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EME

DPCR4 – FBPQ ANALYSIS AND CAPEX PROJECTIONS

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APPENDICES:

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)
EME	East Midlands Electricity
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)
SSAP	Standard accountancy practice

FOREWORD

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

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

We have however reviewed the expenditure and drivers of the DPCR4 Base Case Scenario only, with a limited overview of the Ofgem Scenario/Sensitivity and the DNO Alternative Case. In particular, we have taken note that Ofgem's requirement that capital expenditure included in the Base Case Scenario should be only that necessary to maintain the distribution system at its existing performance level in respect of quality of supply. It follows in our view that the level of network risk experienced during DPCR3 should also be held constant during the forthcoming review period. Where DNOs have included expenditure that may not fit with those objectives then such expenditure is not deemed 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 modeling 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 modeling 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 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 modeling 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 EME's adjusted DPCR3 projection, adjusted DPCR4 forecast, PB Power's modelling results and opinion of proposed expenditure.

Expenditure Category	Adjusted DPCR3 Projection (£m)	Adjusted DPCR4 Forecast (£m)	Model Output (£m)	PB Power Opinion (£m)	PB Power Comments
Load Related Expenditure - Gross	309.9	394.0	391.0	369.0	Our view is that the allowed expenditure should be the adjusted DPCR4 forecast less £25m in respect of potential savings on reinforcement schemes,and earth loop impedance schemes.
Customer Contributions	(198.3)	(196.7)		(196.7)	
LRE Net	**111.6**	**197.3**		**172.3**	
Asset Replacement	158.1	299.2	230.5	230.5	We consider that the allowed asset replacement expenditure should correspond with the model at £230.5m.
Other	104.9	146.8		144.8	£144.8m comprises diversions (£37.5m), SCADA (£5.0m), metering (£64.6m) and fault capex (£37.8m).
NLRE Total	**263.0**	**446.0**		**375.3**	
Non Operational	19.3	6.2		6.2	
DNO Total	**393.9**	**649.7**		**553.8**	
DNO Total				*445.3*	*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 EME forecast has been adjusted for pension funding deficit and lane rentals.

Our principal findings are summarised below.

Load related expenditure

- The forecast reinforcment expenditure is high due to:
    - reduced capacity headroom and need for completely new substations rather than transfomer changes – 3 Grid Supply Points and 4 Bulk Supply Points;
    - overstressed switchgear expenditure due to changes in NGC and EME calculation methods and low risk approach and,
    - legacy LV network design problems (loop impedance) which may need to be aligned nationally.
- New connections forecast reflects past bouyant trends.
- Taking into account pensions and lane rentals the model indicates a higher projection than forecast due to low historic expenditure and high forecast.

Non load related expenditure

- The replacement forecast to maintan performance is lower than the model as EME has taken into the impact of account ESQCR and diversions to meet Ofgem's criteria for maintaining performance.
- Overhead line replacement forecast is particularly low from our bottom up assessment and model. If ESQCR is reduced overhead line replacement may need to be increased and redirected from LV to 11 kV.
- The replacement programme is overall well matched by modelling and coincides with our bottom up review.
- EME has carried out a desk top exercise on ESQCR requriements and the forecast of £66.4m is considered to be overestimated and a DPCR4 allowance should be in line with other DNOs.

- EME has high diversions expenditure due to activities of professional negotiators and local factors. The allowance reflects historic trends. .

- The quality of supply and DNO alternative are relatively high compared with other DNOs as EME includes further line refurbishment / replacement which is less effective in meeting quality of supply targets than network automation but reflects EME's views on the needs of the network.

We would also make the following general comments:

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

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

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

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

PB Power view on load related and non-load related allowances (Base Case)

Load related expenditure

Our view is that the allowed gross load-related expenditure should be £369.0m, being the adjusted DPCR4 forecast less £25m in respect of potential savings on reinforcement schemes and earth loop impedance schemes.

Non-load related expenditure

The model indicates much lower cable expenditure than forecast. EME has a policy of undergrounding much greater quantities of overhead line assets than other DNOs. In that regard the model, which is based on industry-level parameters, will not recognise EME practice and hence applies a constraint to this practice. However, the converse with regard to overhead lines is also true. In that, the modelled output for that asset class is higher than EME forecast based on different allocations due to non like-for-like practice. . Overall the modelled output coincides with our bottom up view and in PB Power's opinion, the allowed asset replacement expenditure should be £230.5m; this amount excluding ESQCR related expenditure that is being reviewed separately. With the inclusion of diversions, SCADA, metering and fault capital expenditure the corresponding overall non-load related expenditure would be £375.3m.

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

Conclusion

The above considerations would indicate that a level of net capital expenditure of £553.8m 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 the each DNO's forecast with a PB Power forecast using a PB Power model based on the methodology set out in Appendix D.

c. For the Base Case non-load related expenditure, a comparison of the DNO forecast with the output of a PB Power model using industry average weighted 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

EME has forecast its Base Case in line with Ofgem requirements and has included a 1.5% improvement in efficiency which is more than offset by increases pension costs, lane rentals and landfill tax. EME has also included a 2% rise in labour costs in the early years due to the need to use additional contract labour until EME rebalances internal and external labour to meet the forecast increase in work load.

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	**286.7**	**309.9**	**455.7**	**0.0**	**455.7**
Non Load Related	**252.1**	**263.0**	**472.7**	**6.4**	**479.1**
Gross Capex less Non Op Capex	***538.8***	**572.9**	***928.4***	***6.4***	***934.8***
Non Op Capex (Not Assessed)	16.8	**19.3**	6.2	0.0	6.2
Total Gross Capex	**555.6**	**592.2**	**934.6**	**6.4**	**941.0**
Contributions	-164.3	-198.3	-236.2	0.0	-236.2
Net Load Related	**122.4**	**111.6**	**219.5**	**0.0**	**219.5**
Total Net Capex	**391.3**	**393.9**	**698.4**	**6.4**	**704.8**
Non Load Related Summary					
Replacement	205.2		197.4	15.4	212.8
ESQCR			66.4	0.0	66.4
Heath & Safety			27.7	0.0	27.7
Environment			13.8	0.0	13.8
Sub Total - Model Comparison	**205.2**	**158.1**	**305.2**	**15.4**	**320.6**
Diversions	17.9	30.7	55.7	-9.0	46.7
SCADA		0.7	5.4	0.0	5.4
Sub Total	***223.1***	***189.5***	***366.3***	***6.4***	***372.7***
Metering (Not Assessed)	29.0	47.4	64.6	0.0	64.6
Sub Total	***252.1***	***236.9***	***430.9***	***6.4***	***437.3***
Fault Capex (Not Assessed)		26.1	41.9		41.9
Non Load Related Total	**252.1**	**263.0**	**472.7**	**6.4**	**479.1**

The forecast has been adjusted for:

- gross market LRE adjustment, to take account of customer connection expenditure by third parties
- pension funding deficit

- capitalised overheads
- inter-company margin and
- lane rentals.

The adjusted DPCR4 forecast is presented in the table below.

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

	Adjustment to DPCR4 Forecast					
Item	**Gross Market LRE Adjustment**	**Pension Funding Deficit**	**Capitalised Overhead**	**Inter-company Margin**	**Lane Rentals Adjustment**	**Adjusted DPCR4 Forecast**
Gross Load Related	0.0	-16.2	0.0	0.0	-45.5	**394.0**
Non Load Related	0.0	-14.8	0.0	0.0	-18.1	**446.2**
Gross Capex less Non Op Capex	***0.0***	***-31.0***	***0.0***	***0.0***	***-63.6***	**840.2**
Non Op Capex (Not Assessed)						6.2
Total Gross Capex	**0.0**	**-31.0**	**0.0**	**0.0**	**-63.6**	**846.4**
Contributions	0.0	8.4	0.0	0.0	31.1	-196.7
Net Load Related	**0.0**	**-7.8**	**0.0**	**0.0**	**-14.4**	**197.3**
Total Net Capex	**0.0**	**-22.6**	**0.0**	**0.0**	**-32.5**	**649.7**
Non Load Related Summary						
Replacement		-7.6	0.0	0.0	-4.1	201.1
ESQCR		-2.4	0.0	0.0	-3.5	60.6
Heath & Safety		-1.0	0.0	0.0	-1.3	25.5
Environment		0.5	0.0	0.0	-1.2	12.1
Sub Total - Model Comparison		**-11.4**	**0.0**	**0.0**	**-10.0**	**299.2**
Diversions		-1.7	0.0	0.0	-5.5	39.5
SCADA		-0.2	0.0	0.0	-0.2	5.0
Sub Total		***-13.3***	***0.0***	***0.0***	***-15.7***	***343.7***
Metering (Not Assessed)		-0.0	0.0	0.0	-0.0	64.6
Sub Total		***-13.3***	***0.0***	***0.0***	***-15.7***	***408.3***
Fault Capex (Not Assessed)		-1.5	0.0	0.0	-2.6	37.8
Non Load Related Total		**-14.8**	**0.0**	**0.0**	**-18.3**	**446.0**
Total Adjustments	**0.0**	**-31.0**	**0.0**	**0.0**	**-63.6**	**-94.7**

2.1.2 Base case submission

EME's Base Case forecast is based on work identified in the risk register and asset risk management processes and EME's assessment of obligations. The Base Case forecast and scenarios are compliant with the Ofgem's assumptions of maintaining network performance and fault rates and are based on a robust analysis of the impact of all investment on fault rates and network performance taking into account all expenditure including the £67m of work on overhead lines to meet ESQCR obligations.

EME expects its DPCR3 actual expenditure to be in line with the DPCR3 allowance and has requested an additional £12.5m for essential work. As indicated in our HBPQ (Part 1) report EME considers that it has been allowed and spent less than comparable DNOs since privatisation and that this has had an effect of producing a cumulative backlog. EME has provided information on the relative expenditure of DNOs since privatisation and an explanation as to why EME considers that the cumulative backlog may not have been picked up in the modelling on which allowances have been based. This may warrant consideration when comparing the DPCR3 non load related allowances for DPCR3 with other DNOs. EME has identified a slight deterioration in MTP performance and in particular its medium term HV overhead line reliability of around 12 faults per 100 km is worse than the DNO average of around 10. The 2002/03 figure for HV line reliability was 15 faults per 100km.

EME has identified a number of areas where costs are forecast to rise in DPCR4 due to implementation of ESQCR regulations, increased network reinforcement, switchgear overstressing, a legacy low voltage network design problem (loop impedance), continued pressure on wayleave terminations and deteriorating network performance associated with an ageing network. The forecast represents a significant rise in expenditure which is profiled to increase over the five year period and EME has a strategy to develop resources by recruitment and retraining and re-balancing resources between internal and external service providers.

2.1.3 Load related capex

EME has produced its demand forecasts on the basis of historic rates of load growth and customer numbers but points to some significant developments in demand patterns.

- Increase in summer loading has resulted in reduced capacity in summer which now becomes the network constraint in city centres and holiday coastal areas.
- In its HBPQ EME indicated that network headroom had reduced as the utilisation factor for transformers has improved from 2.5 which was the industry norm at privatisation to 2.1.

2.1.3.1 Network reinforcement

EME's forecast of load related network reinforcement of £219m compares with a DPCR3 outturn of around £40m.

Network reinforcement is dependent on demand growth and with overall growth rates of 1% only small changes in assumptions on growth rate can lead to significant swings in the forecast level of expenditure. EME has carried out a sensitivity study on the programme which is robust for growth rates of between 0.5% per year to 1.5% per year. Most of the reinforcements are forecast in areas of higher than average potential growth.

EME has provided a detailed account of network reinforcements to relieve overloaded Grid Supply Points and 132 kV substations and these are summarised in Table A 6 provided by EME and in further narrative in Appendix A, amounting to £53m prime costs.

The reinforcement forecast includes an unusually high number of new substations including three new Grid Supply Points in Lincolnshire, Nottingham and Northampton.

EME forecasts that 18 of the 132 kV sites will become overloaded and, although it has contained the proposed development to transformer changes at four sites, four new 132 kV substations are required.

We have reviewed the Grid Substation and 132 kV substation reinforcements against EME's Long Term Development Statements and it is noted that a shift in timing of one year at the end of the programme could reduce the expenditure by £15m cost and we consider this is a real risk to expenditure need during the review period.

EME has provided a detailed breakdown of major projects required for reinforcing supplies to primary substations. Projects include transformer changes or additions on 16 sites and 12 new primary substations. All sites are currently over 97.5% of firm capacity up to 122% over firm capacity. The programme is considered to be reasonable in the light of the current loading on these sites but as a shift in one year's expenditure could reduce the programme by £5.9m prime costs the programme is considered to be back-loaded with a commensurate real risk, in the order of £8m, to expenditure need during the review period.

The current run rate for 11kV reinforcement is £600,000 per year direct costs and the EME forecast increase to £1,000,000 per year has not been sufficiently justified.

The current run rate for correction of voltage complaints is £80,000 per year prime costs and the EME forecast increase to £200,000 per year has not been sufficiently justified.

The current run rate for reinforcement associated with new connections is £1m per year and the EME forecast increased to £2m per year has not been sufficiently justified. This figure excludes reinforcement to correct loop impedance described below.

EME has identified a legacy problem with high loop impedance on certain long underground low voltage networks. The result is that 20 new connections per month require alterations to the network to bring the network up to standard at a cost of £0.5m per year. EME intends in DPCR4 to remedy deficiencies on the complete substation where this issue comes to light as a result of new connection enquiries. This approach increases costs by £5m per year.

EME has explained that it has a problem with overstressed switchgear and identified a programme of switchgear changes of around £40m shown in Table A 5 Appendix A. EME indicates that National Grid has changed the basis for calculation of the source short circuit level which, together with increases in demand and embedded generation, has led to an increase in short circuit level. EME now also takes account of infeeds from customer induction motors on the 11 kV system which were normally considered as a lump contribution at the 33 kV busbar.

2.1.3.2 New connections forecast expenditure

EME has based its forecasts on the historic growth rates of 1% per annum growth in customer numbers and 1.25% growth in demand. New connections are difficult to predict in the long term as most developments have a short planning horizon.

2.1.4 Comments and issues associated with the load related expenditure forecast

i. The forecast increase in the number of domestic new connections is based on analysis of regional development plans and government targets and appears to a reasonable assumption bearing in mind the high levels of activity around the transport corridors and overspill from the South East into the south of the region and from Birmingham to the west.

ii. Overall we have identified potential savings in reinforcement costs of around £41m prime costs or £59m with overheads:

   -
   - loop impedance £29m
   - major substations £15m
   - primary substations £8m
   - other HV and LV reinforcement £11m

   It is expected that savings of £25m are achievable without unduly increasing EME's risk.

iii. EME's proposals for reinforcement includes a significant amount of expenditure on network deficiencies such as overstressed switchgear and the LV loop impedance issue which is abnormal.

iv. We have investigated EME's programme for overstressed switchgear and the replacements are based on maintaining short circuit levels within 95% of rating at maximum short circuit conditions. Some DNOs operate with short circuit levels within 98% to 100% of rating. However taking into account the age of some of the switchgear we consider the programme to be reasonable..

v. The loop impedance problem is likely to be experienced by all DNOs and EME has drawn the issue to their attention. However other DNOs have not included expenditure to remedy loop impedance deficiencies. Consdieration may wish to be given as to whether an industry-level risk assessed approach should be undertaken with any remedial action undertaken in a coordinated manner approach over a longer period.

vi. Reinforcement is higher than would be expected due to the lack of capacity headroom, solutions which involve the development of three new

Grid Supply Points and a higher than normal requirement for new 132 kVand primary substation sites as opposed to transformer replacements and additions to existing sites. The timing of schemes particularly the end of DPCR4 could lead to significant savings of £23m.

vii. Reinforcement at 11 kV and below includes significant increases on historic run rates.

2.1.5 Non-load related capex

EME proposes to refurbish tower overhead lines by replacing conductor and fittings rand repairing towers. ESQCR safety requirement impacts on 31.5km and asset replacement for performance on 163.5km of 132kV overhead lines. In DPCR3 0.05% pa were impacted and in DPCR4 it is proposed to impact 3.0% pa.

33kV lines are mainly wood pole and it is proposed to replace double circuit lines with two single circuit lines as part of replacement for security reasons. In DPCR3 0.8% pa were impacted and in DPCR4 it is proposed to impact 400km or 3.9% pa.It is proposed to impact around 1300km of 11kV overhead line of which around 900km is associated with safety related work, mainly ESQCR related and 400 km of work related to performance although it is recognised that the ESQCR also contributes significantly to improved performance. In DPCR3 0.9% pa were impacted and in DPCR4 it is proposed to impact 400km or 2.6% pa. EME plans 28% of the impacted line to be rebuilt, 13% rebuilt with covered conductor, 43% refurbished and 17% undergrounded.

It is proposed to impact around 1000km of LV overhead line of which around 750km is associated with safety related work, mainly ESQCR related and 200 km of work related to performance although it is recognised that the ESQCR related also contributes significantly to improved performance. In DPCR3, 0.12% pa of LV kV lines were impacted and in DPCR4 it is proposed to impact 0.35% pa.

ESQCR and other safety considerations are the driver for replacement of around 6,000 services and a further 18,000 services are planned to be undergrounded as a result of undergrounding associated LV overhead lines. In DPCR3 0.12% pa of services were impacted and in DPCR4 it is proposed to impact 0.35% pa.

During DPCR3 EME contained the risk of the inadequate switchgear by adopting operational restrictions on defective switchgear. Restrictions lead to short time interruptions during switching operations as the switchgear cannot be operated live and the whole circuit must be de-energised in order to reconfigure the network which can also have an adverse impact on IIP performance as well as increasing short time interruptions. We have investigated the types of switchgear planned for replacement in DPCR4 and consider that the some are of a type which require priority replacement. The switchgear to be replaced is in addition to that replaced under load related replacement due to overstressing and the switchgear replacement overall amounts to £120m in DPCR4. EME will continue to impact 2.6% of 11 kV switchgear in DPCR4. EME also intends to address the 800 service turrets in Northamptonshire which are deteriorating and considered a public safety risk.

Four 132 kV transformers and fourteen 33 kV transformers have been identified for replacement on condition and we can confirm that there is no double counting of these assets with those requiring replacement due to overloading. EME carries out on site and off site diagnostic testing of transformers and refurbishes transformers where it is economic to do so.

Distribution and pole mounted transformers are replaced on failure or due to the impact of overhead line strategies. EME plans to replace 2000 pole mounted transformers and this compares with around 500 from initial modelling. The remainder are to be replaced as part of the overhead line programme.

Environmental expenditure of around £14m is required and appears to be reasonably justified.

EME has forecast £56m of expenditure for diversions, compensation and purchase of easements due to wayleave terminations which meets the requirement of the Base Case to reflect the current level of expenditure. EME has corrected their submission by a reduction of £9m which arose from double counting certain wayleve easements. EME has included a further £6m in its DNO case as it expects wayleave terminations to continue to increase. EME has encountered a high level of “professional” activity promoting wayleave terminations and compensation claims due to the activities of ex-employees and land surveyors advising landowners. This approach is not responsive to normal tough negotiating measures which were historically effective in deterring wayleave terminations.

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

i. EME’s non-load related replacement programme of £203m has been strictly limited to that required to maintain network performance in the Base Case. Despite the high non-load related forecast the amount included for replacement is relatively modest especially for overhead lines and overall reflects a reasonable assessment of requirements. Pressure is put on the amount that may be spent on overhead line refurbishment to maintain performance by other obligations under the non load related programme such, wayleave terminations/diversions of £56m and ESQCR and other safety related work of £94m.

ii. EME has taken into account the contributions of this other expenditure in maintaining existing levels of performance and, should any reduction in other expenditure be made for wayleaves and ESQCR, it will be necessary to increase overhead line replacement expenditure to maintain existing levels of performance and redirect such expenditure from LV to 11kV.

iii. EME’s forecast of ESQCR expenditure of £67m is out of line with the rest of the industry. EME has carried out some preliminary risk assessments and developed forecasts by means of a desk top exercise. DNOs have until 2008 to complete risk assessments and 2013 to take action, although

DTI has indicated that immediate action is require on priority sites. EME's forecast may identify that certain sites that do not require action or where risks may be addressed by less expensive techniques. EME has argued that it has a special case with regard to line clearances but in our view this may not be so and consider EME should be set an allowance for ESQCR in line with the other DNOs. We have been informed that some DNOs have performed a number of risk assessments associated with the requirements set out by ESQCR and that those may well influence the level of capital expenditure allocated between ESQCR and asset replacement.

iv. We have discussed the wayleave termination issue with the managers involved who have informed us that EME closely monitors termination notices and has systems in place to mitigate the risk at lowest cost. EME is affected by "professional negotiators" who do not repsond to traditional robust approaches to termination notices. EME also has wayleave terminations due to the activities of the extraction industry and increasingly agriculture. The provision for wayleaves terminations below 33 kV appears to be abnormally high. We believe that further consideration with regard to the level of incentive necessary to apply a downward presure on wayleave terminations may be beneficial.

2.1.7 Major schemes submitted

EME has submitted outline scheme papers only which give a summary of network requirements and proposed solutions and alternative solutions but are not sufficiently detailed to allow an opinion on justification. However they do provide information on network needs well into DPCR4 and it is not expected that detailed schemes would be available for some of the schemes at this stage.

Table 2.3 - Major Schemes Submitted

Project	£ M Prime Cost
Lutterworth New Bulk Supply Point	5
Stanton – Toton 132kV Inter-connector	3
Warwick – Harbury P2/5 Security	4.2
Bicker – Lincolnshire GSP Reinforcement	4
Corby 33kV Switchgear Replacement	2.5
Replacement Operational Locking Suite	3.5
Alfreton / Annesley – New Bulk Supply Point	5
Coventry 132kV Switchgear Replacement	5
Walpole 132kV Switchgear Change	2
Chesterfield 132kV Switchgear Change	7
Northampton South New Bulk Supply Point	8
Milton Keynes new Bulk Supply Point	6

Project	£ M Prime Cost
Eastcote – Northamptonshire GSP Reinforcement	10
Stoke Bardolph – Nottingham GSP Reinforcement	8
Spondon 132kV Switchgear Replacement	7.5

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 2.4 - 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
EME	81.4	94.5	78.3	87.9	75.2	75.7	70.6	57.3	104%	116%

EME indicates that it may not meet its 2004/05 quality of supply targets, although it plans to ramp up the network automation with 800 additional remote control points installed in 2004/05. EME appears to be much later than most other companies in introducing remote control and this is explained to some extent by the late installation of an 11kV network management system in the control centre

EME should be able to meet its 2010 and 2020 quality of supply targets with additional expenditure of £39.5m including network remote control projects and an additional 600km of overhead line refurbishment. The overhead line refurbishment is in essence an extension of EME's Base Case refurbishment programme to partly make up the backlog of line improvement work. The targets might also be achieved at lower cost via urban automation at the expenses of resilience of the overhead line network.

2.2.2 Overhead line upgrade

The upgrade programme impacts on 75% of the network that is not affected by the Base Case, about 10,000 km and includes some heavy duty lines which are already of robust design.

2.2.3 Resilience undergrounding

EME's proposals for undergrounding is £46.5m and it is noted that EME's overhead line Base Case refurbishment would result in 17% of the refurbished network being undergrounded. ESQCR work plans also contributes significantly to undergrounding of overhead lines.

2.2.4 Amenity undergrounding

EME does not favour the undergrounding in National Parks and Areas of Outstanding Natural Beauty due to cost practicability and low overall benefit compared with costs. However EME's overhead line refurbishment will result in 17% of the refurbished network being undergrounded and ESQCR work plans also contribute significantly to undergrounding of overhead lines.

2.3 DNO alternative scenario

The alternative case is forecast at £38m.

EME's alternative scenario involves an additional 600km of overhead line refurbishment and remote control, the latter being at lower cost than for the quality of supply scenario.

EME has also included additional expenditure for diversions due to wayleaves as the status quo allowed for in the Base Case is not considered adequate to cater for the increased level of activity due to ex-employees and land surveyors advising landowners on wayleave terminations and compensation claims.

A modest amount is included for improved visual amenity of substations in sensitive areas.

3. PB POWER MODELLING AND COMPARISONS

3.1 Introduction

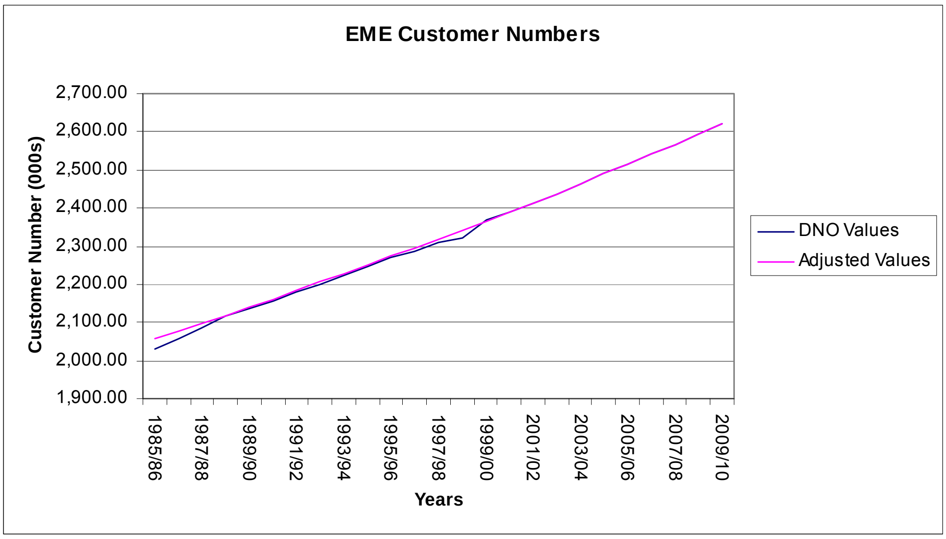
PB Power has carried out modelling of forecast expenditure using both DNO data and PB Power data with a view to understanding better how DNOs have arrived at forecast expenditure and with a view to informing Ofgem of issues that may be considered in arriving at allowances for DPCR4.

Detailed descriptions of the models are provided in Appendices D, E & 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

An average annual growth of 1% has been applied to the historic customer numbers. This has been used to remove a small amount of noise between 1997/98 and 2000/01.



EME's own forecasts of GWh have been adopted for modelling.

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)
270	310	394	**391**

3.2.3 Load related expenditure modelling comments

The model output indicates that EME's forecast is high andwe have used the model output mainly as a guide.

We propose instead that the allowed gross load-related expenditure should be £369m, being the adjusted DPCR4 forecast less £25m in respect of potential savings identified earlier in the report and comprising reductions in reinforcement schemes (£12m) and earth loop impedance schemes (£10m) as well as reflecting the liklihood of re-phasing of schemes to after 2010.

3.3 Non-load related expenditure

3.3.1 Model inputs

No specific model input adjustments were made for EME.

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	63.7	61.4	Lines & services	99.9	87.7	94.4	
Cables	58.4	56.3	Cables & services	67.8	21.5	18.0	
Transformers	23.6	22.8	Substations	101.1	137.3	101.1	
Switchgear	69.1	66.6	Part Submission Total	268.7	246.6	213.6	
Services and Lines	51.8	49.9					
SMC	0.0	0.0					
Other Substations	12.2	11.8					
Other Not Modeled	22.2	22.2	Other Not Modeled	22.2		17.0	
Total	301.0	290.9	Total	290.9		230.5	230.5

3.3.3 Non load related expenditure modelling comments

The model indicates higher expenditures for substations than the forecast and so, after benchmarking, the model output is the same as the forecast expenditure.

For cables the model output indicates much lower cable expenditure, particularly for LV cables and HV cables. For LV mains cables the model is indicating negligible expenditure whereas the forecast in FBPQ Table 26 is indicating about £18m expenditure (non-fault capex, health and safety and environmental). For HV cables the forecast is about £25m which includes a high proportion of “health and safety” whereas the model predicts only about £5m. Accordingly after benchmarking the model output is only £18m.

The overall model output is £230.5m and we have used the model to inform our view namely that the allowed expenditure corresponding to the model output should be £230.5m. This amount excludes ESQCR expenditure, diversions, SCADA, 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	**309.9**	**394.0**	**391.0**	**369.0**
Non Load Related	**263.0**	**446.2**		**375.3**
Gross Capex less Non Op Capex	**572.9**	**840.2**		**744.3**
Non Op Capex (Not Assessed)	19.3	6.2		6.2
Total Gross Capex	**592.2**	**846.4**		**750,5**
Contributions	-198.3	-196.7		-196.7
Net Load Related	**116.6**	**197.3**		**172.3**
Total Net Capex	**393.9**	**649.7**		**553.8**
Non Load Related Summary				
Replacement		201.1	**230.5**	
ESQCR		60.6		
Heath & Safety		25.5		
Environment		12.11		
Sub Total - Model Comparison	**158.1**	**299.2**		**230.5**
Diversions	30.7	39.5		37.5
SCADA	0.7	5.04		5.0
Sub Total	***189.5***	***343.7***		***273.0***
Metering (Not Assessed)	47.4	64.6		64.6
Sub Total	**236.9**	***408.3***		**337.6**
Fault Capex (Not Assessed)	26.1	37.8		37.8
Non Load Related Total	**263.0**	**446.0**		**375.3**

Notes:

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

APPENDIX A

BASE CASE SUBMISSION

APPENDIX A – BASE CASE SUBMISSION

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.

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	62.1	57.3	61.6	68.1	76.6	325.7
Capital Contributions	(34.6)	(43.1)	(39.1)	(38.6)	(42.7)	(198.1)
Non Load Related	69.5	45.6	47.1	52.5	46.8	261.5
Non-operational capex	5.4	5.2	4.0	2.4	2.3	19.3
Total Capital Expenditure	102.4	65.0	73.6	84.4	83.0	408.4

A.2 Base Case capital expenditure forecast for DPCR4

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

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

	Forecast					Total
	2005/06	2006/07	2007/08	2008/09	2009/10	
Capital Expenditure						
Load Related	90.3	90.2	90.6	92.6	92.0	455.7
Capital Contributions	(48.5)	(47.3)	(46.7)	(46.9)	(46.8)	(236.2)
Non Load Related	**75.4**	**89.1**	**98.9**	**103.3**	**105.9**	**472.6**
Non-operational capex	1.5	1.1	1.3	1.4	0.9	6.2
Total Capital Expenditure	118.7	133.1	144.1	150.5	152.1	**698.5**

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

Projections of future load related Capex

EME'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**
Reinforcement	41.6	42.9	44.0	45.9	45.5
New Connections	48.6	47.2	46.7	46.7	46.5
LRE Total Gross	**90.2**	**90.1**	**90.7**	**92.6**	**92.0**
Customer Contributions	(48.5)	(47.3)	(46.8)	(47.0)	(46.8)
LRE Total Net	**41.7**	**42.8**	**43.9**	**45.6**	**45.2**

Network reinforcement

EME has provided information on major network reinforcements to relieve overloaded substations at 33 kV and above and provided information on major projectsin DPCR4.

Table A.4 – 132 kV Reinforcement Expenditure – Prime Costs

Reinforcement £m	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**Total**
Overstressed switchgear	3.245	5.530	6.260	5.990	6.310	27.4
Overloaded primary substations	3.300	4.400	4.500	6.000	5.900	24.1
Other major reinforcement EHV	11.750	10.300	10.200	10.500	10.500	53.3
11 kV reinforcement	1.000	1.000	1.000	1.000	1.000	5.0
Voltage complaints	0.200	0.200	0.200	0.200	0.200	1.0
Reinforcement associated with new connections	3.000	3.000	3.000	3.000	3.000	15.0
Reinforcement to correct loop impedance	5.000	5.000	5.000	5.000	5.000	25.0
Total Direct Costs	**27.5**	**29.4**	**30.2**	**31.7**	**31.9**	**150.7**
Total costs with overheads	**41.6**	**42.9**	**44.0**	**45.9**	**45.5**	**219.9**

Note: EME has provided the detailed information on its programmes of work as prime costs as follows:

Network loading

EME has produced its demand forecasts on the basis rates of load growth but points to some significant developments in demand patterns.

- Increase in summer loading has resulted in reduced capacity in summer which now becomes the network constraint in city centres and holiday coastal areas.

- In its HBPQ EME indicated that network headroom had reduced as the utilisation factor for transformers has improved from 2.5 which was the industry norm at privatisation to 2.1
- EME has had an increase in number of customers of 17% and maximum demand of 25% since privatisation and over the same time transformer capacity has increased by 20%.

Network reinforcement is wholly dependent on demand growth and with overall growth rates of 1% only small changes in assumptions on growth rate. EME has carried out a sensitivity study on the programme which is robust for growth rates of between 0.5% per year to 1.5% per year. Most of the reinforcements are forecast in areas of higher than average potential growth.

Major reinforcements – grid supply points and 132 kV substations

EME has provided a detailed account of network reinforcements to relieve overloaded Grid Supply Points and 132 kV substations and these are summarised in Table A 6 and amount to £53m prime costs.

Grid supply points

EME is proposing three new GSPs which is abnormally high for a single five year period and reflects the current loading situation on GSPs and P2/5 security considerations to major cities of Northampton and Nottingham and congested parts of the network in Lincolnshire.

Bicker Fen £4.5m prime cost

Proposals include a new Grid Supply Point at Bicker Fen 2005/06 and 2006/07 to overcome long-standing 132 kV circuit loading issues in Lincolnshire. This scheme is required in the early part DPCR4 and a such an essential part of the programme.

Eastcote (Northampton) £5.0m prime cost

A grid supply point is required to ensure P2/5 security at Grendon Supergrid substation and 132 kV circuits currently feeding from Coventry to the Northampton area. The proposed Grid Supply Point also supplies into the Northampton and Milton Keynes area which continues to grow. The reinforcement is required in the middle of the DPCR4 period and is required.

Stoke Bardolph (Nottingham East) £1.0m prime cost (£7.0m in DPCR5)

Part of the strategy for securing supplies to Nottingham which is currently islanded on Ratcliffe supergrid point and is deferred until there is a P2/5 requirement for reinforcement due to overloading of Ratcliffe GSP. This scheme is currently shown as being required in DPCR5 and it is considered prudent to include £1m in DPCR4.

132 kV substations prime cost £53m

EME will have eighteen 132 kV substations overloaded in DPCR4 and its programme includes transformer changes at four sites and four new 132/33/11 kV substations, three of which are associated with abnormal growth in the Milton Keynes and Northampton Areas. The balance are dealt with by transfer and 33 kV circuit reinforcement. The alternatives of 33 kV transfer capacity which would normally be considered for some of these reinforcements would have a short effective life in areas that are earmarked for load growth.

The number of sites for which reinforcement is required is around twice that which would be expected in a normal; five year period and reflects the pressure on substation headroom and high growth rates in parts of EME's area. Since the submission EME has also identified a requirement for a near junction 24 on the M1 which in the plan was scheduled for relief by 33 kV interconnection but for which there is now a major load enquiry.

EME has identified a number of other areas where there is potential for new connections and a need for reinforcement around transport corridors.

Overall the proposals for Grid Substation and 132 kV substation reinforcements are considered to be high and it is noted that a shift in timing of one year could reduce expenditure by £15m.

Reinforcement of primary substations prime cost £24m

EME has provided a detailed breakdown of major projects required for reinforcing supplies to primary substations. Projects include transformer changes or additions on 16 sites and 12 new primary substations. All sites are currently over 97.5% of firm capacity up to 122% over form capacity. The programme is considered to be reasonable in the light of the current loading on these sites but a shift in one years expenditure could reduce the programme by £8m and the programme is considered to be end loaded.

EME also notes that its forecast excludes those primary substations that are expected to be funded by customer contributions although the principle is constantly challenged by developers and Ofgem has recently ruled that where DNOs put in additional capacity to give headroom then the 25% rule is applied to the total capacity and this encourages development of small substations that may be uneconomic in the long-run.

11 kV reinforcement

The current run rate for 11 kV reinforcement is £600,000 per year direct costs and the EME forecast increase to £1,000,000 per year has not been fully justified.

Voltage complaints

The current run rate for correction of voltage complaints is £80,000 per year prime costs and the EME forecast increase to £200,000 per year has not been fully justified.

Reinforcement associated with new connections

The current run rate for reinforcement associated with new connections is £1m per year and the EME forecast increased to £2m per year has not been fully justified. This figure excludes reinforcement to correct loop impedance below.

Overstressed switchgear

EME has explained that it has a problem with overstressed switchgear mainly at 132 kV and 33 kV and EME has identified a programme of switchgear changes of around £40m shown in Table A 5 Appendix A. Overstressed switchgear represents a significant safety hazard and DNOs do not normally operate with switchgear outside the short circuit rating as the switchgear is only certified to operate correctly within its rating. The industry Operations and Systems Group produced a report in 2001 setting out a risk assessment approach to overstressed switchgear[1]. EME has based its own approach on this report which is covered in a separate paper[2] together with full details of it short circuit level studies for 2003[3]. EME indicates that National Grid has changed the basis for calculation of the source short circuit level which together with increase in demand and embedded generation has led to an increase of short circuit level at 132 kV. EME now also takes account of infeeds from customer induction motors on the 11 kV system which were normally considered as a lump contribution at the 33 kV busbar. EME also has an X/R ratio problem which triggers a number of the reinforcements.

EME has historically operated with high short circuit levels due to its position on the national grid and have provided details of the methodology for calculating short circuit levels which are reasonable although EME uses a reference voltage of 1.025 rather than 1.05 in its calculations which will give optimistic results. The detailed calculations have not been checked. EME has also explained the operational methods used for containing short circuit levels by operating with busbars split and operating transformers on open standby and that these methods continue to be adopted where appropriate. EME is also considering use of reactors across bus sections at EHV voltages although this is not an economic option for 11 kV switchboards or where the life of EHV switchgear is limited due to age identified in the current programme.

The programme includes the replacement of 3 x 132 kV switchboards 3 x 33 kV switchboards and 9 x 11 kV switchboards with a further 4 x 33kV and 4 x 11 overstressed switchboards 4 being replaced on condition in the replacement programme. The majority of the overstressed switchboards are older than 40 years. Mitigation short of replacement has been adopted at 17 other sites.

We have investigated EME's programme and the replacements are based on maintaining short circuit levels within 95% pf rating at maximum short circuit conditions. Some DNOs operate with short circuit levels within 98% to 100% of rating. Overall taking into account the age of switchgear the programme is considered to be reasonable and it is recognised that short circuit levels may increase further during the DPCR4 period.

Reinforcement to correct loop impedance

EME has identified a problem with high loop impedance on certain long underground low voltage networks often associated with small pole transformer substations. The loop

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[1] EA Operations and Systems Group Report - Overstressing of Distribution Network Operators Switchgear 2001
[2] EME Report Strategy for dealing with overstressed switchgear
[3] EME Short Circuit Level Survey 2003

impedance should be around 0.35 ohms in order to allow the correct operation of the DNO fuse and customer electrical protection systems. Historically DNOs have designed networks on the basis that the limiting criteria for sizing and loading of cables is voltage drop. As a result of these studies EME now designs low voltage networks on the basis of loop impedance and has developed design tools which are used tool is used by the new connections business.

The result is that 20 new connections per month require alterations to the network to bring the network up to standard at a cost of £0.5m per year. EME intends in DPCR4 to remedy deficiencies on the complete substation where these come to light as a result of new connection enquiries ramping up to £5m per year.

This problem is likely to be experienced by all DNOs and EME has drawn the issue to their attention. However other DNOs have not included expenditure to remedy lop impedance deficiencies. It is our view that an industry risk assessed approach should be considered for this issue and that remedial action could be phased in a coordinated approach over a longer period.

Table A.5 - Proposed Overstressed Switchgear Replacement

Substation	Voltage	age	no of sw	I make as % of 3Q rating	I break as % of 3Q rating	I make as % of 1Q rating	I break as % of 1Q rating	proposed solution	£	2006	2007	2008	2009	2010
Berkswell	132	1968	6	95.7	79.7	101.1	95.3	SGT on to open standby						
Chesterfield	132	1956	14	104.7	90.2	104.7	95.8	Replace - also has X/R issue	£7,000,000				£3,500,000	£3,500,000
Coventry	132	1962	10	96.2	79.7	118.6	111.9	replace	£5,000,000		£2,500,000	£2,500,000		
Enderby	132	1990	6	96.5	82.4	96.6	92.7	Split bar at Leicester						
Grendon	132	1966	9	96.4	87.0	91.7	91.5	Manage / make - auto-open-BS	£50,000			£50,000		
West Burton	132	1965	4			106.9	97.6	replace - condition ngt				£1,400,000		
Willington	132	1960	9	95.6	77.6	94.4	87.4	Manage / make - auto-open-BS	£50,000			£50,000		
								Subtotal 132kV	**£15,100,000**					
Coventry South	33	1958	19	111.9	96.4			replace	£1,900,000					£1,900,000
Coalville	33	1962	15	102.5	94.2			replace - condition						
Toton	33	1963	11	103.3	95.1			replace - condition						
Derby South	33	1956	24	110.5	95.7			Replace - also has X/R issue	£2,400,000		£2,400,000			
Clipstone	33	1962	16	110.9	95.7			replace	£1,600,000	£1,600,000				
Corby	33	1958	19	Potential overstressing due to				replace - condition						
Irthlingborough	33		7	known generator enquiries				replace - condition						
Skegness	33		15											
			126											
								Subtotal 33kV	**£5,900,000**					
Ford	11	1974	5	111.4	90.1			Manage / make - auto-open-BS	£35,000			£35,000		
Sheepbridge	11	1952	13	102.4	95.7			replace	£455,000	£455,000				
Burton	11	1973	30	103.8	82.8			run GTA open standby Manage / make - auto-open-BS	£35,000			£35,000		
Coalville	11	1958	11	100.8	89.9			replace condition						
Whetstone	11	1966	12	99.2	77.1			Manage / make - auto-open-BS	£35,000			£35,000		
Leic (Filbert St)	11	1990	14	96.0	86.3			reconfigure 132kV	£35,000			£35,000		
Wigston	11	1959	17	95.1	83.7			Manage / make - auto-open-BS	£35,000			£35,000		
ABR Foods	11			118.7	92.3			Manage / make - auto-open-BS	£35,000			£35,000		
Corby	11	1956	11	95.5	93.0			replace condition & tf						
Kingsthorpe	11	1964	11	95.1	83.2			Manage / make - auto-open-BS	£35,000			£35,000		
Toton	11	1960	11	104.5	92.1			replace	£385,000			£385,000		
St Annes	11		21	96.3	88.9			Manage / make - auto-open-BS	£35,000			£35,000		
North Wilford	11	1985	20	101.7	89.0			Manage / make - auto-open-BS	£35,000			£35,000		
Gedling	11	1960	11	95.3	84.0			Manage / make - auto-open-BS	£35,000			£35,000		
Holbrook	6.6	1966	20	139.3	122.0			replace	£700,000	£700,000				
Dunlop	6.6	1956	7	103.4	92.9			replace condition						
Sandy Lane	6.6	1968	19	96.6	84.0			Manage / make - auto-open-BS	£35,000			£35,000		
London Rd	6.6	1963	15	108.6	99.1			replace	£525,000		£525,000			
Walsgrave	6.6	1965	14	95.9	93.4			replace	£490,000				£490,000	
Osmaston Rd	6.6	1963	15	96.3	85.6			Manage / make - auto-open-BS	£35,000			£35,000		
Switch boards derated beyond break fault level because of X/R ratio														
						% of Derated break								
Staythorpe	132	1965	6			98%		replace	£3,000,000			£1,000,000	£2,000,000	
Tamworth Town	11	1963	13			96%		replace X/R ratio	£455,000			£455,000		
Acreage Lane	11	1982	15			118%		Auto open Bus section	£525,000		£35,000			
Coventry West	11	1965	14	106.1	93.0	112%		replace	£490,000					£490,000
Leicester East	11	1986	16			98%		Auto open Bus section	£35,000		£35,000			
Allenton	11	1984	23	107.1	93.3	102%		Auto open Bus section	£35,000		£35,000			
Sinfin Lane	11	1960	14	119.9	94.8	124%		replace	£490,000	£490,000				
Heanor	11	1963	12			95%		replace	£420,000					£420,000
								Subtotal 11kV	**£5,425,000**					
								TOTAL	**£26,425,000**	£3,245,000	£5,530,000	£6,260,000	£5,990,000	£6,310,000

33kV/switch *£100,000*
11kV/switch *£35,000*

Priority
1. Replace swgr with break of over 100% - and pre 1965
2. Replace swgr with break of over 95% - and pre 1965
3. Manage with auto open on "Close" scheme for swgr with make over 95% but break less than 95%
4. Consider replacing pre 1960 swgr with over 90% in areas of expected DG penetration

Table A.6 - Grid Supply Point and 132 KV substation reinforcements

Project	Reason	T/f MVA ±	£m	2006	2007	2008	2009	2010	DR5	DR3
Warwick Harbury Security	To resolve P2/5 security on Berkswell Warwick 132kV circuit		4.2	£2,200,000						2000000
Lutterworth Grid BSP	Load increase at Magna Park	90	5	£1,000,000						4000000
Burton to Marchington 33kV circuit and double circuit to Hatton	load increase at Hatton		0.25	£250,000						
Kettering	Change overloaded 132kV transformers	90	1	£1,000,000						
Toton to Beeston 33kV reinforcement	33kV interconnection to support Nottingham BSP		1	£1,000,000						
Daventry	Change overloaded 132kV transformers	60	0.7	£700,000						
Stanton to Toton 132kV reinforcement	132kV interconnection to support Ratcliffe GSP		3	£3,000,000						
Bicker GSP	132kV reinforcement for North Lincolnshire	480	4	£2,600,000	£1,000,000					
Hinckley BSP	Change overloaded 132kV transformers	60	0.7		£700,000					
Leicester West reinforcement	33kV reinforcement to cater for load growth		3		£2,000,000	£1,000,000				
Willington	132/11kV substation at Willington to support load growth	60	1.4		£1,400,000					
Willoughby	Change overloaded 132kV transformers	90	0.7		£700,000					
Nottingham BSP	Add fourth transformer to cater for load growth	30	3		£2,000,000	£1,000,000				
Coventry South	change overloaded 132kV transformers	90	0.7			£700,000				
Boston to Stickney & Horncastle	33kV reinforcement to support load growth		1			£1,000,000				
Spondon / Stanton 132kV circuit	P2/5 issue with load growth		2			£2,000,000				
Alfreton / Annesley	132/33kV group load P2/5 issue and load growth	180	5		£1,500,000	£2,500,000	£1,000,000			
Milton Keynes area 132kV capacity	New BSP to reinforce MK at Broughton?	180	6		£1,000,000	£2,000,000	£3,000,000			
Northampton	New BSP SW Northampton to cater for P2/5 issues	180	8				£3,000,000	£3,000,000	£2,000,000	
Coventry and Grendon	Eastcote GSP to cater for P2/5 issues at Grendon and Coventry/ Hinckley circuits	480	10				£3,500,000	£3,500,000	£3,000,000	
Irthlingborough and wellingborough	New BSP Finedon Road to cater for overload	180	5					£3,000,000	£2,000,000	
Nottingham North and Ratcliffe	New Gsp Stoke Bardolph	480	8					£1,000,000	£8,000,000	
				£11,750,000	£10,300,000	£10,200,000	£10,500,000	£10,500,000		
			TOTAL	**£53,250,000**						

Table A.7 - Primary Substation Reinforcements

Firm Capacity	Percent load	Percentage of year over firm	Credible Solution	T/f kVA+	est £	2006	2007	2008	2009	2010
12	105	12.9	change transformers	22	£300,000	£300,000				
24	119.17	20.1	Jupiter west add primary	38	£1,000,000	£1,000,000				
19.6	108.16	1	Kimberley	38	£2,000,000	£2,000,000				
24	129.17	15.6	Kimberley		*					
14.5	117.93	15	Rippingale ? (see Bilingborough) -		£100,000		£100,000			
21.8	95.87	2.3	11kVtransfers??		£100,000		£100,000			
10.9	115.6		Change transformers	22	£300,000		£300,000			
6	106.67		add primary Rippingale (see Bourne)	12	£600,000		£600,000			
			Relieves Burton and Wellington St -	19	£800,000		£800,000			
20	122.5	15.6	Raynesway Primary		£1,000,000		£1,000,000			
24	112.92	10.1	Raynesway Primary	38	*					
24	118.33	9.9	Uprate transformers and circuits	22	£1,500,000		£1,500,000			
14.5	102.76	1.4	change transformers & switchboard	22	£400,000			£400,000		
14.5	106.9	0.6	new primary 10km cct +10km refurb	38	£1,000,000			£1,000,000		
35.2	107.67	0.1	Oadby	38	£1,000,000			£1,000,000		
26.4	109.85		Northampton East	38	£1,000,000			£1,000,000		
23.6	111.02	1.5	New primary	38	£1,100,000			£1,100,000		
10.9	122.94	0.3	change transformers	22	£300,000				£300,000	
12	100		change transformers	22	£300,000				£300,000	
20	103.5	3.1	change transformers	22	£300,000				£300,000	
24	98.33		Add transformer NC	19	£600,000				£600,000	
15.9	106.29	1.2	establish Bramcote	38	£1,000,000				£1,000,000	
24	105.83		Bramcote?		*					
24	97.5		Brackley 132/11	60	£1,000,000				£1,000,000	
20	98		uprate Wise St transformers and ccts	22	£1,000,000				£1,000,000	
			North Kenilworth Primary	38	£1,500,000				£1,500,000	
12	104.17	0.1	change transformers	22	£300,000					£300,000
10.9	107	0.1	change transformers	22	£300,000					£300,000
14.5	96.55		Change transformer - reinforce 33kV	22	£600,000					£600,000
4	102.5	3.7	add transformer & cct 16km from	12	£700,000					£700,000
24	98.33		Kingston	38	£1,000,000					£1,000,000
24	97.08		New primary a	38	£1,000,000					£1,000,000
33	95.76		Far Cotton Primary	38	£1,000,000					£1,000,000
39	100.26	0.1	Fazeley	38	£1,000,000					£1,000,000
						£3,300,000	**£4,400,000**	**£4,500,000**	**£6,000,000**	**£5,900,000**
			TOTAL		**£24,100,000**					

New connections forecast expenditure

New connections expenditure and customer contributions are forecast as follows:

Table A.8 - New Connections Expenditure

£M	2005/06	2006/07	2007/08	2008/09	2009/10
New Connections	48.6	47.2	46.7	46.7	46.5
Customer Contributions	48.5	47.3	46.8	47.0	46.8
New Connections - Net	0.1	-(0.1)	-(0.1)	-(0.3)	-(0.3)

Non-load related expenditure

The forecast envisages increased expenditure on replacement and refurbishment of assets as shown in Table A 9. The work has been profiled over the period to match resource and planning constraints. In order to accommodate an anticipated long lead time for additional overhead line resources, increases in overhead line work have been delayed until the second year of the period. This profile has been chosen for most other categories of work to again allow time to build up the resources necessary. The non-load related expenditure has been developed from analysis of the specific needs of:

- environmental, health and safety legislation
- maintenance of network reliability (and consequently CMLs and CIs)
- mitigation of other risks where appropriate.
- Diversions and securing wayleaves for overhead lines

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

Table A.9 - Non-load related expenditure

Expenditure Classes	Non-Load Related (£m)					
	2005//06	2006/07	2007/08	2008/09	2009/10	Total
Non Fault Replacement	28.4	37.0	43.0	46.2	48.1	**202.8**
Metering	7.2	8.8	9.0	9.0	9.0	**43.0**
Capex adjustment for metering	3.8	4.6	4.4	4.4	4.4	**21.6**
Faults	8.2	8.3	8.4	8.4	8.4	**41.9**
Diversions	12.2	11.9	10.7	10.4	10.5	**55.7**
Health and Safety	12.3	15.8	20.8	22.2	23.0	**94.1**
Environmental	3.3	2.7	2.7	2.6	2.5	**13.8**
Total	**75.4**	**89.1**	**98.9**	**103.3**	**105.9**	**472.7**

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

Table A.10 - Base Case Capital Expenditure Against Risk

Sum of Replacement Money	
Risk Description	**£ DPCR4**
Cable Reliability	1,357,933
Earthing Deficiencies	4,245,300
Environmental Damage due to Asset/Location	7,459,904
Fluid filled Cable Failure	5,184,158
Inadequate Substation Security	3,660,500
Loss of Legal Rights	50,147,825
OHL Performance and Safety	87,278,428
Planned CMLs	3,537,750
Protection Failure	9,149,823
Safety of LV Equipment	16,896,057
Service Condition	3,711,585
Switchgear Reliability	66,922,522
Tree Clearance	-
P2/5 Non-compliance	126,292,713
Earth Loop Impedance	36,530,363
Voltage Complaints	396,482
Other Power Quality Issues	713,782
Overstressed Equipment	34,503,835
Civil Structures	8,462,183
OHL Safety Clearances and ESQC	67,774,960
Repair on Failure	39,259,986
Transformer Reliability	13,320,084
Telemetry System Capacity	5,361,186
Grand Total	**586,031,977**

Summary of EME risk management process which identifies risk as legal obligations and discretionary performance related risks.

Table A.11 - Base Case Capital Expenditure Against Asset Class

Sum of Replacement Money	
Asset	**£ DPCR4**
- LV Overhead Services	13,298,482
- LV Underground Services	49,219,786
- 11kV Pole Mounted Transformers	10,201,064
- 11kV Transformers	9,724,340
- 132kV Cables	30,600,410
- 132kV Circuit Breakers	48,785,134
- 132kV Overhead Lines	21,221,143
- 132kV Transformers	20,664,268
- 33kV Cables	43,150,918
- 33kV Circuit Breakers	28,951,693
- 33kV Overhead Lines	14,267,669
- 33kV Transformers	14,940,000
- 6.6 & 11 kV Bare conductor	31,606,564
- 6.6 & 11 kV Covered conductor	7,258,998
- 6.6 & 11kV A/RC & Sect, urban automation	500,236
- 6.6 & 11kV Cables	46,677,566
- 6.6 & 11kV CB	12,865,893
- 6.6 & 11kV RMU	30,892,985
- 6.6 & 11kV switches (excluding RMU & CB)	2,763,171
- 6.6kV Pole Mounted Transformers	21,985
- 6.6kV Transformers	52,899
- LV cables	50,710,048
- LV Link box	451,476
- LV OHL Bare conductor	6,086,736
- LV OHL Covered conductor	16,796,527
- LV pillar	1,558,533
Battery Replacement Programme	2,633,672
Bird Flight Divertors	707,550
Civil Works	8,462,183
Cut-outs and Meter Boards	15,434,017
Earthing	4,245,300
Electro Mechanical Relay Replacement	4,447,113
H Protection Renewal	2,071,380
Low Frequency Protection Change	388,502
LV Generation	3,537,750
New Suite of Locks	3,660,500
Noise Abatement Measures	707,550
Oil Containment Measures	966,472
Oil Gauge Replacement	353,775
Telecontrol Changes	5,361,186
Wayleave Easements and Property Managemer	12,735,900
Tree Clearance	-
- 132kV Protection	1,295,349
- 33kV Protection	1,892,101
- 6.6 & 11kV Protection	3,861,619
Grand Total	**586,030,197**

Asset Replacement and safety related work

EME's non load related replacement programme of £203m has been strictly limited to that required to maintain network performance in the Base Case. Pressure is put on the amount that may be spent on overhead line refurbishment to maintain performance by other obligations under the non load related programme such, wayleave terminations/diversions of £56m less a downward correction of £9m and ESQCR and other safety related work of £94m.

Overhead lines

EME proposes to refurbish tower overhead line replacing conductor and fittings replacement and repairing towers. ESQCR safety requirement impacts 31.5 km and asset replacement for performance 163.5 km 132 kV overhead lines. In DPCR3 0.05% pa were impacted and in DPCR4 it is proposed to impact 3.0% pa.

33 kV lines are mainly wood pole and it is proposed to replace double circuit lines with two single circuit lines predominantly for performance and condition reasons. In DPCR3 0.8%pa were impacted and in DPCR4 it is proposed to impact 400km or 3.9%paIt is proposed to impact around 1300km of 11kV overhead line of which around 900 km is associated with safety related work, mainly ESQCR related and 400 km of work related to performance although it is recognised that the ESQCR also contributes significantly to improved performance. EME plans 28% of the impacted line to be rebuilt, 13% rebuilt with covered conductor, 43% refurbished and 17% undergrounded. Most of the overhead lines to be refurbished are in Lincolnshire and the south of the area and work is prioritised by safety, condition and design features such as narrow crossarms and small cross section conductors. EME has taken into account all replacement in assessing the Base Case requirement to maintain reliability although 250 km does not contribute to performance improvement. In DPCR3 0.9% pa of 11 kV lines were impacted and in DPCR4 it is proposed to impact 2.6% pa.

It is proposed to impact around 1000km of LV overhead line of which around 750 km is associated with safety related work, mainly ESQCR related and 200 km of work related to performance although it is recognised that the ESQCR also contributes significantly to improved performance. In DPCR3 0.12% pa of LV kV lines were impacted and in DPCR4 it is proposed to impact 0.35% pa.

ESQCR and other safety considerations are the driver for replacement of around 6000 services and a further 18000 services are planned to be undergrounded as a result of undergrounding associated LV overhead lines. In DPCR3 0.12% pa of services were impacted and in DPCR4 it is proposed to impact 0.35% pa.

Underground cables

Underground cable are mainly impacted by overhead line work and the table below sets out the volumes and percentage of cables impacted by the EME work programme over the DPCR4 period. There is no significant deterioration of cables anticipated in the DPCR4 period. EME is monitoring cable deterioration and using the KEMA data to obtain information about the potential future deterioration of cables.

	Circuit km	DR4 Impact pa
LV cables	32,597	0.03%
HV cables	13,074	0.04%
33kV	1,898	0.21%
132kV	202	0.50%

Substation equipment

During DPCR3 EME contained the risk of the inadequate switchgear by adopting operational restrictions on defective switchgear. Restrictions lead to short time interruptions during switching operations as the switchgear cannot be operated live and the whole circuit must be de-energised in order to reconfigure the network which can also have an adverse impact on IIP performance as well as increasing short time interruptions. We have investigated the types of switchgear planned for replacement in DPCR4 and consider that the majority are of a type which require priority replacement. The switchgear to be replaced is in addition to that replaced under load related replacement due to overstressing and switchgear replacement overall amounts to £120m in DPCR4. EME will continue to impact 2.6% of 11 kV switchgear in DPCR4. EME also intends to address the 800 service turrets in Northamptonshire which are deteriorating and considered a public safety risk.

Transformers

Four 132 kV transformers and 14 33 kV transformers have been identified for replacement on condition and we can confirm that there is no double counting of these assets with those requiring replacement due to overloading. EME carries out on site and off site diagnostic testing of transformers and refurbishes transformers where economic.

Distribution and pole transformers are replaced on failure or due to the impact of overhead line strategies. EME plans to replace 2000 pole mounted transformers and this compares with around 500 from the modelling. The remainder are to be replaced as part of the overhead line programme and may be capable of re-use.

Comparison of forecast with EME modelling

The table below presents a comparison of volumes replaced with those predicted by EME's repalcement modelling.

Table A.12 - Comparison of EME's NLRE forecast with EME's Model

Category	Asset Replacement Model	Base Case - Non Load Related			
		Impacted	Installed/ Built	Refurbish	Replace on Failure
Overhead Lines					
- LV mains Bare conductor	672	844	53	106	53
- LV mains Covered conductor	0	130	286	223	5

- LV services Covered conductor	48,669	33,173	17,202	0	6,250
- 6.6 & 11 kV Bare conductor	1,364	1,458	430	531	70
- 6.6 & 11 kV Covered conductor	0	0	134	66	
- 33kV Single Circuit length (kms)	508	413	248	132	100
- 132kV	366	195	0	195	
Cables					
- LV cables	187	19	310	-	150
- LV services (PILC)	54,654	5,750	21,721	-	5,400
- HV cables	34	19	355	-	255
- 33kV cables	102	16	72	-	110
- 132kV cables	0	3	3	-	0
Switchgear					
- LV pillar	2,690	105	105	-	-
- LV Link box	288	60	50	-	-
- 6.6 & 11kV switches (excluding RMU & CB)	3,491	2,742	237	-	-
- 6.6 & 11kV RMU	1,182	735	1,568	-	-
- 6.6 & 11kV CB	1,563	570	570	-	-
- 6.6 & 11kV A/RC & Sect, urban automation	58	30	30	-	-
- 33kV CB (O/D)	106	90	90	-	-
- 132kV CB - other (O/D)	49	32	32	-	-
Transformers					
- 6.6kV PMT	0	5	5	-	-
- 6.6kV GMT	0	5	5	-	-
- 11kV PMT	517	2,558	1,981	-	-
- 11kV GMT	132	260	836	-	-
- 33kV GMT	29	14	14	-	-
- 132kV	8	5	5	-	-

All the figures above represent volumes of assets in the Base Case Non Load Related investment plan.

EME adopts a modified birthday asset replacement model as a sanity check against its risk assessed replacement programme. The output of the model is compared with the total non load related expenditure except diversions. EME therefore recognises the replacement impact of EQQCR expenditure on its replacement programme.

Impact

This is the volume of assets that need impacting excluding wayleaves and failures (for overhead lines and cables). Wayleaves are excluded since the assets impacted by a termination notice are not discretionary and therefore not targeted at assets in poor condition and need of replacement or refurbishment. The linear assets impacted by replacement on failure are recorded in a separate column.

The actual work done may affect a different asset type. For example, an overhead line may be in poor condition and the chosen solution may be to underground. In this instance, the volume of line affected would be recorded in the Impact column against the overhead asset type. However, the corresponding entry to record the solution will be entered against the cable asset category.

Installed/built and refurbish

As described above, these columns contain the volume of particular assets installed or refurbished due to NLR expenditure (excluding wayleaves and failure).

Replacement on failure

This is the volume of linear assets replaced due to failure. For non-linear assets (switchgear and transformers), the volumes of assets to be replaced on failure are included in the Impacted column.

Volumes quoted are likely to exceed the quantity replaced in practice. This is because the volumes listed are those needed to produce appropriate fault costs using standard unit costs.

Health and safety

The extent of the work associated with the implementation of ESQCR is indicated in the summary of work on asset replacement above. The ESQCR programme is costed at £67m as set out in Appendix Aand although it contributes to the replacement programme. It does not appear to be well targeted to improve performance and makes the Base Case more expensive than it otherwise would be. The volume of work is far above that of other DNOs.

LV line patrols have identified 270km of open wire close to buildings and trees. In the process of addressing these sites, additional work will be required. For example, several spans may need to be replaced to solve the problem with a single span. Both ABC and underground cable solutions will be required. Earth loop impedance problems that are identified during the process must be resolved and may create additional work. On the other hand, potential synergies with work required for earth loop impedance have also been identified and the budget adjusted accordingly. The requirement for service replacements are based on less specific site information.

ESQCR Programme

Table A.13 - ESQCR Programme

LV Overhead line	£8,975,428
Overhead services	£5,888,876
LV cable	£11,083,429
Underground services	£10,258,655
LV & Services Total	**£36,206,389**
11kV Overhead line	£17,684,567

11kV Cable	£10,074,329
11kV Total	**£27,758,897**
33kV Overhead line	£1,487,492
33kVCable	£709,728
33kVTotal	**£2,197,219**
132kV Overhead total	**£1,487,492**
ESQC Total	**£67,649,996**

This desktop exercise may be significantly reduced when more complete risk assessment which is required to be carried out as required by DTI by 2008. The electricity industry standard.

The risk assessment may identify that certain sites that do not require action particularly where there is little risk of persons climbing trees. This issue may also be affected by a targetted tree cutting programme which is generally ad-hoc for EME on the low voltage network. This issue may be compounded by difficulties occassioned by landowner consent refusal.

Environment

Environmental expenditure of around £14m is required for the following and appears to be reasonably justified.

- To deal with risks as found from AsbestosTo monitor fluid filled cables any remedial action takenFor further bunding of transformers to mitigate oil leaksTo reduce transformer noise and for enhanced tests and remedial workTo mitigate release of substances into environment eg SF6 etc**Diversions**

EME has £56m (less £9m correction) for expenditure for diversions, compensation and purchase of easements due to wayleave terminations which meets the requirement of the Base Case to reflect the current level of expenditure. EME has a high level of professional activity promoting wayleave terminations and compensation claims due to ex-employees and land surveyors advising landowners. This approach is not responsive to normal tough negotiating measures which were historically effective in deterring wayleave terminations. It is noted that EME has included an increase over the historic spend in the DNO alternative case as wayleave terminations are forecast to increase further.

Wayleaves impacts some 100 km of EHV overhead line and 610 km of HV and LV lines. The wayleaves impact on HV and LV line appears to be excessive.

We have discussed the wayleave termination issue with the managers involved and EME closely monitors termination notices and has systems in place to mitigate the risk at lowest cost. Most of the expenditure is in respect of diversions but £2m per year is associated with compensation for sterilisation of development due to 132 kV lines. EME has a large number of small towns with 132 kV overhead line entries. EME also has wayleave terminations due to extraction industry and increasingly in agriculture.

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, EME is required to reduce the number of unplanned Customer Interruptions (CI) by 4% and unplanned Customer Minutes Lost (CML) by 16% by 2010, in comparison to the average performance experienced in the last two years.

The QoS Scenario builds on the Base Case and this reflects planned work in the final year of DPCR3 to target end of DPCR3 CML and CI targets. Any work to meet CI target will improve CML performance beyond the set target and no specific work is included to target CMLs. EME have used the Grond network reliability-modelling tool to model the wide range of possible performance investment options for circuits across all 11kV disaggregated groups.

B.1.1 Description of investments 2005 to 2010

Overhead line performance

In order to achieve an improvement in quality of supply, EME considers it essential that the reliability improvement is spread more evenly across the network. Therefore, the first work planned is to replace and refurbish more overhead network. The additional 600km of network in this Scenario means that a total of 2.8% of the 11kV overhead network is then impacted annually. Some of this work will be undergrounding of overhead line in the proportion of cases where it is not possible to negotiate wayleaves for the replacement overhead line. In determining the appropriate level of work, EME has used reliability modeling linked to the asset health index based predictions of network deterioration.

EME proposes an additional 600km of network to be replaced or refurbished compared to the Base Case. As part of this work, where it is not possible to renegotiate wayleaves for overhead lines there will be a need to underground the network. However, this is anticipated to be in short sections such that additional ground mounted switching points are not required. The 600km would be impacted as follows: Rebuild 30%; Rebuild - covered conductor 20%; Refurbish 40%; Underground 10%.

The total cost of this element of the work is £22.3m.

Network automation

This workstream comprises the protection of spurs on overhead lines with Auto Sectionalising Links (ASLs) and protection of main lines with feeder circuit breakers. The company has indicated that modeling has been undertaken to determine ranking of proposals based on cost/benefit from different combinations of ground mounted feeder circuit breakers positioned mid-circuit and Auto Sectionalising Links (ASLs).

The company has also identified that additional protection will be required to support delivery of CI and CML benefit. Spur protection is proposed where it is most beneficial on some of the predominantly underground mixed groups.

Volumes of work and impact

The QoS Scenario contains the following total volumes, costs and benefits. These proposals were generated on an incremental basis by additional cost/benefit solutions until the target is met.

Activity	Quantity	CML Benefit	CI Benefit	Cost (£m)
11 kV Overhead line	600 km	0.9	1.1	22.3
1 feeder circuit breaker per circuit	155 circuits	0.7	1.6	2.9
2 feeder circuit breakers per circuit	745 circuits	1.9	4.3	27.5
Sectionalising links and sectionalisers	1400 circuits	0.4	0.7	3.4
Total		**3.9**	**7.7**	**56.1**

The increased opex costs do not start until 2011 since this is maintenance associated with the remote control and protection fitted in the 2005-10 period. The forecast capex costs do not go beyond 2015 since modeling predicts that sufficient benefit will have been obtained to meet the 2020 target.

B.1.2 Ofgem sensitivity scenario three: further two per cent improvement in CI by 2010

The following projects were added to the Base Case work stream to achieve the necessary CI improvement at an additional cost of £10.6m.

Some circuits where the planned solution was to fit 1 feeder circuit breaker have been changed to 2 feeder circuit breakers.

The coverage of automation/protection has been extended too more disaggregated groups.

Activity	Quantity	CML Benefit	CI Benefit	Cost (£m)
11 kV Overhead line	0	0.0	0.0	0.0
1 feeder circuit breaker per circuit	4 circuits	0.0	0.0	0.0
2 feeder circuit breakers per circuit	282 circuits	0.3	0.6	10.4
Sectionalising links and sectionalisers	40 circuits	0.0	0.0	0.1
Total		**0.3**	**0.6**	**10.6**

B.1.3 Ofgem sensitivity scenario five: further five per cent improvement in CML by 2010

The following projects were added to the Base Case work stream to achieve the necessary CI improvement at an additional cost of £14.8m.

Some circuits where the planned solution was to fit 1 feeder circuit breaker have been changed to 2 feeder circuit breakers or the installation of switchgear actuators

The coverage of automation/protection has been extended too more disaggregated groups.

Activity	Quantity	CML Benefit	CI Benefit	Cost (£m)
11 kV Overhead line	0	0.0	0.0	0.0
1 feeder circuit breaker per circuit	4 circuit breakers and 159 actuators	0.7	0.0	1.2
2 feeder circuit breakers per circuit	187 circuit breakers and 932 actuators	1.9	0.9	13.5
Sectionalising links and sectionalises	0	0.0	0.0	0.0
Total		**2.6**	**0.9**	**14.8**

B.2 Overhead line upgrade

The upgrade programme impacts on 75% of the network that is not affected by the base case about 10,000 km and includes some heavy duty lines which are already of robust design.

B.3 Resilience undergrounding

EME's proposals for undergrounding is £46.5m and it is noted that EME's overhead line base case refurbishment results in 17% of the refurbished network being undergrounded ESQCR work plans also contributes significantly to undergrounding of overhead lines.

B.4 Amenity undergrounding

EME does not favour the undergrounding in National Parks and Areas of Outstanding Natural Beauty due to cost practicability and low overall benefit compared with costs. However EME's overhead line refurbishment results in 17% of the refurbished network being undergrounded and ESQCR work plans also contributes significantly to undergrounding of overhead lines.

APPENDIX C

DNO ALTERNATIVE SCENARIO

APPENDIX C – DNO ALTERNATIVE SCENARIO

C.1 DNO alternative scenario

The company has identified that it has approached the scenario in a manner that attempts to address and balance a number of issues:

- provides overall improvements to CMLs, CIs and multiple interruptions
- includes cost-effective improvements to CMLs
- maintains a reasonably even improvement in performance of the 11kV network
- provides improvements to network resilience
- is deliverable
- includes adequate budget to cover foreseeable wayleave termination costs
- provides improvements to environmental amenity.

The scenario contains an additional £39m of capital expenditure compared to the Base Case. Operating expenditure in the Alternative Scenario is substantially the same as that in the Base Case (minor movements of overheads occur because of the increased capital expenditure).

EME plans to increase work on network performance by £31m, additional provision for wayleave terminations of £6m and environmental improvements of £6m. These are offset by consequential reductions in overheads in the Base Case programme.

An additional 600km of network will be replaced or refurbished in the Preferred Scenario (at an additional cost of £21m). Where it is not possible to re-negotiate wayleaves for overhead lines there will be a need to underground the network. However, this is anticipated to be in short sections such that additional ground mounted switching points are not required. The Preferred Scenario contains activity on 1880 km of 11kV overhead line (equivalent to work on 2.8% of the network per annum). The balance of the improvement work is for network automation and other quality of supply initiatives.

The Scenario includes the following environmental improvements

- undergrounding overhead lines in sensitive areas for amenity
- improving the amenity of distribution substations
- reducing noise levels associated with transformers
- bunding all new ground mounted transformers and accelerated retro-fitting of bunds to primary transformers.

The Scenario contains a small amount of additional investment to carry out undergrounding or screening of certain assets, thereby enabling EME to better demonstrate compliance with Schedule 9 requirement.

It is not considered feasible to undertake a larger programme of work because of constraints on availability of a skilled workforce. If more work were to be done then EME believe that the unit costs would increase to the point where customers would not receive value for money for the work done.

EME plans to introduce a proactive programme of noise reduction. EME will fit acoustic enclosures where noise levels are excessive and public nuisance could be realistically envisaged. This policy would aim to reduce noise levels in a proactive manner and prior to receiving complaint. The planned cost is £1.0m. This is sufficient to reduce noise on 5 BSP and 25 primary transformers.

All existing primary transformers have been previously risk assessed for potential damage to the environment resulting from an oil leak. This work has left 200 transformers without bunds from the population of 700. EME proposes to install bunding on these remaining transformers with a 20-year programme. This equates to a cost of £0.7m over the DPCR4 period.

EME is including increased levels of obligatory wayleave expenditure. This equates to an increase in non-load related capital expenditure of £7m total over the period.

APPENDIX D

LOAD RELATED EXPENDITURE MODELLING

APPENDIX D – LOAD RELATED EXPENDITURE MODELLING

The methodology used in the modeling 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 modeling 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 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.

D.1.1.2 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 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 modeling 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.

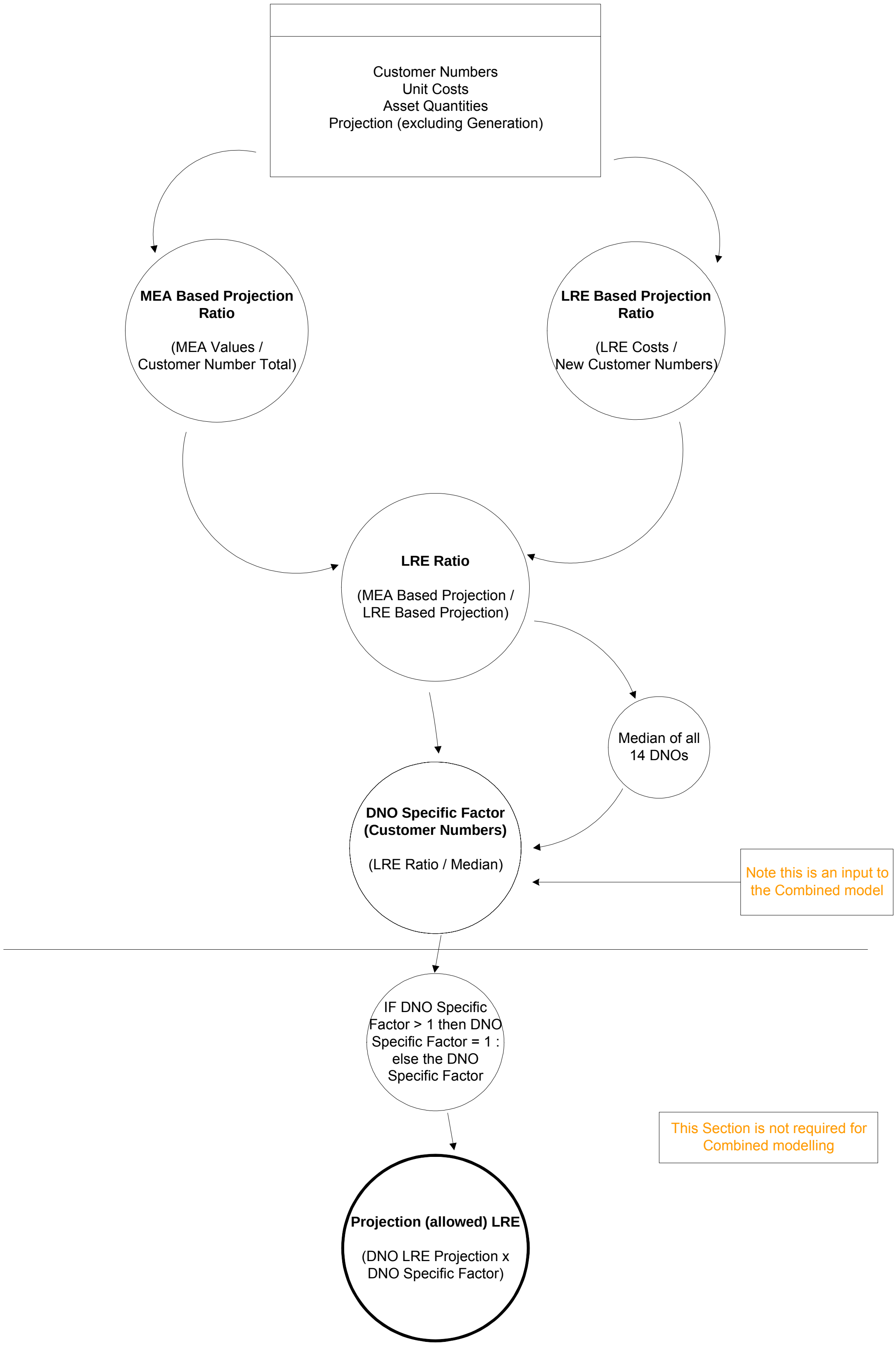
Being benchmarked on a median rather than on an average implies that extremes do not affect the adopted benchmarking position. It also means that the LRE of each company is compared relative to its cost base against the Industry Trend and not in absolute cost terms. This approach recognises therefore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

D.1.4 Period of analysis

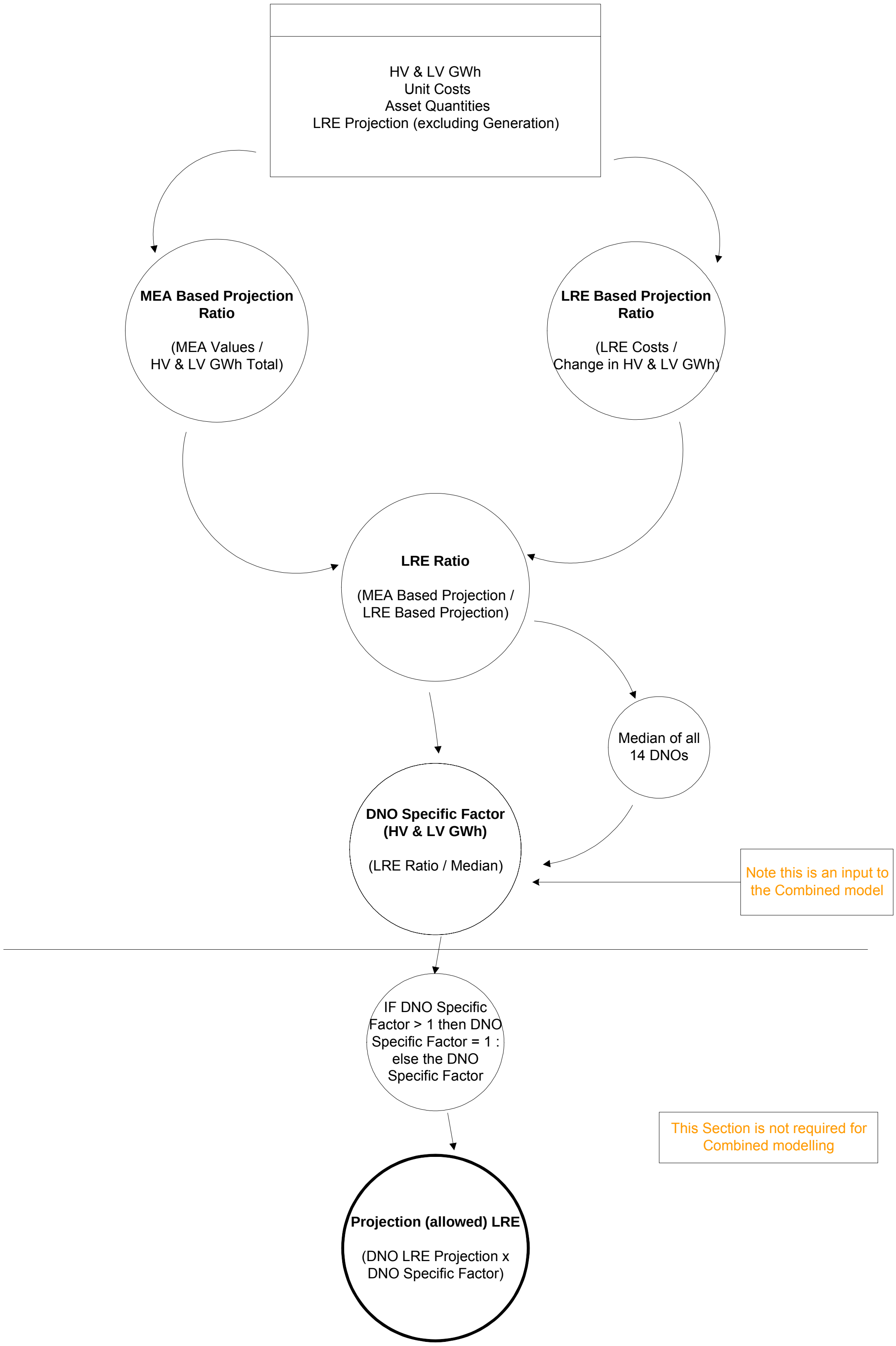
Each DNO's network is comprised of a large number of smaller networks that have a range of spare capacities depending on load growth and when the individual networks were last reinforced. While a peak in reinforcement may arise as a consequence of a larger number of the smaller networks requiring reinforcement within one regulatory period this may not be the case in a subsequent period and hence a peak in expenditure will arise.

This issue can be addressed by modeling 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 modeling carried out in the current review therefore looked at growth and expenditure over DPCR2 and DPCR3 in addition to the forecast growth and expenditure for DPCR4.

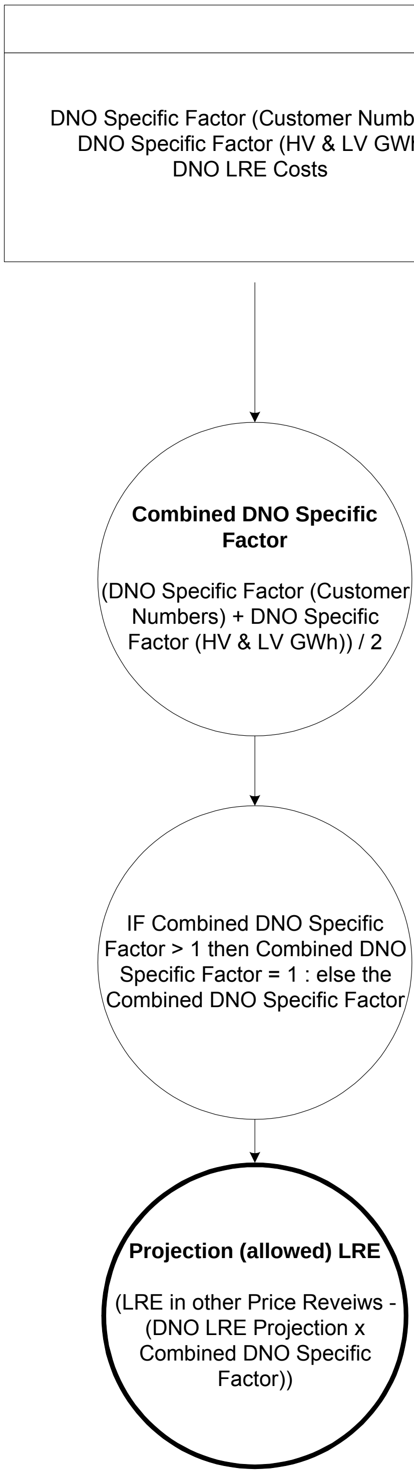
Combined Load Related Expenditure Modelling (Phase 1A Customer Numbers)



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



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



APPENDIX E

DEMAND GROWTH ANALYSIS

APPENDIX E - DEMAND GROWTH ANALYSIS

E.1.1 Introduction

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

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

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

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

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

E.1.2 Gross value added (GVA)

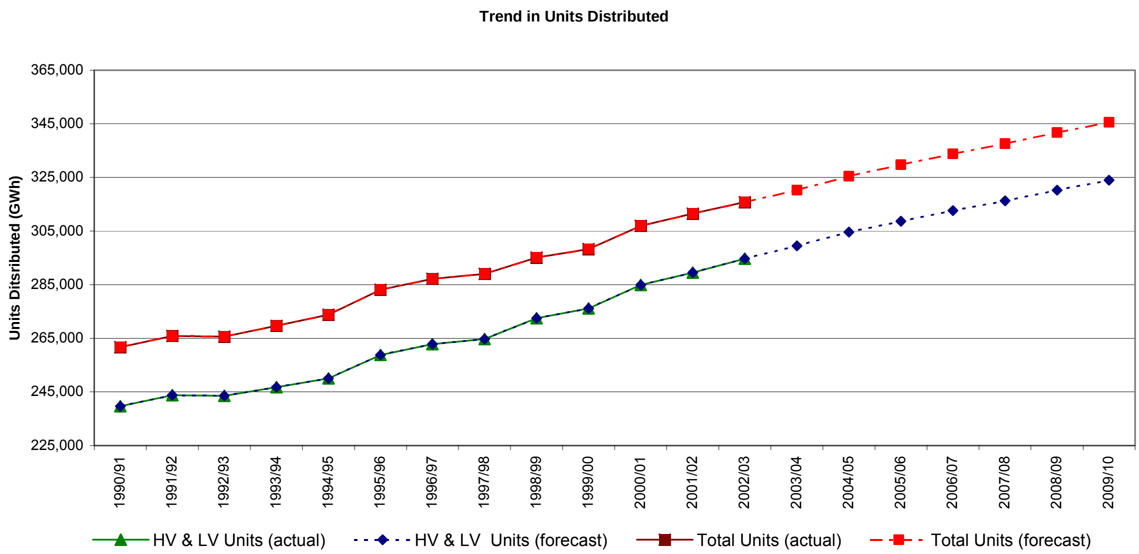
For the purposes of this review, GVA is treated as being synonymous with gross domestic product (GDP). Furthermore Regional Accounts are currently published in terms of GVA1 only. Statistics are published by geographical region in accordance with the Nomenclature of Units for Territorial Statistics (NUTS)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

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

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

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

Trend of energy distributed against time.



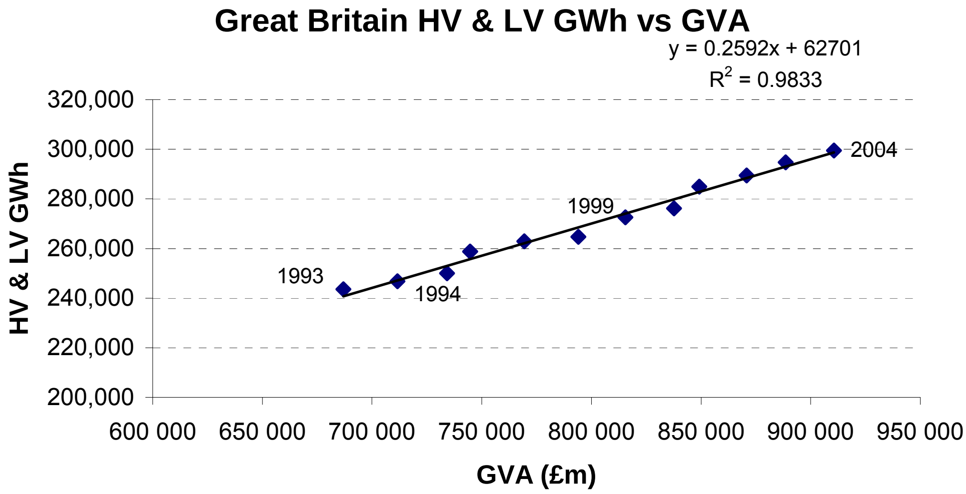
The total regulated units are HV and LV units and the total regulated units include EHV units. Up to and including 2003/03, the units distributed are actual units whereas from 2003/04 onwards these are forecast.

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

E.1.3 Historic trend of units distributed against GVA

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

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



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

E.1.4 GVA growth rates

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

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

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[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 modeling 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 modeling 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 modeling 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 modeling 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 modeling. 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

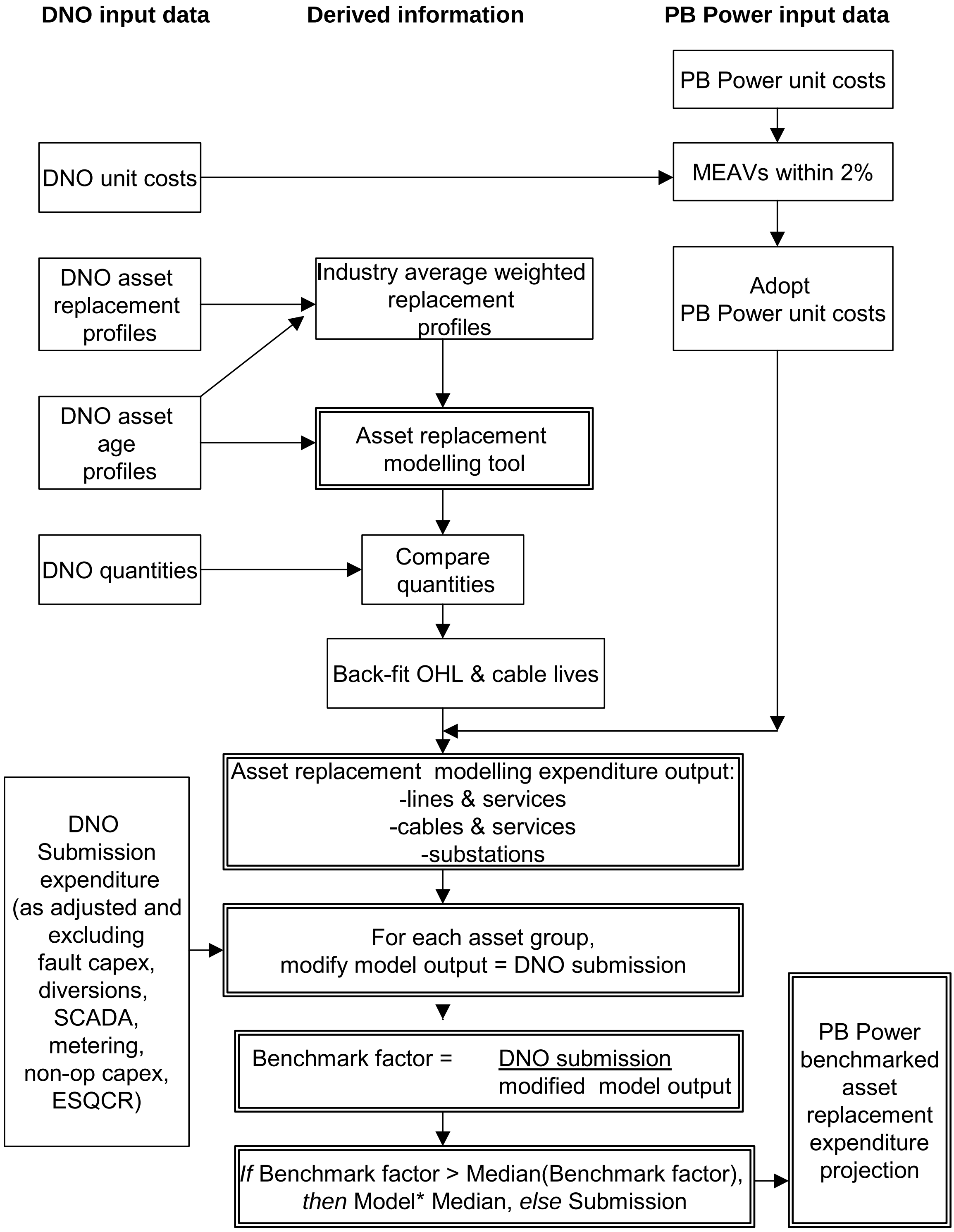
The model output is initially modified so that for each of the asset groups the overall industry (14 DNOs') expenditure predicted by the model is the same as that forecast by the DNOs. (The differences had in any case been small.) For each asset group, benchmark factors of DNO submission/model output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