C H A R T E R
C O N S U L T I N G

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COUNTIES POWER LTD

REVIEW OF 2001 ODV VALUATION OF 110KV SYSTEM

February 2003

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Executive Summary

Counties Power Ltd question the validity of that part of the 2001 Optimised Deprival Valuation of their network which optimises their 110kV lines and associated substation to their 33kV equivalents, because it did not take into account additional consequent costs. The calculations carried out by the valuers have ignored these costs. It is now claimed that the ODV Handbook implies that these costs should have been taken into account and alternative calculations indicate that when they are, the optimisation used by the valuers would produce a higher cost alternative for Counties. It is concluded that the valuation should have proceeded without this degree of optimisation and consequently the 2001 ODV valuation should be $85,265,772, an increase of $1,299,065 over the reported figure.

Counties Power Ltd

Review of 2001 ODV Valuation of 110kV System

1. Introduction

Counties Power Ltd have requested Charter Consulting to review that part of their network Optimised Deprival Valuation as at 31 March 2001 relating to the 110kV transmission Bombay – Pukekohe and the associated equipment at Pukekohe zone substation (**Appendix 1)**.

Counties are concerned that their valuers, in optimising the 110kV equipment to its 33kV equivalent, have not taken into account the additional Transpower charges consequent on a change to 33kV which Counties claim would make the 33kV a more costly option than the current 110kV system. Thus it is claimed, the optimisation is invalid and results in an incorrect ODV valuation.

2. Background

As far back as 1992, Counties recognised that the two existing single circuit 33kV Bombay – Pukekohe lines were becoming inadequate for the increasing load delivered from the existing Pukekohe zone substation **(Ref. 1, 2)**. Several internal and external reports considered a number of options for reinforcement, including changing to 110kV transmission. It was concluded that reinforcement at 33kV would probably entail the construction of a further line and that, because of aging and inadequate equipment considerable upgrading at Pukekohe would be required. Additionally, because of difficulty of access and the possibility of electrical hazards to surrounding premises, relocation of the substation would have to be considered. Economic analysis indicated that the additional Transpower charges resulting from an enhanced 33kV transmission – resulting mainly from the need to install larger 110/33kV transformers at Bombay – would be a crucial factor in any decision. A 20 year NPV analysis indicated only a small difference between the 33kV and 110kV options but the 110kV option showed advantage through its longer term suitability, lower losses, better voltage regulation and its isolation from future increased Transpower charges. A decision was made to proceed with the 110kV option and to relocate and re-equip the Pukekohe zone substation. Installation was completed in June 1996, but a dispute with a landowner led to a diversion of part of one of the lines which was completed in 2000.

Charter has reviewed the relevant reports and concludes that this decision was the most appropriate.

3. ODV Report 31.3.01

Under the heading of **Schedule of Optimisation** the ODV report **(Ref. 3)**, states:

> "Subtransmission circuits: the 110kV line from Bombay to Pukekohe has been optimised to 33kV, resulting in a reduction in RC (Replacement Cost) of $438,448 and DRC (Depreciated Replacement Cost) of $412,506.
>
> Zone substation land: land holdings were optimised down to smaller areas to meet the actual needs required at the Glenbrook, Waiuku, Tuakau, Ramarama, Pukekohe, Pukekawa, Opaheke, Mangatawhiri and Karaka sites. The total reduction in RC and DRC is $360,795.
>
> Zone substation equipment: the Pukekohe substation has been optimised from 110kV to 33kV, resulting in a reduction of RC of $1,178, 250 and DRC to(of) $1,024,822."

4. Commerce Commission Audit

Later in 2001, the Commerce Commission assisted by Parsons Brinckerhoff Associates (PB) undertook a comprehensive audit of the ODV report as originally submitted. Letters between Commerce Commission and PB and Counties are listed in **(Ref.4).** Relevant passages from these letters are:

> "**Subtransmission Network/Lines**
>
> The subtransmission network is mainly 33kV and made up of rings or radial feeders. Pukekohe zone substation is supplied from two 110kV feeders from Bombay GXP. These have been optimised down to 33kV.
>
> **Zone Substations**
>
> Counties Power has eight 33kV/11kV and one 110/22/11kV zone substations. The 110/22/11kV Pukekohe zone substation has been optimised down to 33/22/11kV."

The assumption is reasonably made that PB and the Commerce Commission accepted that these optimisations were correct and appropriate. The valuers have recently confirmed this **(Ref.5)**.

5. Review of the Optimisation Calculations in the ODV Report

Checks have been carried out as indicated in **Appendix 2**. In all cases, the form of the calculations is correct, and the results are correct using the stated replacement costs and the stated and implied optimisation assumptions. However, it is suggested that land negotiation and design costs should be taken into account in the costing of the replacement 33kV lines and that a significant number of the optimisation assumptions

are inappropriate. Taking these changes into account, a reviewed ODV for the lines (the 33kV option) would be $1,104,786 compared with the reported figure of $832,167, and the substation figure would be $2,556,776 compared with the valuer's figure of $2,187,830. Further, if Counties standard switchgear arrangements were adopted, the ODV would rise to $3,097,173.

It must be emphasised that these changes are Charter's opinion and are open to argument. However there is no argument about the fact that valuers did not take into account any additional Transpower charges resulting from a 33kV optimisation. In a recent communication **(Ref.5)**, the valuers state: " Transpower charges were considered as operational costs for the provision of supply to the Counties Power network, not entering into the composition of the ODV of network assets".

6. Optimised Deprival Valuation "Rules"

6.1: ODV Handbook:

The 2001 valuation was carried out in accordance with the guidelines set out in the Handbook for Optimised Deprival Valuation of System Fixed Assets of Electricity Line Businesses, Fourth Edition, issued by the Ministry of Economic Development in October 2000. The principles of the ODV methodology (originally developed in the insurance industry) are explained in Section 2.2 which states:

> " The aim of applying the ODV methodology is to value the assets at the level at which they can be commercially sustained in the long term, and no more. The resulting value should be equal to the loss to the owner if they were deprived of the assets and then took action to minimise their loss"

The argument that Counties Power puts forward is that if they were deprived of their 110kV system, they would not replace it with a 33kV system since this would not be commercially sustainable in the long term, largely because of the increased Transpower charges. The proper action to take would be to rebuild the 110kV system in its current form (because it has already been decided that this is the most economic form), and the loss they would sustain would be the cost of rebuilding it at its current replacement cost.

It is acknowledged that the ODV Handbook does not refer specifically to the need to take into account other consequent costs when carrying out optimisation. The Handbook concerns itself primarily with the replacement cost of fixed assets. However, there are statements in the Handbook which, in Charter's opinion, at least imply that this should be the case. Section 2.6 requires the valuation to "measure the cost of replicating the system…….. in the most efficient way possible". Section 3.12 says that when deciding Modern Equivalent Assets one of the indicators that can be used is "least lifetime costs (taking into account all aspects of performance eg losses)". In section 3.30, when discussing optimisation, the Handbook states: "The resulting ODRC should be based on an optimal, modern efficient design" Again in section 3.47 it says: "The optimised configuration is the one that satisfies the relevant optimisation criteria at minimum overall cost".

It is our view that the word “efficient” implies that an optimisation must be done in a way that produces a lower total cost to the line company than does the current asset set. Additionally, phrases such as “least lifetime costs” and “minimum overall cost” seem to support this.

A telephone conversation with Ministry of Economic Development indicated that this was their view also.

6.2 Other References:

A brief review of the Electricity Act 1992 and its amendments, and of the Electricity (Information Disclosure) Regulations 1999 and their amendments did not reveal anything helpful in this matter.

7. Transpower Charges

An alternative to the optimisation calculations lying behind the ODV report will relate to the level of charges which Counties experience from Transpower in respect to their supply from the Bombay substation. The charges relevant to the capacity at the substation are the Point of Supply Connection Charge and the New Investment Charge.

7.1: “110kV” Charges:

In its current configuration, the supply assets at Bombay Substation include a 110kV busbar, two 110kV transformer circuit beakers, two 30MVA transformers, two 33kV incoming circuit breakers, a 33kV busbar, seven 33kV circuit breakers connecting to Counties subtransmission circuits, one 33kV circuit breaker connecting to WEL and two 110kV circuit breakers connecting to the two Bombay – Pukekohe lines – together with all the air break switches associated with this equipment.

A Transpower April 2001 pricing sheet indicates the connection charge as $493,460 per annum. Additionally a new investment charge of $36,112 per annum was payable for a 20 year term, making a total of $529,572 per annum.

7.2: “33kV” Charges:

The 33kV load at Bombay is now close to the capacity of the current 30MVA transformers. If the current 33kV subtransmission circuits remain, Counties and Transpower will have to consider replacing the two 30MVA transformers with 50MVA transformers. Upgrading the capacity of associated equipment would also have to be considered.
If Counties 110kV lines were replaced by supplies at 33kV, two subtransmission circuits would be required. The changes at Bombay would be: Replacing the required 50MVA transformers with 75MVA transformers, installing two new 33kV circuit breakers for the two subtransmission circuits, and uprating the associated switchgear. Transpower also indicate that with the additional 33kV circuits a new 33kV switchboard would be required.

Transpower indicate that the net increase in connection and new investment charges would be of the order of $260,000 per year.

8. Alternative Optimisation Calculations – 33kV Option

Appendix 3 indicates the calculations taking into account Transpower charges at Bombay substation as indicated in Section 7 above. NPV analyses have been carried out for the current 110kV supply and the 33kV supply suggested in the ODV report optimisation. Analyses have been carried out at 7.67% - the nominal WACC calculated in the ODV Report and at 10%. A 20 year term has been used because this is the term Counties uses to pay its Transpower charges. A check has been made for a 10 year term (noting the higher Transpower charges) because the 10 year load forecast is the maximum allowed for the Pukekohe load. The results for a 20 year term at 7.67% are:

110kV system (existing):	NPV = $10,758,000
33kV system (optimised):	NPV = $12,103,000

In all cases, the NPV for the 33kV option is significantly higher than for the existing 110kV system. Obviously if the changes suggested in the review of the valuers' optimisation calculations in Appendix 2, and referred to in Section 5 above, were made the NPV for the 33kV system would be significantly higher.

Therefore it is clear that a 33kV alternative for the Bombay-Pukekohe transmission and associated substation would involve Counties Power in considerably higher total costs than the current 110kV system. In Charter's opinion, the optimisation to 33kV is invalid.

9. Corrected Optimisation Calculations – 110kV

On the assumption that it is not correct to optimise the 110kV system to 33kV, it is necessary to consider optimisation of the 110kV system as it existed on 31.3.03. **Appendix 4** shows the appropriate calculations. It is considered necessary to apply a degree of optimisation mainly because (a) the line conductors have a capacity in excess of the forecast load; (b) the transformers are not at an optimum size for the forecast load and they operate at 11kV only; (c) the incoming and feeder circuit breakers and busbar are rated for 22kV but they operate at 11kV.

In this regard, it is noted that Counties Power plan to uprate their system to 22kV within the next 10 years. This would make some of these optimisations unnecessary. However, the ODV rules do not allow for this sort of planned change within a load forecast period.

The result of these corrected optimisation calculations are:

Lines: Optimised Depreciated Replacement Cost (=ODV): **$1,177,900**
(representing an increase in ODRC of $345,733 over the ODV Report figure)

Substation: Optimised Depreciated Replacement Cost (=ODV): **$3,141,162**

These corrections lead to an increase in network ODV from the reported figure of $83,966,707 to **$85,265,772.**

10. Corrective Action

The normal interpretation of the Electricity (Information Disclosure) Regulations 1999 is that they effectively require an ODV valuation to be carried out every 3 years. However, the regulations actually state in Section 19 (c): "the valuation must have been carried out no earlier than 3 years before the beginning of the relevant financial year". This does seem to open up the possibility of carrying out a "corrective" valuation within the 3 year period. It would seem prudent to consult the Commerce Commission on this possibility. In its recent papers on Regulation of Electricity Lines Businesses, the Commerce Commission has made a number of possibly relevant statements about valuation:

In its 31.1.03 paper, the Commission states that a company's 2003 valuation:

> "should be based on the ODV valuation report approved by the Commission, adjusted as necessary for asset additions, disposals and accumulated depreciation since the date of the approved ODV valuation"

This statement makes no provision for changes resulting from re-optimisation. However, the Commission have informally said that this adjustment action might provide an opportunity for other changes. In any case, the Commission would be prepared to separately accept a request for an adjustment.

The paper also indicates that the Commission considers that companies should be able to choose either ODV or DHC (Depreciated Historic Cost) valuations in the future (presumably this would require a change in the regulations). It is understandable that Counties would want to be confident about the validity of their current ODV valuation before making this decision. The Commission have indicated that they appreciate this position.

11. Conclusions

11.1 Overall, it is concluded that the degree of optimisation carried out on the Bombay-Pukekohe 110kV lines and on the Pukekohe Substation, which changed these assets to 33kV equivalents, as reported in the 2001 ODV Report was invalid.

11.2 The reported optimisation did not take into account the additional Transpower charges that Counties Power would have to face if the supply was changed to 33kV. Whilst the ODV Handbook makes no specific reference to allowance for costs consequential to optimisation, there are strong implications that a company should be no worse off in total cost terms as a result of optimisation. In this regard, the Commerce Commission expects that the need for clarifications to the ODV Handbook would be

included in Companies' submissions on its recent papers on possible regulation which are due by 28 February.

11.3 Some optimisation of the 110kV system as it stands is appropriate. If this is carried out as suggested the 2001 ODV valuation would rise to **$85,265,772** from its reported figure of **$83,966,707**.

12. References

1. Bombay-Pukekohe Security of Supply – Grant Margison 1994

2. Comment on Proposed Extraordinary Capital Works – Eddie Graham 1993

3. Line Business ODV Valuation as at 31 March 2001 – Meritec 2001

4. Letters from Commerce Commission to Counties Power – 31 January 2002, 15 February 2002, 31 May 2002.

5. Email Meritec – Counties Power 26 February 2003

Appendix 1

Brief

From: Maurice Hoskins
Sent: Thursday, 13 February 2003 17:28
To: dell@extra.co.nz'
Subject: REVIEW OF ODV VALUATION OF CPS 110KV SYSTEM

Brief:

Background

In the last ODV valuation CP's 110kV Bombay -Pukekohe Lines and the 110kV/22kV-11kV Pukekohe Substation were optimised to 33kV lines and a 33kV/11kV substation. This resulted in the allowed value being reduced by $1,505,000 from the DRC . This "economic" argument overlooked Transpower charges that then and still do make the 110kV option the most economic option.

Requirement

1) To give a qualified opinion re the need for the optimisation.

a) Comment on the most appropriate evaluation for the 110kV line and substation within the ODV Handbook Rules and for the need for them to be treated as one rather than the lines and substation separately.

b) To make comment about transformer sizes at 110kV and their economics at the smaller end eg 15/30, 17.5/35 and 20/40MVA, the later being the size of the Pukekohe transformers.

c) Comment re the relative costs of relatively light (1600amp) 22kV switchgear in the Pukekohe Substation and heavy (2400amp-300amp) 11kV switchgear

2) Comment on how you see CP proceeding if we want to get a change to our ODV between the statuary valuations.

Appendix 2

Review of the Optimisation Calculations in ODV Report

Information for this review has been obtained from the ODV Report, discussions with Counties, mainly with Maurice Hoskins, a set of spreadsheets supplied by Richard Ray of Counties and from the valuers by Counties.

A. 110kV Lines

1. Replacement Costs and Depreciation: (note: these figures are as indicated in the Report and may not be strictly accurate because they are derived from detailed spreadsheets and have been rounded. For example, the valuers have recently indicated that the total line length used in the optimisation calculations was 17.69km. The ODV Report states 17.2km. The differences which result from this difference are inconsequential.)

Data Used:

Total line length:	17.2 km
Age (weighted average)	4 years
Replacement Cost	$77,000 per km
Maximum Life	60 years

Total Replacement Cost: 17.2*77000=$1,322,900

Depreciated Replacement Cost: 1322900*56/60=$1,244,700

Comment: The results stated here correspond reasonably with those stated in the ODV Report. The form of the calculations is correct. The valuers have used a non-standard replacement cost for the lines. This was derived by taking the cost of the nearest size Transpower line and adding the cost of Counties' land negotiations and line design. This is a reasonable approach.

2. Optimisation: The ODV Report states: "the 110kV line from Bombay to Pukekohe has been optimised to 33kV, resulting in a reduction in RC of $438,448 and DRC of $412,506".

The valuers used a non-standard replacement cost of $50,000/km for the 33kV lines, presumably in order to achieve capacity and sufficient voltage regulation. This would make the total replacement cost $860,000. This leads approximately to the reduction figures given. (It is suggested that a conductor of less than 300sq.mm. would be adequate and this would have a replacement cost of $40,000/km).

Comment: No provision was made for line negotiation or design costs. It is Charter's view that the costs that Counties experienced in building the 110kV lines could well have occurred in rewiring the original 33kV lines with a heavy conductor. The cost of

$50000/km used implies a conductor of about 400 sq. mm. Whilst this will reduce losses, it may involve additional costs for stronger line components. Taking these matters into consideration, it is reasonable to add the additional costs into the 33kV option. This would make its optimised replacement cost $1,174,264 compared with the figure in the ODV Report of $884,500. Similarly, the ODRC of the lines would be $1,104,786 compared with the ODV Report figure of $832,167.

B. Pukekohe Substation:(the following information is taken from one of the valuer's spreadsheets)

Data Used:

Asset	Description	Unit Replacement Cost	Total Replacement Cost	Optimised Replacement Cost
Land		205,000	205,000	137,350
Site improv & Buildings		225,000	225,000	168,750
ST Structure & foundations		237,000	237,000	118,500
ST transformer 1	110/22-11kV 20/40MVA	925,000	925,000	601,250
ST transformer 2	110/22-11kV 20/40MVA	925,000	925,000	601,250
Earth mat Cable trench		64,000	64,000	64,000
Distribution bd Incomers & BC	1600A 22kV 1600A bus	51,000	153,000	134,640
Distribution bd feeders	630A 22kV, 1600A bus	45,000	405,000	315,900
Incomer cables	2x400mm2 22kV	32,000	64,000	32,000
Control,& protection		130,000	130,000	97,500
Scada & Comms	UHF, fibre optic, and scada	86,000	86,000	86,000
Scada & Comms	For spliting GXP for metering	10,000	10,000	10,000
Station Equipment	Also includes RMU	62,000	62,000	62,000
Load Control		181,000	181,000	0

Total Replacement Cost:

- (Unit Replacement Cost)*(Number of Units)

= $3,672,000

Depreciated Replacement Cost: • (Replacement Cost)*(Max.Life-Age)/(Max. Life)

=$3,280,651

Comment: The results stated here correspond with those stated in the ODV Report. The form of the calculations is correct. The valuers appear to have used the actual construction costs as replacement costs. This is reasonable because none of the items are specified in the ODV Handbook and the installation was comparatively recent.

Optimisation: The optimised replacement costs derived by the valuers for a replacement 33kV substation are shown in the table. Optimisation Factors range from 0 to 1.0.

Comment:

- The land area has been reduced by one third. In our view, the shape of the site would make this difficult to achieve and still provide laydown and working areas. A 20% reduction seems more reasonable which would change the optimised replacement cost from $137,350 to $164,000.
- The value of site improvements and buildings has been reduced by 25%, presumably on the basis that the building would have to contain smaller 11kV switchgear. The size difference does not warrant this reduction alone but because site improvements have been provided for 3 lines a reduction factor of 20% might be sustained. This would change the optimised replacement cost from $168,750 to $180,000.
- The value of the structure and foundations has been reduced by 50%. Counties point out that the 33kV structure costs would if anything be higher taking into account the heavier conductor. Circuit breaker foundations would be added and only slightly smaller transformer foundations. With these assumptions, it is difficult to justify any optimisation. This would change the optimised replacement cost from $118,500 to $237,000.
- The ODV report indicates that the transformers should be optimised to two 20MVA 33/11kV transformers. Having in mind that there is minimal 11kV backup available, in order to provide N-1 security 25MVA transformers should be provided. This would change the optimised replacement cost for each transformer from $601,250 to $702,900.
- The value of the distribution incomers and bus coupler has been reduced by 12 %. Whilst the current rating is appropriate, the optimised installation would be for 11kV gear which is estimated to cost 15% less than the gear installed. This would change the optimised replacement cost from $134,640 to $130,050.
- Similar arguments apply to the distribution board feeders. A 15% reduction on value would change the optimised replacement cost from $315,900 to $344,250.

- Again, the incoming cables should be valued at their 11kV equivalents. This reduction is estimated to be 13%. This would change the optimised replacement cost from $32,000 to $55,680.
-

- The value of control and protection has been reduced by 25%. It is difficult to find justification for this especially as 33kV line circuit breaker protection and control (see below) would be required. This would change the optimised replacement cost from $97,500 to $130,000.
- Scada and Comms values have not been optimised. In the 33kV option no comms link to Bombay would be required on the assumption that 33kV line circuit breakers would be installed (see below). This change would decrease the optimised replacement cost from $86,000 to $56,000.
- The load control plant has been optimised out completely. It is assumed that this is because the age of the existing Bombay plant has exceeded the maximum life of 20 years, despite the upgrading that would be required for the 33kV option.
- The valuers have assumed that no additional 33kV circuit breakers would be required at Pukekohe. Counties state that if they were developing the substation at 33kV, line and transformer circuit breakers would be installed. It is accepted that this is arguable but it is confirmed as the company's policy. The costs of 4 circuit breakers, buswork and voltage transformers is conservatively estimated at $600,000.

The total of the optimised replacement costs used by the valuers in the above table is $2,425,750 and the ODRC found by the valuers was $2,187,830. If the changes suggested in the comments above are made the optimised replacement costs become $2,838,780, and the corresponding ODRC is $2,560,350. If the cost of additional switchgear is added, the optimised replacement cost becomes $3,438,780 and the ODRC is $3,101,150.

Appendix 3

A. COSTS AND CHARGES - CURRENT SYSTEM

DATA	**$**	
Replacement Cost 110kV lines	1322948	ODV Report
Replacement Cost Pukekohe substation	3672000	Valuers' spreadsheet
Relevant Transpower Connection Charges pa	493460	April 2001 quoted charges - assumed to be constant in real terms for next 20years
Transpower New Investment Charges pa	72223.8	Charges applicable from 1 July 1998, 20 year term - assumed to be constant in rea
Losses pa	5691+	per M. Hoskins

	Year0	Year1	Year2	Year3	Year4	Year5	Year6	Year7
110kV lines	1322948							
Pukekohe Substation	3672000							
Relevant Transpower Connection Charges		493460	493460	493460	493460	493460	493460	49346
Transpower New Investment Charges		72223.8	72223.8	72223.8	72223.8	72223.8	72223.8	72223.
Losses		5691	5850	6010	6228	6393	6561	673
Totals	4994948	571375	571,534	571,694	571,912	572,077	572,245	572,41

NPV @7.67%(Nominal WACC) **$10,758,000.00**

NPV @10% **$9,869,000.00**

B. COSTS AND CHARGES - 33kV OPTIMISED SYSTEM

Data	$	
Replacement Cost 33kV lines	884,500	ODV Report
Pukekohe Substation @33kV	2425750	Valuers' spreadsheet(ORC + Land ORC)
Relevant Tpr Conn. Charges @33kV plus Tpr New Investment Charges @33kV pa	825683.8	493460+72223.8+260000 (Net increase of 260,000pa)
Losses pa	37857+	per M. Hoskins

	Year0	Year1	Year2	Year3	Year4	Year5	Year6	Year7
33kV Lines	884500							
Pukekohe Substation @33kV	2425750							
Relevant Tpr Conn. Charges @33kV plus Tpr New Investment Charges @33kV		826783.8	826783.8	826783.8	826783.8	826783.8	826783.8	826783.
Losses		37,857	38,911	39,979	41,426	42,529	43,645	44,77
Totals	3310250	864640.8	865694.8	866762.8	868209.8	869312.8	870428.8	871559.

NPV@7.67%(Nominal WACC) **$12,099,000.00**

NPV@10% **$10,739,000.00**

Difference in NPV between A & B @7.67% **$1,341,000.00**

Difference in NPV between A & B @10% **$870,000.00**

Notes:
1. Not including losses the difference at 7.67% reduces to $943,000
2. Including losses, but using the alternative optimisations stated in the review report, the difference increases to $2,042,000
3. As for note 2 but adding the cost of additional switchgear at the substation, the difference is $2,171,000

Appendix 4

Corrected Optimisation Calculations – 110kV

It is necessary to consider optimisation of the 110kV system in order that its capacity matches the 10 year load forecast at Pukekohe Substation – 24.7MVA as stated in the ODV Report. It is noted that during 2001 this load exceeded 23MVA with full load control. This implies that the ODV Report figure was too low. However it was presumably accepted at the time and should therefore, be used in these calculations.

A 110kV Lines:

These are currently strung with Cricket conductor (the same conductor as used in the replaced 33kV lines). With a current rating of 420A each line has a capacity of 80MVA. Replacing this conductor with Grasshopper with a current rating of 290A would provide lines of 55MVA capacity. This still exceeds the 10 year forecast at Pukekohe, but with its small diameter of 11.73mm, it is considered that this is the smallest practical conductor that could be used without creating corona loss and radio interference problems. March 2001 costs for these conductors were:

Cricket	$2.59/m
Grasshopper	$1.41/m
Difference	$1.18/m

It is considered that there would be no significant difference in line hardware or construction costs.

Cost difference for the two lines = 17.2*1000*3*1.18 = $60,888

Thus the optimised replacement cost for the lines should be:
1,322,900-60,888 = $1,262,012

and the optimised depreciated replacement cost (ODRC=ODV) becomes **$1,177,900**

B Pukekohe Substation:

Land: It is considered that the land area is not excessive for the 110kV equipment installed and that no optimisation is warranted, i.e. the replacement cost should remain at $205,000.

Site Improvement and Buildings: These are considered appropriate both in size and building construction for the 110kV installation and thus no optimisation is warranted, i.e. the replacement cost should remain at $225,000.

Structure and foundations: These are considered appropriate both in size and building construction for the 110kV installation and thus no optimisation is warranted, i.e. the replacement cost should remain at $237,000.

Transformers: There are two 110/22-11kV 20/40MVA 3 phase transformers, currently operating at 11kV, with a replacement cost of $925,000 each. Taking account of the forecast substation load the apparent optimised replacement would be two 110/11kV 25MVA transformers which would provide the required N-1 security. Transpower costing for this alternative is $894,530 each, which is the optimised replacement cost.

Earth mat, Cable trench: These items are appropriate for the installation and no optimisation is warranted.

Distribution Board Incomers and Busbar: The installation comprises two incoming and one bus coupler1600A 22kV circuit breakers and a 22kV 1600A busbar. The optimised installation would be at 11kV and equipment rated for 25MVA. 1600A is a standard rating. The next lowest rating would be inadequate for the forecast load. It is estimated that 11kV circuit breakers and busbars would be approximately 15% lower in cost than the 22kV installation, i.e. the optimised replacement cost would be $51,000*3*85% = $130,050.

Distribution Board Feeders: The installation is nine 630A 22kV feeder circuit breakers and a 22kV 1600A busbar operating at 11kV. The optimised installation would be nine 11kV feeder circuit breakers and an 11kV busbar rated for 25MVA. As above, the current rating is practical but with a reduced voltage, the optimisation would result in a 15% cost reduction, i.e. the optimised replacement cost would be $45,000*9*85% = $344,250.

Incoming Cables: As mentioned earlier, there are two three phase sets of 22kV incoming cables, each set comprising nine cables – a total of 18 cables and they operate at 11kV. Each cable has a current rating of approximately 520A or 1560A per phase. As above, this current rating is appropriate but the reduction in operating voltage warrants some optimisation. 11kV cables are estimated to be some 16% less expensive than 22kV cables but taking into account the similar laying costs, it is estimated that the optimisation should be 13%, i.e. the optimised replacement cost would be $32,000*2*87% = $55,680.

Control & Protection: The equipment is appropriate to the installation and no optimisation is warranted.

Scada & Comms (UHF, fibre optic and normal Scada): The equipment is appropriate to the installation and no optimisation is warranted.

Scada & Comms (GXP, metering): The equipment is appropriate to the installation and no optimisation is warranted.

Station Equipment: The equipment is appropriate to the installation and no optimisation is warranted.

Load Control: Prior to the 110kV installation, Counties' Eastern network load control plant was sited at Bombay, operating at 33kV. The 110kV installation meant that the impedance of the 110kV transformers at Bombay and Pukekohe would degrade the

signal and injecting at Pukekohe was necessary. The equipment is appropriate to the installation and no optimisation is warranted.

The optimisation is summarised below:

Asset	Total Replacement Cost	Optimised Replacement Cost	Optimised Depreciated replacement Cost (ODRC)
Land	205,000	205,000	205,000
Site improv & Buildings	225,000	225,000	198,281
ST Structure & foundations	237,000	237,000	207,374
ST transformer 1	925,000	894,530	819,916
ST transformer 2	925,000	894530	819,916
Earth mat Cable trench	64,000	64,000	56,000
Distribution bd Incomers & BC	153,000	130,050	118,227
Distribution bd feeders	405,000	344,250	312,955
Incomer cables	64,000	55,680	49,493
Control,& protection	130,000	130,000	113,750
Scada & Comms	86,000	86,000	57,333
Scada & Comms	10,000	10,000	8,000
Station Equipment	62,000	62,000	54,250
Load Control	181,000	181,000	120,667
TOTALS	**$3,672,000**	**3,519,040**	**3,141,162**

C Total ODRC (=ODV) of the 110kV System:

= Lines total + Substation total

= $1,177,900 + $3,141,162

= **$4,267,219**