 37.8GWh reduction was calculated as part of the GVA analysis.



SPM submitted its load-related expenditure forecast net of 3rd party connections. Following discusssion with SPM and as indicated earlier in this report, a gross market LRE adjustment has been applied to SPM's forecast to reflect overall LRE.

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 Capex 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)
153	177.2	215.4	**122.6**

3.2.3 Load related expenditure modelling comments

The modelling indicates that the SPM load-related expenditure, taken over DPCR2, DPCR3 and DPCR4, is high in relation to the corresponding increase in MEAV as indicated by growth in customers and units distributed, particularly the latter. Furthermore a comparison of MEAVs calculated using SPM's and PB Power's unit costs show that the former are high. After deducting the DPCR2 and DPCR3 expenditures from the overall model prediction, the balance of expenditure remaining for DPCR4 is low.

The modelled level of load-related expenditure for DPCR4 suggests that issues may exist that are specific to SPM. (We note that it may be more costly to reinforce an interconnected system as on Merseyside than a more conventional network as elsewhere.) Historically SPM appears to be a provider with a relatively high cost per new service connection, which may be reflected in SPM's forecast of increased penetration by third parties offering connections. Furthermore the low level of growth on the network together with relatively high expenditure may suggest an underlying level of load movement (churn) whereas, for instance, a network with a high growth rate may more readily accommodate demand movement and/or stranded assets over a long period. The growth forecast by SPM in relation to the corresponding load-related expenditure is however low. Inward investment on brownfield sites is related issue that may well drive reinforcement need without associated growth indemand, depending on the nature of the load that eventually materialises. This phenomenon may also manifest itself through a higher cost per connected customer.

Some of the other network operators have to varying degrees identified similar issues. At present no substantive case has been made by SPM to suggest that it has a significantly worse set of factors that would allow the modelled output to be adjusted to accommodate such DNO-specific drivers.

SPM has identified problems of lack of spare capacity, particularly for 33/11kV groups. The proposed expenditure on general network reinforcement for the years 2004/05, 2005/06 and 2006/07 however shows a rapid rise above the long-term trend line (which is itself rising). We would question such a rapid increase in expenditure. Conversely the model output indicates an appreciable reduction in expenditure that we have not been able to reconcile with the forecast.

Accordingly we propose that the gross load-related expenditure to be allowed for DPCR4 be limited to that projected for DPCR3, namely £215m.

3.3 Non-load related expenditure

3.3.1 Model inputs

No specific model input adjustments were made for SPM.

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 outputs 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	121.9	113.0	Lines & services	121.2	78.6	84.6	
Cables	28.9	26.8	Cables & services	29.3	16.4	13.7	
Transformers	19.1	17.7	Substations	137.0	93.7	81.3	
Switchgear	89.7	83.1	Part Submission Total	287.4	188.7	179.7	
Services and Lines	11.6	10.7					
SMC	0.0	0.0					
Other Substations	39.0	36.1					
Other Not Modeled	10.5	10.5	Other Not Modeled	10.5		6.1	
Total	320.7	297.9	Total	297.9		185.8	215.8

3.3.3 Nonload related expenditure modelling comments

For overhead lines, the model predicts appreciably lower expenditures for replacement/refurbishment of lines at all three voltage levels than forecast by SPM. At EHV and HV this difference reflects SPM's policy of replacing 33kV and 11kV interconnector overhead lines with lines of a higher specification which represent an estimated £25m additional cost for resilience. We would nevertheless consider SPM's approach to be justified in view of recent storm experience.

With regard to underground cables, the model predicts lower expenditure on replacement of HV cables, the difference before adjustment being some £17m. SPM's expected average asset lives are considerably shorter (52 years for HV and 50 years for 33kV) than the adjusted industry average weighted lives derived by PB Power (Appendix F). Moreover the standard deviation declared by SPM for HV cables is long (15 years) and would tend to result in the modelling of replacement earlier than otherwise. SPM's unit costs for replacement of HV and EHV cables are either the same as or lower than PB Power's. The differences in asset lives and standard deviations would explain the difference between SPM's submission and the model output. We would therefore conclude that SPM is proposing replacing HV cables at a much earlier age than the rest of the industry in general and may reflect difficulty targetting poor condition assets for replacement. This conclusion is also borne out by SPM's forecast HV cable replacement expenditure showing a rapid increase from £0.7m in 2006 to £6m in 2010.

The model predicts some £16m higher transformer expenditure than SPM's forecast. However the model predicts appreciably less expenditure on switchgear (including protection) than the submission, the differences being LV switchgear (about £7m), HV switchgear (about £40m) and EHV and 132kV switchgear (about £10m)[1]. The switchgear expenditure differences may be attributed to the influence of SPM's risk assessment policy although the SPM's replacement unit costs are high for HV and 33kV circuit breakers (£52,200 and £180,000 respectively) and so may also contribute to this difference.

In PB Power's opinion, the allowed non-load related expenditure corresponding to the model output should be £215.8m, the increase above the model output of £30m being an allowance for line and switchgear replacement. 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	**177.2**	**215.4**	**122.6**	**215.0**
Non Load Related	**247.4**	**437.4**		**326.0**
Gross Capex less Non Op Capex	**424.7**	**652.8**		**541.0**
Non Op Capex (Not Assessed)	5.0	**-**		0.0
Total Gross Capex	**429.7**	**652.8**		**541.0**
Contributions	-75.3	-68.4		-86.9
Net Load Related	**101.9**	**147.0**		**128.1**
Total Net Capex	**354.3**	**584.4**		**454.1**
Non Load Related Summary				
Replacement		280.2	**185.8**	
ESQCR		27.8		
Heath & Safety		15.4		
Environment		2.2		
Sub Total - Model Comparison	**121.5**	**325.6**		**215.8**
Diversions	11.6	12.6		11.6
SCADA	5.0	7.6		7.1
Sub Total	***138.0***	***345.9***		***234.5***
Metering (Not Assessed)	23.1	32.6		32.6
Sub Total	**161.1**	***378.5***		**267.1**
Fault Capex (Not Assessed)	86.3	58.9		58.9
Non Load Related Total	**247.4**	**437.4**		**326.0**

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

[1] The disaggregation of switchgear expenditure has been derived from Figure C1.9 of SPM's Forecast Business Plan.

- 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

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.

SPM's forecast reflects their anticipated loss of market share of the connections market. £50.9m has been added to gross expenditure and capital contributions in the DPCR4 forecast and £12.7m in the DPCR3 projection to reflect the total connections market on a comparable basis with other DNOs, historic expenditure and modelling. The adopted market is currently 68% and when the market matures SPM expects only 12% of the market to remain licensed.

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 Gross Market	31.5	40.2	47.3	53.6	67.6	240.2
Load Related SPM share	31.5	40.2	47.3	47.7	60.8	227.5
Capital Contributions	-18.7	-17.2	-12.7	-12.5	-10.0	-71.1
Non Load Related	37.7	49.2	65.0	49.6	62.5	264
Non-operational capex	5.0					5
Total Capital Expenditure	55.6	72.2	99.6	84.8	113.3	425.5

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 Gross Market	60.2	52.2	48.3	46.1	46.5	253.3
Load Related (SPM share)	50.6	42.0	38.1	35.6	36.1	202.4
Capital Contributions	-4.8	-4.8	-4.9	-4.8	-4.9	-24.2
Non Load Related	74.0	77.1	84.4	89.4	95.3	420.2
Non-operational capex						
Total Capital Expenditure	119.8	114.3	117.6	120.2	126.5	598.4

Note that the above figures are presented without normalisation or adjustment for pensions, lane rentals profits on recharges.

Projections of future load related Capex

SPM's load related capital expenditure projections for the Base Case Scenario are as set out in the following table:

Table A.3 - Base Case Load Related Capex Projections

LOAD RELATED CAPITAL EXPENDITURE - £M	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**Total**
LRE Total Gross Market LRE	60.2	52.2	48.3	46.1	46.5	**253.3**
Total Connections Market	23.7	24.2	24.4	24.7	24.6	**121.6**
SPM,s loss of market share	9.6	10.2	10.2	10.5	10.4	**50.9**
SPM's Market Share of Connections	14.1	14.0	14.2	14.2	14.2	**70.7**
Customer Contributions SPM	4.8	4.8	4.9	4.8	4.9	**24.2**
Net Connections	9.3	9.2	9.3	9.4	9.3	**46.5**
Reinforcement from FBPQ	31.1	22.8	19.3	17.0	17.2	**107.4**
Other SPM funded LRE	5.5	5.2	4.6	4.4	4.7	**24.4**
LRE Total Net	**45.8**	**37.2**	**33.2**	**30.8**	**31.2**	**178.2**

The above table sets out the affect of the adjustments made for loss of market share. The table includes an amount for reinforcement as set out in the FBPQ and we have not been able to reconcile this declared reinforcement with the total net load related expenditure leaving some £24.4m of expenditure unexplained.

Network reinforcement

SPM has provided information on major network reinforcements to relieve overloaded substations at 33 kV and provided information on major projects planned for DPCR4.

Table A.4 - Network Reinforcement Programme

Summary of Major projects anticipated during DPCR4

								Project Summary						
								DPCR3			DPCR4			
								2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Area	Activity	Description	Issue No.	Concept Approval	Weighted Score	Cat	**Total (£k)**	Load	Load	Load	Load	Load	Load	Load
SD&C	31165	Liverpool City Centre Infrastructure reinforcement				R	**£2,641**	0	0	2641	0	0	0	0
SD&C	31066	Liverpool City Centre Primary Uprating				R	**£4,000**	0	0	2000	2000	0	0	0
SD&C	31165	Legacy - Oswestry 132kV				R	**£2,200**	0	0	2200	0	0	0	0
SD&C	31165	Mid Wales Reinforcement				R	**£5,000**	0	0	0	0	0	0	5000
SD&C	31066	Knutsford Reinforcement				R	**£3,022**	0	0	3022				
SD&C	31066	Knutsford Busbar Protection				R	**£690**			690				
SD&C	31165	Lostock Carrington				R	**£2,649**		0	2649				
SD&C	31066	Wharton 33kV Switchboard/Winsford Grid				R	**£750**			750				
SD&C	31165	Crewe Grid Additional Grid Transformer				R	**£600**			600				
SD&C	31165	Bold Grid additional Grid Transformer				R	**£840**			840				
SD&C	31165	New 132/33kV Substation at Chirk				R	**£0**							
SD&C	31066	Flint Reinforcement				R	**£5,000**				2500	2500		
SD&C	31165	Aintree T2 - Gillmoss T2 Loading (Fazakerley Grid)				R	**£0**							
SD&C	31165	Speke T3 - Garston T2 Loading				R	**£6,000**				3000	3000		
SD&C	31165	Replace Two Grid Transformers at Ince				R	**£5,000**			2500	2500			
SD&C	31165	Reconfigure Elworth Grid (Hays Chemicals)				R	**£1,661**			1500	161			
SD&C	31165	New 132/33kV Substation Thelwall/Stretton				R	**£5,000**					3000	2000	
SD&C	31165	New 132/33kV Substation Omega (Cheshire)				R	**£4,563**						2063	2500
SD&C	31165	Southport 'D' line rebuild as double circuit				R	**£7,000**					3000	4000	
SD&C	31165	Anglessey New 132/33kV s/s				R	**£0**							
SD&C	31066	33kV Bus Section Breaker @ Saltney				R	**£753**							753
SD&C	31066	Wervin - Tarvin 33kV				R	**£0**							
SD&C	31165	Kirkby Southport 132kV Reinforcement				R	**£5,000**						2500	2500
SD&C	31165	Fiddlers Ferry SGT and 132kV Switchgear				R	**£3,000**			1500	1500			
Mersey	31066	Coppenhall - Wheelock Interconnector				R	**£1,000**			1000				
Mersey	31165	Southport - Formby OHL reinforcement				R	**£1,300**			300	1000			
Mersey	31066	Stanney Lane Ellesmere Port				R	**£750**		0	750				
Mersey	31066	Runcorn Shopping City / Town Centre				R	**£810**				250	560		
Mersey	31066	Sandbach Reinforcement				R	**£800**				800			
Mersey	31066	Senator Point New conn reinforcement				R	**£1,000**		0	300	700			
Mersey	31066	Southport Steam Port				R	**£350**		0	350				
Mersey	31067	Great Sankey 6/11kV Uprating				R	**£600**	0	0	600				
							£0							
	31067	SPM funded reinforcement for new conns (25% rule)				R	**£36,000**	0	0	7100	8700	7300	6400	6500
	31068					R	**£0**	0	0					
		Total Above					**£107,979**	0	0	31292	23111	19360	16963	17253
From Table NC1.5														
		Previous New connection capex					**£0**	0	0					
		Additional circuits for new conn security					**£6,800**	0	0	1400	1600	1400	1200	1200
		SPM funded reinforcement for new conns (25% rule)					**£36,000**	0	0	7100	8700	7300	6400	6500
		General Load growth					**£65,179**	0	0	22792	12811	10660	9363	9553
							£107,979	0	0	31,292	23,111	19,360	16,963	17,253
									0					

SPM has explained the rationale behind four reinforcement projects as follows:

Liverpool city centre infrastructure reinforcement

The investment requirements for this project dominate the SPM forecasts for DPCR4 and account for a significant part of the gradual rise in investment as part of the city's 800 year anniversary and City of Culture celebrations in 2008, Liverpool Vision has made SP Manweb aware of an estimated 40MW of additional load. This load will result in major regeneration and development of large parts of the city centre and based upon current system loads and operating parameters the existing infrastructure will be inadequate at all voltage levels. In order to meet this need additional capacity will be required and will be provided by the establishment of a new grid sub-station at Sparling Street and an additional grid transformer at Lister Drive. This will allow a system reconfiguration from 2 groups of 3 transformers to 3 groups of three transformers all mutually supportive. The project will require significant site works and cabling through the city.

Liverpool city centre primary uprating

Due to the same drivers as above this proposal meets the needs of the high voltage groups within the city centre. At the present time the primary substation infrastructure in the area consists of 54 primary transformers arranged in 22 groups. 15 of these groups operate at 33/6.6kV and are already under pressure with respect to thermal capacity and fault levels. These groups will be uprated to 33/11kV and this will result in a requirement to change 289 secondary substations from 6.6/0.433kV to 11/0.433kV. The network will be reconfigured to improve utilisation, meeting the needs of Liverpool well into the 21st century and providing all the necessary capacity for associated load growth.

Legacy - Oswestry 132kV

This project seeks to reinforce the network between Legacy and Oswestry 132kV sites. The Grid Supply Point site at Legacy supports 9 off 132/33KV substations and would result in thermal overloads in both summer and winter conditions. Future load growth will exacerbate this problem. The levels anticipated rapidly place the group outwith P2/5 compliance. An additional circuit will be provided and further capacity made available to support both load growth and alleviate system compliance issues.

Mid - Wales reinforcement

This project seeks to reinforce the network to mid-Wales by securing loads and providing the capacity necessary facilitate the high number of renewable energy generators wishing to connect in the area. At the present time the existing system does not provide adequate capacity to ensure reliable supplies and even modest increases in load would result in non-compliance with Engineering recommendation P2/5.

New connections forecast expenditure

New connections expenditure and customer contributions are forecast as follows:

Table A.5 - New Connections Expenditure

NEW CONNECTIONS EXPENDITURE - £M	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**Total**
New Connections SPM	14.1	14.0	14.2	14.2	14.2	**70.7**
Customer Contributions SPM	4.8	4.8	4.9	4.8	4.9	**24.2**
LRE Total Net	**45.8**	**37.2**	**33.2**	**30.8**	**31.2**	**178.2**

Non-load related expenditure

The amount of non-load related expenditure projected by SPM for the Base Case Scenario is as follows:

Table A.6 - Non-load related expenditure

Expenditure Classes	Non-Load Related (£m)					
	2006	**2007**	**2008**	**2009**	**2010**	**Total**
Non Fault Replacement	52.3	56.0	61.6	65.9	71.3	**307.1**
Metering	2.9	2.3	3.2	3.4	3.1	**14.9**
Faults	12.5	12.4	13.1	13.6	14.0	**65.6**
Diversions	2.8	2.7	2.7	2.7	2.7	**13.6**
Health and Safety	3.0	3.2	3.3	3.4	3.7	**16.6**
Environmental	0.5	0.5	0.5	0.4	0.5	**2.4**
Total	**74.0**	**77.1**	**84.4**	**89.4**	**95.3**	**420.2**

This report does not refer to capitalised fault expenditure and metering.

Overhead lines

SPM has stated that long-term modelling of this asset type using failure characteristics (PDF Curves) cannot reflect the impact of severe weather events, only performance under typical conditions. Therefore, whilst the long-term modelling outputs suggest an overall requirement to increase investment, these outputs do not take into account the additional levels of investment required to manage risks in the event of severe weather. It is therefore necessary to balance long-range investment forecasts for overhead lines with asset risk management techniques. This involves the detailed analysis of practical storm experiences and Met Office reports. As a result of analysis and practical storm experiences, SPM has further developed the methodology originally specified within EATS 43-40. This has enabled an approach to overhead line specifications that recognises the existence of geographic areas with greater exposure to severe weather events and the need for more robust specifications within those areas. The ratios between the two areas are as follows:

- severe weather area, represents 41% of SPM's HV overhead line network
- normal weather area, represents 59% of SPM's HV overhead line network.

'Storm resilient' overhead lines in severe weather areas are required to withstand a maximum combination of 70 mph winds and 40mm diameter ice accretion.

'Low weather areas' are required to withstand 50 mph winds and 40mm diameter ice accretion.

SPM has stated that replacement timescales have been developed taking into account wayleave, landowner and planning constraints. All inter-connected 33kV overhead lines would be storm resilient within 20 years in severe weather areas and 30 years in normal weather areas. Similarly, for 11kV the strategy would ensure that inter-connected overhead lines would be storm resilient within 15 years in severe weather areas and 40 years in normal weather areas. The 33kV overhead line network is a medium criticality asset, has circuit duplication and more robust 11kV interconnection. As a result, SPM has assumed that the high criticality 11 kV overhead line network should be made storm resilient over a shorter period. Any extension beyond these timeframes would dilute the ability to achieve restoration of all customers during these events within a 2 to 4 day window. This represents a line strengthening rate of 132km per year in severe weather areas and 74km per year in normal weather areas. In this respect the SPM forecast may be some £5m per year higher than a strictly Base Case scenario. It is noted that the DNO case includes a further 115km of overhead line strengthening

SPM has not completed the refurbishment information requested within Table 13.1 of the FBPQ. Where minor refurbishment is undertaken, it is performed to the existing overhead line specification standards and will not improve severe weather resilience. SPM only undertakes this form of minor refurbishment on non-interconnected sections of its overhead line networks (spurs) which have very few customers connected.

SPM considers that in rural villages there is a strong case for removing existing open wire overhead lines to enhance safety and reduce environmental impact. In some instances, old construction standards have resulted in inadequate clearances between open wire lines and buildings and other structures. The highest risk locations have been identified and are being rectified on a prioritised, programmed basis. When such lines are due for replacement a modern equivalent LV overhead line construction based upon ABC or undergrounding is adopted. The continued presence of overhead service lines to properties however, prevents the full benefits of wholly under-ground networks from being realised as replacement of services is often expensive and disruptive to customers.

SPM includes this safety work on LV overhead lines as work as part of normal risk assessed replacement SPM has identified an ESQCR programme of £30m.

Table A.7 - Breakdown of proposed overhead line investment

Asset	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
LV Overhead Lines	2.4	6.1	5.9	5.9	5.9	5.9	**29.6**
11kV Overhead Lines	12.2	12.7	13.1	13.2	13.4	14.3	**66.7**
33kV Overhead Lines	7.2	4.7	4.8	4.8	4.	5.0	**23.9**
132kV Overhead Lines	4.5	2.5	2.4	2.5	2.5	2.5	**12.4**
All Overhead Lines	**26.3**	**26.0**	**26.2**	**26.3**	**26.4**	**27.7**	**132.5**

Of the above about £2m per year is fault expenditure.

In summary SPM is proposing an increased level of investment in the DPCR4 period, relative to DPCR3, to improve reliability of LV overhead lines and enhance safety for the general public through removal of open wire LV overhead lines in rural villages. Due to local authority planning constraints, landowner consents etc., investment in 11 and 33kV overhead lines is subject to some degree of annual variation as indicated in the HBPQ submission. Proposed investment in 11 and 33 kV overhead lines is however, consistent with the average level of expenditure during DPCR3 and represents a continuation of the ongoing programme to reconstruct lines and improve storm resilience. There is a reduction in expenditure levels on 132 kV overhead lines.

SPM's approach is considered to be beyond that required by the Base Case scenario due to the additional resilience and safety related LV overhead line work by around £43m. Nevertheless in view of storm experience the replacement of interconnector lines with a more resilient design is considered to be prudent and could be considered by Ofgem and DTI as a model for other DNOs in that the resilience expenditure is restricted to 33kV and interconnector lines and the timescales are reasonable and for less severe weather areas would only be completed when the lines need to be replaced.

Underground cables

SPM has identified certain strategic 33kV and 11kV cables which are deteriorating and have a steeply increasing replacement programme based on identifying specific sections for replacement. Forecast replacements rise from £1m to £9.7m We do not consider the increase to be justified due to the relatively static fault rate and identification of deteriorating cable from partial discharge studies is not considered to be a sufficient cause for the increase.

Expenditure on replacement of service cables is similar to DPCR3.

Switchgear and transformers

Switchgear expenditure slightly increases in the DPCR4 period compared to DPCR3. This continued level of investment is necessary to manage the risks associated with ongoing disruptive failures, increasing numbers of reported switchgear defects and condition information including; increasing trends in SOPs (Suspension of Operational Practice), DINs (Dangerous Incident Notification) and ORs (Operational Restriction) as reported through the Electricity Association's NEDERS system (National Equipment Defect Reporting Scheme) over recent decades; and condition issues such as Lucy (water ingress and rusting), RA4 (overheating issue) and ABB Sentinel (manufacturing defect) and J & P (rusting) which have and will continue to, force increased replacement investment over the DPCR3 and DPCR4 periods.

Although SPM is not proposing a programme to address the replacement of oil filled switchgear, SPM has adopted a procurement policy based on the purchase of non-oil filled switchgear.

Transformer replacements are forecast to be similar to DPCR3 although pole transformers are not only replaced on failure but also as a part of overhead refurbishment.

The increase expenditure on protection assets over the DPCR4 period is associated with replacement of particular 33kV unit protection schemes (Hardex pilots and MPR) to address performance and supportability of these systems. It also deals within SPM some particular limitations associated with voltage control and sensitive earth fault protection for 11kV overhead lines.

Expenditure on Telecontrol/ SCADA over the DPCR4 can be attributed to addressing performance and support issues associated with RTU equipment in substations and control room SCADAsystem.

Non load related investment

SPM has identified expenditure associated with compliance with ESQCR of £30m. .

A.3 Health and safety

Only a small proportion of SPM's investment is specifically allocated to Safety and environment to address certain switchgear issues such as safety and asbestos.

A.4 Diversions

SPM has included relatively modest amounts for diversions in their forecasts reflecting the robust approach to managing wayleave terminations.

Major replacement projects

The key replacement projects identified in the plan are shown below:

Table A.8 - Major Non Load Related Expenditure Projects

Major Projects and Programmes DPCR4

SP Manweb

Project Description	Activity	2005/06	2006/07	2007/08	2008/09	2009/10
Capenhurst 132kV Refurb	132kv S/s	■	■	■		
St Asaph 132kV Refurb	132kv S/s	■				
Bold 132kV Refurb	132kv S/s			■		
Lister Drive 132kV Refurb	132kv S/s	■	■	■		
Oswestry 132kV Refurb	132kv S/s				■	■
Ellesmere Port 132kV Refurb	132kv S/s				■	■
Gateacre 132kV Refurb	132kv S/s				■	■
Halewood 132kV Refurb	132kv S/s					■
Speke 132kV Refurb	132kv S/s					■
Bersham Colliery	33kV S/s	■				
Rhydlydan	33kV S/s	■				
Warrington/Dallam CH Line	132kV OHL	■				
Bold Spur CB Line	132kV OHL	■				
Crewe/Whitfield/Cellarhead	132kV OHL		■	■		
Distribution OHL Programme	33kV/11kV & LV OHL	■	■	■	■	■
Switchgear OHL Programme	11kV Switchgear	■	■	■	■	■
132kV Cable Replacement Programme	132kV U/G			■	■	■
Ince Grid - Shell Oil Sites Road & Air Products	33kV U/G	■				
33kV Cable Replacement Programme	33kV U/G	■	■	■	■	■
11kV Cable Replacement Programme	11kV U/G	■	■	■	■	■
Southport LV Refurb	LV U/G	■	■			
Wallasey Changeover	Service Refurb	■	■			
NMS / SCADA / Telecontrol	Other	■	■	■	■	■
Strategic Telecomms	Other	■	■	■	■	■
Anti Oil Pollution Bunding	Other	■	■	■	■	■

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, SPM is not required to reduce the number of unplanned Customer Interruptions (CI) or unplanned Customer Minutes Lost (CML) in comparison with the average performance experienced in the last two years, as SPM is already outperforming the Ofgem targets. SPM's urban HV network design differs from other DNOs in that it has automatic sectionalising features which limits the number of substations and customers disconnected in the event of a circuit fault.

SPM has established the current level of performance for unplanned HV and LV CIs and CMLs by averaging the underlying performance reported for 2001/02 and 2002/03 using the audited IIP exceptional event adjustments. For EHV CIs and CMLs SPM has established the current performance to be equal to its average performance over the 10-year period 1993/94 to 2002/03. The outcome is that SPM's starting point represents an out-performance of the IIP 2004/05 CML target by 14.3% but a failure to achieve its IIP 2004/05 CI target. (SPM has previously discussed with Ofgem what SPM considers to be the aggressive nature of the IIP 2004/05 target.) SPM is not therefore proposing any investment to meet the central quality of supply scenario.

However customers in rural areas experience a level of quality of supply inferior to that in other areas and as the improvement of supply to these customers is of concern to SPM it is addressed in the DNO Alternative Scenario proposals.

It is also noted that SPM intends to replace a large number of HV ring main units in DPCR4. These units are similar to the type of automatic equipment being installed by other DNOs in their quality of supply scenarios and in this respect the switchgear replacement expenditure is comparable with other DNO automation expenditure.

SPM is proposing a modest expenditure to meet the targets for the 2% and 5% quality of supply scenarios and the required improvement targets are set out below:

Variable	SPM Starting Position	Ofgem 2010 (and 2020) target	2010 Improvement Sensitivity	Required Improvement
Unplanned CI	45.8	60.4	44.8 (2%)	1.0
Unplanned CML	48.7	48.7	46.3 (5%)	2.4

In establishing the 2010 and 2020 performance targets for each DNO, Ofgem made a number of key assumptions in relation to each of the 22 HV circuit groups (established as part of the dissagregation exercise conducted between Ofgem and DNOs). These assumptions are that within each of the 22 HV circuit groups DNOs will move towards achievement of:

- national average customers per fault – a measure of network design;

- national average faults per km – a measure of asset reliability; and
- upper quartile average duration of supply interruption – a measure of operational response.

SPM has based its improvement plans on gap analysis of the performance of its circuits within each of the 22 Ofgem quality of supply circuit categories.

B.1.1 Ofgem sensitivity scenario three: further two per cent improvement in CML by 2010

The **additional** initiatives required to improve CI and hence CML performance by a further 2 % are shown below:

Circuit Category	Activity	CI benefits	Cost (£m)
OH1B	Maximise number of customers within the main protection zone, removal of performance defects and application of insulated shrouding to overhead line plant	0.5	7.016
MC1B	Maximise number of customers within the main protection zone, removal of performance defects and application of insulated shrouding to overhead line plant	0.5	5.562
Total		**1.0**	**12.578**

B.1.2 Ofgem sensitivity scenario five: further five per cent improvement in CML by 2010

SPM takes, on average, longer to restore customers relative to other DNOs and needs to improve its performance against this measure. Minimising the average duration of a customer interruption can be achieved through the basic philosophy of restoring supply to more customers in as short a duration as possible. SPM's recently created Control, Restoration and Repair (CR^2) business unit aims to achieve improved operational efficiency through the implementation of a range of business process and operational improvements.

As the CR^2 business unit becomes established and implements the required changes to the end-to-end management of fault repair and supply restoration processes, SPM expects that a 5% improvement in CML (2.4CML) could realistically be achieved by 2010 with the addition of 3 operational staff. At £70,000 per annum per person this equates to an operational expenditure of £1.05m.

SPM has not presented a Deterioration Sensitivity Analysis as this would otherwise represent deterioration on current performance.

B.2 Overhead line upgrade

SPM has included only a modest figure of £16.0m for the accelerated overhead line upgrade since its overhead line strategy of line strengthening is a feature of its ongoing asset replacement plans.

SPM's Base Case proposals include the rebuild of 1030 km of HV overhead lines to improve the safety and resilience of the networks within the period to 2010 in line with the timescales for the proposed HV overhead lines programme of:

- 15-year timeframe for HV overhead lines in severe weather areas; and
- 40-year timeframe for HV overhead lines in normal weather areas.

SPM states that these timescales are consistent with its assessment of what is achievable given delays associated with the wayleaves and consents process and resource availability.

In responding to the question on accelerated upgrade of HV overhead line, SPM presents the costs and volumes associated with accelerating the Base Case HV overhead line modernisation programme by five years.

The overhead line upgrade profile detailed within this sensitivity analysis has the following timescales:

- 10-year timeframe for HV overhead lines in severe weather areas; and
- 35-year timeframe for HV overhead lines in normal weather areas.

In order to accelerate the rebuilding of overhead lines by five years a total of 1413km of overhead lines would be targeted during the DPCR4 period, at an estimated cost of £16m. SPM has however qualified its response stating that resource constraints would preclude the accelerated line upgrade programme being delivered within the specified timescale. The response is therefore illustrative only.

B.3 Resilience undergrounding

SPM has forecast £125m for resilience undergrounding (of 2 per cent of overhead lines) but states that this is not achievable within the timescale proposed due to resource constraints and planning and consents issues.

B.4 Amenity undergrounding

SPM would need to invest £831m for under grounding in National Parks and Areas of Outstanding Natural Beauty. This scenario would imply the under-grounding of 3626km of overhead lines. SPM does not favour under grounding in its own right for amenity purposes due to resource constraints and negative environmental factors.

APPENDIX C

DNO ALTERNATIVE SCENARIO

APPENDIX C – DNO ALTERNATIVE SCENARIO

C.1 DNO alternative scenario

SPM's DNO Alternative Scenario includes improvements in key outputs relative to the Base Case and a corresponding increase in expenditure over and above the Base Case of £17.5m capital expenditure and £0.7m annual operating expenditure during the DPCR4 period.

The DNO Alternative Scenario includes initiatives (additional to the Base Case) necessary, in SPM's view, to meet the expectations of customers, deliver a positive environmental impact and manage risk through:

- improvements in Quality of Supply (addressing worst served customers and communities and improving global CI/CML);
- installation of low loss distribution transformers; and
- real time system developments to mitigate the threat of terrorism.

Incremental volumes of work are shown below:

Activity	2006	2007	2008	2009	2010	Total
HV Overhead line bare (kms)	-13	-13	-13	-13	-13	-65
HV Overhead line covered (kms)	9.8	9.8	9.8	9.8	9.8	49
HV Cables	3.3	3.3	3.3	3.3	3.3	16.5
HV Switchgear Automation (Units)	18	18	18	18	18	90
Low loss transformers						
Real Time Systems Security						

Note: No additional transformers are planned. Instead existing 11kV ground mounted transformers would be replaced with low loss units, as and when due for replacement.

Additional capital expenditure (£m) is shown below:

Activity	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Quality of Supply	3.15	3.15	3.15	3.15	3.15	15.8
Low loss transformers	0.04	0.04	0.04	0.05	0.05	0.2
Real Time Systems Security	0.62	0.64	0.11	0.13		1.5
Total	3.8	3.8	3.3	3.3	3.2	**17.5**

The incremental benefits of the DNO Alternative Scenario are shown in the table below:

Activity	**Reduction in**	**2006**	**2007**	**2008**	**2009**	**2010**
Quality of Supply	Unplanned CIs	0.0	0.1	0.2	0.3	0.4
Quality of Supply	Unplanned CMLs	0.0	0.1	0.2	0.3	0.4
Low loss transformers	Losses (GWh)	0.0	0.4	0.8	1.2	1.6

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.

D.1.1 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.

D.1.1.1 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.

Analysis 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.

D.1.2 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.

D.1.3 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.

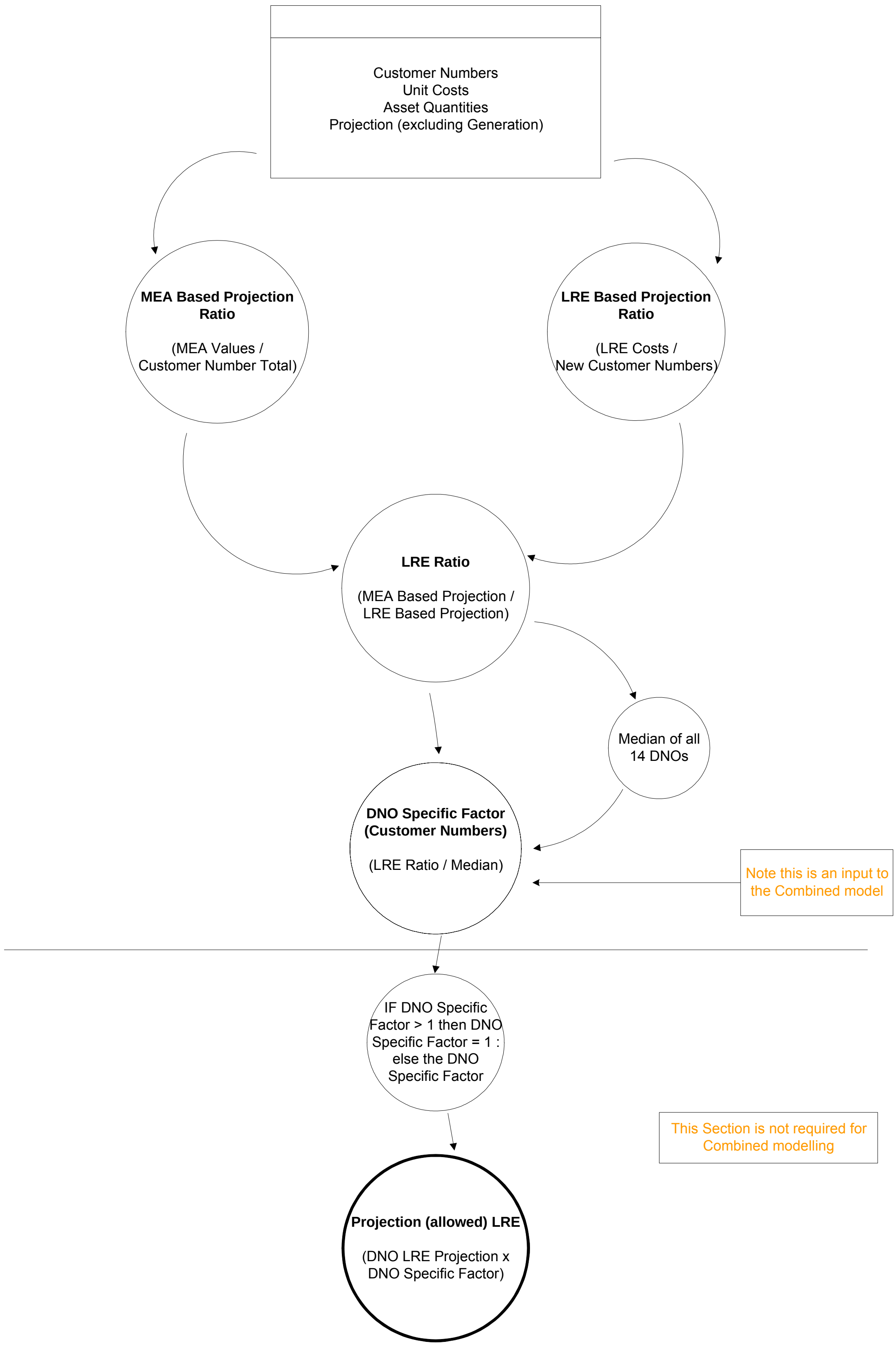
Being benchmarked on a median rather than on an average implies that extremes do not affect the adopted benchmarking position. It also means that the LRE of each company is compared relative to its cost base against the Industry Trend and not in absolute cost terms. This approach recognises therefore 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

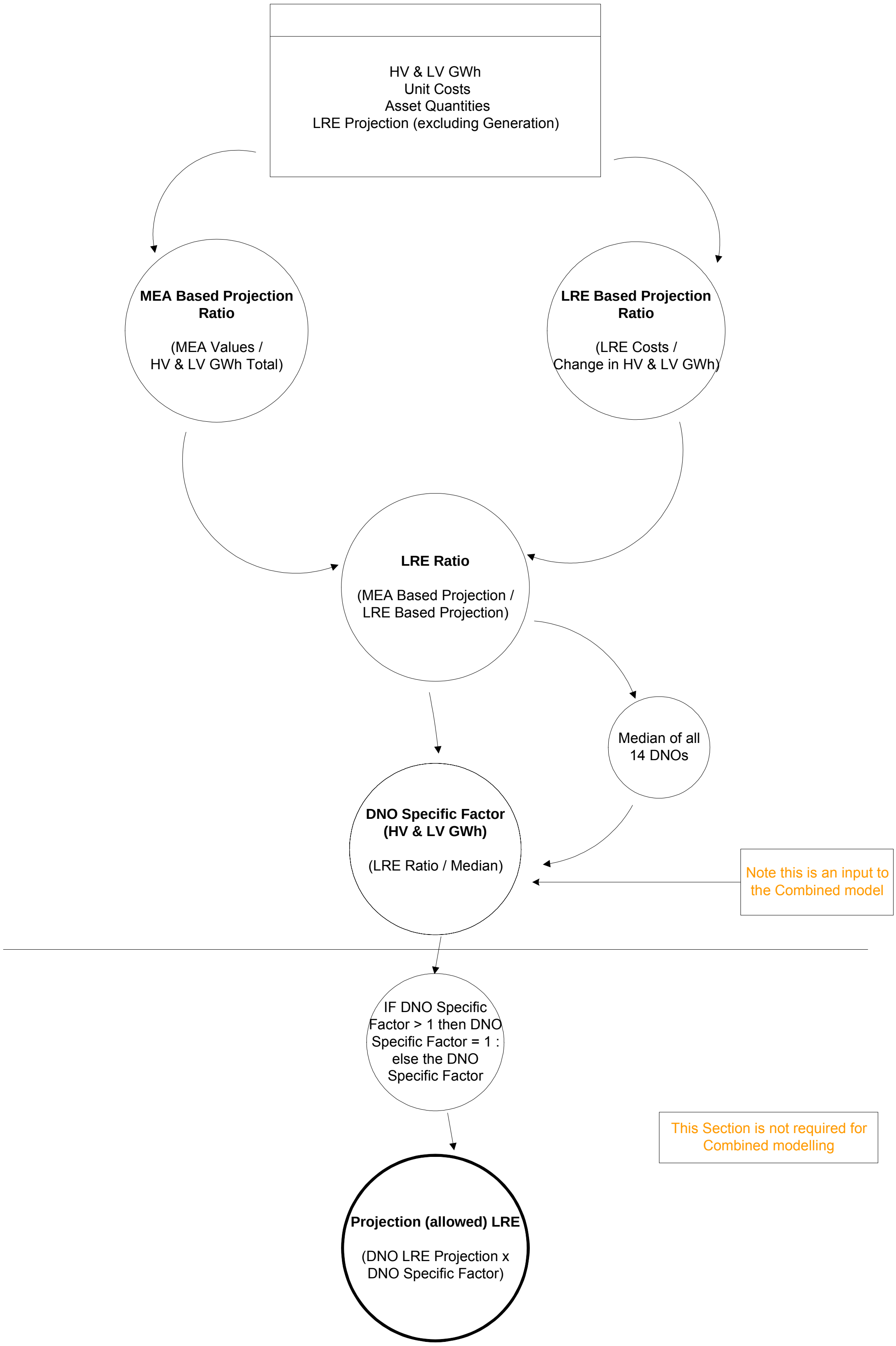
Although each DNO's network is comprised of a large number of smaller networks and that it would be expected that these would have a range of spare capacities depending on local load growth and when individual networks were last reinforced, it is possible that a larger number of the smaller networks 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.

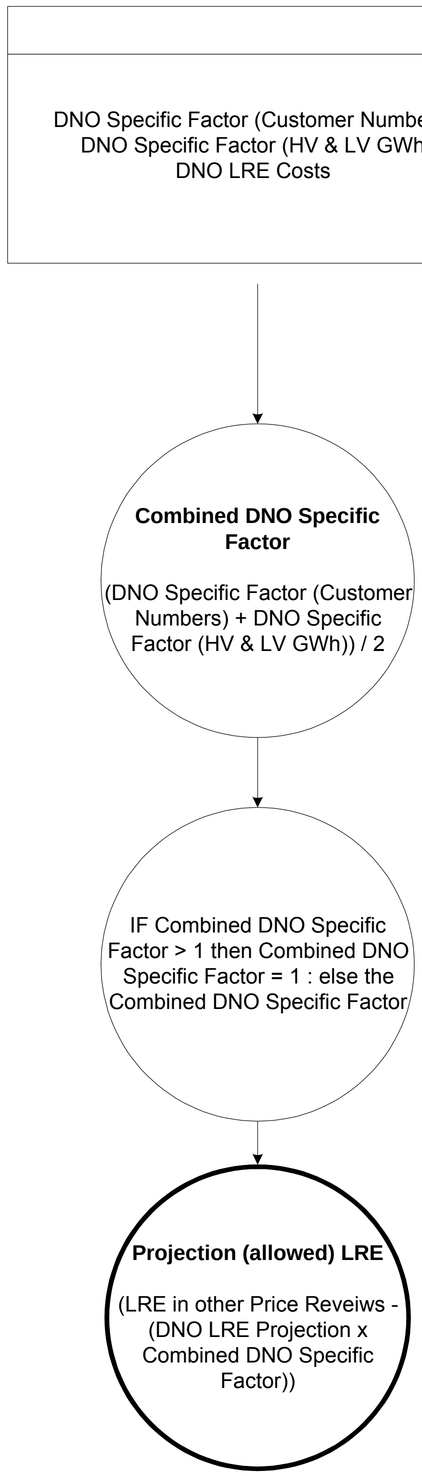
Combined Load Related Expenditure Modelling (Phase 1A Customer Numbers)



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)

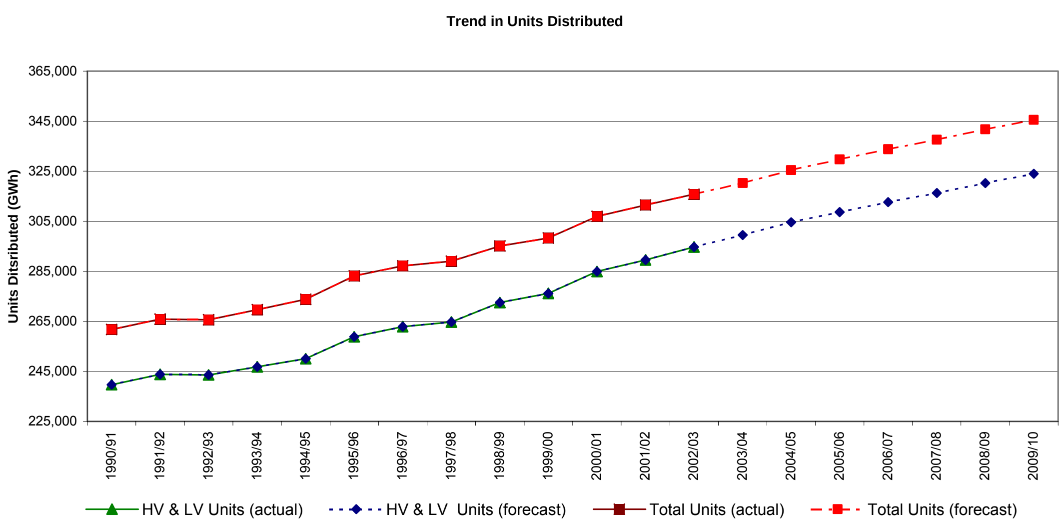
For the purposes of this review, GVA is treated as being synonymous with gross domestic product (GDP). Furthermore Regional Accounts are currently published in terms of GVA[1] only. Statistics are published by geographical region in accordance with the Nomenclature of Units for Territorial Statistics (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



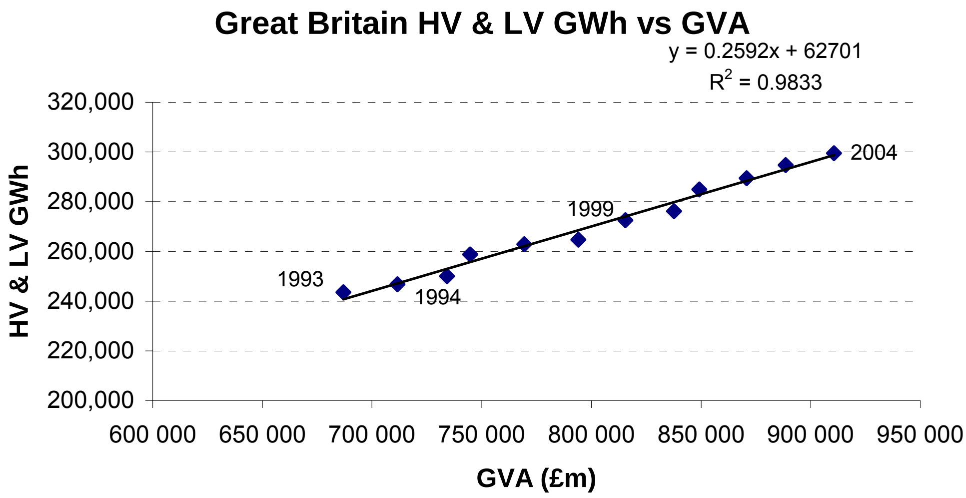
The total regulated units are HV and LV units and the total regulated units include EHV units. Up to and including 2003/03, the units distributed are actual units whereas from 2003/04 onwards these are forecast.

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.

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

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 2004[3] 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 CAPEX 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

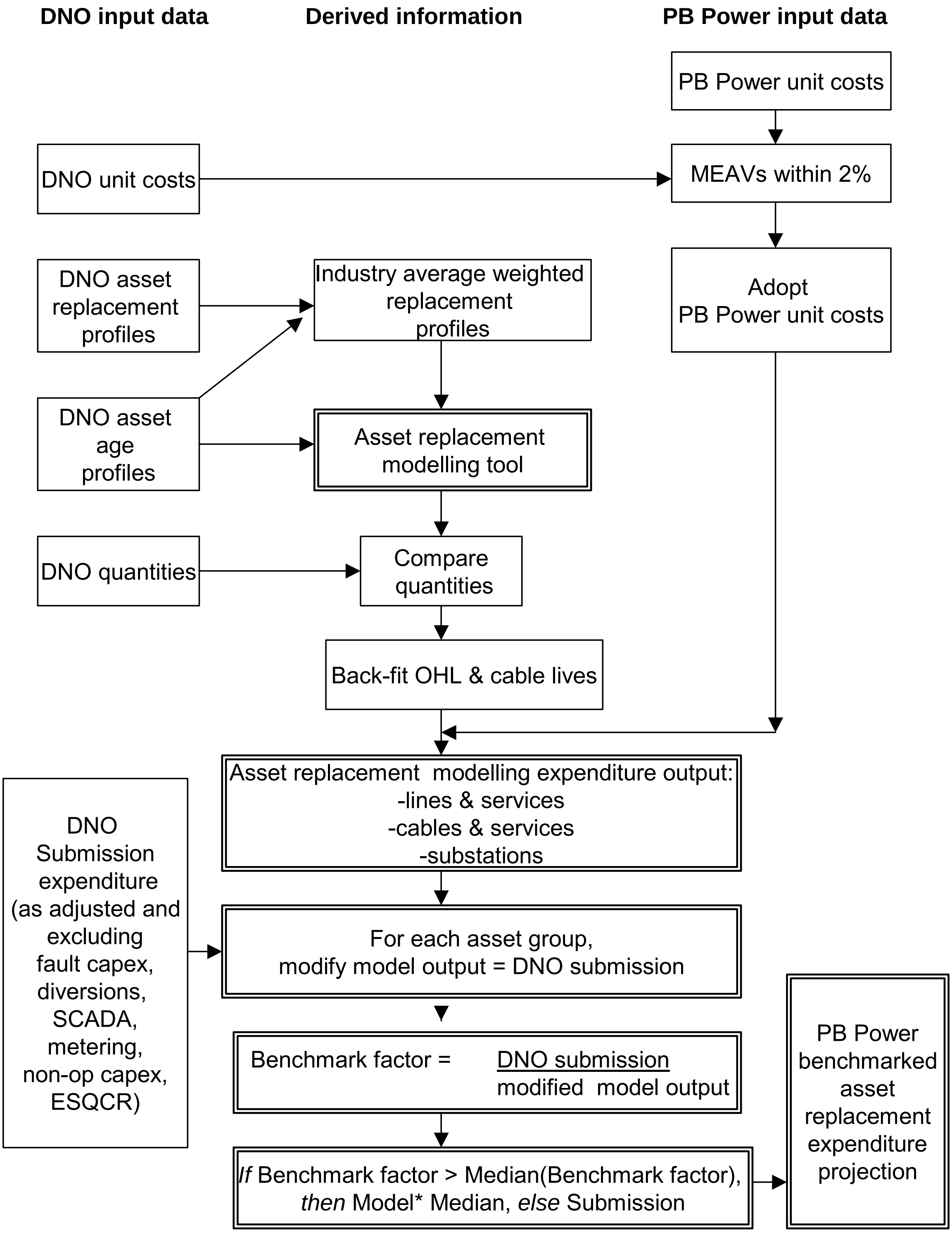
The model output is initially modified so that for each of the asset groups the overall industry (14 DNOs') expenditure predicted by the model is the same as that forecast by the DNOs. (The differences had in any case been small.) For each asset group, benchmark factors of DNO submission/model output 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%