Handbook for Optimised Deprival Valuation of System Fixed Assets of Electricity Lines Businesses

REVISED DRAFT FOR CONSULTATION

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ABBREVIATIONS USED IN THE HANDBOOK

Abbreviation	**Term**
A	Ampere
AC	Alternating Current
ACAM	Avoidable Cost Allocation Methodology
ACR	Automatic Circuit Recloser
Al	Aluminium
CB	Circuit Breaker
Cu	Copper
CBD	Central Business District
DB	Double Busbar
DCct	Double Circuit
Dcp	Double circuit pole
Dcst	Double circuit steel tower
Distribution ELBs	ELBs other than Transpower
DRC	Depreciated Replacement Cost
ELB	Large Electricity Lines Business or Large Line Owner or Large Electricity Distributor
EV	Economic Value
GST	Goods and Services Tax
HV	High Voltage (1000 volts and above)
ID	Indoor
IEC	International Electrotechnical Commission (Standard)
km	kilometre
kV	kiloVolt
kVA	kiloVoltAmpere
LV	Low Voltage (below 1000 volts)
M	metre
MEA	Modern Equivalent Assets
MW	MegaWatt
NRV	Net Realisable Value
OD	Outdoor
ODRC	Optimised Depreciated Replacement Cost
ODV	Optimised Deprival Value
O/H	Overhead
OLTC	On Load Tap Changer
ORC	Optimised Replacement Cost
Ph	Phase
PV	Present Value
PVC	Polyvinyl Chloride
RC	Replacement Cost
RL	Remaining Life
SB	Single Busbar
SCADA	System Control And Data Acquisition
Scp	Single circuit pole
Scst	Single circuit steel tower
sqm	square metre
SWER	Single Wire Earth Return
TB	Triple Busbar
TL	Total Life
U/G	Underground
V	Volt
VT	Voltage Transformer
XLPE	Cross Linked Polyethylene

PART ONE: INTRODUCTION

The Optimised Deprival Valuation Methodology

1.1 This handbook details the optimised deprival valuation (ODV) methodology that large electricity lines businesses, large line owners, and large electricity distributors (collectively, ELBs) are required to use when valuing their "system fixed assets" on an ODV basis for the purposes of the regulatory regime under Part 4A of the Commerce Act 1986 (the Act). System fixed assets are defined in the Electricity Information Disclosure Requirements (the Requirements) issued by the Commerce Commission (the Commission) pursuant to subpart 3 of Part 4A of the Act.

1.2 The ODV method measures the economic value of system fixed assets to an ELB on the basis that the ELB operates in an efficient manner that is sustainable over time and is not able to extract monopoly rents. To this end the method assumes a hypothetical operating environment where the relevant market is contestable and there are no material barriers to entry into that market by an alternative service provider or efficient new entrant. In such a situation the incumbent ELB's revenue could not exceed the amounts customers would need to pay an efficient new entrant employing a sustainable, cost reflective pricing strategy. In the situation where conventional system fixed assets are economic, a new entrant's revenue would be determined by the efficient cost of capital required to fund the installation of replacement modern equivalent assets (MEAs) and efficient operating costs. However, in areas where the use of conventional system fixed assets is not economic, a new entrant's revenue would be determined by the minimum cost of providing an equivalent service using non-system fixed assets, which generally would relate to an alternative source of generation.

1.3 In a contestable market a new entrant would endeavour to minimise its costs and would not necessarily replicate the asset base employed by the incumbent ELB. Similarly, if the incumbent ELB were deprived of its assets, and then took action to minimise its loss, it would not necessarily replicate the existing asset base. Optimisation of an ELB's existing system fixed assets is therefore necessary to ensure that the valuation asset base is not over designed. The optimisation process must consider system configuration, network capacity and network engineering. Optimisation of the system configuration eliminates existing assets that are not needed to provide the required level of service. Optimisation of the network capacity ensures that any provision in the valuation asset base for future demand growth is prudent, given the need to balance on the one hand the long life of system fixed assets, economies of scale and greater cost of incremental augmentation of the ELB's network assets with on the other hand the planning risks inherent in the installation of capacity over and above existing requirements. Optimisation of the network engineering ensures that the standard of design and construction of the valuation asset base is consistent across the network and no higher than needed to meet customer service level requirements in the most cost effective manner.

1.4 Consistent with the assumption of a sustainable operation in a contestable market without material barriers to entry, the ODV method requires the replacement cost of existing system fixed assets to be valued as follows:

(a) Assets that deteriorate in service are to be valued at the replacement cost of MEAs, depreciated to reflect their remaining life. In particular, buildings are to be valued at the replacement cost of a building with a standard of construction no higher than that which would be constructed by an efficient new entrant, having regard to the building location and current local authority planning requirements.

(b) Land, and any other assets that do not deteriorate in service (such as easements), are to be valued at market value, as a proxy for their opportunity cost.

Deleted: and have potential alternative uses

(c)

Deleted: Easements, and any other assets that do not deteriorate in service and do not have potential alternative uses, are to be valued at historic cost, without depreciation or indexation. In respect of easements, this implies a hypothetical operating environment where a new entrant has access to existing line routes on the same basis as the incumbent ELB. This is consistent with the overriding assumption that there are no material barriers to entry into the ELB market.

1.5 Where the cost of providing network services using optimised MEAs could be higher than the cost of meeting customers' requirements with alternative assets, an economic value (EV) test should be applied. In such circumstances the EV of the system fixed assets should be based on the net present value of the minimum charges that customers would pay for an equivalent service using the least cost practical solution. In most cases the least cost practical solution would be to use alternative sources of generation instead of the existing network assets.

The ODV Method as Applied in this Handbook

1.6 This handbook sets out the mandatory rules to be applied to determine the valuation of the system fixed assets of an ELB using the ODV method for the purposes of the regulatory regime under Part 4A of the Act. The rules are intended to reflect a practical application of the ODV method based on the design and construction of an ELB's system fixed asset base as typically found in the New Zealand context.

1.7 The valuation of an ELB's system fixed assets using the ODV methodology includes the following steps:

1. preparation of a valuation asset register;

2. determination of the MEA replacement cost (RC) of the individual assets that make up the existing valuation asset base to determine the RC;

3. optimisation of the existing valuation asset base to determine the optimised replacement cost (ORC);

4. depreciation of the RC on the basis of the remaining life of the existing assets to determine the depreciated replacement cost (DRC);

5. depreciation of the ORC to determine the optimised depreciated replacement cost (ODRC);

6. application of the EV test, to the extent that this is required;

7. determination of the overall ODV, being the aggregation over all assets of the lower of the ODRC and EV values for each asset; and

8. preparation of an asset valuation report.

1.8 This handbook does not require a comprehensive EV test to be applied where an ELB is satisfied that the application of such a test will not lead to an ODV valuation that is materially lower than the ODRC valuation.

1.9 All assets and circumstances for which valuation methods and parameters are described in this handbook must be valued in accordance with the handbook. For system fixed assets and/or circumstances where the valuation method is not covered by this handbook, the valuation is to be undertaken in a manner that is consistent with the overarching ODV valuation methodology as set out in this section (i.e. Part 1). The valuation approach used for such assets must be described in the valuation report. The Commission reserves the right to require valuations carried out under this handbook to be revised where it is not satisfied that the valuation complies with the requirements of the handbook.

Materiality

1.10 Materiality is a concept that is central to all valuation methodologies as it recognises the impossibility of a valuation being 100% accurate. In undertaking an ODV valuation, valuers and reviewers should work within materiality bounds of 5% of ODV.

PART TWO: PRACTICAL AND MANDATORY VALUATION PROCEDURES

ASSESSMENT OF REPLACEMENT COST

Preparation of a Valuation Asset Register

2.1 An ELB shall maintain comprehensive and accurate databases of its system fixed assets. These databases shall record individual assets to the extent that: (i) the accuracy of the information on an individual asset can be verified by field survey; (ii) each individual asset can be classified into an asset class in accordance with the different asset classes scheduled in Appendix A; and (iii) the age or commissioning date of each individual asset is unique.

2.2 The asset databases should be updated on an ongoing basis to reflect changes in the makeup of the asset base and to ensure that the databases remain complete and accurate. The updating process must be up to date at the time an ODV valuation is required.

2.3 The asset databases shall be used to compile a valuation asset register that shall form the basis for the ODV valuation of system fixed assets. The valuation asset register should be in a form that facilitates scrutiny and a ready understanding of how it is composed and how the data has been collated from the information in the asset databases.

2.4 The valuation asset register shall divide the individual assets into asset types with each asset type further subdivided into asset classes, consistent with the breakdown of assets shown in the tables in Appendix A. For each asset class, the valuation asset register shall record, as a minimum, the following information:

- quantity of assets;
- average age of assets;
- quantity of assets to which multipliers or other factors have been applied in accordance with the provisions of Appendix A;
- total RC of assets; and
- total DRC of assets.

2.5 It is recognised that some system fixed assets might not currently be individually recorded in the asset databases and estimations of asset quantities and ages may therefore be necessary for inclusion in the valuation asset register. However, all new system fixed assets are to be recorded in the asset databases as they are commissioned. In this way the completeness and accuracy of the asset databases, and the valuation asset register, can be expected to improve over time.

Assets to be Included in the Valuation

2.6 Only system fixed assets owned by the ELB or subject to a finance lease are to be included in the reported ODV valuation. System fixed assets are assets that are tangible in nature, have relatively long useful lives, and are used, or intended to be used, for the conveyancing or supply of electricity. Where an easement forms an integral part of a network asset, it should be considered to be a system fixed asset and may be included in the ODV valuation. Stores and spares held in stock that can be used in the network in place of existing network assets may be included in the ODV valuation to the extent that the quantities of items included in the valuation are appropriate considering the historical reliability of the equipment and the number of items installed on the network. Stores and spares included in the ODV valuation must be separately categorised in the valuation asset register.

2.7 The following assets shall not be included in the ODV valuation:

- office buildings, except where required for the real time operation and control of the distribution or transmission network;
- depots and workshops;
- office furniture and equipment;
- motor vehicles;
- tools, plant and machinery;
- works that are under construction;
- consumer-based meters and load control relays (except transmission revenue meters);
- non-network land, and non-network stores and spares;
- computer systems, except computer systems that are used for real time network operation and control;
- asset management systems, including geographic information systems, except where such systems are used for real time network operation and control;
- street lights and poles or other structures used exclusively for the support of streetlights;
- street light control relays and circuits or other equipment used exclusively for street light control;
- mobile substations and generators; and
- assets where the ownership is disputed or unclear.

2.8 This handbook covers only the valuation of system fixed assets using the ODV methodology. The handbook does not cover the valuation of non-system fixed assets that ELBs may own, such as those listed in clause 2.7 above.

Estimating Asset Quantities and Ages

2.9 Where the quantities and ages of certain classes of system fixed assets are required to be estimated, ELBs must use a statistically robust methodology in undertaking estimations. The valuation report shall identify system fixed assets for which the quantities and ages have been estimated and include details of the methodologies used to derive the estimates.

2.10 Estimates of system fixed asset quantities and weighted-average ages shall be regularly reviewed to account for the removal of assets from the network and/or the availability of more accurate information.

Determination of Replacement Cost

2.11 Individual system fixed assets are to be valued using the replacement costs (RCs) of modern equivalent assets (MEAs) that would be installed today to provide the same service potential as the existing assets. The MEA shall not reflect a service potential required by legislative or regulatory changes made since the assets were first built or installed (except where this is inherent in equivalent assets available on the market at the time of valuation) if the existing assets do not yet need to comply with the additional requirements e.g. where grandfathering provisions apply. The standard replacement costs for MEAs for commonly used system fixed assets (standard assets) are set out in tables in Appendix A. Other details regarding the valuation of particular types of assets are also contained in Appendix A.

2.12 Where a standard replacement cost for a system fixed asset is not provided in Appendix A (a non-standard asset), the MEA would normally be the asset that: (i) can be purchased or constructed using current technology at the time of valuation; and (ii) has an equivalent service potential to that of the existing asset; and (iii) has the lowest lifetime cost. Indicators that can be used to determine the service potential of an MEA include:

(a) number of faults/100km of line/year;

(b) voltage complaints/100km of line/year;

(c) proven reliability of the technology;

(d) functional compliance with operating requirements;

(e) meeting any statutory, environmental and industry safety requirements that existed at the time the existing asset was installed.

2.13 Replacement costs for non-standard assets should be determined on the basis that construction occurs around all existing infrastructure and development (other than the asset being valued). Furthermore, replacement costs must be commensurate with a significant scale of construction rather than with piecemeal additions. As a guide, replacement costs for zone substations, subtransmission circuits and distribution feeders should be determined on the basis that each complete substation, circuit or feeder is constructed as a single project.

2.14 Equipment purchase costs for non-standard assets should be based on costs charged by manufacturers or suppliers operating in a competitive environment. Construction cost estimates should be based on knowledge of the work involved and efficient industry practice with competitive costs, such as would be charged by efficient private contractors operating in a competitive environment. Alternatively, costs may be based on competitive quotes by turnkey private contractors.

2.15 The valuation report shall identify each class of non-standard asset that is included in the valuation. It shall also describe the basis for the determination of the MEAs, and the replacement costs and asset lives of such assets. Details of any analysis used to determine the appropriate MEA, including details of relevant indicators and life cycle cost analysis, and the basis for estimating the replacement cost and asset life used for valuation purposes must also be provided.

2.16 Any grants or contributions towards system fixed assets that have been received should be ignored, as it is the deprival value of the assets that is required, not the actual investment.

2.17 Aggregating the RCs of the individual system fixed assets will produce the total network RC.

OPTIMISATION

Introduction

2.18 Under the deprival approach to asset valuation an optimised network would use the most cost efficient design that would provide the required service potential. Such a design could conceptually be undertaken using an approach that disregards completely the design and configuration of the existing asset base. This approach, which is cost intensive and likely to result in variable and inconsistent outcomes, is not, however, required by the valuation rules in this handbook. Instead, these rules allow the existing network to be used as a starting point. A series of optimisation tests must be systematically applied to the whole network to identify stranded assets, excess capacity and over-engineering. The minimum optimisation tests required to be carried out by ELBs are included in Appendix B. Where necessary, the network is notionally redesigned to provide an optimised network. The ORC is the undepreciated replacement cost of the optimised network. A general description of the methodology used to optimise the network must be included in the valuation report.

2.19 The most cost efficient design is the one that minimises the present value of the total costs of the assets and their use over their standard life. In undertaking life cycle cost analyses to determine the most efficient design an ELB may take into account: (i) the capital and operating costs over the life of the asset; (ii) other costs that are incurred by the ELB as a result of the use of the asset[1]; and (iii) the cost of losses to the extent that these are caused by the existing load and the allowed future load growth.

2.20 Optimisation should be undertaken after the RC of the existing network asset base has been calculated.

2.21 The optimised network should:

(a) provide a quality of supply similar to that which currently exists, except where this exceeds the ELB's standard quality of supply criteria; and

(b) have a capacity similar to that of the existing network, except where this exceeds allowed future load growth.

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[1] An example of such costs is transmission connection charges incurred by a distribution ELB.

2.22 Optimisation consists of five stages:

(a) exclusion of stranded assets;

(b) optimising the configuration of the network;

(c) optimising the capacity of elements in the network;

(d) optimising network engineering; and

(e) optimising stores and spares.

2.23 The determination of MEAs that would replace existing individual network components is NOT part of the optimisation process. This must be done prior to calculating the RC and, for most network components, is already reflected in the standard replacement costs given in Appendix A.

Constraints on Optimisation

2.24 The optimisation process must be carried out subject to the following constraints:

(a) the potential level of service of the optimised network must not exceed that of the existing network and the performance of any part of the optimised network must not exceed the ELB's disclosed quality of supply criteria, unless non-standard contracts with customers exist that require the ELB to provide an enhanced quality of supply;

(b) the location of points of connection to other networks should be assumed to be fixed. However, where a point of connection can be bypassed and replaced with a more cost efficient network arrangement, then that point of connection must be deleted for valuation purposes;

(c) the location and number of connection points to consumers should be assumed fixed;

(d) the optimised network should only use the voltage levels used on the existing network[2]; and

(e) the existing geographic boundaries of the ELB's supply area should be assumed to be fixed.

The Process of Optimisation

2.25 Optimisation of the network should be undertaken on a systematic basis. The optimisation process must examine the existing network and determine whether a more cost efficient design could meet the required quality of supply criteria throughout the allowed planning period. Optimisation must be undertaken systematically across the network and must include, in particular the following network components:

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[2] This does not preclude existing equipment being optimised down to a lower standard network voltage. However, there is no requirement to optimise down to a non-standard voltage level.

(a) points of connection to other networks;

(b) transmission lines and transmission substations;

(c) zone substations and primary distribution switching stations;

(d) subtransmission lines and primary distribution circuits[3];

(e) each high voltage distribution feeder. For the purposes of the valuation rules in this handbook, a feeder includes any circuit of the distribution network, excluding a low voltage circuit, used to directly supply customers or to supply one or more distribution substations feeding the ELB's own low voltage network; and

(f) the low voltage distribution system.

Future Load Growth

2.26 The maximum capacity of any part of the optimised network shall be determined by the allowed future load growth, which is the maximum forecast load on the relevant part of the network under contingency operating conditions over the allowed planning period. However, in no case shall optimised capacity exceed existing capacity.

2.27 In order to ensure compliance with clause 2.26, ELBs must disclose, in the valuation report, both existing loads and the load forecast used as a basis for optimisation. As a minimum, existing and forecast loads must be provided for each point of connection, each zone substation and each high voltage distribution feeder. Clear justification and a detailed derivation of the load growth forecasts are required. Both the existing maximum demand and the highest forecast maximum demand during the planning period must be provided. Allowances should be made, where possible, for different growth rates in different parts of the network. Existing loads may be estimated where metering is not available.

2.28 The load forecast shall include only future electricity loads that can reasonably be expected to be supplied from the ELB's network. A load outside the existing geographic boundaries of an ELB's area of supply shall not be included in the forecast unless a written customer contract to supply the load exists at the time of the valuation.

2.29 Distribution ELBs shall disclose in their valuation reports any new separately identifiable load or load increment exceeding either 5% of the ELB's existing maximum demand or 10 MW (whichever is the lower) that occurs from one load forecast to the next for any year within the load forecast. Transpower shall similarly disclose any separately identifiable new load or increment of an existing load at a grid exit point that changes by more than 100MVA between two load forecasts.

2.29 Transpower shall also disclose any situation where maximum demand at a grid exit point is growing at 10% per annum for more than one year.

[3] A primary distribution circuit is a distribution voltage circuit that is used for the transport of electricity but not for the supply of electricity to customers or for the supply of distribution substations that feed an ELB's low voltage network.

Deleted: Distribution ELBs shall disclose in their valuation reports any new separately identifiable load or load increment exceeding either 5% of the ELB's existing maximum demand or 10 MW (whichever is the lower) that is included in the load forecast. Transpower shall similarly disclose any separately identifiable new load or increment of an existing load greater than 100 MW that is included in the load forecast. Transpower shall also disclose any situation where the load forecast includes an increase of greater than 20% of the maximum demand of a grid exit point within a two year period.

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2.30 The planning periods over which future load growth can be allowed for shall not exceed the following:

(a) for transmission networks (being networks with a voltage above 33 kV), sub-transmission lines, zone substations (excluding transformers), primary distribution circuits and points of connection to a transmission network, 35 years;

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(b) zone substation transformers, 10 years;

(c) for HV and LV distribution, and other network assets, 5 years; and

(d) for distribution transformers, no future load growth is permitted. Distribution transformers must be optimised in terms of capacity utilisation, based on current network loadings in accordance with clause B.11.

Quality of Supply

2.31 The optimised network must be designed to supply the existing load, and the allowed future load growth, with a quality of supply that matches the level that currently exists for each part of the network, except where this is greater than the disclosed quality of supply criteria.

2.32 An ELB must disclose in its valuation report the quality of supply criteria that it currently uses as a basis for network design. This should be based on the ELB's analysis of customer requirements and its assessment of network maintenance requirements and costs.

2.33 Relevant quality of supply criteria include:

(a) the degree of security (redundancy) in different circumstances or localities;

(b) target reliability indices for different areas of the network (CBD, urban, rural);

(c) voltage regulation criteria; and

(d) levels of electrical losses.

2.34 The degree of security may be disclosed either in probabilistic or deterministic terms. A deterministic approach could reference the level of in-built redundancy, i.e. as (n) or (n-1) or (n-2) component redundancy. (An (n) security level implies no component redundancy so that if a component fails, then customer supply is lost. An (n-1) security level is one in which customer supply is not interrupted in the event of any single component outage etc.) Irrespective of whether probabilistic or deterministic criteria are used, it is necessary for an ELB to express its degree of security criteria in such a way that the optimisation process is transparent and can be shown to have been applied consistently across all parts of the network.

2.35 The quality of supply criteria for Transpower's network should take account of prudent standards and practices followed in overseas countries, such as those adopted in Australia and the United Kingdom. Furthermore, the quality of supply criteria should be in accordance with relevant decisions of the Electricity Commission and the contractual relationship between Transpower and its connected customers. For the avoidance of doubt, optimisation of transmission projects that have been approved by the Electricity Commission is not required. In addition the actual cost of Electricity Commission approved investments may be used as the replacement cost for those assets, if the replacement cost is materially different to the actual cost.

2.36 Existing system fixed assets that provide a quality of supply greater than that disclosed by the ELB must be optimised out, except where the assets are required to meet the ELB's contractual obligations to provide an improved quality of supply to specific customers.

Excluding Stranded Assets

2.37 Any system fixed assets not required to supply line services to existing customers, and which could therefore be disconnected, should be identified and excluded from the optimised network. Such assets are known as stranded assets and should be treated in accordance with clause 2.44.

Optimising the System Configuration

2.38 Optimisation of the system configuration must be carried out by considering alternative configurations subject to the constraints on optimisation and in accordance with the relevant criteria relating to the quality of supply declared by the ELB. The optimised configuration is the one that satisfies the relevant optimisation criteria in the most cost efficient manner.

2.39 In the process of optimising the system configuration, certain assets or groups of assets may become excess to requirements and should be valued at nil, while other new assets may need to be notionally brought in. The minimum tests to be carried out by ELBs in optimising the system configuration are set out in Appendix B.

Optimising Network Capacity

2.40 After the configuration of the system has been optimised, the elements within that system must be optimised by considering whether lower capacity, more cost efficient elements would be adequate. The minimum tests to be carried out by ELBs in optimising the network capacity are set out in Appendix B.

2.41 Civil engineering works such as spare ducts, cable tunnels and switchyard bays not currently used shall be optimised out unless they will be required to meet the allowed future load growth. If the future use of such assets is only intended to provide an improved quality of supply, rather than an increase in system capacity, the assets shall be optimised out since the optimised system must not provide a quality of supply greater than that which currently exists.

Optimising Network Engineering

2.42 As part of the process of optimising the network, the engineering of the network must be examined to confirm that the optimised asset base is not over-engineered, given the required quality of supply criteria. Over-engineering may occur if parts of the existing asset base are engineered to a standard that exceeds the ELB's current practice or if a more cost efficient engineering arrangement or configuration would be used if the existing assets were replaced. The ELB's documented design and construction standards, and the standard of engineering applied to its most recent projects should be used as the benchmark for this test. Where a more cost efficient arrangement would result if the required level of service were provided by applying the ELB's existing engineering standards then the relevant assets must be replaced by a notional asset arrangement that reflects current practice. The minimum tests to be carried out by ELBs in optimising the network engineering are set out in Appendix B.

Optimising Network Equipment Spares

2.43 Network equipment spares may be included in the ODV as long as the spares are suitable replacements for assets installed in the network. However, the quantity of spares valued in the ODV must not exceed the reasonable quantity of spares required to meet the ELB's disclosed quality of supply criteria.

2.44 Stranded assets may be valued as network spares, subject to the criteria set out in clause 2.43. Stranded assets not required as network spares shall be assigned a zero value for the purposes of calculating the ODV.

Determining the Optimised Replacement Cost

2.45 Once the optimised system has been determined, those parts of the optimised network that are different from the existing network must be re-evaluated. This entails applying the replacement costs of MEAs to the optimised notional network. A schedule of all network optimisations and details of the valuation impact of each optimisation, including details of the assets removed as stranded assets, must be included in the valuation report.

2.46 When assets are notionally brought into the network as a result of the optimisation process, they should be valued at their replacement costs in accordance with the relevant requirements of this handbook to determine the total replacement cost of the system fixed assets.

2.47 Aggregating the individual ORCs of the system fixed assets in the optimised system will produce the total ORC for the network.

DEPRECIATION

Approach to Depreciation

2.48 An asset replacement cost shall be depreciated when the existing asset's remaining service life is less than the total life (TL) that would normally be expected from a new asset. The depreciation effectively recognises the limited remaining life (RL). The MEA replacement cost of an individual asset shall be depreciated according to the RL of the existing asset.

2.49 The straight-line method of depreciation shall be used such that the depreciated replacement cost (DRC) of an asset is determined as:

$$DRC = RC \times RL/TL$$

where:

RC	=	Undepreciated replacement cost
RL	=	Remaining life
TL	=	Total life.

The total lives and the remaining lives need to be established for all system fixed assets.

Determining Asset Total Lives

2.50 The standard TLs of MEAs for different asset classes are set out in the tables in Appendix A. The appendix also contains other details regarding the TLs to be used for particular types of assets.

Determining Asset Remaining Lives

2.51 The life of each system fixed asset commences when the asset is commissioned. The basic procedure for determining RLs is to subtract the ages of assets from their TLs. The age of an asset should be determined either from records establishing the age or, where necessary, from substantive engineering assessments of the age.

2.52 Where an asset's commissioning date is unknown, the age of the asset must be based on the age used for the previous ODV valuation. Reassessment of the date of installation of an asset or a group of assets is allowable only if clearly documented objective evidence is available to justify the reassessment. Evidence of a purely subjective nature, even when provided by a technical expert, is insufficient to satisfy the requirements of this clause. The valuation report shall describe in general terms the evidence used as the basis for changing asset installation dates from those used in the previous ODV valuation, except where the change in installation date is due to the replacement of an asset or the replacement of poles on a transmission or distribution line.

2.53 Where an asset may be retired early from service because it may become redundant as part of a network development, this should not be taken into account in assessing the RL of that asset. However, when assets of a particular design are routinely replaced before their technical lives expire as part of the evolution of the network, the standard lives of such assets may be reduced for valuation purposes. The reductions applied and the reasons for them should be recorded in the valuation report.

Refurbishment

2.54 Clauses A36 and A37 provide procedures for assigning RLs in cases where system fixed assets have been refurbished.

Minimum Residual Life

2.55 Assets whose remaining life is less than three years shall be deemed to have a residual life of three years.

Determining the Depreciated Replacement Cost

2.56 Aggregating the DRCs of the individual system fixed assets will produce the total network DRC.

Determining the Optimised Depreciated Replacement Cost (ODRC)

2.57 When optimisation leads to an existing system fixed asset being notionally replaced, the replacement asset shall be depreciated for the same proportion of its TL as the existing asset was depreciated. When the optimisation involves groups of assets being reconfigured, the replacement assets shall be depreciated as a group to reflect the RL of the existing group as a proportion of that group's TL, calculated on a weighted-average basis, with the weighting factor being replacement cost.

2.58 Aggregating the ODRCs of the individual system fixed assets in the optimised network will produce the total network ODRC.

ECONOMIC VALUE

2.59 Economic valuation is an integral part of the ODV valuation method. However, in calculating the ODV value in accordance with this handbook a comprehensive EV test only needs to be applied if the ELB believes that the ODRC of the assets to be written down in asset value that would result from an application of the EV test on all potentially uneconomic assets would be greater than [x]% of the ODRC of the complete valuation asset base. The total ODRC of the system fixed assets that an ELB considers to be potentially uneconomic as a proportion of the total ODRC of all the system fixed assets in the network may be used as a guide to determining whether a comprehensive EV test should be applied.

Deleted: 1

2.60 Uneconomic system fixed assets are those network assets that provide a service that could realistically be provided at a lower cost to users of the network by other means. Such assets should be valued at EV rather than ODRC. A comprehensive EV test, if required, should be applied to all potentially uneconomic network assets in the following manner:

2.60.1 Determine the least cost method of providing an alternative service to that provided by the ELB's uneconomic assets. This will be achieved through the use of non-system fixed assets such as alternative generation plant.

2.60.2 Determine the total capital and operating cost of providing the alternative service over the total service life of the existing network assets. This may require allowance for cycles of replacement of the alternative assets. Where the existing network asset comprises a group of individual assets with different total lives the total life of the existing network assets will be the weighted-average total life with the weighting factor being replacement cost.

2.60.3 Determine the present value of the operating and maintenance cost of providing the network service using the existing network assets over the total life of the assets. For simplicity this may be estimated as a percentage of the RC of the existing assets.

2.60.4 The EV of the potentially uneconomic system fixed assets is the present value of the total costs of providing the alternative service less the present value of the total operating and maintenance costs of the existing network assets, discounted at the ELB's WACC and depreciated to reflect the weighted-average remaining life of the existing network assets. This can be expressed as

EV = (PV1-PV2) x RL/TL

where:	PV1	=	Present value of the total capital and operating costs of the alternative service over the total life of the existing network assets;
	PV2	=	Present value of the total operating and maintenance costs of the existing network assets over their total life;
	RL	=	Weighted-average remaining life of existing network assets;
	TL	=	Weighted-average total life of existing network assets.

2.61 Where an ELB does not undertake a comprehensive EV test on any of its network assets in accordance with the provisions of clause 2.59, it shall include in its valuation report a signed statement stating that: (i) it has reviewed its system fixed asset base and sought to identify assets that may potentially be uneconomic; and (ii) it is satisfied that an EV analysis of these assets would not result in an ODV of its system fixed assets that is materially less than the ODRC of its system fixed assets. The valuation report should further describe the basis upon which this conclusion was formed.

2.62 Where an ELB conducts a comprehensive EV test to analyse its potentially uneconomic assets in accordance with clause 2.59, the valuation report shall include: (i) a description of the methodology used to identify the potentially economic assets to which an EV test was applied; (ii) a description of the EV test methodology; and (iii) the ODRC and calculated EV of the assets tested. Detailed EV calculations need not be included.

ODV

2.63 The ODV value of an asset is the lower of its EV or ODRC. Aggregation of the ODV values, whether ODRC or EV, of the network assets will produce the value of the network system fixed assets at ODV.

ODV VALUATION REPORT

2.64 It is important to the integrity of the Commission's Requirements under subpart 3 of Part 4A of the Act that valuations be transparent. ELBs are therefore required to provide an ODV valuation report. As a general principle, sufficient information should be included in a valuation report to allow stakeholders to independently assess the validity and robustness of the reported ODV valuation of the system fixed assets.

2.65 As a minimum, an ODV valuation report must contain the following information:

1. the asset quantities in the valuation asset base, excluding stores and spares. This information should be broken down into asset classes consistent with the asset classes included in the tables in Appendix A;

2. the RC, ORC, DRC, ODRC, and ODV for each asset class and for the valuation asset base as a whole. This information should be shown separately for stores and spares, which need not be disaggregated into asset classes;

Deleted: and

3. a description of the method used for the valuation of any assets in circumstances where the ELB considers that the valuation method is not prescribed by the rules given in this handbook (clause 1.9);

4. a schedule of asset classes where asset quantities and/or asset ages have been estimated. For each such asset class the valuation report shall describe the methodology used to derive the estimates (clause 2.9);

5. a schedule of asset classes and asset quantities to which multipliers or other adjustments have been made to the standard replacement costs given in the tables in Appendix A. The schedule must show the actual multipliers or other adjustments applied as well as the change in the RC and DRC resulting from the use of multipliers or other adjustments applied for each asset class. In cases where a range of multipliers or other adjustments is allowed, the valuation report must also describe the basis for the selection of a particular multiplier or other adjustment within the range (clause A.4);

6. a schedule of replacement costs and asset lives used as the basis for valuing non-standard assets where standard replacement costs or asset lives are not provided in Appendix A, and a general description of the basis for determining the replacement costs or lives of these assets. This information should include, where appropriate, the basis for selection of MEAs and the methodology used to determine the current replacement cost of the MEA (clause 2.15);

7. a schedule of asset classes and quantities for which standard asset lives have been extended or reduced in accordance with the provisions of clauses A.32-A.44, together with the actual lives used and the impact on the DRC for each asset class

affected by a change in asset life, and a schedule showing the date of return to service and remaining life applied to individual assets that have been refurbished since the last valuation (clause A.31);

8. a general description of the methodology used to optimise the network (clause 2.18);

9. the existing loads and the load growth forecast used as a basis for optimisation. This information should be disaggregated by point of connection, zone substation and high voltage distribution feeder (clause 2.27);

10. forecast new loads or load increases required to be separately disclosed in the valuation report (clause 2.29);

11. a description of the quality of supply criteria used as the basis for optimisation (clause 2.32);

12. a schedule of all network optimisations and details of the valuation impact of each optimisation, including details of the assets removed as stranded assets (clause 2.45);

13. a general description of the evidence forming the basis for any change in the date of commissioning of assets from that used in the previous ODV valuation, except where this change is due to the replacement of assets.(clause 2.52);

14. details of assets to which a reduction in standard life is applied due to routine replacement as part of the evolution of the network (clause 2.53);

15. the justification for the inclusion of underground circuits in the optimised system fixed asset base (clauses B.7, B.9, B.12);

16. details of any separate network segments with non-coincident peak loads where the distribution transformer capacity was optimised separately from the balance of the network (clause B.11); and

17. where an ELB does not undertake a comprehensive EV test on any of its system fixed assets in accordance with the provisions of clause 2.59, a signed statement stating that (i) it has reviewed its system fixed asset base and identified assets that are potentially uneconomic, and (ii) it is satisfied that an economic valuation of these assets would not result in a material reduction of the ODV of its system fixed assets and a description of the basis on which this conclusion was formed (clause 2.61); or

18. where a comprehensive EV test is undertaken as part of the valuation process, (i) a description of the methodology used to identify the potentially economic system fixed assets to which the comprehensive EV test was applied, (ii) a description of the EV test methodology, and (iii) the ODRC and calculated EV of the assets tested (clause 2.62).

APPENDIX A: VALUING ASSETS AND STANDARD ASSET REPLACEMENT COSTS AND LIVES

A.1 This appendix gives the methodology to be applied in determining replacement costs and asset lives for valuing the system fixed assets of ELBs. The appendix also contains Table A.1 (for distribution ELBs) and Tables A.2–A.8 (for Transpower) which specify the standard replacement costs and asset lives for the purpose of assessing the depreciated replacement costs of ELB system fixed assets.

ELB Standard Replacement Costs

A.2 Standard replacement costs are shown in Table A.1 (for distribution ELBs) and Tables A.2–A.8 (for Transpower). These values may be varied for valuation purposes only by the application of multipliers and other adjustments as provided for in this appendix.

A.3 The values in the tables are based on installed costs of modern equivalent assets (MEAs). They reflect efficient construction costs, achieved through bulk or term purchasing, a significant scale of construction and competitively tendered installation contracts, and include the following elements:

(i) costs of materials delivered to store;

(ii) direct labour including indirect costs (ACC, holiday pay, sick leave, training, supervision, etc.) of installation and commissioning;

(iii) transport and plant costs for delivery and erection; and

(iv) on-costs incorporating business administration, design, construction supervision, and project management costs.

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

A.4 For equipment used or installed in adverse conditions, multipliers or traffic management allowances can be applied to the values specified in the tables, but only subject to conditions as specified in clauses A9, A.10, A.14, A.15, A.19 and A.20. To ensure appropriate application of the cost multipliers or traffic management allowances, a record of their application shall be retained by the ELB. The record should include:

(i) multipliers or allowances used;

(ii) quantity of the item to which each multiplier or allowance is applied; and

(iii) the specific conditions justifying the use of the multipliers or allowances.

Furthermore, a schedule of asset quantities and asset classes to which multipliers, traffic management allowances and other adjustments have been applied shall be included in the ODV valuation report. For each asset class, the valuation report shall also indicate the change in the RC and DRC resulting from the application of multipliers or allowances.

Where this handbook specifies a range of possible multipliers or allowances, the valuation report shall also show the basis on which the ELB selected a particular value within the range.

A.5 Where more than one multiplier (as specified in paragraphs A.9, A.10, A.14, A.15, A.19 and A.20) is applicable to a particular asset the effect of the multipliers is to be summated, not multiplied. (e.g. if multipliers of both 1.25 and 1.3 apply to an asset to adjust for specific construction conditions, then the combined multiplier is 1.55). For the avoidance of doubt, seismic factors and IDC factors are to be multiplied.

A.6 Where the nature of an asset in service differs from any in the tables, an engineering assessment of the replacement cost must be made in accordance with the requirements of clauses 2.12-2.14. Calculations and other relevant records relevant to the assessment must be retained by the ELB.

ELB Asset Types

A.7 In the following sections additional information is given in relation to the valuation of certain types of assets used by ELBs.

Overhead lines

A.8 The economic life of pole type lines shall be based on the weighted-average number of wooden and concrete poles on the line. Similarly, the age of the line for valuation purposes should be equal to the average age of the poles on the line at the time of valuation. To comply with this provision, and notwithstanding the requirements of clauses 2.51 and 2.52, the economic life and age of such lines may be adjusted at each valuation. Consistent with the requirements of clauses 2.51 and 2.52, ELBs must retain documented objective evidence supporting such adjustments. If records of pole replacements are not available then the age of the line should be based on the age used for the previous valuation.

A.9 *Distribution ELBs*: The maximum overhead 33kV, 22kV and 11kV line costs in Table A.1 have, except where otherwise indicated, been based on three-phase construction in a rural environment utilising 70-80m spans. For lines of these voltages in other environments, standard replacement costs can be established by applying the following multipliers:

overhead line urban	:	1.5 to 1.8 times Table A.1 cost
overhead line remote area	:	1.0 to 1.25 times Table A.1 cost
overhead line rugged terrain	:	1.2 to 1.3 times Table A.1 cost,

Remote areas are those which are situated more than 75 km from the ELB's nearest works depot. Rugged terrain includes those areas where normal line construction vehicles and plant cannot be used and where it is necessary to use helicopters, tracked vehicles, boats, or other specialised plant.

A.10 *Transpower*: The standard overhead line costs for AC transmission lines in Table A.8 have been based on nominal average span lengths of 165m and 375m for pole and tower lines respectively, in flat rural land with an assumption that the work is carried out 50km from the nearest urban area. There is no adjustment for further remoteness. Costs for overhead lines in Table A.8 in other terrain can be established by applying the following multipliers:

overhead line hilly terrain	:	1.07 times Table A.8 cost
overhead line mountainous terrain	:	1.23 times Table A.8 cost
overhead line urban terrain	:	1.20 times Table A.8 cost.

A.11 The standard costs in Table A.1 for circuits of lower voltage erected on higher voltage lines (i.e. underbuilt) have been based on the marginal cost of additional materials and installation.

A.12 Standard replacement costs for special configurations (e.g. composite 33kV/11kV/LV lines and aerial bundled conductor construction) and for construction at other voltages (e.g. 110kV, 66kV) should be determined in accordance with clause A.6.

Underground Cables

A.13 The standard underground cable replacement costs in Table A.1 have been based on laying underground cables in an urban area with developed infrastructure.

A.14 Cables laid in business districts require special consideration, and a multiplier of 1.15 to 2.0 times the costs in Table A.1 may be applied. This multiplier takes into account, restricted access times, special reticulation requirements and areas requiring substantial reinstatement and/or special backfilling. Business districts can include main arterial roads (generally those with traffic counts exceeding 10,000 vehicles per day) radiating from them where the roading authority sets requirements similar to those in CBD areas. The actual multiplier used should take account of the density of development and other relevant factors that impact cable installation costs. It may be appropriate to use different multipliers for cables installed in different areas or for different sections of a cable route.

A.15 For cables laid in rocky ground a multiplier of 1.5 to 2.0 times the costs in Table A.1 can be applied.

A.16 The Table A.1 cost of double circuit (viz two) cables, including cables of differing voltages laid together, incorporates the marginal cost of the extra cable and laying in a joint trench. Where more than two cables of the same voltage are laid together the replacement cost should be determined in accordance with this principle and clause A.6.

A.17 The cost of cables intended to operate at voltages other than 33kV, 22kV, 11kV, LV and submarine cables should be determined in accordance with clause A.6.

A.18 The standard replacement cost of all 33kV, 22kV and other HV cables should be based on unarmoured XLPE cables being the deemed MEA. The replacement cost of LV cables should be based on PVC or XLPE unarmoured construction.

Traffic Management

A.19 The standard replacement costs for overhead lines and cables include the cost of temporary traffic management as normally required for roads with low traffic volumes. However, where extensive traffic management provisions (e.g. the provision of dedicated staff to direct/control traffic) are required by road control authorities, a traffic management allowance may be added to the standard replacement cost, after any other multipliers have been applied, for every kilometre of cable or line route length. The allowances are:

Overhead Lines

Level 1 temporary traffic management requirements[4]	$800 per km
Level 2 temporary traffic management requirements	$1,500 per km

Underground Cables

Level 1 temporary traffic management requirements	$6,000 per km
Level 2 temporary traffic management requirements	$15,000 per km
Level 2 temporary traffic management requirements with excavation in the carriageway.	$40,000 per km

A.20 A traffic management allowance shall only be applied if the ELB has objective evidence (such as a classification by the road control authority in accordance with section A3 of the Transit Code of Practice for Temporary Traffic Management in New Zealand) that a given level of traffic control would apply to a particular location. Evidence relied on to support the application of traffic management allowances shall be retained by the ELB. Furthermore, the carriageway excavation allowance shall be applied only in situations where no more cost efficient cable route is available. Any traffic management allowance shall only be applied to the actual length of line or excavation requiring the specified level of traffic control.

Zone Substations

A.21 The replacement costs for zone substations should be determined in accordance with clause A.6 and should be presented in the asset classes set out in Table A.1 (for distribution ELBs) and Tables A.2 and A.3 (for Transpower).

A.22 The replacement cost of substation buildings should be included in the zone substation valuation, but the land value should be treated separately.

Distribution Substations

A.23 Distribution substations should be valued without distribution transformers, and the land value should also be treated separately. Standard replacement costs for overhead and underground distribution substations are given in Table A.1.

Distribution Transformers

4 As defined in the Transit Code of Practice for Temporary Traffic Management in New Zealand.

A.24 Replacement costs for distribution transformers are given in Table A.1 (for distribution ELBs) for currently available distribution transformer sizes. Replacement costs for distribution transformers for Transpower are given in Table A.4. Where other sizes are in service, the standard replacement cost of the next largest available size should be used for valuation purposes.

Streetlighting

A.25 Streetlights and field equipment for streetlight control are not to be included in the valuation. Where LV reticulation is not available to supply streetlights, streetlighting mains owned by the ELB can be valued as a stand-alone two core cable or underbuilt two wire line, using the standard replacement cost given in Table A.1.

System Control Facilities

A.26 All system control facilities associated with a system control centre should be valued together as a master station. The value of remote units should be incorporated in the value of the appropriate substation.

Communication Facilities

A.27 Terminal facilities should be valued as a master station. The value of remote units should be incorporated in the value of the appropriate substation.

Easements

A.28 Easement rights obtained and registered against a land title after 1 January 1993, (or in the case of Transpower, additionally between 1 January 1988 and 1 January 1993), may be valued at market value. Market value is to be determined by reference to the market value of the land at the time the easement was purchased and the increase in land market value since that date.

Deleted: the original cost of purchase

Deleted: No depreciation or indexation shall be applied.

ELB Standard Lives

A.29 Standard total lives for standard ELB assets are given in Table A.1 (for distribution ELBs) and Tables A.2-A.8 (for Transpower). These lives are to be used for the purpose of determining TLs of assets, except as provided for in clause A.31.

A.30 Total lives of assets not listed in Table A.1 (for distribution ELBs) and Tables A.2-A.8 (for Transpower) should be established on a comparable basis with those in the tables. Such lives should not exceed the total lives included in the tables for comparable assets. Assessment of the TL of such assets must include:

(i) examination of asset service records;

(ii) discussion with maintenance personnel; and

(iii) physical inspection.

A.31 The total lives of assets listed in Table A.1 (for distribution ELBs) and Tables A.2-A.8 (for Transpower) may only be changed from the standard values given in the tables in accordance with the provisions of clauses A.32-A.44. ELBs shall include in their valuation reports a schedule of the asset classes and quantities affected by a change to standard asset lives together with the actual lives used and the impact of the DRC of each asset class as a result of the change to the standard asset life. Assets whose lives have been extended since the last valuation as a result of refurbishment in accordance with clauses A.36-A.37 shall be itemised individually in a separate schedule showing the date of return to service and the remaining lives applied to each asset.

A.32 TLs less than the standard lives in Table A.1 (for distribution ELBs) and Tables A.2-A8 (for Transpower) shall be assigned where considered appropriate. In particular, transmission lines operating in a coastal environment are to be given a TL of 35 years. Circumstances where it may be appropriate to shorten the TL of other assets include:

(i) assets in coastal environments;

(ii) assets subject to particularly high use or high fault levels or showing systematic premature retirement due to failure;

(iii) assets which have been poorly maintained.

A.33 The TL of certain assets, as specified below, may be extended where specified conditions have been satisfactorily met. These are:

zone substation transformers	(clause A.40)
indoor 11kV, 22kV and 33kV switchgear	(clause A.42)
distribution transformers	(clause A.43)
transmission lines	(clause A.44).

A.34 In order to justify the extension of TLs as provided in clause A.33, the following information, as applicable, shall be documented and retained by the ELB:

(i) an age profile of the assets of the type or class concerned, showing the original population, survival population in each year and number of failures in each year. These records should demonstrate that the asset type warrants, on average, the application of a life extension; and/or

(ii) information on the standard or specification used in the purchase of the asset or that type or class of asset. The information should demonstrate use of a technology that would warrant the application of a longer life.

A.35 In addition, the following documented information shall be available, where relevant:

(i) a maintenance policy statement indicating the nature, scope and regularity of maintenance work carried out on the asset or class of asset since its installation, sufficient to support the claim for a longer life;

(ii) maintenance and test records of the asset (or, where the life extension relates to a type or class of asset, representative records for that type or class of asset) sufficient to demonstrate that the maintenance policies have been applied over the life of the asset; and

(iii) information on the loading applied to the asset or type or class of asset over time, demonstrating circumstances that would warrant a life extension.

Refurbishment

A.36 Refurbishment is classed as work done on the asset (or set of assets) that results in a material extension of its service life beyond its normal TL. This is distinct from maintenance work, which is done to ensure that an asset is able to perform its designated function for its normal TL.

A.37 When an asset has been refurbished, the ELB should assign an RL, effective from the time of refurbishment, but this RL should not be greater than the standard TL as specified in Table A.1 (for distribution ELBs) and Tables A.2-A8 (for Transpower). The ODV value of the asset after refurbishment shall be the new optimised replacement cost of an MEA with an equivalent service potential, depreciated to reflect the assigned remaining life. Where an asset is assigned a new RL in accordance with the provisions of this clause, the ELB shall prepare an engineering report detailing the refurbishment work undertaken and the basis for determining the new remaining life. This engineering report should be retained by the ELB.

Lives for Particular Asset Types

A.38 In the following sections, additional information is given in relation to the assessment of lives of certain types of asset.

Overhead Lines

A.39 Two different sets of life maxima are given in Table A.1 – one for concrete poles, and the other for wooden poles. This is notwithstanding the fact that a single set of standard replacement costs has been given reflecting the MEA asset replacement type.

Zone Substation Transformers

A.40 The standard TL of zone substation transformers is 45 years, as shown in Table A.1. However, in accordance with clauses A.33-A.35, where sound maintenance programmes have been in place over the life of the asset, the TL for any such transformers may be extended, but to not more than 60 years. Such an extension assumes a typical urban and commercial load curve and cyclic loading in accordance with IEC 354 and should cover most situations in New Zealand.

A.41 In order to justify an extension to TL the documented records required under clause A.35 must, as a minimum, show that (i) the loads applied to the transformers over their lives have been below the manufacturers' ratings, (ii) that the transformers have been subjected to a maintenance program that includes regular inspection and oil testing, and (iii) any maintenance requirements noted during inspection and testing are addressed in a timely manner.

Indoor Distribution Switchgear

A.42 The standard TL of indoor distribution switchgear is 45 years, as shown in Table A.1. However, in accordance with clauses A.33-A.35, where indoor distribution switchgear is of modern, sealed design and specified to operate without maintenance for an extended number of operations, the TL may be extended, but to not more than 55 years. The TLs in this clause are also applicable to indoor zone substation incoming (33kV) switchgear.

Distribution Transformers

A.43 The standard TL of distribution transformers is to be taken as 45 years, as shown in Table A.1. However, in accordance with clauses A.33-A.35, distribution transformer lives may be extended, but to not more than 55 years. The major factor in determining the ultimate life of the transformer is then the life of the core and windings. For the application of an extension to the TL, the ELB must have a documented maintenance policy and maintenance records consistent with the requirements of clause A.35. These records must, as a minimum, demonstrate that the ELB inspects its distribution transformer assets in accordance with a planned inspection programme and proactively addresses maintenance problems such as oil leaks and excessive corrosion in a timely manner.

Transmission Lines

A.44 The standard TL of transmission lines is 55 years, as shown in Table A.8. This is the TL allowed for transmission lines constructed in areas with normal environmental conditions. In accordance with clauses A.33-A.35, transmission lines lives may be extended, but to not more than 70 years, where those transmission lines are in lower than normal corrosive conditions (dry inland).

Distribution ELB Standard Replacement Costs and Lives

A.45 The following table gives standard replacement costs and lives that should be applied in valuing distribution ELB system fixed assets.

Table A.1: Distribution ELB Standard Replacement Costs and Lives

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
SUBTRANSMISSION					
				Pole Type	
				Concrete	**Wood**
33 kV Lines – Heavy (≥ 150 mm^2 · ≤ 300 mm^2 Al)	km	b	59	60	45
33 kV Lines – Light (< 150 mm^2 Al)	km	b	43	60	45
33 kV Lines – DCct Heavy	km	b	92	60	45
33 kV Lines – DCct Light	km	b	72	60	45
				Cable Type	
				XLPE	**PILC**
33 kV - Cables (≤ 240 mm^2 Al)	km	c	175	45	70
33 kV - Cables DCct (≤ 240 mm^2 Al)	km	c	280	45	70
Pilot/Communications Ccts O/H	km	b	**	45	
Pilot/Communications Ccts U/G	km	c	**	45	
33 kV Isolation	No.	i, p	9	35	
33 kV Surge Arresters (3 phase set)	No.		8	35	

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
ZONE SUBSTATIONS					
Land	No.		-	-	
Site Development and Buildings	No.		**	50	
Transformers	No.		**	45	
33 kV Indoor Switchgear Cubicle	No.	j	50	45	
33 kV Bus Section/Coupler Indoor Switchgear	No.	j	55	45	
33 kV Outdoor Circuit Breakers	No.		45	40	
Incoming Outdoor Switchgear	No.	k	**	40	
Transformer Outdoor Switchgear	No.	k	**	40	
Feeder Outdoor Switchgear	No.	k	**	40	
Bus Section/Coupler Outdoor Switchgear	No.	k	**	40	
Incoming Circuit Protection & Controls	No.		**	40	
Transformer Protection and Controls	No.		**	40	
Feeder Protection and Controls	No.		**	40	
Bus Section/Coupler Protection and Controls	No.		**	40	
				Pole Type	
				Concrete	**Wood**
Outdoor Structure if not included above	Lot		**	60	45
SCADA and Communications Equipment	Lot.		**	15	
Ripple Injection Plant	Lot		**	20	
LV supplies (excluding local service transformer)	Lot		**	20	
DC supplies, batteries and inverters	Lot		**	20	
Other Items			**	40	

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
DISTRIBUTION LINES & CABLES				**Pole Type**	
Lines				**Concrete**	**Wood**
22 kV O/H Heavy (≥ 150 mm^2 · ≤ 240 mm^2 Al)	km	b	32	60	45
22 kV O/H Medium (> 50 mm^2 , < 150 mm^2 Al)	km	b	29	60	45
22 kV O/H Light (≤ 50 mm^2 Al)	km	b	27	60	45
22 kV single phase or SWER lines	km	b	24	60	45
22 kV O/H DCct Heavy	km	b	50	60	45
22 kV O/H DCct Medium	km	b	46	60	45
22 kV O/H DCct Light	km	b	42	60	45
22 kV O/H Underbuilt Heavy	km	b	17	60	45
22 kV O/H Underbuilt Medium	km	b	16	60	45
22 kV O/H Underbuilt Light	km	b	14	60	45
11 kV O/H Heavy (≥ 150 mm^2 · ≤ 240 mm^2 Al)	km	b	31	60	45
11 kV O/H Medium (> 50 mm^2 , < 150 mm^2 Al)	km	b	27	60	45
11 kV O/H Light (≤ 50 mm^2 Al)	km	b	25	60	45
11 kV single phase or SWER lines	km	b	21	60	45
11 kV O/H DCct Heavy	km	b	46	60	45
11 kV O/H DCct Medium	km	b	42	60	45
11 kV O/H DCct Light	km	b	38	60	45
11 kV O/H Underbuilt Heavy	km	b	15	60	45
11 kV O/H Underbuilt Medium	km	b	14	60	45
11 kV O/H Underbuilt Light	km	b	12	60	45

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
				Cable Type	
Cables				**XLPE**	**PILC**
22 kV U/G Heavy (> 240 mm^2 , ≤ 300 mm^2 Al)	km	c	155	45	70
22 kV U/G Medium(> 50 mm^2 , ≤ 240 mm^2 Al)	km	c	118	45	70
22 kV U/G Light (≤ 50 mm^2 Al)	km	c	94	45	70
22 kV U/G DCct Heavy	km	c	220	45	70
22 kV U/G DCct Medium	km	c	160	45	70
11 kV U/G Heavy (> 240 mm^2 , ≤ 300 mm^2 Al)	km	c	125	45	70
11 kV U/G Medium(> 50 mm^2 , ≤ 240 mm^2 Al)	km	c	103	45	70
11 kV U/G Light (≤ 50 mm^2 Al)	km	c	81	45	70
11 kV U/G DCct Heavy	km	c	170	45	70
11 kV U/G DCct Medium	km	c	135	45	70
DISTRIBUTION SWITCHGEAR					
22/11 kV Disconnector 3 ph (Excl Pole)	No.	p	3.5	35	
22/11 kV Disconnector 2 ph (Excl Pole)	No.	p	2.5	35	
22/11 kV Load Break Switch (Excl Pole)	No.	p	6.5	35	
22/11 kV Dropout Fuse 3 Ph (Excl Pole)	No.		2.5	35	
22/11 kV Dropout Fuse 2 Ph (Excl Pole)	No.		2.0	35	
22/11 kV Sectionaliser (Excl Pole)	No.	p	18	40	
22/11 kV Recloser (Excl Pole)	No.	p	26	40	
22/11 kV Circuit Breaker	No.	p, q	30	40	
Voltage Regulator	No.		**	55	
Ring Main Unit – 3 Way	No.	p, q	16	40	
Extra Oil Switch	No.	p, q	6	40	
Extra Fuse Switch	No.	p, q	8	40	

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)
DISTRIBUTION TRANSFORMERS (kVA)				
22/0.4 and 11/0.4 kV Single/Two Phase Units				
Up to and including 15	No.	d	2.6	45
30	No.	d	3.3	45
50	No.	d	4	45
75	No.	d	5	45
100	No.	d	7	45
Three Phase Units (Pole Mounted - Bushing Terminations)				
22/0.4 kV				
Up to and including 30	No.	d	6	45
50	No.	d	8	45
100	No.	d	10	45
200	No.	d	15	45
300	No.	d	18	45
500	No.	d	23	45
11/0.4 kV				
Up to and including 30	No.	d	5	45

Asset Class	Unit	Notes	Standard Value ($000) a	Standard Life (Years)
50	No.	d	7	45
100	No.	d	9	45
200	No.	d	13	45
300	No.	d	16	45
500	No.	d	20	45
Three Phase Units (Cable entry, one or both voltages)				
22/0.4 kV				
100	No.	d, q	10	45
200	No.	d, q	16	45
300	No.	d, q	18	45
500	No.	d, q	25	45
750	No.	d, q	29	45
1,000	No.	d, q	34	45
1,250	No.	d, q	46	45
1,500	No.	d, q	53	45
11/0.4 kV				
100	No.	d, q	9	45
200	No.	d, q	14	45
300	No.	d, q	16	45
500	No.	d, q	22	45
750	No.	d, q	26	45
1,000	No.	d, q	29	45
1,250	No.	d, q	40	45
1,500	No.	d, q	46	45

Asset Description	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
DISTRIBUTION SUBSTATIONS					
Pole Mounted (50 kVA or less)	No.	e, l	1	45	
Pole Mounted (100 kVA or more)	No.	e, l	2	45	
Ground Mounted (Covered)	No.	f	4	45	
Kiosk (Masonry or block enclosure)	No.	f	9	45	
On Customer's Premises with Feedout	No.		2	45	
LV LINES				**Pole Type**	
				Concrete	**Wood**
Overhead Heavy 4 wire LV only (>150 mm^2 Al)	km	g	45	60	45
Overhead Medium 4 wire LV only (≤150 mm^2 Al)	km	g	42	60	45
Overhead Medium 2 wire LV only (>50 mm^2 ≤150 mm^2 Al)	km	g	36	60	45
Overhead Light 2 wire LV only (≤ 50 mm^2 Al)	km	g	30	60	45
Overhead Heavy Underbuilt 4 wire (>150 mm^2)	km	g	24	60	45
Overhead Medium Underbuilt 4 wire (≤ 150 mm^2)	km	g	21	60	45

Asset Description	Unit	Notes	Standard Value ($000) a	Standard Life (Years)	
Overhead Medium Underbuilt 2 wire (>50 mm^2 ≤ 150 mm^2) Al	km	g	17	60	45
Overhead Light Underbuilt 2 wire (≤ 50 mm^2) Al	km	g	14	60	45
				Cable Type	
				XLPE or PVC	**PILC**
Underground Heavy - LV Only (>240 mm^2)	km	g, h	72	45	70
Underground Medium - LV Only (≤ 240 mm^2)	km	g, h	63	45	70
Underground Heavy - with HV (>240 mm^2)	km	g, h	40	45	70
Underground Medium - with HV (≤ 240 mm^2)	km	g, h	32	45	70
Underground 2 core street lighting circuit	km	r	16	45	70
LV LINES (continued)					
2 way Link Pillar	No.		2	45	
4 way Link Pillar	No.		4	45	
CUSTOMER SERVICE CONNECTIONS EXCLUDING METERS AND RELAYS					
LV overhead - 1 ph	No.	m	0.07	45	
LV overhead - 3 ph	No.	m	0.18	45	
LV underground - 1 ph shared fuse pillar	No.	n	0.25	45	
Own fuse pillar	No	n	0.5	45	
LV underground - 3 ph shared fuse pillar	No.	n	0.4	45	
Own fuse pillar	No	n	0.8	45	
OTHER SYSTEM FIXED ASSETS					
SCADA and Comms (Central Facilities)	Lot	o	**	15	

a All values are based on installed costs (excluding GST) for an MEA.

b Values relate to costs for rural construction.

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

d For intermediate sizes value at next size up.

e Excludes dropout fuses.

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

g 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.

h Values are based on costs for suburban subdivisions.

i 33 kV Isolation equipment includes load break switches, air break switches and links/isolators.

j Standard 33 kV circuit breaker complete with one set of protection CTs, disconnectors and earth switches. Excludes protection.

k This includes disconnectors, earth switches, and buswork required to connect the equipment together. Excludes circuit breaker.

l This cost includes the conductor from both the HV and LV lines to the transformer terminals, all HV and LV transformer and line connections, the fuse on the LV side of the transformer, transformer earthing and the transformer platform.

m Connection includes conductor from the LV line to the property boundary, connection from the line to the LV service and all pole top fuses and fuse holders.

n Connection includes cable from the LV line to the property boundary, connections from the line to the LV cable, a boundary service pillar, all pillar terminations, fuses and fuse holders. This also covers connection to underground cables. The shared fuse pillar costs shall generally be used except where location requires an individual fuse pillar.

o Any communications equipment required to communicate with remote control switches should be included with this item. This includes transmitters, repeaters and receiving stations.

p Any actuator or motor units required to enable a switch to be remotely operated shall have a maximum value at $3,000/unit. This value shall only be included if the switch can be operated remotely at the time of the valuation.

q The cost of all cable terminations 11 kV or greater have been included in the cost allowed for switchgear or transformer, as appropriate.

r Includes terminations to 10 streetlight poles.

** No maximum value assigned.

Transpower Standard Costs And Lives

A.46 The following tables give standard replacement costs and lives that should be applied in valuing Transpower's system fixed assets.

A.47 The standard replacement costs included in the tables are subject to adjustment for seismic factors (for substations) and interest incurred during construction. The adjustment factors are shown in tables A.9 and A.10.

Substations by Standard Size

A.48 For valuing establishment and buildings, substations are split into facilities of four standard sizes - Major, Medium, Small and Rural.

Table A.2: Establishment Building Block Costs

Type	Description	Standard Value ($000)	Standard Life (years)
Major	accommodating on average 14x220kV, 19x110kV and 15x33kV or 15x11kV bays, roadways, etc	3,184.75	55
Medium	accommodating on average 8x220kV, or 8x110kV and 10x33kV or 10x11kV bays, roadways, etc.	1,203.07	55
Small	accommodating on average 6x110kV and 15x33kV or 15x11kV bays, roadways, etc	1,072.82	55
Rural	accommodating on average 2x66kV, 6x33kV or 6x11 bays, roadways, etc	973.34	55

Substations (Standard sizes) by Indoor/Outdoor

A.49 For costing buildings at substations, the four standard sizes are further broken down to differentiate between indoor or outdoor facilities.

Table A.3: Buildings Building Block Costs

Type	Description summary	Standard Value ($000)	Standard Life (years)
Major OD	Facilities associated with outdoor switchyard with on average 14x220kV, 19x110kV and 15x33kV or 15x11kV bays, 155.5sqm control room.	175.91	55
Major ID	Facilities associated with outdoor switchyard with on average 14x220kV, 19x110kV bays and indoor switchgear and control facilities with on average 15x33kV or 15x11kV bays with 155.5sqm control room and 201.6sqm switchgear room	365.81	55
Medium OD	Facilities associated with outdoor switchyard with on average 8x220kV or 8x110kV and	143.30	55

Type	Description summary	Standard Value ($000)	Standard Life (years)
	10x33kV or 10x11kV bays, 103.7sqm control room		
Medium ID	Facilities associated with outdoor switchyard with on average 8x220kV or 8x110kV bays and indoor switchgear and control facilities with on average 10x33kV or 10x11kV bays with 103.7sqm control room and 159.6sqm switchgear room	143.30	55
Small OD	Facilities associated with outdoor switchyard with on average 6x110kV and 10x33kV or 10x11kV bays, 86.4sqm control room	121.65	55
Small ID	Facilities associated with outdoor switchyard with on average 6x110kV bays and indoor switchgear and control facilities with on average 10x33kV or 10x11kV bays with 86.4sqm control room and 159.6sqm switchgear room	286.87	55
Rural OD	Facilities associated with a rural outdoor switchyard with on average 2x66kV and 6x33kV or 6x11kV bays, 69.1sqm control room	112.95	55
Rural ID	Facilities associated with outdoor switchyard with on average 2x66kV bays and indoor switchgear and control facilities with on average 6x33kV or 6x11kV bays with 69.1sqm control room and 109.2sqm switchgear room	244.86	55

Transformers

A.50 Replacement costs for a large number of power transformer options have been provided to cover the range of power transformer sizes and configurations used by Transpower. Generally, costs are provided for power transformers with On-load Tap Changers, except where identified.

Table A.4: Power Transformer Building Block Costs

HV	LV	TV/ MVA	Vector	Phase	MVA 3ph	OLTC	Standard Value ($000)	Standard Life (years)
220	110	11/60	A	3	200	No	2,842.58	55
220	110		A	3	200	Yes	2,535.81	55
220	110	11/60	A	1	200	Yes	1,541.83	55
220	110		A	3	180	Yes	2,372.31	55
220	110	14.5/ 141.5	A	3	141.5	Yes	2,300.44	55
220	110		A	3	120	Yes	2,062.22	55
220	110	11/60	A	3	100	Yes	1,958.86	55
220	110		A	3	100	Yes	1,852.42	55
220	110	11/60	A	1	100	No	1,056.57	55
220	110		A	3	90	Yes	1,907.18	55
220	110	33/30	A	3	70	Yes	1,803.81	55
220	110	11/30	A	1	65	No	902.01	55
220	110	11/30	A	3	60	Yes	1,752.13	55

HV	LV	TV/ MVA	Vector	Phase	MVA 3ph	OLTC	Standard Value ($000)	Standard Life (years)
220	110	11/30	A	3	50	No	1,489.46	55
220	110	11/30	A	1	50	No	836.11	55
220	66	11/60	S-S	3	200	Yes	3,047.37	55
220	66	11/60	S-S	1	200	Yes	1,643.80	55
220	66	11/60	S-S	3	100	No	2,151.45	55
220	66	11/60	S-S	1	100	No	1,126.35	55
220	66	33/30	S-S	3	70	Yes	1,930.09	55
220	66	11/30	S-S	1	50	No	917.92	55
220	55		TR	1	18	Yes	820.79	55
220	55		TR	1	15	Yes	778.87	55
220	33		S-D	3	200	Yes	3,278.42	55
220	33		S-D	1	200	Yes	1,315.29	55
220	33		S-D	3	150	Yes	2,715.32	55
220	33		S-D	3	120	Yes	2,366.39	55
220	33		S-D	3	100	Yes	2,273.37	55
220	33		S-D	1	100	Yes	1,000.29	55
220	33		S-D	1	63	No	793.15	55
220	33		S-D	3	60	Yes	1,668.55	55
220	33		S-D	3	50	Yes	1,639.87	55
220	33		S-D	1	50	No	723.70	55
220	33		S-D	1	30	No	616.84	55
220	33		S-D	3	30	Yes	1,319.64	55
220	33		S-D	3	25	Yes	1,261.48	55
220	33		S-D	3	20	No	1,155.49	55
220	33		S-D	3	18	Yes	1,180.06	55
220	33		S-D	3	15	Yes	1,145.17	55
220	33		S-D	3	10	Yes	1,017.85	55
220	33		S-D	3	5	No	925.47	55
220	22		S-D	3	50	Yes	1,632.54	55
220	22		S-D	1	50	Yes	744.47	55
220	16	33/60	S-D	1	240	Yes	1,383.60	55
220	11		S-D	3	100	Yes	2,415.16	55
220	11		S-D	3	70	Yes	1,955.02	55
220	11		S-D	3	60	Yes	1,801.64	55
220	11		S-D	3	12	Yes	1,065.42	55
220	11		S-D	3	10	Yes	1,034.75	55
110	66		D-S	3	60	Yes	1,184.96	55
110	66		D-S	3	55	Yes	1,119.64	55
110	66	11/10	A	1	30	No	498.89	55
110	66	11/10	A	1	20	No	456.02	55
110	66	11/10	A	1	15	No	434.58	55
110	50		D-S	3	30	No	835.05	55
110	50		D-S	1	30	No	451.61	55
110	50		D-S	1	20	No	400.28	55
110	50		D-S	1	15	No	374.61	55
110	50		D-S	1	14.1	No	369.99	55
110	50		D-S	3	10	No	663.97	55
110	50		D-S	1	10	No	348.94	55
110	33		D-S	3	120	Yes	1,803.28	55

HV	LV	TV/ MVA	Vector	Phase	MVA 3ph	OLTC	Standard Value ($000)	Standard Life (years)
110	33		D-S	3	100	Yes	1,628.28	55
110	33		D-S	1	100	Yes	797.40	55
110	33		D-S	3	75	Yes	1,403.33	55
110	33		D-S	3	70	Yes	1,358.33	55
110	33		D-S	3	60	Yes	1,268.35	55
110	33		D-S	3	60	Yes	1,268.35	55
110	33		D-S	1	50	No	555.42	55
110	33		D-S	3	50	No	1,084.92	55
110	33		D-S	3	40	Yes	1,088.38	55
110	33		D-S	1	40	No	512.97	55
110	33		D-S	3	38	No	968.60	55
110	33		D-S	3	35	Yes	1,043.38	55
110	33		D-S	1	30	Yes	477.53	55
110	33	11/10	D-S	1	30	No	487.33	55
110	33		D-S	3	30	Yes	1,033.22	55
110	33	11/10	D-S	3	30	No	1,067.96	55
110	33		D-S	3	28	No	871.67	55
110	33		D-S	1	27.5	No	459.92	55
110	33		D-S	3	25	Yes	953.41	55
110	33		D-S	1	20	No	428.08	55
110	33		D-S	3	20	No	859.65	55
110	33		D-S	3	20	Yes	908.41	55
110	33		D-S	3	18	Yes	890.41	55
110	33		D-S	3	15	Yes	833.57	55
110	33		D-S	1	10	No	389.00	55
110	22		D-S	3	50	Yes	1,193.51	55
110	22		D-S	1	50	Yes	604.07	55
110	22		D-S	3	30	Yes	945.94	55
110	22		D-S	1	30	Yes	449.90	55
110	11		D-S	3	60	Yes	1,322.73	55
110	11		D-S	3	50	Yes	1,201.15	55
110	11	33/20	S-D	3	50	Yes	1,253.74	55
110	11		D-S	3	40	Yes	1,078.51	55
110	11		D-S	1	30	No	449.01	55
110	11		D-S	3	30	Yes	955.85	55
110	11		D-S	1	30	Yes	483.78	55
110	11		D-S	3	28	No	884.29	55
110	11		D-S	1	28	No	441.09	55
110	11		D-S	3	27	Yes	919.07	55
110	11		D-S	1	27	Yes	472.31	55
110	11		D-S	3	25	Yes	894.53	55
110	11		D-S	1	25	Yes	461.26	55
110	11		D-S	3	20	Yes	836.52	55
110	11		D-S	1	20	Yes	433.65	55
110	11		D-S	3	15	Yes	771.89	55
110	11		D-S	3	10	Yes	710.56	55
110	11		D-S	1	10	Yes	396.65	55
110	11		D-S	1	8	Yes	367.36	55
110	11		D-S	3	7.5	Yes	679.90	55

HV	LV	TV/ MVA	Vector	Phase	MVA 3ph	OLTC	Standard Value ($000)	Standard Life (years)
110	11		D-S	1	7.5	Yes	364.60	55
110	11		D-S	3	5	Yes	649.24	55
110	11		D-S	1	5	Yes	350.79	55
110	11		D-S	1	4.5	No	349.28	55
110	11		D-S	3	4	No	636.19	55
110	11		D-S	3	3	Yes	624.72	55
110	11		D-S	1	2.25	Yes	322.44	55
110	11		D-S	3	1	Yes	597.94	55
66	33		D-S	3	60	Yes	1,113.53	55
66	33		D-S	3	45	Yes	958.40	55
66	33		D-S	3	40	Yes	906.68	55
66	33		D-S	3	20	Yes	699.83	55
66	33		D-S	1	20	Yes	377.70	55
66	33		D-S	3	16	Yes	658.46	55
66	33	11/7.5	A	1	15	No	429.14	55
66	33		D-S	3	15	Yes	648.12	55
66	33		D-S	3	10	Yes	596.41	55
66	33		D-S	3	9	No	537.82	55
66	33		D-S	3	5	Yes	544.69	55
66	33		D-S	1	5	No	260.90	55
66	11		D-S	3	45	Yes	999.11	55
66	11		D-S	3	40	Yes	946.53	55
66	11		D-S	3	30	Yes	841.35	55
66	11		D-S	1	30	Yes	433.23	55
66	11		D-S	3	20	Yes	736.17	55
66	11		D-S	1	20	Yes	366.69	55
66	11		D-S	3	16.5	Yes	699.35	55
66	11		D-S	3	10	Yes	630.99	55
66	11		D-S	1	10	Yes	300.15	55
66	11		D-S	3	5	Yes	578.40	55
66	11		D-S	1	5	Yes	266.88	55
66	11		D-S	1	3.75	No	217.70	55
66	11		D-S	3	3	Yes	557.36	55
66	11		D-S	1	3	Yes	253.57	55
66	11		D-S	3	1	No	361.75	55
66	11		D-S	3	0.5	Yes	531.07	55
50	33		S-S	3	5	No	477.81	55
50	33		S-S	1	5	No	260.90	55
50	11		D-S	1	15	Yes	350.09	55
50	11		D-S	3	7.5	Yes	558.83	55
50	11		D-S	1	7.5	Yes	288.76	55
50	11		D-S	1	5	Yes	268.32	55
50	11		D-S	1	3	No	189.88	55
50	11		D-S	1	2.25	No	219.93	55
50	11		D-S	3	2	Yes	438.30	55
33	11		D-S	3	20	Yes	562.58	55
33	11		D-S	3	15	Yes	540.10	55
33	11		D-S	3	13	Yes	531.12	55
33	11		D-S	3	10	No	524.19	55

HV	LV	TV/ MVA	Vector	Phase	MVA 3ph	OLTC	Standard Value ($000)	Standard Life (years)
33	11		D-S	1	10	No	286.45	55
33	11		D-S	3	7.5	Yes	506.39	55
33	11		D-S	3	5	Yes	495.15	55
33	11		D-S	3	2.25	No	357.38	55
33	11		D-S	3	2	No	352.00	55
11	11		A	3	4.5	Yes	494.52	55

Oil Containment

Oil containment is costed based upon the capacity of the facility.

Table A.5: Oil Containment Building Block Costs

Capacity (m^3)	Description	Standard Value ($000)	Standard Life (years)
10	Oil Containment System	68.78	45
15	Oil Containment System	75.24	45
18	Oil Containment System	76.83	45
25	Oil Containment System	80.52	45
30	Oil Containment System	83.16	45
35	Oil Containment System	85.79	45
40	Oil Containment System	88.43	45
45	Oil Containment System	91.07	45
50	Oil Containment System	93.60	45
55	Oil Containment System	96.34	45
60	Oil Containment System	98.98	45
65	Oil Containment System	101.62	45
70	Oil Containment System	104.26	45
75	Oil Containment System	106.90	45
80	Oil Containment System	109.53	45
85	Oil Containment System	112.17	45
90	Oil Containment System	118.46	45
115	Oil Containment System	128.00	45
160	Oil Containment System	149.02	45

Switchgear

Table A.6: Switchgear Building Block Costs

kV	Description	CB qty	Bus Type	Out/ In	Standard Value ($000)	Standard Life (years)
220	1.5 Line Breaker	1	SB	O	947.20	45
220	1.5 Half Breaker	1	-	O	763.64	45
220	1.5 Transformer Breaker	1	SB	O	631.59	45
220	Transmission Line - No Bus	1	-	O	754.35	45
220	Transmission Line - Single Bus	1	SB	O	835.37	45
220	Transmission Line - Double Bus	1	DB	O	985.22	45
220	Transmission Line - Triple Bus	1	TB	O	1,183.52	45
220	Connection Circuit - No Bus	1	-	O	361.78	45
220	Connection Circuit - Single Bus	1	SB	O	442.80	45
220	Connection Circuit - Double Bus	1	DB	O	592.65	45
220	Connection Circuit - Triple Bus	1	TB	O	790.95	45
220	Generator - No Bus	0	-	O	68.23	45
220	Generator - Single Bus	0	SB	O	149.24	45
220	Generator - Double Bus	0	DB	O	299.09	45
220	Generator - Triple Bus	0	TB	O	497.40	45
220	Bus Section	1	SB	O	418.20	45
220	Bus Coupler – Dual Bus	1	DB	O	980.02	45
220	Bus Coupler - Triple Bus	1	TB	O	1,057.88	45
110	Transmission Line - No Bus	1	-	O	403.29	45
110	Transmission Line - Single Bus	1	SB	O	476.75	45
110	Transmission	1	DB	O	668.04	45

kV	Description	CB qty	Bus Type	Out/ In	Standard Value ($000)	Standard Life (years)
	Line - Double Bus					
110	Connection Circuit - No Bus	1	-	O	251.62	45
110	Connection Circuit - Single Bus	1	SB	O	325.08	45
110	Connection Circuit - Double Bus	1	DB	O	516.37	45
110	Incomer - No Bus	1	-	O	251.62	45
110	Incomer - Single Bus	1	SB	O	325.08	45
110	Incomer - Double Bus	1	DB	O	516.37	45
110	Generator - No Bus	0	-	O	50.55	45
110	Generator - Single Bus	0	SB	O	124.01	45
110	Generator - Double Bus	0	DB	O	315.31	45
110	Bus Section	1	SB	O	283.42	45
110	Bus Coupler	1	DB	O	836.95	45
110	Bus VT		-	-	46.11	45
66	Transmission Line - No Bus	1	-	O	389.79	45
66	Transmission Line - Single Bus	1	SB	O	454.11	45
66	Transmission Line - Double Bus	1	DB	O	630.83	45
66	Connection Circuit - No Bus	1	-	O	245.48	45
66	Connection Circuit - Single Bus	1	SB	O	309.80	45
66	Connection Circuit - Double Bus	1	DB	O	486.52	45
66	Incomer – No Bus	1	-	O	245.48	45
66	Incomer – Single Bus	1	DB	O	309.80	45
66	Incomer – Dual Bus	1	DB	O	486.52	45
66	Generator – No	0	-	O	48.00	45

kV	Description	CB qty	Bus Type	Out/ In	Standard Value ($000)	Standard Life (years)
	Bus					
66	Generator – Single Bus	0	SB	O	112.32	45
66	Generator – Double Bus	0	DB	O	289.04	45
66	Bus Section	1	SB	O	275.89	45
66	Bus Coupler	1	DB	O	791.92	45
66	Bus VT		-	-	38.96	45
50	Transmission Line – No Bus	1	-	O	386.53	45
50	Transmission Line – Single Bus	1	SB	O	446.23	45
50	Connection Circuit - No Bus	1	-	O	244.78	45
50	Connection Circuit - Single Bus	1	SB	O	304.48	45
50	Incomer – No Bus	1	-	O	244.78	45
50	Incomer – Single Bus	1	SB	O	304.48	45
50	Bus Section	1	SB	O	275.13	45
50	Bus Coupler	1	DB	O	0.00	45
50	Bus VT		-	-	38.96	45
33	OD Feeder – No Bus	1	-	O	221.22	45
33	OD Feeder – Single Bus	1	SB	O	245.40	45
33	OD Feeder – Dual Bus	1	DB	O	283.55	45
33	OD Incomer – No Bus	1	-	O	202.74	45
33	OD Incomer – Single Bus	1	SB	O	223.62	45
33	OD Incomer – Dual Bus	1	DB	O	261.77	45
33	OD Bus Section	1	SB	O	194.96	45
33	OD Bus Coupler	1	DB	O	243.33	45
33	OD Bus VT		-	-	0.00	45
33	Recloser	1	ACR	O	45.21	45

11	OD Feeder - Single Bus	1	SB	O	81.44	45
11	OD Feeder - Dual Bus	1	DB	O	98.66	45
11	OD Incomer - Single Bus	1	SB	O	94.24	45
11	OD Incomer - Dual Bus	1	DB	O	110.51	45
11	OD Bus Section	1	SB	O	90.05	45
11	OD Bus Coupler	1	DB	O	102.54	45
11	Recloser	1	ACR	O	36.43	45
33	Circuit Breaker - Indoor Bus Coupler	1	DB	I	128.80	45
33	Circuit Breaker - Indoor Bus Section	1	SB	I	99.57	45
33	Circuit Breaker - Indoor Feeder	1	SB	I	86.77	45
33	Circuit Breaker - Indoor Feeder - Double Bus	1	DB	I	127.40	45
33	Circuit Breaker - Indoor Incomer	1	SB	I	92.77	45
33	Circuit Breaker - Indoor Incomer - Double Bus	1	DB	I	131.50	45
22	Circuit Breaker - Indoor Bus Coupler	1	DB	I	120.70	45
22	Circuit Breaker - Indoor Bus Section	1	SB	I	87.65	45
22	Circuit Breaker - Indoor Feeder	1	SB	I	83.25	45
22	Circuit Breaker - Indoor Feeder - Double Bus	1	DB	I	119.90	45
22	Circuit Breaker - Indoor Incomer	1	SB	I	84.45	45
22	Circuit Breaker - Indoor Incomer - Double Bus	1	DB	I	124.20	45

11	Circuit Breaker 500MVA - Indoor Bus Coupler	1	DB	I	107.77	45
11	Circuit Breaker 500MVA - Indoor Bus Section	1	SB	I	71.07	45
11	Circuit Breaker 500MVA - Indoor Feeder	1	SB	I	69.47	45
11	Circuit Breaker 500MVA - Indoor Feeder - Double Bus	1	DB	I	107.37	45
11	Circuit Breaker 500MVA - Indoor Incomer	1	SB	I	73.47	45
11	Circuit Breaker 500MVA - Indoor Incomer - Double Bus	1	DB	I	110.67	45
11	Circuit Breaker 750MVA - Indoor Bus Coupler	1	DB	I	232.96	45
11	Circuit Breaker 750MVA - Indoor Bus Section	1	SB	I	98.57	45
11	Circuit Breaker 750MVA - Indoor Feeder	1	SB	I	95.57	45
11	Circuit Breaker 750MVA - Indoor Feeder - Double Bus	1	DB	I	195.16	45
11	Circuit Breaker 750MVA - Indoor Incomer	1	SB	I	145.57	45
11	Circuit Breaker 750MVA - Indoor Incomer - Double Bus	1	DB	I	274.96	45

Reactive Power Plant

Table A.7: Reactive Power Plant Building Block Costs

Description	Standard Value ($000)	Standard Life (years)
110 kV Two Zone Bus Protection	130.51	15
220 kV Two Zone Bus Protection	130.51	15
66 kV Two Zone Bus Protection	130.51	15
Neutral Earthing Resistor 11kV 12.5 ohms 500A	66.00	45
Neutral Earthing Resistor 22kV 25 ohms 500A	71.00	45
Neutral Earthing Resistor 33kV 37.5 ohms 500A	76.00	45
Neutral Earthing Resistor 17.5kV 2 ohms 300A	66.00	45
Neutral Earthing Resistor 17.5kV 2 ohms 1500A	76.00	45
Neutral Earthing Resistor 17.5kV 2 ohms 3000A	86.00	45
Neutral Earthing Resistor 17.5kV 2 ohms 6400A	96.00	45

Transmission Lines

Table A.8: Transmission Line Building Block Costs

kV	Config	Rating	Conductor	Temp.	Standard Value ($000)	Standard Life (years)[5]
11	Scp	220	1/mink	50	36.64	55
33	Dcp	315	1/hyena	50	61.98	55
33	Dcp	360	1/coyote	50	66.21	55
33	Dcp	525	1/wolf	75	74.40	55
33	Scp	220	1/mink	50	37.29	55
33	Scp	315	1/hyena	50	41.09	55
33	Scp	360	1/coyote	50	43.21	55
33	Scp	410	1/hyena	75	41.03	55
33	Scp	525	1/wolf	75	47.36	55
50	Scp	220	1/mink	50	40.00	55
50	Scp	315	1/hyena	50	43.80	55
66	Dcst	315	1/hyena	50	112.14	55
66	Dcst	410	1/hyena	75	114.37	55
66	Dcst	525	1/wolf	75	137.48	55
66	Dcst	640	1/goat	50	170.65	55

5 Transmission lines are assigned lives according to environmental factors (see clause A.44).

kV	Config	Rating	Conductor	Temp.	Standard Value ($000)	Standard Life (years)[5]
66	Dcst	1960	2/zebra	75	318.88	55
66	Dcp	290	1/mink	75	65.92	55
66	Dcp	525	1/wolf	75	90.07	55
66	Dcp	640	1/goat	50	115.38	55
66	Scst	315	1/hyena	50	91.61	55
66	Scp	220	1/mink	50	40.84	55
66	Scp	315	1/hyena	50	44.64	55
66	Scp	360	1/coyote	50	46.77	55
66	Scp	410	1/hyena	75	44.28	55
110	Dcst	315	1/hyena	50	123.14	55
110	Dcst	360	1/coyote	50	128.81	55
110	Dcst	410	1/hyena	75	125.92	55
110	Dcst	525	1/wolf	75	141.18	55
110	Dcst	640	1/goat	50	176.57	55
110	Dcst	750	1/zebra	50	194.99	55
110	Dcst	840	1/goat	75	180.55	55
110	Dcst	980	1/zebra	75	195.41	55
110	Dcst	1050	2/wolf	75	223.74	55
110	Dcst	1280	2/goat	50	295.26	55
110	Dcst	1500	2/zebra	50	321.20	55
110	Dcst	1640	1/chukar	75	273.37	55
110	Dcst	1680	2/goat	75	296.05	55
110	Dcst	1960	2/zebra	75	324.84	55
110	Dcp	400	1/wolf	50	97.00	55
110	Dcp	525	1/wolf	75	100.14	55
110	Scst	315	1/hyena	50	91.57	55
110	Scst	360	1/coyote	50	96.61	55
110	Scst	410	1/hyena	75	92.98	55
110	Scst	525	1/wolf	75	104.48	55
110	Scst	640	1/goat	50	128.46	55
110	Scp	315	1/hyena	50	51.41	55
110	Scp	360	1/coyote	50	53.48	55
110	Scp	410	1/hyena	75	53.91	55
110	Scp	525	1/wolf	75	57.02	55
110	Scp	640	1/goat	50	66.05	55
220	Dcst	750	1/zebra	50	210.54	55
220	Dcst	980	1/zebra	75	212.97	55
220	Dcst	1280	2/goat	50	319.92	55
220	Dcst	1500	2/zebra	50	353.41	55
220	Dcst	1640	1/chukar	75	307.03	55
220	Dcst	1680	2/goat	75	324.31	55
220	Dcst	1960	2/zebra	75	362.80	55
220	Dcst	3280	2/chukar	75	538.91	55
220	Scst	640	1/goat	50	132.34	55
220	Scst	750	1/zebra	50	146.96	55
220	Scst	980	1/zebra	75	149.87	55
220	Scst	1280	2/goat	50	210.85	55

Table A.9: Seismic adjustment factors (for substations)

Equipment Type	Zone A *(high risk)*	Zone B *(medium risk)*	Zone C *(low risk)*
Establishment	1.14	1.06	1.00
Buildings	1.02	1.01	1.00
Oil Containment	1.14	1.06	1.00
Transformers	1.04	1.02	1.00
Switchgear	1.02	1.01	1.00
Other Plant	1.02	1.01	1.00

Table A.10: Interest during construction factors

Asset Type	Factor (Annualised Rate)
Substation assets	4.8%
Transmission line assets	4.0%

APPENDIX B: OPTIMISATION FOR ELECTRICITY LINES BUSINESSES

Introduction

B.1 Optimisation of an ELB's system fixed assets shall be undertaken in accordance with the requirements of clauses 2.18-2.46. The general approach is to first determine the appropriate optimisation criteria and then to systematically test the network configuration, network capacity and network engineering against the optimisation criteria. The network is adjusted in an incremental fashion in situations where it is found that a more cost efficient design will meet the predetermined criteria. This appendix describes the minimum tests that must be applied in all cases in order to optimise a network in accordance with the requirements of this handbook.

Optimisation of Network Configuration

B.2 Connection/Supply Points

Issue: Whether all existing points of supply are required, given the ELB's disclosed quality of supply criteria.

Approach: Location and supply voltage may be considered fixed. All points of supply must be tested to determine whether a more cost efficient network would result if the point of supply were eliminated and the load supplied from adjacent points of supply. If possible, the point of supply should be optimised out and replaced with a notional more cost efficient network.

B.3 Transmission/Subtransmission/Primary Distribution Circuits

Issue: Whether the number of transmission/subtransmission lines exceeds the number required given the ELB's disclosed quality of supply criteria and allowed future load growth.

Approach: The route of each line may be considered fixed. Assess the number of transmission/subtransmission lines in relation to the ELB's disclosed quality of supply criteria and allowed future load growth. Optimise out those that are not required. Furthermore, assess whether the existing voltage is still required or whether the lines could be replaced with a lower voltage network. If possible, the lines should be optimised out and replaced by a notional lower voltage network.

B.4 Transmission Substations/Zone Substations/Primary Distribution Substations

Issue: Whether the number and voltage of substations exceeds that which is required to meet the ELB's disclosed quality of supply criteria and allowed future load growth.

Approach: The location of all substations may be considered fixed. Each substation must be tested to determine whether a more cost efficient network would result if the substation were eliminated or reduced in voltage. Optimise out assets not required and replace with a notional more cost efficient network.

Issue: Whether substation configuration exceeds ELB's requirements.

Approach: Review the configuration of each substation, including the need for more than a single busbar. Where the ELB's quality of supply requirements can be met by a more cost efficient design replace existing configuration with a notional more cost efficient configuration.

B.5 High Voltage Distribution Network

Issue: Use of very low capacity or less than three phase distribution lines.

Approach: Where the existing distribution line or a part of it is of less than three phase construction, the line must be valued accordingly. Three phase distribution spur lines in rural areas shall be optimised to single phase two wire lines where there are no existing three phase customers and it is possible to meet the ELB's quality of supply criteria with a two wire arrangement.

Issue Valuation of single wire earth return circuits.

Approach These systems should be valued as if they were constructed using a light single phase two wire distribution circuit with the isolating transformer optimised out. ELB's may use non-standard replacement costs for single wire systems provided the total replacement cost of the system is less than the standard replacement cost of the equivalent two wire design.

Transpower

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Optimisation of Network Capacity and Network Engineering

B.7 Transmission/subtransmission/primary distribution lines and cables

Issue: Conductor and cable size.

Approach: Determine the required capacity of the line or cable given the disclosed quality of supply criteria and allowed future load growth. Optimise down the size of the conductor or cable to the most cost efficient standard size that meets the required capacity utilising the short-term ratings of the conductors or cables as appropriate.

Issue: Whether underground cables are justified.

Approach: Review existing underground transmission, subtransmission and primary distribution cables to determine whether undergrounding is justified. Possible justifications for undergrounding include:

1. Local authority planning criteria prohibit the construction of new overhead circuits;
2. The use of underground cable is the most cost efficient means of achieving the disclosed quality of supply criteria;
3. Economic analysis shows that underground cable is the most cost efficient method of providing the required network service;
4. Consultation with customers affected (including those affected by having to pay higher electricity distribution prices) has demonstrated a willingness to pay the additional cost of the underground service.

If suitable justification for existing underground circuits cannot be provided then optimise the underground circuits to overhead. The justification for retaining underground cable in the optimised network must be described in general terms in the valuation report.

Issue: Underground cable trenching.

Approach: Optimise the trenching arrangement of existing underground cables. Cables running close together, or on the same side of any road or street must be optimised to a single trench except where this would not meet the ELB's disclosed quality of supply criteria. Derating factors applicable to cables run in a single trench should be considered when making this assessment. If more than one underground cable is laid in a trench, only the incremental cost of the additional cable(s) may be included in the valuation. Table A1 provides standard costs for double circuit cables.

B.8 Substations/zone/primary distribution substations

Issue: Under-utilised equipment is installed at substations.

Approach: Optimise the size of the equipment used, including transformers, to the lowest standard rating that meets the disclosed quality of supply criteria and allowed future load growth.

Issue: Land and buildings.

Approach: Optimise indoor substations to outdoor where land is available and this will result in more cost efficient design unless there are clear technical reasons or local authority requirements that prevent this.

Optimise out any unutilised or under-utilised land so that the value of the land allowed reflects only the area of land required to meet the ELB's disclosed quality of supply criteria and allowed future load growth.

Reduce the replacement cost of buildings to that of a simple standard modern structure using pre-fabricated or other low cost designs. A higher standard of construction is allowed only where the ELB can provide evidence to show that a lower cost design will not meet local authority planning requirements, given the location of the substation. The size of the optimised design should not exceed that required to meet the essential functionality of the building.

Issue: Whether substation engineering exceeds ELB requirements.

this Approach: Review the standard of engineering of each substation. If possible, recent projects undertaken by the ELB should be used as a benchmark for this test. If it is found that a more cost efficient standard of engineering would meet the ELB's disclosed quality of supply criteria, the existing assets should be notionally reengineered and the replacement costs reduced accordingly. Compliance with territorial local authority conditions for the substation location should be retained in any notional redesign.

Issue: Fire protection and oil retention facilities.

Approach: Include equipment currently installed unless not required for MEA.

B.9 High Voltage Distribution

Issue: Conductor and cable size.

Approach: Examine thermal ratings, faults and current levels to determine most cost efficient conductor size for each feeder, given the disclosed quality of supply criteria and allowed future load growth. Optimise down where necessary.

Issue: Whether underground cables are justified.

Approach: Review existing underground distribution cables to determine whether undergrounding is justified. Possible justifications for undergrounding include:

1. Local authority planning criteria prohibit the construction of new overhead circuits;
2. The use of underground cable is the most cost efficient means of achieving the disclosed quality of supply criteria;
3. Economic analysis shows that underground cable is the most cost efficient method of providing the required network service;
4. Consultation with customers affected (including those affected by having to pay higher electricity distribution prices) has demonstrated a willingness to pay the additional cost of the underground service.

If suitable justification for existing underground circuits cannot be provided then optimise the underground circuits to overhead. The justification for retaining underground cable in the optimised network must be described in general terms in the valuation report.

Issue: Underground cable trenching

Approach: Optimise the trenching arrangement of existing underground cables. Cables running close together, or on the same side of any road or street must be optimised to a single trench except where this would not meet the ELB's disclosed quality of supply criteria. Derating factors applicable to cables run in a single trench should be considered when making this assessment. If more than one underground cable is laid in a trench only the incremental cost of the additional cable(s) may be included in the valuation. Table A1 provides standard costs for double circuit cables.

B.10 Voltage Control Devices

Issues: Degree of control.
Manual and on load tap changes.

	Line regulators and line drop compensation. Reactive compensation.
Approach:	Test requirements for all existing voltage control devices and optimise out where there is no clear justification for the equipment.

B.11 Distribution Transformers (pole, kiosk, ground types)

Issue: Transformer rating.

Approach: Optimise out excess distribution transformer capacity so that the capacity utilisation (ratio of current peak load, converted to MVA at an assumed power factor of 0.95, to total distribution transformer capacity) for the network is not less than 30% unless a lower utilisation is provided for in a specific customer non-standard contract. Transformer capacity optimised out shall be valued at the average DRC per kVA of the ELB's transformer equipment.

In applying this test, ELBs may separate out segments of the network (zone substations or high voltage feeders) with peak loads that are not coincident with the network peak and apply this test separately to such segments. If this approach is taken, details must be included in the optimisation description included in the valuation report.

B.12 Low Voltage Distribution

Issue: Whether underground cables are justified.

Approach: Review existing underground low voltage cables to determine whether undergrounding is justified. Possible justifications for undergrounding include:

1. Local authority planning criteria prohibit the construction of new overhead circuits;
2. The use of underground cable is the most cost efficient means of achieving the disclosed quality of supply criteria;
3. Economic analysis shows that underground cable is the most cost efficient method of providing the required network service;
4. Consultation with customers affected (including those affected by having to pay higher electricity distribution prices) has demonstrated a willingness to pay the additional cost of the underground service.

If suitable justification for existing underground circuits cannot be provided then optimise the underground circuits to overhead. The justification for retaining underground cable in the optimised network must be described in general terms in the

Issue: Underground Distribution Trenching.

Approach: Optimise the trenching arrangement of existing underground cables. Cables running close together, or on the same side of any road or street must be optimised to a single trench except where this would not meet the ELB's disclosed quality of supply criteria. Derating factors applicable to cables run in a single trench should be considered when making this assessment. If more than one underground cable is laid in a trench only the incremental cost of the additional cable(s) may be included in the valuation. Table A.1 provides standard costs for double circuit low voltage cables.

Issue: Whether the configuration and engineering of the low voltage distribution network exceeds the standard required to meet the ELB's quality of supply criteria.

Approach: Review the standard of engineering of the low voltage distribution network, using recent projects undertaken by the ELB as a benchmark for this test. If it is found that a more cost effective standard of engineering would meet the ELB's disclosed quality of supply criteria, those parts of the low voltage network containing excess asset value should be notionally reconfigured so that they do not exceed the required standard. Assets that are not required should be optimised out.

In applying this test, it is not required that ELBs examine each individual low voltage circuit. It is acceptable to estimate the proportion of the ELB's low voltage distribution network that is over-engineered and apply an appropriate optimisation factor. However details of the approach taken should be included in the optimisation description included in the valuation report in accordance with clause 2.65(8).

B.13 System Control

Issue: Degree of sophistication of SCADA equipment.

Approach: Determine whether equipment is appropriate on the basis of disclosed quality of supply criteria. Reduce replacement cost to that of a MEA of the required sophistication.

Issue: Need for load control system and degree of sophistication.

Approach: Determine whether equipment is appropriate for the degree of control required. If necessary, reduce replacement cost to that of a MEA of the required sophistication.

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B.6Security Guidelines for Transmission Planning				
Load (MW)	**Basic Security**	**Transmission Circuits**	**Busbars**	**Transformers**
Less than 10	n	One circuit	One bus or bus section	1 x 3-phase units.
(10 to 40, if more than 40km remote and local generation can limit load shed to 25%)	n	One circuit	One bus or bus section	4 x 1-phase or 1 x 3-phase unit, if backed up from alternative supply point.
From 10 to 300	n-1	Two circuits	Two busbars or bus sections	7 x 1-phase units or 2 x 3-phase units. Firms supply of peak demand using any short term overload capability.
More than 300	n-2	Three circuits on at least two routes	One redundant bus or bus section, such that supply is not lost after a single contingency while one bus is out of service for maintenance	7 x 1-phase units or 2 x 3 phase units. Firms supply of peak demand using any short term overload capacity.
More than 600	Loss of station	Supply into region should be diversified across more than one major terminal substation.		