REPORT

Network Fixed Asset Valuation:

Replacement Costs and Lives

VERSION: Public Version
Confidential information in this report is contained in square brackets

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	Prepared for Powerco's submission to the Commerce Commission on Development of the ODV Handbook
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Investigation Into Asset Replacement Costs

1. Introduction

1.1 Scope and Objective of this Report

This report forms part of Powerco's submission to the Commerce Commission on the review of the ODV Valuation Handbook. The objective of the report is to review the replacement costs included in Table B1 of the Handbook. Once reviewed, the intent is that these replacement costs will be suitable for valuation purposes. The document concludes with a table setting out per unit replacement costs and multipliers along with associated lives for each of the main asset categories existing in electricity distribution networks.

1.2 Independent Review and Verification

The methodology used in preparing this report, and its findings, have been reviewed independently by Wilson Cook & Co Limited, engineering and management consultants, advisers and valuers, and their letter of verification is appended.

1.3 Background to Handbook

The Ministry of Economic Development's Handbook for the Optimised Deprival Valuation of System Fixed Assets of Electricity Line Businesses (Handbook) sets out the methodology to be used to value the system fixed assets of Electricity Lines Businesses as part of the country's information disclosure regulatory regime.

The Handbook includes a table (Table B1) that sets out mandatory maximum costs and lives for various standard asset groups. When the Handbook was first prepared in 1993 (First Edition), the purpose of the Handbook was to facilitate commonality of valuation amongst electricity line businesses in order for cost-effective inter-company comparisons to be made. At that stage, Table B1 did not set out mandatory maxima but costs and lives to be used as a guide.

The Second Edition (1998) updated some of the lives.[1] It also tightened up the use of the costs and lives so that the guideline replacement costs and lives became mandatory maxima replacement costs and lives. It however did not update any of the costs.

Apart from the update of lives and the change to mandatory maxima in the second edition, the Handbook costs and lives have not been updated since the first Handbook was prepared[2]. In respect of lives, in Powerco's view apart from a small number of items described in Section 7, the lives outlined in the Handbook are generally suitable for the intended purpose, but in respect of replacement costs, inflation, improved technologies and changed work practices during the period since the first Handbook was prepared imply that costs for replacing equipment could have changed materially.

The Commerce Commission recognises that it is timely that the replacement costs and lives should be reviewed and proposes to carry out work in this regard. It is with this background that this project was set up to investigate replacement costs.

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[1] In particular, zone substation transformers were allowed to have a life of 60 years (extended from 45 years) on evidence of a sound maintenance programme, distribution transformers were allowed to have a life of 55 years (extended from 45 years) on evidence of a sound historical maintenance programme throughout their life and switchgear of modern sealed design specified to operate without maintenance for an extended number of operations was allowed to have a life of 55 years.

[2] Although a recent version of the Handbook includes additional categories of single-phase line and SWER.

1.4 Present Handbook Requirements

According to the Handbook[3], the values in the replacement cost tables are based on installed costs for Modern Equivalent Assets (MEA). They are based on industry best practice and competitive pricing and include the following elements:

- Costs of materials delivered into store;
- Direct labour including indirect costs (ACC, holiday pay, sick leave, training, supervision, etc);
- Transport and plant costs for delivery and erection; and
- On-costs incorporating business administration, design, construction supervision, and project management costs.

The costs of land use consents, easements, and compensation are excluded. GST is excluded but other taxes and duties incurred in the construction of the assets are included.

The Handbook also requires4 that any costs assessed by the Valuer should be based on competitive pricing estimates, and should be commensurate with a significant scale of construction (within the limits of available resources), not piecemeal additions.

The Handbook allows multipliers to be applied to values where equipment is used in adverse conditions but only subject to the conditions specified in section B9, B14 and B15.

1.5 Issues Arising in Preparation of the Report

Issues arising in the preparation of the report included the following:

1.5.1 Implied Scale of Construction

The Handbook rightly requires that replacement costs be based on a large scale of construction, rather than on piecemeal network additions. Where actual projects considered in this report are of a small scale of construction their associated costs have been adjusted to reflect a suitably large scale of construction.

1.5.2 Implied Greenfields approach

We have assumed non green-field[5] replacement, that is, the presence of other existing services (such as storm water pipes, gas pipes and telecommunications cables) and infrastructure (pavements, etc) and the consequential need for reinstatement.

1.5.3 Live Line Costs

It is assumed that line construction will be carried out under dead line conditions rather than live line since that is the method used for most new construction (renewal work is generally done live line).

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[3] Appendix B, Clause B3.

[4] Appendix B, Clause B6.

[5] That is, "brown fields" replacement. The Handbook does not define these terms but the presence of other services is assumed. In this report, we take brown fields replacement to mean replacement of the electricity network leaving other infrastructure unchanged. Therefore, the presence of existing infrastructure such as telecommunications, gas and road services is assumed along with their present usages and existing traffic flows. The costs of restoring existing infrastructure to its original condition as part of replacement of the electricity network, such as footpath paving or road seal, should be accommodated. The need to manage existing pedestrian and traffic flows while construction proceeds should also be accommodated. The report does not assume any change to present use of other infrastructure or traffic flows due to the notional lack of the electricity network.

1.5.4 Maximum v. Mean Costs

The term Replacement Cost Maximum implies that standard replacement costs should not be exceeded but lower replacement costs are allowed. Actual costs for network construction comprise a spread about a mean, which by nature should be suitable for valuation purposes as a replacement cost. However if the mean were regarded as a replacement cost maximum, then values in excess of the mean would not be allowed creating a distortion in the valuation.

Rather than determining replacement cost maxima, this report determines mean replacement costs that are suitable for application in network asset valuations in order to ‘get the valuation right’.

1.5.5 Non Standard costs

The replacement costs of non-standard asset categories, such as zone substation equipment, are not defined in Table B1[6]. In practice, the valuer determines these at the time of valuation.

Powerco considers that, apart from some minor changes described later in this report, the range of asset classes that have replacement costs assigned is appropriate and needs no change.

Powerco believes that it is not appropriate that standard replacement costs should be assigned to present non-standard asset categories because of the wide variety of different designs and standards of construction. For this reason, this report does not consider replacement costs for non-standard assets.

[6] The Handbook does however specify the lives for non-standard fixed network asset classes in electricity distribution.

2. Methodology

2.1 Summary of Approach

Replacement costs have been developed by three methods: (a) estimates using **[ ]** pricing models; (b) collated tendered costs, and in the case of cable installation; and (c) calculated costs based on the building-block rates in **[ ]** contract agreements. The following sets out how the replacement costs for each asset category were derived.

Within this framework the methods Powerco has used to derive its replacement costs are consistent with the following principles set out in the Handbook:

- Replacement costs should include installation, testing, commissioning, project management, construction supervision, design and overhead allocation for own construction. They exclude costs of land use consents, easements, and compensation. GST is excluded but other taxes and duties incurred in the construction of the assets can be included.
- Replacement costs have been based on actual competitive tenders where possible. The tenders have been gathered sufficient to be satisfied about the adequacy of competitiveness and to identify any necessary adjustments to account for scope.
- Replacement costs should be the present day costs to replace assets now (or as close to as possible). Sampled replacement costs have been collated from over the previous two years.
- For the purposes of one-dimensional analysis, the replacement cost samples gathered are as similar as possible. At the same time however, a wide variety of terrains and conditions have been considered so as to enable multipliers to be properly analysed.
- The sample size was as large as possible to provide a representation of the costs being incurred whilst limited by the number of contracts undertaken.
- As a check to confirm that the tendered costs are competitive, replacement costs have been estimated from bottom up using competitively tendered labour and plant rates including on-costs and notional profit margin.

2.2 Asset Definitions

The following sets out Powerco's interpretation of what is included in the Handbook's replacement costs.

Overhead distribution lines - Base Handbook replacement costs (without multipliers) assume flat rural terrain without significant difficulties for construction. The pole spacing assumed was 70 to 80m. For heavy conductors, pole spacing of approximately 60m are necessary in these types of conditions due to the heavier conductor and wind loadings.

LV Overhead Lines - the Handbook does not allow multipliers to be applied and therefore we have assumed that pole spacings are 40m in line with standard practice of one pole for every second ICP boundary.

Underground cables - Base Handbook replacement costs (without multipliers) assume suburban conditions with some but not significant road crossings or significant disruption to traffic, pedestrians and connected customers; and easy digging conditions.

Distribution Transformers - We assume that the Handbook's distribution transformer costs include the cost of transformers ex store, their purchase and costs of transport to site. For intermediate sizes, the cost of the next size up should be applied for valuation purposes. The cost excludes lightning arresters.

Distribution Substations - The distribution substation costs should include the cost of mounting the transformer, steel work and enclosing structure, additional poles if applicable, cost of earthing, and cost of LV fuses. In the case of pad-mounted transformers, the cost should include the cost of pad and cable terminations to the transformer and LV frame. It should exclude any HV switchgear. In the case of pole-mounted transformers, the cost should include the cost of HV droppers, but exclude the cost of the pole; ABS and MV drop out fuse. Land should be excluded.

Street Lighting Mains - the MEA of street lighting mains should be the marginal cost of an additional core, including conductor, stringing, insulator and longer cross arm. Control of street lighting as a photoelectric cell as an integral part of a lantern is allowed by the B.24 of the valuation handbook but is not regarded as Powerco's modern equivalent asset.

Customer Connections - customer connection costs include cable or line connections from mains to property boundary and LV fuses. It should also include the cost associated with fuse holder in pillar or on pole, and termination of cable or overhead line connection. The costs should exclude meters and relays.

Distribution Switchgear - This should include mounting, pad, special steelwork, marginal cost of additional poles or additional pole size, and cable termination.

2.3 Basis of Estimates

2.3.1 Collated Tendered Prices

A range of tendered costs have been collated, analysed and adjusted in accordance with the basis in section 2.1 above. These were combined into a spreadsheet and summarised by asset category in the form of a pivot table. In many cases adjustments have had to be made to these prices to bring them into a common base in line with the asset definition (Section 2.2) and to reflect a large scale of construction. Details of the adjustments made are shown in the tables in Section 3. The tendered project costs are inclusive of material on-costs except for distribution transformers and certain switchgear, and exclusive of all asset owner on-costs.

2.3.2 Field Contractors' Rates

In the case of underground cables, the replacement costs that result from applying the building block costs in the **[ ]** compare favourably with those estimated for competitive tenders. For cables, replacement costs derived using **[ ]** rates are taken to be inclusive of materials on-costs but exclusive of asset owner on-costs.

For line construction, however, the contracted project building block costs in [ ] contract agreements are suitable only for one off piecemeal projects that include significant gearing up costs, without including benefits due to economies of scale. **[ ]** In these cases, contract prices are usually negotiated based on agreed hourly labour and plant rates.

The labour and plant rates existing in some contracts **[ ]** have been benchmarked for competitiveness **[ ]**.

2.3.3 Powerco's Pricing Models

[ ] estimating team has prepared price estimates for the construction of a range of different asset categories as if they were competitively tendered. The bases for scopes of these price estimates are those given in Section 2.2. Further detail on the pricing calculations can be provided to the Commission if requested.

2.3.4 Powerco's Capitalisation Policies

[ ] estimates and the tendered projects take into account Powerco's capitalisation policies. According to these policies, the cost of self-constructed assets includes the cost of all materials used in construction, direct labour, and any financing costs that are directly attributable to the project. Costs cease to be capitalised when the asset is ready for use (i.e. when it is commissioned).

Capital expenditure is the expenditure to create new assets or to increase service performance or service potential of an existing asset beyond its original design service performance or service potential. It is separated into two classes, development expenditure and renewal expenditure. Expenditure is capitalised when it increases the economic benefits over the total life of an asset, or when the expenditure was incurred to enable the economic benefits to be realised. Expenditure that improves an asset is deemed capital expenditure, and that which restores an asset is repairs and maintenance.

2.4 On-Costs

2.4.1 Network Owner Contract Supervision

Contract supervision comprises two parts – contract supervision provided by the project contractors and contract supervision provided by the Asset Owner. The former is taken to be already included in contract costs and price estimates. The latter however is not included in the contract costs and the true project cost should reflect some amount of contract supervision cost experienced by the Asset Owner.

From this year on, Powerco proposes to capitalise a sum of 4.4-4.5% of total project cost to cater for Asset Management Group (network owner) contract supervision and project auditing overheads. The exact figure is to be determined. Contract supervision is carried out largely by Powerco's Service Delivery Group. The role of this group is to:

1. Manage the relationship with contractors. Generally the costs associated with the management of the relationship with contractors are classed as Opex.
2. Arrange and manage the delivery of network development and renewal (Capex) and maintenance and operating services (Opex) on the electricity assets by contractors.
3. Review condition monitoring results and arrange repair of defects and any in depth maintenance (in Eastern electricity region defect and maintenance follow-up is the responsibility of the Contractors). The management of the condition monitoring and defects process is generally Opex.
4. Manage the defects process. The scheduling and repair of defects is largely the responsibility of contractors. The Service Delivery Team's role is to set guidelines for defect repairs, monitor compliance, monitor trends in the type and location of the defects and approve defects outside the Contractors delegated authority.
5. Manage the customer initiated works process. This process is largely capital work.
6. Manage customer complaints and third party damage to the network. Customer complaints (including voltage complaints) are managed by the Customer Works Coordinators. Contractors are used to undertake field investigations and LV analysis. Issues relating to the HV network will typically be escalated to the Planning Team. This is largely Opex.

The Service Delivery Group comprises a team of 18 full time employee positions. The makeup of these positions is shown in Table 1 along with the estimated amount of time spent by each position on capital works projects versus operational work.

Given that the contracts team is heavily utilised[7], the market hourly rate for the team could be reduced. It is also likely that there could be greater efficiencies for the provision of their services than at present. To cater for these reductions Powerco considers it reasonable that the overhead rate be reduced by 15% to accommodate for these greater utilisations and efficiencies[8]. Spread over a total capital expenditure of 34.083 million, this represents a 3.4% overhead for Asset Owner contract supervision applicable to each project.

Table 1: Breakdown of Contracts Group Capex Related Costs

Contracts Group Position Type	Number of Positions in Team	% work time spent on Capex projects[9]	% work time spent on Opex work	FTE on Capex	Estimated Market C/O Rate	Annual Capex Overhead[10] $ 000
Service Delivery Manager	1	2	98	0.02	$150	5.6
Contracts Manager	2	8	92	0.16	$125	37.6
Western Region Project Engineers	4	50	50	2	$90	338.4
Eastern Region Project Engineers	2[11]	80	20	1.6	$90	270.1
Project Engineer (Defects)	1[12]	0	100	0	$90	0
Contract Performance Administrators	2	0	100	0	$70	0
Customer Initiated Works Team Leader	2	50	50	1	$100	188.0
Customer Initiated Works Coordinator	4	80	20	3.2	$85	511.4
Total	18			7.36		1,351.1

Powerco also carries out field auditing of contractors as part of its obligations to health and safety. Auditing is undertaken by external providers and represents an annual cost of $560,000 across both electricity and gas networks. Auditing is carried out for both capital and maintenance type works. Total network expenditure budgeted for the 2004 year is $65.4 million per annum[13], equating to an on-cost of 0.85 % applicable to electricity network Capex items.

[7] That is, in comparison with the consulting environment as a benchmark, the members of the team do not have to tender or search for work as a consultant does.
[8] To illustrate this point, Powerco has, on occasions, filled planning engineer roles by the secondment of staff from its consultants and received a 15% reduction in the consultants' normal hourly rates on account of the length of engagement.
[9] Estimated by Contracts Managers.
[10] Based on 8 hours per day over 47 weeks, viz. 1,880 hours per year.
[11] Project engineers in Western Region schedule maintenance and vegetation management but in Eastern Region partner contractors handle this.
[12] [ ] fulfil the Defects process:
[13] Made up of $10.2 million and $7.4 million for Western and Eastern Electricity Maintenance respectively, $4.1m for gas maintenance, $34.4 million for electricity capex and $9.3 million for gas capex.

The project engineers and contract managers travel approximately 20,000 km in distance each year in the course of their work[14]. Therefore the total cost associated with contract management travel is (0.16+2+1.6) FTEs * 20,000km * $0.60 per km = $45,000. This represents an on-cost of 0.13%.

External consultants are used from time to time to assist with the supervision of certain complex or non-routine projects. Examples of situations where external consultants are used are preparing concept designs for zone substation projects and for witnessing tests of certain items of equipment where special expertise is required. Costs associated with external consultants generally pertain to special projects to do with assets that are non-standard as far as the Handbook is concerned.

A total on-cost of 4.4% – the lower end of the range mentioned above – has thus been applied to standard asset components to accommodate asset owner contract supervision.

2.4.2 Network Owner As-Building

An amount of 0.5% of the total project costs has been allowed for GIS "as building"[15]. Although Powerco presently expenses these costs as overheads, it is reasonable that should they be included in the replacement cost as the activities are an essential part of all capital projects. Total As-Building costs amount to $600,000 annually. The proportion of capital work to non-capital work is estimated to be approximately 30%. Assuming a total capital budget of $34 million this equates to an on-cost of $600,000 * 0.30/ $34,000,000 or 0.5%.

2.4.3 Stores

[ ] supply materials as part of the partnership agreements for capital works and network maintenance service provision. **[ ]** are separate companies and the materials they purchase, store and use can be considered to include the costs associated with stores overheads already.

In the Western Region, during the course of a project, material costs are recorded in the Job Costing System at the original purchase cost into store with a certain mark up to allow for handling and stores costs. When a construction project is completed and the works have been commissioned, the costs recorded in the Job Costing System are then capitalised.

Project costs estimates prepared by Powerco's contractors in the Western Region include the mark ups on materials to accommodate material handling and storage.

2.4.4 Stores On-Costs for Transformers and Switchgear

Powerco procures transformers and some switchgear and provides them free-of-charge to its contractors for installation. The costs associated with procuring, storing and handling these items are not currently capitalised in the company's financial statements but are treated as operational expenditures. Project cost estimates for work involving transformers and switchgear thus do not include the handling costs associated with these items.

In order to reflect the full cost of resources applied, and thus a ensure a more correct statement of value, the costs of transformers and certain switchgear purchased in the Western Region have thus been increased by an amount reflecting the handling costs. For these items the stores on-costs were estimated by dividing the annual stores expenses by the annual value of materials throughput. The annual stores expenses should reflect the costs to provide the services provided by the stores in a competitive market place. This should represent the lower of the present

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[14] Estimated by Contracts Manager Western.

[15] The contractor provides as-built sketches and mark-ups to the Asset Owner. The associated costs are built into the contract prices and estimates. The Asset Owner carries out the updating of the GIS and other information systems.

expenditures with some adjustment to allow for possible greater efficiencies, and the cost if the stores function were outsourced.

Presently the Western Region stores expenditures comprise two components - stores expenses that include salaries, transport, telephone and other like costs, exclusive of depreciation; and building rental costs that are presently covered by the Powerco business owner. The former comprised a sum of $902,113 per annum for the 2003 year and is budgeted to be $950,000 for the 2004 year. Powerco expects that greater efficiencies are available on present stores costs and a 20% reduction in expenditure is considered to represent a realistic efficient expenditure level for the services the stores provide. Building rental costs have been valued at market rate as $373,000 per year. Total Western Region store materials turnover for last financial year was $8.965 million.

Powerco has conducted a study into different stores service provision models. These included the complete outsourcing of the services that the present stores provide. Three external stores service providers were requested for prices to provide the services. The lowest outsourced price was higher than the existing stores overheads.

This represents a total on cost of ($902,000 x 80% + $373,000) / $8,965,000 = 12.2% applicable to large items of switchgear.

For transformers, time-in-motion studies have shown that the cost of transformer management is $144,000 per year. The total value of stores throughput of transformers is $2.47 million. Transformer management therefore represents 5.8% of the value of transformers. To this should be added building rental costs of 4.2%. This represents a total on cost of 10.0% applicable to transformers.

2.4.5 Interest During Construction (IDC)

Powerco understands that the Handbook standard costs do not include interest during construction (IDC) but, for replacement costs determined on the basis of large-scale construction, an allowance should be made for IDC. This is already included in Powerco's estimates of non-standard asset costs but, for the purpose of deriving the schedule of recommended mean standard replacement costs in this report, it has been added also to lines and cables. The increase in line replacement costs is 1.1% and the increase in cable replacement costs is 0.4%.

3. Replacement Costs

3.1 Replacement Costs of Specific Assets

3.1.1 33kV Lines

Replacement costs have been estimated from **[ ]** pricing models for different types of 33kV line. The replacement costs are summarised in Table 2.

The calculated costs for 33kV, 11kV and LV lines allow for two bends in every kilometre of line and accordingly include costs of two stayed angle poles. While some lines are straight and have no bends, most lines need to have stayed angle poles along their route. A quantity of two per kilometre is regarded as a low-end average.

The distance for travel between line depot and site is taken to be 50km on average. This represents the average distance for a circle around the distance of 75km, above which is regarded as remote rural.

Table 2: Replacement Costs for 33kV Lines and ABS Estimated by [ ] Costing Models

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
33kV Lines - Heavy (between 150 and 300 sq mm Al)	57.1	6.0%[16]	60[17]
33kV Lines – Light (up to 150 sq mm Al) (Dog)	40.5	6.0%	42
33kV Lines – DCct Heavy	90.0	6.0%	96
33kV Lines – DCct Light (Dog)	74.6	6.0%	80
33kV Air Break Switch	9.5	4.9%	10

Two recent 33kV line projects have been analysed and their associated costs are shown in Table 3. They (and all other contracted prices shown below) are exclusive of asset owner on-costs. These two projects both pertain to heavy conductor and have required adjustment to bring them into line with the same basis as the Handbook replacement costs.

[16] Contract supervision, as-building and IDC on-cost. Refer to section 2.4.
[17] Rounded to nearest two units.

Table 3: Recent Contracted Costs for 33kV Line

Item	Category	Cost ($ 000)	Quant (km)	Adjusted Unit Cost ($ 000/km)	Comment
1	33kV Heavy	75.5	0.6	75.8	Busy road[ ] requiring extensive traffic control (reduced by factor of 1.25 to allow for traffic control). Under-built with LV including UG services and road crossings (cost reduced by $12,000 per km to allow for underbuilt construction). Council restriction including work times and no local site setup allowed and every pole in same hole (cost reduced by 25% to allow for special Council restrictions).
2	33kV Heavy	17	0.28	57.6	**[ ]** Replacement of 4 hardwood poles. - 70 metre spans assumed. Increased by $2,500 ($9/m) to allow for new Cockroach conductor. Project includes 11kV underbuilt – costs reduced by $12,000/km ($12,000*0.28 = $3,360) to allow for 11kV crossarms.

The first project indicates that the replacement cost estimated from **[ ]** for 33kV heavy line is too low although the second supports the estimated replacement cost. However because both projects involved short lengths of line and the scale of adjustments necessary was significant, greater confidence should be placed in the costs estimated from **[ ]** in Table 2.

3.1.2 33kV Cables

Replacement costs for 33kV underground cables were estimated based on **[ ]** rates. The costs of laid 33kV cable are summarised in Table 4.

The trenching rates were confirmed during recent work done **[ ]** for gas pipe trenching. The 400mm width of trench for laying gas pipes is similar to the widths used for laying cable. The depth of trench for gas pipes is generally 600mm in road areas and 400mm in the berm. This tends to be smaller than that used for electrical cable where generally depths of 600mm are used for distribution cable and 800mm to 1000mm for subtransmission cable. These differences are understood to cause little difference in trenching cost.

Table 4: Replacement Costs for 33kV Cables estimated from [ ]

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
33kV Cables (up to 240mm^2 Al)	168	5.3%[18]	175[19]
33kV Cables Double Cct (up to 240mm^2 Al)	279	5.3%	295

Although recent examples of 33kV cable exist, their size has tended to be larger than 240mm^2. There are therefore no recent contracts against which the replacement costs shown in Table 4 can be compared.

[18] Contract supervision, as-building and IDC on-cost. Refer to section 2.4.
[19] Rounded to nearest five units.

3.1.3 11kV Lines

[ ] has estimated replacement costs for 11kV lines from their pricing models and these are summarised in Table 4.

Table 5*:* Replacement Costs for 11kV Lines Estimated by [ ]

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
11kV Lines - Heavy (Weta)	37.5	6.0%[20]	40[21]
11kV Lines – Medium (Dog)	31.3	6.0%	34
11kV Lines – Light (Boron)	20.4	6.0%	22
11kV Lines – Single phase	18.7	6.0%	20
11kV Lines – DCct Heavy (Weta)	56.6	6.0%	60
11kV Lines – DCct Medium (Dog)	52.7	6.0%	56
11kV Lines – DCct Light (Boron)	37.4	6.0%	40
11kV Lines Underbuilt Heavy	23.7	6.0%	26
11kV Lines Underbuilt Medium	20.9	6.0%	22
11kV Lines Underbuilt Light	15.3	6.0%	16

Several recent 11kV line projects have been analysed as shown in Tables 6, 7 and 8.

Table 6*:* Recent Contracted Costs for 11kV Heavy Line

Item	Category	Cost ($ 000)	Quant (km)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Heavy	45	1.4	45	**[ ]** Total conductor replacement from Poko to Weke. Cost reduced by $4,000 per km to allow for removal of old line. To allow for poles, 20 poles (1400metres @ 70m spans) at $1,200 = $24,000 have been added

The project described in Table 6 indicates that the replacement cost for heavy 11kV line may be rather low compared with actual contract costs. However because there is only one recent contract relating to heavy conductor line, we consider that the rate of $37,500 estimated by **[ ]** is conservatively low and can be taken as reasonable.

[20] Contract supervision, as-building and IDC on-cost. Refer to section 2.4.
[21] Rounded to nearest two units.

Table 7: Recent Contracted Costs for 11kV Medium Line

Item	Category	Cost ($ 000)	Quant (km)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Medium	21.5	1.5	32	**[ ]** Conductor replacement & 22 Xarms (11kV). Cost adjusted upwards by adding 22 poles @$1,200.
2	11kV Medium	135	3.8	32	**[ ]** Line upgraded from conversion transformer to mountain gates. Voltage increased from 6.6kV to 11kV[ ]. New conversion transformer installed[ ]. 11kV and 400V reduced by $12,000/km ($18,400*400 metres = $7,400) to remove 400V underbuilt. Reduced by $5,000 to allow for cost of installing new conversion transformer.

The costs shown in Table 7 support the replacement cost of $31,300 for medium 11kV line estimated by **[ ]**. This replacement cost can thus be taken to be realistic.

The weighted average of the replacement costs for light line is $21,500 and weighted standard deviation is $2,200 (10% of mean). The estimated cost by **[ ]** is somewhat light but still within one standard deviation of the average. The estimated cost of $20,400 is therefore reasonable.

Table 8: Recent Contracted Costs for 11kV Light Line

Item	Category	Cost ($ 000)	Quant (km)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Light	12.7	0.47	22.6	Squirrel O/H line,[ ] included heavy angles (reduced by 10% to allow for heavy angles), built over wastewater treatment pond (reduced by 10% to allow for difficulty factor).
2	11kV Light	10.2	1.1	22.6	11KV Squirrel ACSR conductor[ ]. Conductor replacement and cross-arms[ ]. Increased by (1100/70 = 15 * $1,000 = $19,200) to allow for poles.
3	11kV Light	7.6	0.35	21.8	11kV Squirrel conductor,[ ] total replacement.
4	11kV Light	3.4	0.52	22.5	**[ ]** $8,400 added for 7 poles @ $1,200 per pole.
5	11kV Light	36.1	1.75	20.6	11kV Squirrel conductor replacement.[ ]
6	11kV Light	32.4	3.1	25.4	**[ ]** Conductor & pole replacement (11kv) with Boron - 3 poles, 33 cross arms, 3 transformer structures. Adjusted to add extra poles, remove transformer structures and insulators.
7	11kV Light	61.9	2.8	22.1	**[ ]** Full replacement.
8	11kV Light	30.9	1.1	22.1	**[ ]** Adjusted to account for difficult terrain.
9	11kV Light	56.7	3.3	17.3	**[ ]** Light conductor replacement, squirrel.
10	11kV Light	34.2	4.7	21.2	**[ ]** Adjusted to add poles, reduced to cater for remote rural location and dismantling of existing equipment.
11	11kV Light	31.0	3.6	20.6	**[ ]** Renew conductor and cross arms. Adjusted to allow for new poles, decreased to allow for dismantling of existing equipment.
12	11kV Light	33	1.8	22.7	**[ ]** Replaced conductor, cost adjusted to cater for new poles and reduced to allow for dismantling.

Table 9: Summary of 11kV cable replacement costs using [ ] rates.

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
11kV UG cable - Heavy	130	5.3%[22]	135[23]
11kV UG cable – Medium	99	5.3%	105
11kV UG cable – Light	78	5.3%	80
11kV UG cable – DCct Heavy	208	5.3%	220
11kV UG cable – DCct Med	146	5.3%	155

3.1.4 11kV Cable

Replacement costs for 11kV cables have been calculated using **[ ]** rates, and recently tendered rates from **[ ]** for gas pipe trenching. As described in the section above, the costs for gas pipe trenching are similar to those associated with laying cables. Table 9 summarises the results of these calculations and includes the Asset Owner on-costs.

The following Tables 10 to 12 show actual contracted costs to lay 11kV cable.

Table 10: Recent Contracted Costs for 11kV Heavy Cable

Item	Category	Cost ($ 000)	Quant (m)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Heavy Cable	43.7	190	123	**[ ]** Cable replaced under emergency conditions, cable under road with extensive traffic control and reinstatement costs. Urban factor of 1.25 and road reinstatement factor of 1.8 applied.
2	11kV Heavy Cable	30.2	300	146	3C 300sq mm,[ ] OH to UG conversion, no trench provided.

[22] Contract supervision, as-building and IDC on-cost. Refer to section 2.4.
[23] Rounded to nearest five units.

Table 11” Recent Contracted Costs for 11kV Medium Cable

Item	Category	Cost ($ 000)	Quant (m)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Medium Cable	71.5	800	89	3c 185 Al[ ]
2	11kV Medium Cable	22.1	220	90	11kV medium,[ ] short duration outages allowed, cost reduced by 10%.
3	11kV Medium Cable	39.0	350	94.3	95mm cable,[ ] cost reduced to remove some extra installation costs.
4	11kV Medium Cable	7.5	225	78.3	185 mm cable,[ ] trenching added @ $45/m.
5	11kV Medium Cable	25.3	160	97.2	185 mm cable,[ ] adjusted to remove extra trenching and ducts, urban and reinstatement multipliers removed.
6	11kV Medium Cable	11.5	60	115	185 mm cable,[ ] cost adjusted for short cable run.
7	11kV Medium Cable	15	270	101	185 mm cable,[ ] cost adjusted by adding trenching.

Table 12: Recent Contracted Costs for 11kV Light Cable

Item	Category	Cost ($ 000)	Quant (m)	Adjusted Unit Cost ($ 000/km)	Comment
1	11kV Light Cable	21.2	130	76	35 mm cable, [ ] cost adjusted to allow for extra duct installation and other equipment.
2	11kV Light Cable	86	1529	96	35 mm cable, [ ] cost adjusted to include trenching.
3	11kV Light Cable	4.8	100	77	35 mm cable, [ ] cost adjusted upwards to allow for shared trenching.
4	11kV Light Cable	31.9	840	78	35 mm cable, [ ] added cost for trenching.
5	11kV Light Cable	7.3	150	88.5	35 mm cable, [ ] cost adjusted as work excluded trenching.
6	11kV Light Cable	7	130	64	Light cable, [ ] cost adjusted to include trenching.
7	11kV Light Cable	1.8	70	65	35 mm cable, [ ] cost adjusted by adding trenching.
8	11kV Light Cable	10.5	360	69	35 mm cable, [ ] cost adjusted by adding trenching.
9	11kV Light Cable	11.7	150	78	35 mm cable, [ ] adjusted up for trenching, adjusted down to remove transformer
10	11kV Light Cable	19.0	210	61	35 mm cable, [ ] cost adjusted down to allow for RMU and transformer.
11	11kV Light Cable	4.4	150	69	35 mm cable, [ ] cost adjusted by adding trenching.
12	11kV Light Cable	46.8	1165	80	35 mm cable, [ ] cost adjusted by adding trenching.

In most cases, the costs associated with 11kV cable installation projects have had to be adjusted to cater for variations in scope. Adjustments include:

1. The addition of trenching costs because in many subdivision developments, other contractors supply the trenching and this is not accounted for in the job management system.
2. The removal of transformers and ring main units. In many undergrounding projects, the entire cost of the project is bundled together and this can include equipment other than just the cable.
3. Addition or removal of extra trenching or duct, depending on the actual project scope.

Other adjustments have been made to accommodate for things like extra traffic control and special reinstatement.

The average, weighted average and standard deviation of the contracted costs for each size of cable is shown in Table 13.

Table 13: Summary of replacement cost data in Tables 10 to 12

Asset	Weighted Average Replacement Cost ($000)	Weighted Standard Deviation ($000)
11kV Heavy Cable	137	11
11kV Medium Cable	92	7
11kV Light Cable	82	11

Table 13 demonstrates that the replacement costs derived from **[ ]** rates (excluding asset owner on-costs) are within one standard deviation of the sample mean of actual contracted costs adjusted for variations in scope. Whilst the standard deviations are only 13% of the mean, the actual non-adjusted per unit costs show a much broader variation[24].

3.1.5 Distribution Switchgear

Costs for various items of distribution switchgear have been estimated by **[ ]** and these are summarised in the following table.

Table 14: Replacement Costs for Distribution Switchgear Estimated by [ ]

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Repl. Cost ($000)
Distribution Air Break Switch (ABS)	3.3	4.9%[25]	3.5[26]
Load Break ABS	5.7	4.9%	6.0
Drop Out Fuse 3 ph	1.4	4.9%	1.5
Sectionaliser	30.2	4.9%	32
Recloser (without communications)	23.9	4.9%	26[27]

Actual contracted replacement costs for air break switches averaged $3,200 and the standard deviation of the sample was $680.

[24] This is why cable replacement costs were rounded to the nearest $5,000 per kilometre in Table 9.
[25] Contract supervision and as-building on-cost. Refer to section 4.
[26] Rounded to nearest hundred dollars.
[27] Includes an allowance $1000 to check and reset feeder protection.

Drop out fuse installation projects were generally combined with other projects and it was not possible to accurately extract these costs from the main project costs. Some drop out fuse installation was done in the network but it was generally of a piecemeal nature and not mass scale.

A variety of types of ring main units, fuse switches and oil switches exist in the Powerco's network and it is not often clear how to apply the replacement costs given in the Handbook. Because of this, Powerco considers that it would be clearer if these classes of asset were treated as non standard assets. For reference however, Powerco finds that costs to install an ABB SDAF3 unit (Ring Main - 3 way) is approximately $14,000, an ABB SD1 unit (extra switch) is approximately $6,000 and an ABB SDAF unit (extra fuse switch) is approximately $11,000 including asset owner on-costs of 4.9%. To these costs should be added asset owner costs of 4.9%.

Few distribution circuit breakers exist in the field in Powerco's network. It is therefore suggested that this item should be removed from the Table. Instead significant quantities of 11kV circuit breaker cubicles exist in zone substations. The replacement cost for 11kV feeder circuit breakers is generally consistent, being approximately $31,000 per circuit breaker excluding protection equipment (excluding material and asset owner on-costs). Including on-costs, the replacement cost for 11kV circuit breakers without protection is $36,000 (rounded to the nearest $2,000).

3.1.6 Distribution Transformers

Table 15 shows the costs into store for the sizes of distribution transformer that Powerco presently regards as its modern standard. Some of the sizes presented in Table B1 of the Handbook are not given in this table because these are different from Powerco's modern standard sizes. The table also sets out the current replacement cost inclusive of material, contract supervision and as building on-costs. Overall, there is a neutral trend in price change over the Handbook replacement costs – the smaller sizes have lower replacement costs than those given in the Handbook while the larger sizes (above 200kVA) have higher replacement costs.

It is worth noting that commodity prices for materials used in the manufacture of distribution transformers such as copper and aluminium are currently at low historical levels. Future costs for distribution transformers could increase somewhat if commodity prices rebound.

As part of its modern standard, Powerco does not generally install pole-mounted transformers of size larger than 100kVA. The modern equivalent asset is usually a pad-mounted substation. However, Powerco does still have significant quantities of large pole mounted transformers in its network and considers that the present Handbook costs for these items are reasonable.

3.1.7 Distribution Substations

As described in Section 3, included in small (up to and including 50kVA) pole mounted distribution substations are an earth bank, LV fuses, mounting and transport of transformers and LV conductor termination. The cost of an earth bank in good soil is generally approximately $600. Costs for LV fuses are in the order of $200 for three phase and $100 for single phase, and conductor termination is generally in the order $200 for underground cable. Transport and installation is in the order of $300. The total replacement cost for small substations is therefore in the range of $1,100 to $1,300, or an average of $1,200.

A variety of designs exist for pole mounting distribution substations of size larger than 50kVA. For sizes above 100kVA, the modern equivalent asset is generally a pad-mounted substation, but significant quantities of pole-mounted transformers of larger size still exist in the network. Generally, large size transformers are either mounted on H pole arrangements or on a single pole. The present Handbook cost is possibly reasonable for single pole mounted units of 100kVA size. However the H pole arrangements comprise two poles supporting a horizontal structure on which the transformer sits, and the estimated cost for this arrangement is approximately $4,000. This excludes the cost of one pole, which would be required for supporting the line conductors and the cost of any associated HV dropout fuses and air break switches.

Table 15: Replacement Costs for Distribution Transformers

Asset Class	Estimated Cost into store ($)	Additional Asset Owner On-cost	Estimated revised Repl Cost ($000)
Pole Mounted Single / Two Phase Units			
10kVA	1460	14.9% [28]	1.7 [29]
15kVA	1580	14.9%	1.8
30kVA	1898	14.9%	2.2
Pole Mounted Three Phase Units			
15kVA	2256	14.9%	2.6
30kVA	2530	14.9%	2.9
50kVA	3280	14.9%	3.8
100kVA	4885	14.9%	5.6
Pad Mounted Box (Micro Sub) Three Phase			
100kVA	7440	14.9%	8.5
200kVA	10340	14.9%	11.9
300kVA	11780	14.9%	13.5
500kVA	16750	14.9%	19.2
750kVA	19325	14.9%	22.2
1000kVA	24950	14.9%	28.7

In our view the replacement costs for ground mounted and customer's premises transformer substations in the Handbook are reasonable. The replacement cost for kiosk type substations are reasonable only if the cover is of fibreglass construction.

3.1.8 LV Lines

Costs for LV line estimated by **[ ]** costing models are shown in Table 16 below. The cost estimated for LV line in rural areas is based on Ferret conductor and 66m spans; that estimated for urban areas is based on Weke conductor and 40m spans.

In Powerco's Eastern Region, the ratio of rural line quantities to total LV line quantities is estimated to be 22%. This means that the weighted average replacement cost for LV lines in general should be $48,000 per kilometre. Likewise, costs for underbuilt LV line in general should be $26,000 per kilometre.

[28] Material on-cost for transformers (10.0%), Asset owner contract supervision (4.4%) and asset owner as-building on-costs (0.5%). Refer to section 4.
[29] Rounded to nearest hundred dollars.

Powerco has not constructed significant quantities of LV line recently and most recent LV reticulation has been installed underground. One example of recent LV construction however was at Waverley Beach where 300m of LV cross-arms and conductor were replaced, representing a replacement cost of $56,000 per kilometre. Whilst this is not a length significant enough to draw conclusions on LV line replacement costs overall, it does demonstrate that LV line costs are in excess of the Handbook replacement cost.

Table 16: Summary of LV Line replacement costs estimated by [ ].

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
LV Line – Urban Heavy	52.3	6.0%[30]	56[31]
LV Line – Rural Light	28.1	6.0%	30
LV Underbuilt – Urban Heavy	25.8	6.0%	28
LV Underbuilt – Rural Light	16.9	6.0%	18

3.1.9 LV Cables

Replacement costs for LV cables calculated using **[ ]** rates, and recently tendered rates for **[ ]** gas pipe trenching, are shown below in Table 17.

Table 17: Summary of LV Cable replacement costs estimated by [ ].

Asset Class	Estimated Cost ($ 000)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
LV Cable – own trench	73	5.3%[32]	80[33]
LV Cable shared with MV	38	5.3%	40

Recently tendered costs involving LV cables are summarised in Table 18 below.

[30] Contract supervision, as -building and IDC on-cost. Refer to section 2.4.
[31] Rounded to nearest two units.
[32] Contract supervision, as -building and IDC on-cost. Refer to section 2.4.
[33] Rounded to nearest ten units.

Table 18: Recent Contracted Costs for LV Cable

Item	Category	Cost ($ 000)	Quant (m)	Adjusted Unit Cost ($ 000/km)	Comment
1	LV Cable	76	3040	70	[ ] Subdivision, trench provided – cost increased by $45/m.
2	LV Cable	35.9	900	70	[ ] Subdivision, easy trenching – cost increased by $30/m.
3	LV Cable	39.0	330	66	[ ] Subdivision, easy trenching, adjusted by $30/m.
4	LV Cable	14	350	70	[ ] Subdivision, easy trenching – cost increased by $30/m.
5	LV Cable	13.8	550	40	[ ] Subdivision, HV and LV cable. LV cable only, trench cost of $15/m added.
6	LV Cable	37.4	1470	70	Subdivision,[ ] trenching added at $45/m.
7	LV Cable	5.7	167	64	[ ] Subdivision, easy trenching, $30/m added.
8	LV Cable	4.2	180	68	Subdivision,[ ] trenching added at $45/m.
9	LV Cable	4.9	42	99	[ ] Subdivision, cost reduced by 15% to adjust for short length.
10	LV Cable	7.5	34	188	[ ] Subdivision,[ ] cost reduced by 15% to adjust for short length; this is a possible outlier but only a short length of cable.
11	LV Cable	27	1000	72	[ ] Subdivision,[ ] trench provided increased by $45/m.
12	LV Cable	39.2	650	60	[ ] Subdivision,[ ] no adjustment made
13	LV Cable	60.7	325	105	[ ] OH to UG conversion; 5 pillars, 10 LV terminations, 9 service lines, OH dismantling subtracted, adjusted by 10% for short length, 50% reduction for asphalt reinstatement, 20% increase for shared trench with Telecom.
14	LV Cable	9.5	85	78	[ ] OH UG conversion, 10% reduction for short length, 50% reduction for asphalt reinstatement, 20% increase for shared trench with Telecom.
15	LV Cable	107	900	95	[ ] Reconstruction, 40% reduction for asphalt reinstatement, 20% increase for shared trench with Telecom.
16	LV Cable	46.5	380	86	[ ] OH to UG conversion, 10% reduction for short length, 40% reduction for asphalt reinstatement, 20% increase for shared telecom trench.
17	LV Cable	217.2	1325	115	[ ] OH to UG conversion, 50% reduction for asphalt reinstatement and OH removal, 20% increase to allow for shared telecom trench.
18	LV Cable	136.5	650	147	[ ] OHUG conversion, 50% reduction for removal of OH and asphalt reinstatement, 20% increase for shared trench with Telecom.

Table 19: LV cable with shared trench

Item	Category	Cost ($ 000)	Quant (m)	Adjusted Unit Cost ($ 000/km)	Comment
1	LV Cable	13.8	550	41	**[ ]** Subdivision, HV and LV cable, transformer, RMU & pillar boxes. LV cable only, trenching costs added at $16/m
2	LV Cable	34.9	1390	41	**[ ]** Subdivision, scope excludes trenching, $16/m added.

The costs in items 1 to 12 in Table 18 relate to subdivision projects while items 13 to 18 are concerned with overhead to underground conversions. The two types of project are generally different. Subdivision projects generally involve sites where many different services are laid together often in common trenches or the developer often provides the trenching. This has been factored into the adjustments. However subdivision sites are generally greenfield sites and little disruption is caused to society by trenching and laying cables. The project costs therefore are generally lower.

Overhead to underground (OHUG) conversions generally involve more disruption to society because existing services are affected and they generally occur in built up suburban areas or main streets. There are more constraints on the way in which the project is allowed to proceed and correspondingly higher costs.

Because cable replacement costs are based on suburban laying conditions, where some disruption to society is expected and care excavating around existing services is required, actual LV installation costs should be derived from a combination of the two types of project. This is an important point because the Handbook values for LV cable are based on costs for suburban subdivisions (Note k in Table B1)[34].

Table 20 shows that the ratios of standard deviation to mean for the sample of LV cable costs are large. This means a low degree of certainty should be applied to the replacement costs for LV cable. This is reflected in the rounding of costs in Table 17 to the nearest ten units.

Table 20: Weighted Average, Average and Standard Deviation for LV cable costs (non shared trench).

Asset Class	Weighted Average ($/m)	Weighted Standard Deviation ($/m)
LV Cable - subdivisions	70	11
LV Cable – OHUG conversions	111	19
LV Cable – full sample	83	22

The sampled costs in Tables 19 and 20 demonstrate that the estimated cable costs in Table 17 are reasonable.

[34] A more accurate application of the deprival methodology might be to use the cost for overhead to underground conversions because of the account taken of other services and suburban disruption. What is proposed here however is a cross between the two.

The existing handbook cost of $55/m is 1.27 standard deviations below the full sample mean[35]. Applying a normal distribution, LV costs will exceed the handbook cost 90% of the time. It would appear unreasonable to have for a maximum replacement value to only apply 10% of the time.

Table 21: Estimated replacement costs for Customer Service Connections

Asset Class	Estimated Cost ($)	Additional Asset Owner On-cost	Estimated revised Handbook Cost
Customer Service Connections, Underground single phase	110	4.9%[36]	115[37]
Customer Service Connections, Underground three phase	230	4.9%	240
Customer Service Connections, Overhead single phase	145	4.9%	150
Customer Service Connections, Overhead three phase	290	4.9%	305

3.1.10 Customer Service Connections

The Handbook allows two types of Service Connections: LV single phase and LV 3 phase. In Powerco's experience however, there are different costs that apply to underground and overhead service connections and these should be reflected in the Handbook.

The components included in customer service connections are taken to be (refer section 3) fuses and fuse holders, terminations of droppers or cables and short lengths of cable between the pole or pillar and the customer's boundary (2 to 3 metres). **[ ]** has estimated costs to install underground and overhead service connections and these are summarised in Table 21 above.

3.2 Comparison with Handbook Costs

Schedule 1 summarises the proposed replacement costs in comparison with the present Handbook replacement costs. A summary of the changes to the replacement costs is shown in Table 22.

Table 22 shows that network assets replacement costs are generally higher than those given in the Handbook but that in some cases, replacement costs have decreased or remained the same.

3.3 Maximum or Average Replacement Costs

The replacement costs listed in the Handbook Table B1 represent a cap on asset values that should not be exceeded. Valuers are allowed to apply values less than those listed in the Table but not more, unless it can be demonstrated that an asset falls outside the category of a standard asset.

In theory, if several similar projects were compared, the project cost profile would be expected to follow something like a normal distribution spread about the mean. If the objective of this report

[35] This is without asset owner on-costs. It is also 1.36 standard deviations below the subdivisions sample mean, indicating that costs exceed the Handbook value 91% of the time.
[36] Contract supervision and as-building on-cost. Refer to section 4.
[37] Rounded to nearest $5.

were to determine replacement value maxima, then it would be pertinent to ask, what part of the distribution should be taken as the maximum? If the values are maxima, then the maximum replacement cost should be determined by the following formula:

$$\text{Replacement cost} = \mu + N\sigma$$

Table 22: Summary of proposed changes to Handbook Replacement Costs

Asset Group	% Change in Handbook RC	Increase or Decrease
33kV Lines	20 to 60%	Increase
33kV Cables	6 to 11%	Increase
11kV Lines (light)	0 to 10%	Increase
11kV Lines medium & heavy	55 to 60%	Increase
11kV Double Cct	40 to 80%	Increase
11kV Underbuilt	100 to 160%	Increase
11kV Cable	13 to 23%	Increase
11kV Cable Double Cct	15 to 29%	Increase
Distribution Switchgear	0 to 30% (although some items have experienced greater replacement cost increases)	Increase
Distribution Transformers (100kVA or less)	20 to 30%	Decrease
Distribution Transformers (above 100kVA)	0 to 15%	Increase
Distribution Substations (small pole mounted)	140%	Increase
Distribution Substation other than small pole mounted	0%	-
LV Line	26%	Increase
LV Underbuilt	120%	Increase
LV Cable	45%	Increase
LV Cable shared trench	60%	Increase
Customer Service Connection Overhead	70 to 115%	Increase
Customer Service Connection Underground	30 to 65%	Increase

Where: μ is the mean of a sample of replacement costs,

σ is the standard deviation of the sample of replacement costs, and

N is a positive number whose magnitude depends on the fraction of sampled projects where the replacement cost maximum can be exceeded.

This report seeks to determine replacement costs that are suitable for application in network asset valuations rather than replacement cost maxima. The report therefore takes the N factor to be zero. As such, the replacement costs determined in this report should not be regarded as maximum asset values, but instead as asset values suitable for use in an ODV network asset valuation.

This is an important point because whilst the values determined in this report are average values suitable for use in valuations, they are not intended to be maximum allowable values.

4. Multipliers

4.1 Definition of Application

Assuming that multipliers are retained, as opposed to expressing in the Handbook a wider range of permissible costs about a correctly-determined mean, the following summarises Powerco's interpretation of the Handbook's requirements for replacement cost multipliers, what multipliers represent and when they should be applied.

1. The Valuation Handbook standard costs for lines have been based on three-phase construction in a rural environment utilising 70 to 80 metre spans. For lines in other environments, replacement costs can be established by applying multipliers.
2. For underground cables, the Valuation Handbook standard costs have been based on laying in an urban area with developed infrastructure. For cables in rocky ground and business districts, replacement costs can be established by applying multipliers.
3. An overhead line urban multiplier of 1.5 to 1.8 times the standard cost can be applied.
4. An overhead line remote area multiplier of 1.0 to 1.25 times the standard cost can be applied for remote areas situated more than 75km from the nearest works depot of the ELB or the line construction contractor.
5. An overhead line rugged terrain multiplier of between 1.2 and 1.3 times the standard cost can be applied in areas where normal line operating vehicles and plant cannot be used and where it is necessary to use helicopters, tracked vehicles or other special plant.
6. An underground cable multiplier of 1.15 or 1.25 times the standard cost can be applied in business areas to account for greater vehicular and pedestrian traffic, restricted access times, special reticulation requirements and areas requiring special reinstatement.
7. For cables laid in rocky ground, a multiplier of 1.5 to 2.0 times the standard cost can be applied.

4.2 Overhead Line Urban Multipliers

The Handbook multipliers of 1.5 to 1.8 are in Powerco's view reasonable. In some parts of the network, urban lines replacement costs actually exceed the maximum multiplier of 1.8 but other parts of the network compensate for this and the average urban multiplier is calculated to be between 1.7 and 1.8.

4.3 Overhead Line Remote area and Rugged Terrain Multipliers

The combined multipliers allowed by the Handbook are between 1.2 and 1.55. In Powerco's view there is scope to increase the maximum allowed combined multiplier to 1.6.

Pole replacement projects carried out this year in rugged backcountry areas of Taihape and Wanganui are listed as follows:

Table 23: Remote Area and Rugged Terrain Pole Replacement

Area	Number of Poles Replaced	Cost per Pole ($)
[ ] Feeder	15 Poles	2420
[ ] Feeder	8 Poles	2900
[ ] Feeder	15 Poles	3400
[ ] Feeder	7 Poles	2510
[ ] Feeder	20 Poles	2500

According to Table 23, the weighted average of replacing poles in remote and rugged terrain was $2,740. The average pole replacement cost for 11kV line in non-remote and rugged terrain is $1,650. This represents an increase of 66%.

Lines in remote rural areas are predominantly of light construction. On light line, pole costs represent $12.3/m out of a total replacement cost of $20.4/m (excluding asset owner on-costs). An increase of 66% increases line costs by $8.2/m.

In remote rugged terrain areas, Powerco has undertaken no conductor replacement projects in the past year. However in Powerco's experience, conductor stringing costs increase by between 50% and 100%, or by between $2/m and $4/m.

The total increased cost associated with line in remote areas and rugged terrain is therefore between $10.2/m and $12.2/m, representing a combined multiplier of between 1.5 and 1.6.

If the extent of travel from depot to line were to increase from 50km on average to 100km, this would increase the costs of line construction by an estimated $3/m, representing an increase of 15%. The Handbook allows multipliers for remote areas from between 1.0 and 1.25, which on this basis appear reasonable.

The rugged terrain multiplier should therefore be increased from between 1.2 and 1.3 times the B1 cost to between 1.2 and 1.35 times the B1 cost.

4.4 Overhead Line Traffic Management Multiplier

In Schedule 2 we present a case for a new additional multiplier for traffic management during line construction.

In summary, lines on rural roads not covered by the National Road Code should have a multiplier of 1.03 applied. Lines alongside roads where the National Road Code applies and lines alongside roads in urban areas should have a multiplier of between 1.19 and 1.33 applied.

4.5 Underground Cable Rocky Ground Multipliers

The Handbook's rocky ground multiplier of between 1.5 to 2.0 times the costs in Table B1, are reasonable in magnitude.

This however depends on the type of rock. In loose rock, replacement costs can be higher than the normal replacement cost but not necessarily as high as the minimum multiplier of 1.5. For this reason we would favour the multiplier being extended in range from 1.0 to 2.0.

4.6 Underground CBD Multiplier

In Powerco's view, the present Handbook CBD multiplier of between 1.15 and 1.25 reasonably allows for vehicular and pedestrian traffic in CBD areas.

However it does not adequately allow for the costs associated with reinstating footpath and road surfaces. Different Territorial Local Authorities have different requirements towards trench reinstatement although the general trend has been towards a marked tightening of reinstatement requirements in recent years. Some territorial local authorities require excavated soil to be removed from the site as it is dug. Road reinstatement requires greater widths of road to be cut and restored to minimise cracks. Interlocked paving stones on footpaths are expensive to restore. In some cases, trenching is discouraged entirely.

Footpath and road reinstatement involves additional costs above that allowed by the normal replacement cost. Our calculations show that requirements for footpath and road reinstatement increase the normal replacement costs by between 30% and 120%. It is therefore reasonable that a multiplier should be allowed to cater for footpath and road reinstatement of between 1.3 and 2.2 times the B1 cost.

In summary, the Underground CBD multiplier should be replaced with two multipliers, one for cables laid in areas with substantial vehicular or pedestrian traffic of between 1.15 and 1.25. The other multiplier should apply to cables laid under footpaths and roads where substantial trench reinstatement is required, and should be of magnitude between 1.3 and 2.2 times the B1 cost.

5. Lives

5.1 Site Development and Buildings

Some asset lives in the Handbook are clear cases for revision. These include the Handbook's requirement for 40-year life for Site Development and Buildings. The Building Code requires buildings to be designed with a life of at least 50 years. Generally, concrete substation buildings would be assigned a life of in excess of 70 years.

5.2 Battery Banks and Chargers

Some miscellaneous items such as battery banks actually have lives more like 20 years than that of 40 years for Other Items.

5.3 Distribution Substations

Other categories of asset are assigned lives that do not appear to be compatible with the lives applied to other similar assets. Where a standard life of 45 years is allowed for distribution transformers, a standard life of 40 years is allowed for distribution substations. This appears to be inconsistent with actual practice, because renewal and maintenance is done on both items simultaneously. It is not usual to replace a distribution substation before the expiry of its associated transformer's life. Rather the two are generally renewed together.

Appropriate lives for distribution transformers have previously been studied at the time the second edition of the Handbook was promulgated, and the lives for these transformers have generally been accepted in the industry. For the sake of compatibility, the lives assigned to distribution substations should be increased from 40 years to 45 years to be consistent with the lives of distribution transformers.

5.4 Zone Substation Switchgear

The Handbook category, incoming (outdoor) switchgear, protection and controls, creates uncertainty when it comes to assigning a life to indoor incoming switchgear. Powerco believes that indoor switchgear should be assigned a life of 45 years whilst outdoor switchgear is assigned a life of 40 years. To avoid confusion, the category should be renamed as 'Outdoor Switchgear, Protection and Controls'.

It is not clear why the life assigned to Transformer Protection and Controls should different from other forms of protection and control. It could be because transformers are largely outdoor units, but the protection and control equipment is generally installed indoors. To ensure consistency, the life assigned to this category should be increased to 45 years if it is located indoors.

6. Summary and Conclusions

This report demonstrates that the Handbook Table B1 replacement costs are in most cases lower than the mean replacement costs presently experienced by Powerco. For some asset categories however, the Handbook replacement costs are higher than or the same as those actually experienced by Powerco.

The table in Schedule 1 compares the replacement costs in Handbook Table B1 with those that are reasonable for valuation purposes. The shaded areas are where changes should be made. Table 22 shows the percentage movement in replacement costs from those in the Handbook.

For overhead lines, a further multiplier should be allowed to cater for traffic management. The magnitudes of the overhead multipliers allowed by the Handbook are generally reasonable.

The present CBD multiplier allows for vehicular and pedestrian traffic but does not allow for trench reinstatement. For this reason, the CBD multiplier should be split into two multipliers, one for vehicular and pedestrian traffic and the other for increased trench reinstatement costs. The magnitude of the trench reinstatement multiplier should be between 1.3 and 2.2 times the base replacement cost. The magnitude of the rocky ground multiplier is reasonable.

The lives allowed by the Handbook are generally reasonable with the exception of a small number of asset categories described in Section 5.

Schedule 1 – Summary of Replacement Costs and Lives for Network Valuation Purposes

Asset Description	Unit	Notes	Present NZ Handbook Maximum Value ($000)a	Proposed Value Suitable for Valuation Purposes ($000)	Maximum Life (Years)		Proposed Life Suitable for Valuation Purposes (Years)	
SUBTRANSMISSION					Pole Type		Pole Type	
					Concrete	Wood	Concrete	Wood
33kV Lines - Heavy ($\geq$ 150mm^2, $\leq$ 300mm^2 Al)	km	b	40	60	60	45	60	45
33kV Lines - Light (150 mm^2 Al)	km	b	35	42	60	45	60	45
33kV Lines - DCct Heavy	km	b	60	96	60	45	60	45
33kV Lines - DCct Light	km	b	50	80	60	45	60	45
					Cable Type		Cable Type	
					XLPE	PILC	XLPE	PILC
33kV - Cables (< 240mm^2 Al)	km	c	165	175	45	70	45	70
33kV - Cables DCct (<240 mm^2 Al)	km	c	265	295	45	70	45	70
Pilot/Cmmunications Ccts O/H	km	b	**	**	45		45	
Pilot/Communications Ccts U/G	km	c	**	**	45		45	
Air Break Switch	No.	b	8	10	35		35	
ZONE SUBSTATIONS								
Land	No.		-	-	-		-	
Site Development and Buildings	No.		**	**	40		70	
Outdoor Switchgear, Protn. & Controls	No.	d	**	**	40		40	
Transformers	No.	e	**	**	45		45	
Transformer Protection and Controls	No.	l	**	**	40		45	
Distribution CB, Protection and Controls (Incom/Bus)	No.	d	**	**	45		45	
Distribution CB, Protection and Controls (Feeder)	No.	d, m	**	36	45		45	
					Pole Type		Pole Type	
					Concrete	Wood	Concrete	Wood
Outdoor Structure if not included above	No.		**	**	60	45	60	45
SCADA and Communications Equipment	No.		**	**	15		15	
Ripple Injection Plant	No.		**	**	20		20	
Batteries and Chargers	No.			**			20	
Other Items	No.		**	**	40		40	
DISTRIBUTION					Pole Type		Pole Type	
Lines					Concrete	Wood	Concrete	Wood
11kV O/H Heavy ($\geq$150mm^2, $\leq$ 240 mm^2 Al)	km	b	24	40	60	45	60	45
11kV O/H Medium ($\geq$50mm2 , $\leq$150 mm2 Al)	km	b	22	34	60	45	60	45
11kV O/H Light ($\leq$ 50 mm^2 Al)	km	b	20	22	60	45	60	45
11kV single phase	km	b	17	20	60	45	60	45
SWER lines		b	17	17	60	45	60	45
11kV O/H DCct Heavy	km	b	34	60	60	45	60	45
11KkV O/H DCct Medium	km	b	31	56	60	45	60	45
11 kV O/H DCct Light	km	b	28	40	60	45	60	45
11kV O/H Underbuilt Heavy	km	b	10	26	60	45	60	45
11kV O/H Underbuilt Medium	km	b	9	22	60	45	60	45
11kV O/H Underbuilt Light	km	b	8	16	60	45	60	45
					Cable Type		Cable Type	
Cables					XLPE	PILC	XLPE	PILC
11kV U/G Heavy (> 240mm2, < 300 mm^2 Al)	km	c	120	135	45	70	45	70
11kV U/G Medium (>50mm2, < 240mm2 Al)	km	c	90	105	45	70	45	70
11kV U/G Light (< 50mm^2 Al)	km	c	65	80	45	70	45	70
11kV U/G DCct Heavy	km	c	170	220	45	70	45	70
11kV U/G DCct Medium	km	c	135	155	45	70	45	70
DISTRIBUTION SWITCHGEAR								
Disconnector (Excl Pole) (ABS)	No.		2.3	3.5	35		35	
Load Break Switch (Excl Pole)	No.		5.5	6	35		35	
Dropout Fuse 3 Ph or link (Excl Pole)	No.		1.5	1.5	35		35	

DISTRIBUTION TRANSFORMER (kVA)							
Single/Two Phase Units							
10	No.	f, g	2.4	1.7	-29.2%	45	45
15	No.	f, g	2.5	1.8	-28.0%	45	45
30	No.	f, g	3.1	2.2	-29.0%	45	45
50	No.	f, g	4.2			45	45
Three Phase Units (Pole Mounted - Bushing Terminations							
15	No.	f, g	3.3	2.6	-21.2%	45	45
30	No.	f, g	3.6	2.9	-19.4%	45	45
50	No.	f, g	4.7	3.8	-19.1%	45	45
100	No.	f, g	7	5.6	-20.0%	45	45
200	No.	f, g	11			45	45
300	No.	f, g	12.9			45	45
500	No.	f, g	18			45	45
Three Phase Units (Cable entry, one or both voltages)							
100	No.	f, g	7.5	8.5	13.3%	45	45
200	No.	f, g	11.5	11.9	3.5%	45	45
300	No.	f, g	13.3	13.5	1.5%	45	45
500	No.	f, g	18.5	19.2	3.8%	45	45
750	No.	f, g	22	22.2	0.9%	45	45
1,000	No.	f, g	24.9	28.7	15.3%	45	45
1,250	No.	f, g	33			45	45
1,500	No.	f, g	39			45	45
DISTRIBUTION SUBSTATIONS							
Pole Mounted (50kVA or less)	No.	h	0.5	1.2	140.0%	40	45
Pole Mounted (100 KVA or more)	No.	h	1.8	1.8	0.0%	40	45
Pole Mounted (H pole 200kVA or more)	No.	h		4		40	45
Ground Mounted (Covered)	No.	l	4	4	0.0%	40	45
Kiosk (Fibre Glass enclosure)	No.	i	9	9	0.0%	40	45
On Customer's Premises with Feedout	No.		2	2	0.0%	40	45
LV LINES						Pole Type	Pole Type
Overhead						Concrete / Wood	Concrete / Wood
Overhead - LV only	km	j	38	48	26.3%	60 / 45	60 / 45
Overhead - Underbuilt	km	j	12	26	116.7%	60 / 45	60 / 45
						Cable Type	Cable Type
Underground						XLPE / PILC	XLPE / PILC
Underground - LV Only	km	j, k	55	80	45.5%	45 / 70	45 / 70
Underground - with MV	km	j, k	25	40	60.0%	45 / 70	45 / 70
CUSTOMER SERVICE CONNECTIONS EXCLUDING METERS AND RELAYS				($)			
LV Underground - 1 ph	No.		0.07	115	64.3%	45	45
LV Underground - 3 ph	No.		0.18	240	33.3%	45	45
LV Overhead - 1 ph	No.		0.07	150	114.3%	45	45
LV Overhead - 3 ph	No.		0.18	305	69.4%	45	45
OTHER SYSTEM FIXED ASSETS							
SCADA AND Comms (Central Facilities)	Lot					15	15

a Values are based on installed costs excluding GST for MEA.

b Values relate to costs for rural construction.

c Values are based on costs for underground reticulation for suburban areas in average ground

d In accordance with clause B.43 (and the requirements of clause B.33), the lives for indoor distribution (or indoor 33kV) switchgear may be extended, to no more than 55 years, if it is of modern, sealed design and specified to operate without maintenance for an extended number of operations.

e In accordance with clause B.42 (and the requirements of clause B.33), of the lives of zone substation transformers may be extended to no more than 60 years, provided that evidence of a sound maintenance programme is presented to the Valuer.

f Values based on replacement costs for currently available sizes (NZ manufacture). For intermediate sizes value at next size up. (Optimisation factor should take account of any resulting enhancement.)

g In accordance with clause B.44 (and the requirements of clause B.33), the lives of distribution transformers may be extended, to no more than 55 years, provided that evidence of a sound historical maintenance programme over the life of the asset is presented to the Valuer.

h Excludes drop out fuses

i Includes enclosure and LV frame. Use kiosk only where additional LV frames required.

j If detailed records of LV quantities are not available, the quantities used in the valuation should be based on an average length of LV for each size of transformer.

k Values based on costs for suburban subdivisions and OHUG conversions.

l Life of transformer protection and controls can be 45 years if located indoors.

m Cost of 11kV feeder circuit breakers excludes protection equipment.

** No maximum value assigned

Schedule 2 –Traffic Management Multipliers for Overhead Lines

Traffic Management Notes for ODV assessment

Rural Traffic Management not covered by National Rode Code

- Rural roads need men working and works completion signs at either end of construction area
- Cones round all vehicles working alongside or on road
- Cones get moved as vehicles move from site to site.
- If vehicle may block road then 1 man will be used as a stop/go paddle man
- Average costs per day are $250 (1 man 3 hours, hirage, upkeep etc of cones and signs, street opening notices and traffic management plans to local council)

Construction of single circuit rural lines proceeds at an average of 4 poles per day. This involves on average 3 days per kilometre for medium and light constructions and four days per kilometre for heavy constructions. Thus an additional $750 should be added to rural light and medium lines and $1000 to heavy lines existing along rural roads not covered by the National Road Code. This represents a multiplier of 1.035 for light line (costing $21.4k/km), 1.024 for medium line (costing $31.3k/km) and 1.026 for heavy line (costing $37.5k/km). Because most rural lines are of light construction, an average multiplier is approximately 1.03.

State Highway Traffic Management and local authority traffic management in areas local authority require as to do traffic management to full to National requirements for level two roads

- State Highways require a high standard of traffic management.
- All staff have to have their working on the roads certification to work on a state highway.
- The traffic management plan has to be set up by and under the control of a STMS
- Due to the complexity of some of the traffic management plans as well as the amount of signage and coneage required it is easier to contract this work out.
- Cost per day $2000.00

As above, construction of single circuit rural lines alongside National Roads takes 3 days on average per kilometre for light and medium lines; for heavy lines it involves 4 days per kilometre. This represents a multiplier of 1.28 for light line, 1.19 for medium line and 1.21 for heavy line.

Traffic Management Plans in Urban and CBD Areas

- These areas again require a high standard of traffic control
- It will also involve Pedestrian Traffic control if working in footpath areas

- If in CBD can involve removing parking spaces to do work therefore signs need to be out early in the morning before cars are parked in the area and will also be covered by stringent regulations from the local authority as to what hours the parking areas are allowed to be out of commission.

- Due to the complexity of some of the traffic management plans as well as the amount of signage and coneage required it is easier to contract this work out.

- Cost per day $2000.00

At a rate of 4 poles per day with an urban pole spacing of 40metres for one team, construction of urban line proceeds at an average of 6 days per kilometre. Urban traffic management therefore involves an additional cost of $12,000 per kilometre. Traffic management multipliers should therefore be 1 + $12k/($21.3 * 1.7) = 1.33 for light urban line, 1.22 for medium urban line and 1.19 for heavy urban line.

Recommendation for Traffic Management Multipliers

For lines along rural roads, not covered by the National Road Code should have a multiplier of 1.03 applied.

For lines installed alongside roads where the National Road Code applies and lines installed alongside roads in a CBD or urban environment, a multiplier of between 1.19 and 1.33 should be applied.