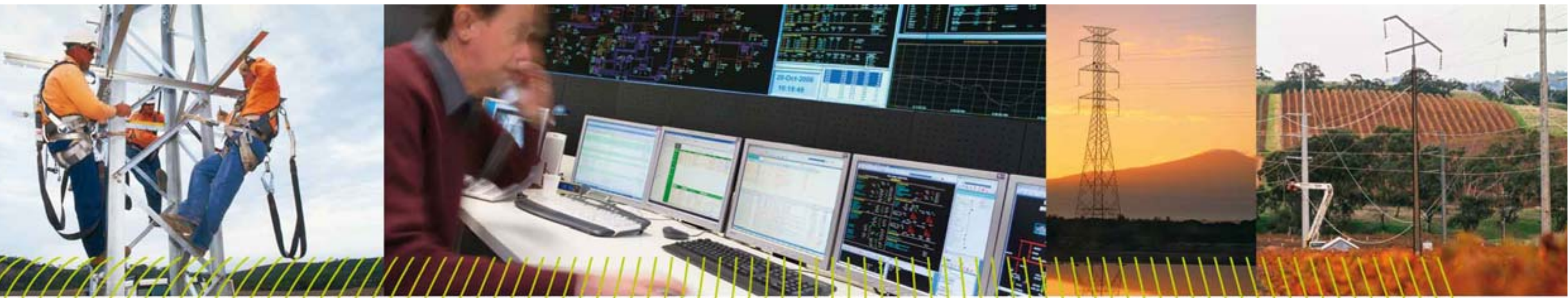
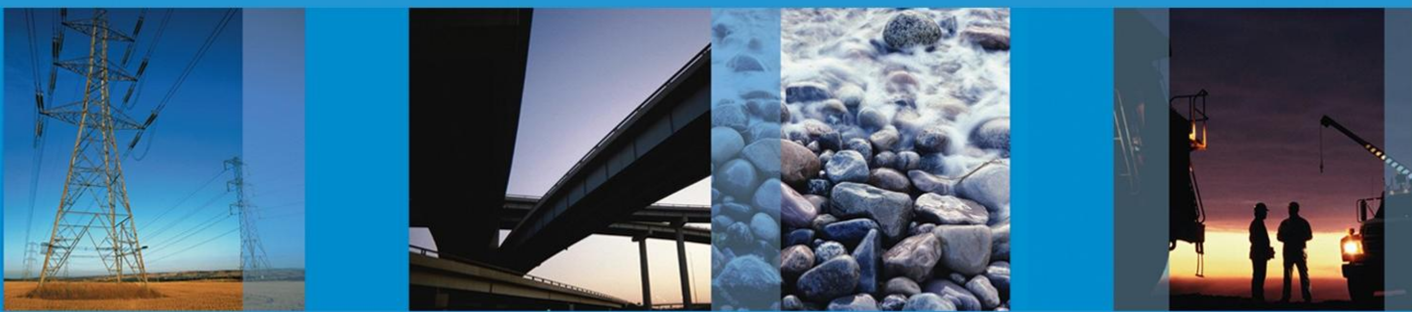


# Appendix U

# Assessment of Asset Lives



# ElectraNet Consultancy Services

## Assessment of Asset Lives

**ElectraNet**

May 2007

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# ElectraNet Consultancy Services

Assessment of Asset Lives

Prepared for

**ElectraNet**

Prepared by

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# Quality Information

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**Final Report**

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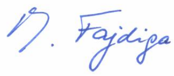
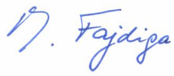
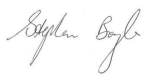
| 1 | 18/04/2007 | Final draft | Michael Fajdiga<br>Industry Director - Power |  |
| 2 | 09/05/2007 | Updated with ElectraNet comments | Michael Fajdiga<br>Industry Director - Power |  |
| 3 | 21/05/2007 | Updated with ElectraNet comments | Stephen Boyle<br>Associate Director - Power |  |



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# Table of Contents

# Executive Summary

ElectraNet engaged Maunsell Australia Pty Ltd in April 2007 to carry out a review of its transmission equipment standard asset lives.

The scope of work required that the standard asset lives be assessed against asset lives used by other Australian transmission utilities as well as possibly New Zealand and other jurisdictional standards. This report presents the findings, comparisons, and conclusions of the research carried out.

It is noted that this review is of a high-level nature. The current age, condition and site specific factors of the individual assets have not been examined.

Maunsell's recommendations based on the research carried out is summarised in Table A below.

| | **Present Asset Life (years)** | **Recommended Asset life (years)** |
|---|---|---|
| Circuit Breaker | 45 | 41(Air Blast and Oil)<br>42 (SF6) |
| Modern protection relays | 27 | 15 |
| Modern control equipment | 27 | 10 |
| Demountable building | - | 15 |
| Current transformers (oil) and Capacitor Voltage Transformers. | 45 | 39 |
| Fences, gates and associated equipment. | - | 35 |

**Table A: Results of the review**

# 1.0 Introduction

ElectraNet engaged Maunsell Australia Pty Ltd in April 2007 to carry out a review of its transmission equipment standard asset lives.

The objective of this review was to identify any appropriate changes to standard asset lives based on industry practice and technological changes and improvements.

Section 2.0 describes the methodology used to assess appropriate standard asset lives along with some of the sources of information used.  An overall discussion regarding asset useful lives and asset management is included in section 3.0. Subsequent sections provide more detail regarding each of the asset categories with conclusions.

# 2.0 Methodology & Assumptions

Maunsell has undertaken a desktop study in reviewing standard asset lives. Maunsell has not carried out a detailed quantitative evaluation of ElectraNet's transmission assets.  Maunsell suggests that data related to asset type, age, condition and environmental factors be considered if a detailed quantitative analysis of asset lives is required.

The following methodology has been adopted for this review:

- ElectraNet was requested to provide all available historical reports regarding the background of asset lives previously used for accounting purposes.
- A literature search on research on the expected life of assets was carried out. Sources of information were;
  - CIGRE,
  - Other transmission utilities,
  - AER & ACCC reports,
  - Maunsell own records.
- Information was assessed and asset lives for the different categories were arrived at. Where inconsistencies in the source data occurred, the most credible and appropriate source was used.

The following assumption was made by Maunsell in the investigation:

- It is assumed that the CIGRE surveys [1 & 2] used as the basis for the recommendations is an industry view of the useful life of assets. This information has been used without further verification.

# 3.0 Standard Useful Lives of Transmission Assets

Asset lives depend on many factors such as quality of the design and construction, the loading and mechanical and electrical stresses that the asset has been subjected to, environmental conditions, maintenance practices, lack of spare parts, obsolete technology and rate of technological change. Strictly speaking each asset will have its own individual life, but for planning and valuation purposes, utilities and regulating authorities use generic lifetime figures for groups of similar assets with similar duties or operating regimes.

The ultimate useful life of an asset will depend on the asset management strategies in place. Maunsell notes that ElectraNet has a comprehensive asset management plan which has not been reviewed as part of this project.

ElectraNet aims to progressively replace old assets to increase the reliability of the network and also to prevent a sudden increase in expenditure when assets simultaneously reach the end of their service lives.

# 4.0 Assessment of Useful lives

## 4.1 Circuit Breakers

Determining the useful life of a circuit breaker is a complex matter due to the many variables that affect the life of the equipment.

Some of major factors that affect the useful life of circuit breakers are as follows:

- Performance.
- Condition. (Deterioration)
- Obsolescence.
- Inadequate rating. ( Changes in required rating or fault level)
- Maintainability.
- Economics.
- Environment.

The above factors would determine whether an ageing circuit breaker should be reconditioned or replaced. The failure of Circuit breakers to perform is very much dependent on the type of circuit breaker. This is demonstrated by Table 4-1. (Excerpt from CIGRE: Life management of circuit breakers WG 13.08)[1]

| CB Type | Forced Outages per Circuit Breaker per year |
|---|---|
| SF6 – dual pressure | 0.2 |
| Air Blast | 0.18 |
| Bulk oil | 0.12 |
| SF6 – single pressure | 0.07 |
| Minimum oil | 0.07 |

**Table 4-1: Canadian utility Circuit Breaker Forced Outage Performance [1]**

The report[1] states that the main reason for the limitation of life is due to change in rating requirements, fault rating changes, maintenance costs, spares obsolescence, mechanical wear, safety and seal problems.

Currently the ElectraNet circuit breaker useful life has been specified as 45 year. The useful life based on a CIGRE survey of 13 countries with equipment of 110kV or above is similar.[2]

| CB Type | Suggested useful life |
|---|---|
| SF6 | 42 |
| Oil | 41 |
| Air | 41 |

**Table 4-2: Circuit Breaker Asset Lives [2]**

The above data was compared with the Transpower (NZ) asset life as listed in its 2006 ODV submission [4]. In this report, asset lives for SF6 circuit breakers, air blast circuit breakers & minimum oil circuit breakers are less than those listed in the CIGRE report.

The CIGRE asset lives are more consistent with Maunsell's own asset life data and more credible. On this basis Maunsell recommends Circuit Breaker asset lives nominated by CIGRE.

## 4.2 Secondary Equipment

The assets considered as secondary equipment are the control, protection and metering equipment.

Digital Electronic Secondary Equipment.

Modern protection and control equipment is electronic and digitally based. Unlike electromechanical equipment, it is not designed to be physically serviced. When faults occur, components such as circuit boards are replaced. The individual circuit boards have a short production life. This limits the effective life of protection and control equipment because replacements parts cannot be sourced.

Electronics equipment is also prone to becoming obsolete due to newly emerging technology, new communications protocols and changing protection and control requirements.

The expected deterioration range of electronic control and monitoring equipment used for circuit breakers is between 10 to 30 years according to CIGRE research [2].

Our research indicates that a useful life of 15 years for electronic protection equipment is common place. However new technologies are tending to reduce this useful age.

It is recommended that the electronic secondary protection equipment life be reduced to 15 years.

SCADA equipment

Modern control equipment is typically based on PLC or microprocessor technology. Such equipment is similar to SCADA equipment in that it is based on software, firmware and operating systems. Very few operating systems, firmware or software is supported for more than 10 years.

The software based technologies are changing and increasing in functional capability even more rapidly than modern protection equipment. On this basis a useful life of 10 years is appropriate being similar to the useful life of SCADA equipment.

Electromechanical Secondary Equipment.

The expected asset life of electromechanical relays is 32 years according to CIGRE research.

The main mode of failure for electromechanical equipment is insulation failure, wear of bearings and contact erosion. The asset life provide in the CIGRE document closely aligns with ElectraNet's 30 years for electro-mechanical equipment.

## 4.3 Substation Demountable Building

ElectraNet uses demountable buildings to house new protection and control equipment. Where possible, the demountable buildings are generally outfitted and commissioned off site before transportation to the site. Each demountable building is to house secondary equipment required for two diameters.

The provision of the demountable buildings together with the secondary equipment is a cheaper solution. The cost of installation and commissioning is reduced since the work can be carried out locally rather than at the substation site. The cost savings will be significant if the substation site is a remotely located site. Savings of up to 25% of the cost of installation and commissioning are expected.

The standard life of digital electronic secondary equipment is 15 years. When the secondary equipment has reached the end of its life, the equipment is replaced along with the building.

The building is not reused due to constructability and economic issues. The life of the building is effectively determined by the life of the equipment contained within it. It is not economical or practical to remove the equipment from the building and replace it. Instead it is replaced by a new demountable building housing the new equipment.

Maunsell recommends that the demountable building useful life be set to 15 years in accordance with the life of digital secondary equipment.

## 4.4 Fences

ElectraNet standards require palisade type fencing for its substations within the metropolitan area and other designated sites. All other sites have a fence of galvanised steel tube and chainwire construction.

ElectraNet experience to date is that substation fences require substantial maintenance after 15 years and some replacement after 25 years. The average age of the fence population in the ElectraNet network is 33 years.

The need for replacement of the fence is due to substantial deterioration or no longer meeting community expectations for public safety. Three substations asset condition assessments that were provided by ElectraNet indicated that the fences were not in accordance with the ElectraNet standards.

Palisade fences that have been used in the UK have achieved a life of between 35 & 45 years. It is not unreasonable to achieve a similar life in Australia.

However due to vandalism, accidental interference and environmental conditions the individual life can be reduced substantially.

Due to the life of the fence being markedly different to other equipment in the “Substation Establishment” category it is recommended that fences be separated out and be given a life of 35 years. This is an optimistic number and should be further revised after close analysis of fence serviceability and compliance ratings given in the substation condition assessment reports.

Any ancillary equipment such as gates with the exclusion of surveillance or perimeter alarm equipment installed as part of the fencing structure should be considered to have the same standard life.

## 4.5 Other Equipment

Given in section 4.3 is a summary and comparison of ElectraNet and CIGRE asset lives [2] used.

<table>
<tr><th>Plant type</th><th>ElectraNet useful asset life</th><th>CIGRE survey results [2]</th></tr>
<tr><td>Earth switches & disconnectors</td><td>50 ( this is the switchbay life)</td><td>42</td></tr>
<tr><td>Current Transformers (oil)</td><td>45</td><td>39</td></tr>
<tr><td>Capacitor Current Transformers</td><td>45</td><td>39</td></tr>
<tr><td>Power Transformers</td><td>45</td><td>42</td></tr>
<tr><td>ACSR – OHL (Normal environment)</td><td rowspan="2">55</td><td>54</td></tr>
<tr><td>ACSR – OHL (Heavily polluted)</td><td>46</td></tr>
<tr><td>Steel Lattice Towers</td><td>55</td><td>63</td></tr>
</table>

**Table 4-3: Asset Lives of other equipment [2]**

The CIGRE survey results provide substantiation for a shorter life for switchbays, current transformers, capacitor voltage transformers, power transformers and some transmission lines.

It is recommended that the switchbay category be broken down to reflect the different equipment available in a switchbay. Different equipment such as disconnectors and earth switches etc can then be assigned its own standard life in line with the CIGRE survey results.

Where transmission lines are in corrosive or heavily polluted environments, the CIGRE survey provides substantiation for a reduction in asset lives. In addition, Transpower (NZ) [4] uses a life of 35 years for transmission lines close to the coast due to the effects of corrosion. If ElectraNet has transmission lines in similar environments then there appears to be some scope to reduce the estimated asset life, Maunsell recommends an asset life of 46 years in line with the CIGRE results for such lines

# 5.0 Conclusions

Literature from ElectraNet, other transmission utilities, CIGRE and other regulatory bodies has been examined in order to research the topic of transmission asset lives used for accounting purposes.

Maunsell has found that ElectraNet's Asset Lives are in accordance with or are longer than industry norms. From the research carried out Maunsell has identified instances where it is recommended that the standard asset life be reduced.

Maunsell recommends a decrease of useful lives as given below:

- Change circuit breaker standard useful life to 41 (for air blast and oil CBs) and 42 for SF6 circuit breakers.
- Change demountable building standard life to15 years along with the housed secondary equipment.
- Change electronic protection and metering equipment standard life to 15 years.
- Change of electronic control equipment to 10 years.
- Fences to be separated from the substation establishment category and given a standard life of 35 years.

In addition to the above Maunsell recommends that the CT and CVT standard lives be changed to 39 years to align with the CIGRE survey.

It is also suggested that the substation switchbay category be broken down to its individual plant to reflect the different equipment available in a switchbay. Different equipment such as disconnectors and earth switches etc can be assigned its own standard life which maybe less than the 50 years used by ElectraNet.

Finally, it is recommended that where ElectraNet's transmission lines are in corrosive or heavily polluted environments that the life of only those lines be lowered to 46 years.

# 6.0 References


[1] Life Management of Circuit Breakers, CIGRE WG 13.08

[2] Ageing of the system. Impact on Planning, CIGRE 2000. WG 37-27

[3] Life cycle assessment if substation: A procedure for an optimised asset management, CIGRE 2002 23-302.

[4] 2006 Report of the Optimised Deprival Valuation of Transpower's System Fixed Assets as at 30 June 2006

[5] Handbook for optimized deprival valuation of system Fixed Assets of Electricity Line Businesses, Ministry of Economic Development, October 2000.

[6] Substation security programme – (document sent by Victor Mecinger of ElectraNet via email on 14/05/07)

[7] Berri, Blanche and Cultana condition assessment reports (documents sent by Robert Adams via email on 18/05/07)

[8] Depreciation – Assessment of useful live (document sent by Robert Adams via email on 11/04/07)