Electricity Transmission Revised Proposal

2008/09 – 2013/14

Appendix N

SAHA response to Draft Decision on Self-insurance

9 October 2007

Mr Geoff Thorn
Business Planning Manager – Strategic and Business Planning
SP AusNet
Level 31
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Southbank Victoria 3006

Dear Geoff,

Subject: Quantification of Self-Insured Risks

Please find enclosed our report for your consideration. We look forward to discussing our findings with you and your colleagues.

Please contact us if you have any questions.

This report has been reviewed by the undersigned, including an actuarial review of the methodologies applied to the quantification of the risks.

Yours sincerely,

Kumar Padisetti	Julie Evans
Partner – Saha International	Fellow of the Institute of Actuaries of Australia

SP AusNet

Response to AER on Self-Insurance Risks Draft Decision

October 2007

Final Report

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DISCLAIMER

Saha International Limited (SAHA) has prepared this report taking all reasonable care and diligence required. This report supports the original SAHA quantification of the risks faced by SP AusNet in relation to their Electricity Transmission business. The terms of reference and the limitations of the report are the same as those used in the original report.

In completing this review we have relied on documents and information provided to us by SP AusNet and other third parties for the purpose of our review. SAHA has not checked information provided by SP AusNet or third parties for accuracy as it is beyond the scope of this report. In the original report it was noted that if any of this information is inaccurate or incomplete, the report may need to be revised and subsequent to the draft decision it has been determined that there was indeed some incomplete data provided to SAHA and therefore this supplementary report was created to address these facts.

While SAHA has used all reasonable endeavors to ensure the information in this report is as accurate as practicable, SAHA, its contributors, employees, and Directors shall not be liable (whether in contract, tort (including negligence), equity or on any other basis) for any loss or damage sustained by any person relying on this document whatever the cause of such loss or damage.

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EXECUTIVE SUMMARY

The aim of this report was to investigate the recommendations of the AER in it's draft decision[1] to ensure that SP AusNet's self-insurance risks are adequately covered.

Saha International (SAHA) reviewed the recommendations from the AER based on the PB report and have concluded that whilst the AER and PB have accepted most self-insurance risks, the three key risks for SP AusNet have been considerably reduced. Therefore, further analysis to justify the original position taken by SAHA has been undertaken to address the concerns of the regulator.

This further analysis has been able to take advantage of:

- the fully collated and audited failure information from the 'Risk Models' recently developed by SP AusNet and made available to PB and the AER for their review. This information was not available for the initial SAHA review of self-insurance risks but has been provided for the analysis undertaken in this report;
- complete data where in the original self-insurance risk quantification it had been identified that incomplete data had been used by SAHA for the key person risk and current transformer risk; and
- additional failure information from events that occurred since the original self-insurance risk quantification was undertaken, namely a power transformer failed in March of this year.

Further to this information SAHA was provided with probability of failure of aged asset curves for power transformers, current transformers and circuit breakers, which allowed for more accurate analysis of the impact of the aging asset profiles. These curves were based on the historical failures of SP AusNet's assets and incorporate the fact that four out of the five power transformer failures in the last 6.3 years were related to aged assets. Therefore these curves have been used as a basis for determining the failure rate profile of the entire asset portfolio of power transformers, current transformers and circuit breakers and therefore the self-insurance required to cover these risk portfolios.

The results of the analysis show the initial recommendations of SAHA relate closely to the aged asset portfolio risk and therefore the same self-insurance risk has been derived by two different analytical methods, which shows the reasonable level of self-insurance risk should be in accordance with the initial recommendations from SAHA. This analysis is summarised in the relevant sections of the report with comparisons made to the original quantifications for these risks.

SAHA accept the revised failure rate for strain towers suggested by PB and adopted by the AER, however question the total reduction for towers and lines, as the only item identified for reduction in the draft determination was the strain towers which resulted in an $18,399 reduction. However the final summary self-insurance table[2] has a reduction of $41,542. This reduction appears to incorporate the conductor self-insurance risk even though the comments in the draft determination suggest the AER and PB accepted the conductor self-insurance. Therefore SAHA believe the self-insurance requirement for SP AusNet for risk

[1] "Draft Decision – SP AusNet Transmission Determination 2008-09 to 2013-14", AER, August 2007.
[2] Table 6.32 AER's draft decision – Self-insurance

of property damage to towers and lines should be $287,452 instead of the $264,309, to include the conductor damage.

The failure rates for transformers and circuit breakers have been revisited as further information was provided for power transformers, current transformers and circuit breakers. The new information provided additional insights into the impacts of aging assets and with this insight SAHA was able to fine tune the methodology for quantifying the risks. This report summarises the revised methodology and highlights the importance of complete data sets in determining failure rates.

An in depth analysis of the age of the assets has been undertaken to show that the risk to the assets is actually increasing at an exponential rate. The analysis however is still assuming that the only increasing risk to the physical condition of the asset is its age, instead of incorporating other key factors such as the increased loading of transformers as the demand in regions increase, and the condition of the assets (environmental conditions, certain environments lead to earlier failure of assets due to deterioration of casings).

The power and current transformer risk results in a combined probability of failure close to the original quantification of 1% for power transformers, however this is now made up of a higher component of current transformer failures as the historical data on current transformers highlighted a bigger issue than the original data provided to SAHA.

The circuit breaker analysis also resulted in a failure rate close to the 0.72% failure rate for circuit breakers initially used by SAHA, however depending on the methodology adopted and the capital expenditure approved by the regulator the failure rate can vary between 0.427% (lowest bound with all Capital expenditure approved) and 0.74% (highest bound based on historical failure rate and PB methodology for power transformer aging assets).

Even though the key person risk was accepted by the AER and PB, the risk was revisited by SAHA to ensure the complete data set did not impact on the original self-insurance premium proposed by SAHA. The additional three general managers' salaries increased the average salary for the general managers, however the overall impact was not considered significant and SAHA believes the original self-insurance amount should still stand. Even though SAHA accept the previous self-insurance amount it is important to include the revised section in this report to ensure the correct tables are provided for review.

SAHA has provided in Table 1-1 a summary of SAHA's original self-insurance risk calculations compared to the revised self-insurance risk calculations, the AER's draft determination for self-insurance risk and the recommendations based on the analysis undertaken in this report.

Table 1-1 – Revised Self-Insurance Risk Estimates

Category of Risk	Original Annual SP AusNet Self-Insurance Risk Submission	Annual Risk Premium Based on Asset Age Profile and Probability of Failure Curves	AER Draft Annual Self-Insurance Risk Decision	SAHA's Recommended Self-insurance Levels
Risk of Property Damage to Towers and Lines	$305,851		$264,309	$287,452
Risk of Power and Current Transformer Failure	$1,154,300	$1,157,551	$546,485	$1,154,300
Risk Of Circuit Breaker Failures	$847,440	$593,208	$353,100	$847,440
Key Person Risk	$63,425	$70,207[3]	$63,425	$63,425

The recommendations of SAHA are based on the comments in each section of this report but are generally based on the following:

- Risk of Property Damage to Towers and Lines – the recommendation of SAHA is to accept the determination of the AER and PB for the reduction in strain towers of $18,399 but to retain the conductor damage self-insurance risk which from the commentary in the determination was accepted by the AER and PB but removed from the final table of allowed self-insurance risks.

- Risk of Power and Current Transformer Failure – the historical failure rate, asset age profile and probability of failure curves for power and current transformers result in a self-insurance requirement only a little higher than originally calculated, therefore SAHA recommend retaining the original self-insurance risk premium.

- Risk Of Circuit Breaker Failures – the historical failure rate, asset age profile and probability of failure curves for the circuit breakers results in a self-insurance risk requirement of $593,208, however the analysis was not using an exact asset age

[3] Original calculations were incorrect as there was incomplete data provided (only data for 6 of the 9 GMs'), and the average calculations were undertaken using a divisor of 9 instead of 6. SP AusNet has since provided the information for all 9 GMs' and therefore SAHA have revised the Key Person Risk to include all the information and correct the calculation to ensure all the information is taken into account

profile but midpoints of ranges, which could lead to errors in the probability calculations. Therefore SAHA investigated two other methods for this risk, first to use the PB methodology for Power Transformers for aging assets, which was to double the historical failure rate and applying this methodology to the historical circuit breaker failure rate. The result of this analysis provided 0.74% based on 10 year history or 0.918% for the last regulatory period, as this analysis is in line with the CIGRE data of 0.72%, SAHA reverted to its original recommendation of using the CIGRE data for circuit breakers.

- Key Person Risk – the recommendation is to retain the level approved by the AER in the draft determination as the difference between the revised calculation and the original calculation is not significant.

1. INTRODUCTION AND BACKGROUND

SP AusNet provided the AER draft decision to SAHA to review and provide comments on the self-insurance risk quantification which was undertaken by SAHA and the recommendations of the AER. As a basis of this review SAHA believes there were a few areas of the draft decision on self-insurance that required further evaluation of the initial position.

This report aims to investigate the recommendations of the AER in its draft decision[4] to ensure that SP AusNet's self-insurance risks are adequately covered. This report is a supplement to the original report undertaken by SAHA and investigates the areas of concern raised by the AER in the draft decision and areas where incomplete data were found. This report needs to be read in the context of the original report with the same reliances and limitations applying to this report.

SAHA have reviewed the recommendations from the AER based on the PB report and have concluded that whilst the AER and PB have accepted most self-insurance risks, the three key risks for SP AusNet have been considerably reduced. Therefore, in SAHA's opinion, further analysis needs to be undertaken to ensure a prudent level of self-insurance is provided to SP AusNet and justify the original position taken by SAHA.

The original report included in the disclaimer the following comment:

> *"It should be noted that if any of this information is inaccurate or incomplete, this report may have to be revised"*

As a result of review of the AER draft determination and the information submitted by SP AusNet to SAHA and the AER, SAHA have found that there was some incomplete data provided and therefore modifications to these sections of the report were required. This supplemental report covers the incomplete data as well as addressing the concerns raised by the regulator. In addition to the incomplete data there was an additional transformer incident that occurred after submission of the initial report, this incident needs to be taken into account as it reflects the impact of aging assets on the transformer failure rate.

SAHA believe this new information is important and should be considered by the AER in making the final determination on self-insurance risks for SP AusNet. The review and further analysis is provided in the following sections of this report: Sections 2 - Risk of Property Damage to Towers and Lines, 3 - Risk of Power and Current Transformer Failure, 4 - Risk of Circuit Breaker Failure and 5 - Key Person Risk.

2. RISK OF PROPERTY DAMAGE TO TOWERS AND LINES

The AER draft determination for property damage to towers and lines appeared to accept the proposed premium in relation to the risk of conductor damage. However, it raised concerns with regards to the proposed allowances for strain towers and catastrophic events. The result of the AER review appeared to be an adjustment for the incident frequency of tower strains resulting in a reduction of $18,399, based on PB's recommended incident frequency.

[4] "Draft Decision – SP AusNet Transmission Determination 2008-09 to 2013-14", AER, August 2007.

However, in table 6.32 AER's draft decision – Self-insurance (2007-08$), the adjustment reported by the AER is $41,542 which, in addition to the $18,399 for tower strains, includes the full risk of conductor damage of $23,143. Therefore, within the draft determination there is an inconsistency as to what has been accepted and what hasn't been accepted.

The incident frequency for tower strains was difficult to determine as there was no historical information from SP AusNet on tower strain incidents. SP AusNet reported three historical incidents, with these resulting in six, seven and ten towers being brought down. Even though these have been reported as suspension towers, there is a possibility, based on the configuration of the network, for a strain tower to have been captured within this information. This is because SP AusNet's system is configured in a standard layout of a strain tower after every five suspension towers. However, based on the information provided by SP AusNet, it is not possible to conclude this, and therefore we agree with the recommendation by PB to lower the expected incident rate to 0.01 and therefore accept the reduction to the tower strains component of this risk.

Nonetheless, we firmly believe that conductor damage should not be removed from this risk premium, and moreover, that the risk premium that we originally quantified for conductor damage was both robust and reasonable. As there are no further details as to why the costs associated with conductor damage may have been removed, it is impossible to make any further specific comments as to why it should still be included, other than to say the report suggests that this cost had been accepted by the AER.

3. RISK OF POWER AND CURRENT TRANSFORMER FAILURE

The AER's determination on self-insurance risks for power and current transformers has been provided below and each will be addressed in Section 3.1 Power Transformers and Section 3.2 Current Transformers.

> *"Power Transformers*
>
> *SAHA assumes a failure rate of 1% for power transformers. PB notes that while this figure is often used by the power industry, SP AusNet's own transformer failure history provides a figure of 0.21% over the population of 238 transformers. An assumption that the failure rate was to double due to the aging transformer population, which is supported by local and international industry experience gives a failure rate of 0.42%. Based on a figure of 0.42%, PB recommends a transformer self insurance premium of $484,806.*[305]
>
> *The AER agrees that the historic failure rates form a realistic basis for assessment of failure risk in this instance, but shares PB's concern that the limited sample of two years of historical data provides an unacceptable benchmark for future performance.*
>
> *The AER considers that PB's recommendation of an adjusted figure of 0.42% is appropriate, and has therefore reduced SP AusNet's proposed power transformer self-insurance premium to $484,806, a reduction of $669,494."*

"Current Transformers

The self-insurance premium for current transformers is calculated separately for 220kV and 500kV transformers.[306] SAHA assumes an incident rate of 1 in 6 years for both 220kV and 500kV transformers. The total risk premium proposed is $66,000, or $33,000 for both 220kV and 500kV current transformers.

SAHA identifies a self-insurance risk premium for current transformer failures of $66,667 per annum, but does not include this figure in its recommendation, instead claiming SP AusNet is adequately reimbursed due to the difference between the international benchmark of 1% and SP AusNet's historical figure of 0.21% for power transformers. Given PB's analysis of the risk to power transformers, PB considers it appropriate to include a self-insurance risk premium for current transformers of $61,679. PB has calculated this allowance based on information provided by SP AusNet, assuming an incident rate for current transformer failures of 1 in 6 years, and an average cost in 2007-08 dollars of $185,000.[307] This assumption results in a self-insurance premium of $30,840 for each of the 220kV and 500kV current transformers.

The AER considers that the increase of $61,679 is prudent in light of the reductions made to the premium for power transformers. The AER accepts the additional allowance proposed by PB of $61,679 as the appropriate self-insurance risk premium for current transformers.

The AER's reduction of $669,494 relating to power transformers and increase of $61,679 relating to current transformers leads to a net reduction of $607,815 per annum."

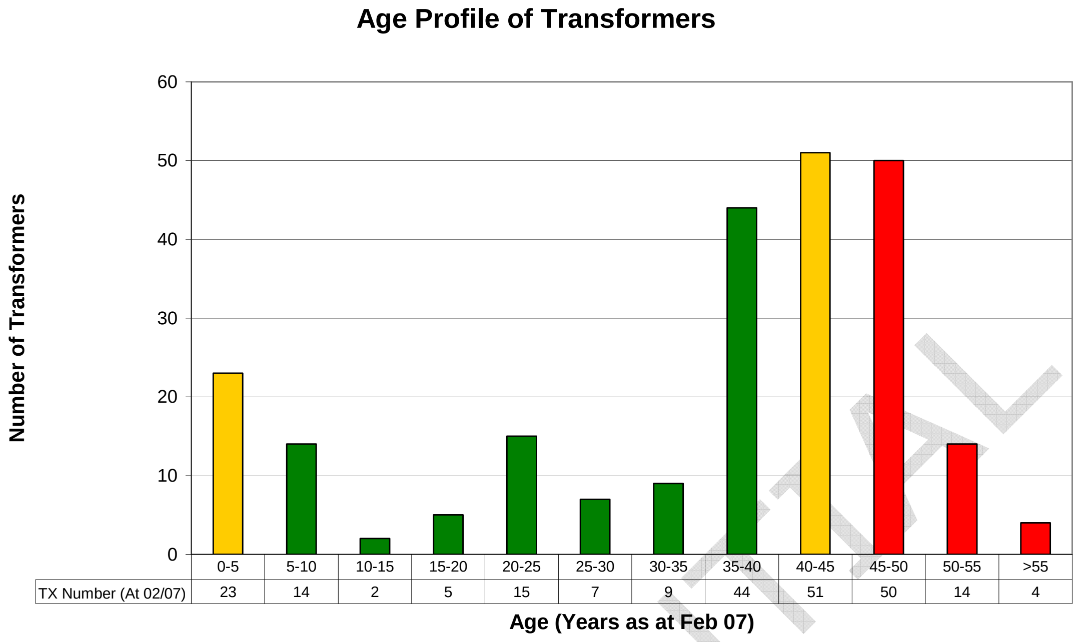
3.1 Power Transformers

As stated in SAHA's original report, the two key causes of power transformer failures are:

- The age of the asset; and
- The operating condition/loading of the transformer.

In relation to the age of the asset, Figure 3-1 below shows the age profile of SP AusNet's power transformers as at February 2007.

Figure 3-1 – Age Profile of Power Transformers as at Feb 2007



Legend for Age Profile Charts

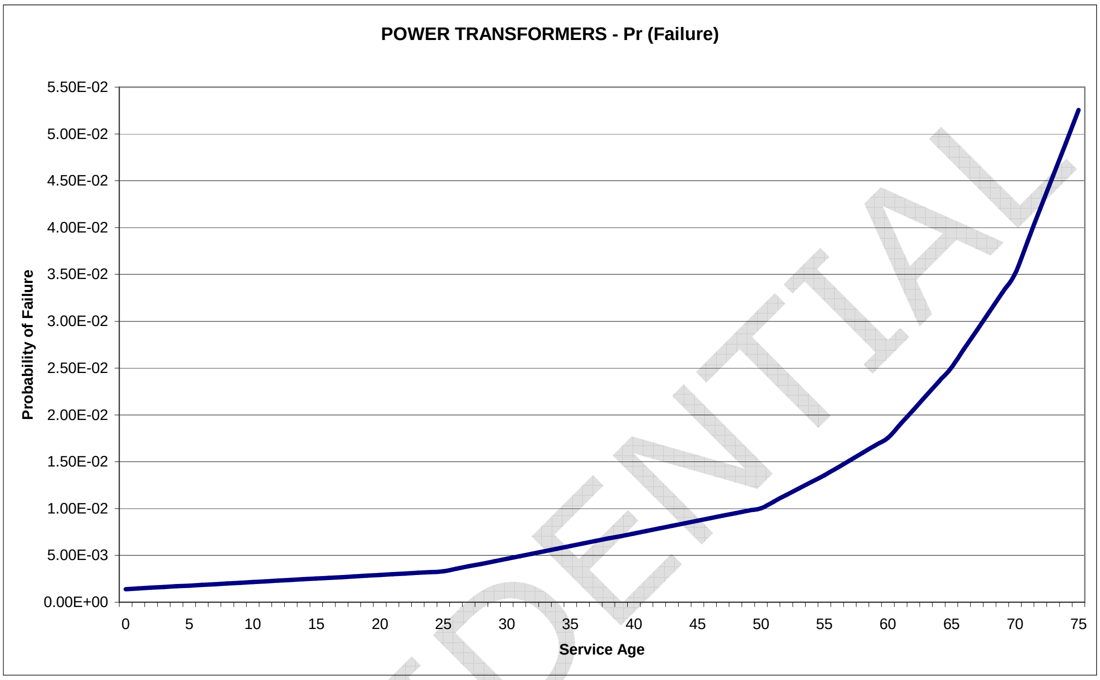
(red)	Assets Reaching or Above Expected Asset Life
(yellow)	Assets Encroaching on Higher Failure Expectation Periods
(green)	Assets Operating in Lower Failure Expectation Periods – Smooth operation period

As can be seen from this chart, there is a large proportion of assets at the tail of the chart, showing a high number of assets reaching the industry standard power transformer asset life of greater than 50 years.

SP AusNet's historical failure rate of power transformers was only 0.21% for the previous regulatory period. This did not include a transformer incident that occurred in March of this year as this was after the review of Self-Insurance risks had been conducted by SAHA. The historical failure rate was based on an age profile which had only 33 transformers at or above 50 years of age, with 15 of these assets being replaced during this period due to their age, thus leaving 18 transformers beyond their expected life. With the additional transformer failure in March the failure rate for SP AusNet will increase. According to SP AusNet, there were a total of 5 incidents recorded from 12 December 2000 to March 2007 (6.3 years). This translates to a historical failure rate of 0.33% per annum from a transformer population of 238 for the last regulatory period.

It is important to highlight that four out of the five transformer failures reported were failures to the aged assets. SAHA has been provided additional engineering data from SP AusNet which involved a probability of failure analysis on their entire power transformer asset class against the age of the power transformer. The SP AusNet engineering data showed the failure rate of a transformer increases exponentially with age and the chart is provided in Figure 3-2. The chart shows a 0.15% failure rate for a one year old transformer[5], but this failure rate increases by more than 6 times when the transformer reaches the age of 50 to 1%. When a transformer reaches the age of 75, the failure rate is calculated to be 5.3% based on SP AusNet's historical experience. This analysis is comparable to the data provided from the US experience and documented in the IEE Power Engineer journal and an international paper on transformer failures.[6]

Figure 3-2 – Probability of Failure of Power Transformers by Age of Asset



It is our understanding that by the start of the next regulatory period, SP AusNet will have 68 transformers at or above the age of 45. Furthermore, it should be noted that a further 51 assets that are currently in the 40-45 year age bracket will be reaching 46-51 years during the next regulatory period. According to SP AusNet, 66 transformers are proposed to be scheduled for replacement during the next regulatory period, which will result in 53 aged assets by the end of the next regulatory period. However, AER and PB recommended 51 transformer replacements as opposed to the 66 proposed by SP AusNet for the next regulatory period, this will result in an extra 15 transformers in the aged asset profile at the end of the next regulatory period (68 in total).

The initial failure rate of 0.21% calculated by PB and SAHA was based on a record of 3 incidents in 6 years instead of 5 incidents in 6.3 years. This is because one of the incidents reported by SP AusNet was in fact two separate incidents at the one terminal station, and the other additional incident occurred in March of this year, which was post

[5] The engineering data shows the higher failure rate of transformers for aging assets, however the failure rates for asset curves typically have a bathtub curve showing higher failures due to installation issues. For this analysis the engineering data from SP AusNet has been used ignoring the potential for installation issues. The age profile chart reflects the typical bathtub curve with the potential for transformers to be at risk in the installation and commissioning phase.

[6] "Extend the lifetime of your transformers by using computer-modelling", Pierre Lorin, IEE Power Engineer, April/May 2005 and "Analysis of Transformer Failures", Bartley, W.H. (2003), a paper presented to the 36th Annual Conference of the Association of Engineering Insurers in Stockholm. William Bartley works for a leading transformer insurance company in the United States – The Hartford Steam Boiler Inspection and Insurance Co.

the initial submission. However this incident is relevant to the analysis as this failure highlights the increasing risk to transformers as a result of the higher age profile. SP AusNet has an asset age profile that is significantly older than other transmission companies in Australia (average age of transformers 7 years older than the Australian transformer average age). Therefore taking this recent incident into account and separating the previous incident at Mt Beauty Terminal Station into the two separate incidents provides a failure rate of 0.33% instead of the initial 0.21% used by PB in formulating their recommendations for this self-insurance risk.

In addition, the engineering data recently provided by SP AusNet shows a relationship between failure rate and asset age which can be used to model the expected failure rate for the ageing asset portfolio. This avoids the need for rules of thumb (such as the doubling of the failure rate in the recent regulatory period). As mentioned earlier, from our understanding, the two key causes of power transformer failures are (1) The age of the asset; and (2) The operating condition/loading of the transformer. Supporting our statements are the engineering data provided by SP AusNet that shows an exponential rate of failure for transformers aged between one and 75 years of age.

Since it is not possible to obtain data to verify the operating and loading conditions of the transformers for their life cycle, SAHA believes that it is all the more prudent to include the engineering data recently provided by SP AusNet to model the expected failure rate for the ageing asset portfolio. This avoids the need for rules of thumb (such as the doubling of the failure rate in the recent regulatory period) and takes into account the actual SP AusNet age profile of transformers against the probabilities of failure curve for the power transformers. As such, we have calculated the probability of failure rate using the PB methodology and the SP AusNet engineering curves under 3 different scenarios to understand the impacts on the self-insurance risks for the different replacement of asset scenarios:

1. Estimated failure rate per annum under AER and PB replacement recommendation;

2. Estimated failure rate per annum under SP proposed replacement regime; and

3. Number of aged transformers at risk assuming no replacements are carried out during the next regulatory period.

All 3 scenarios take into account the asset age profile of SP AusNet's transformers under different replacement regimes, assuming the oldest transformers are replaced first for all scenarios. The analysis is shown in Table 3-1, which has the probability of failure analysed for each year of the next regulatory period and then averaged to determine the annual expected failure rate and number of transformers expected to fail each year. To determine the overall requirement of self-insurance risk, this probability is multiplied by the consequence which we have left unchanged at the average excess level of the transformers. Thus based purely on SP AusNet's specific age profile for transformers an annual self-insurance amount of **at least $657,689** is required, instead of the $484,806 submitted by PB and accepted by the AER in the draft decision. This analysis is undertaken in Table 3-2 for the 3 scenarios.

Table 3-1 – Estimated Failure Rate for Power Transformers Accounting for Aged Assets

POWER TRANSFORMER

Regulatory Period 2008 - 2013	
No. of transformer age > 45 and over Feb 2007	68
No. of transformers to be replaced (AER/PB recommendation)	51
No. of transformers to be replaced (SP AusNet proposal)	66
No. of transformers to be replaced (worst case scenario)	0
AER (PB) Recommendation	
Failure rate estimated for 2008 (assume 9 replacements)	0.632%
Failure rate estimated for 2009 (assume 9 repalcements)	0.617%
Failure rate estimated for 2010 (assume 9 replacements)	0.603%
Failure rate estimated for 2011 (assume 9 replacements)	0.589%
Failure rate estimated for 2012 (assume 9 repalcements)	0.576%
Failure rate estimated for 2013 (assume 6 repalcements)	0.575%
Estimated (average) failure rate	**0.599%**
Estimated number of incident pa	**1.42**
SP AusNet Proposal	
Failure rate estimated for 2008 (assume 11 replacements)	0.623%
Failure rate estimated for 2009 (assume 11 replacements)	0.602%
Failure rate estimated for 2010 (assume 11 replacements)	0.580%
Failure rate estimated for 2011 (assume 11 replacements)	0.560%
Failure rate estimated for 2012 (assume 11 replacements)	0.538%
Failure rate estimated for 2013 (assume 11 replacements)	0.516%
Estimated (average) failure rate	**0.570%**
Estimated number of incident pa	**1.36**
Worst Case Scenario	
Failure rate estimated for 2008 (assume nil replacement)	0.682%
Failure rate estimated for 2009 (assume nil replacement)	0.710%
Failure rate estimated for 2010 (assume nil replacement)	0.740%
Failure rate estimated for 2011 (assume nil replacement)	0.771%
Failure rate estimated for 2012 (assume nil replacement)	0.805%
Failure rate estimated for 2013 (assume nil replacement)	0.842%
Estimated (average) failure rate	**0.758%**
Estimated number of incident pa	**1.80**

Table 3-2 – Risk Premium Estimated Taking into Account Age Profile of Transformers

		Failure Rate (%)	No. of Incident (pa)	Average Excess per Incident ($)	Risk Premium (pa)
Scenario 1	AER & PB recommendation of 51 replacement	0.599%	1.42	485,000	**$691,087**
Scenario 2	SP AusNet proposal of 66 replacement	0.570%	1.36	485,000	**$657,689**
Scenario 3	Assume nil, 0 replacement	0.758%	1.80	485,000	**$875,391**

SAHA notes that in addition to this age related risk, the condition/loading of the assets will also impact on the failure rate, with higher loaded assets aging at a faster rate and reaching the end of their effective life sooner. Consistent with this, SP AusNet's distribution system planning report[7] shows that several stations are running near capacity and therefore, these transformers are likely to have loadings on them that will lead to premature aging of the assets. Whilst there are some mitigation strategies in place to transfer load and install new transformers at the substations[8], these measures will not prevent the premature aging of transformers, as the transformers have already been heavily loaded. This adds to the residual risk borne by SP AusNet, which would support the use of a higher probability of failure for power transformers. Meaning, if we are to also consider the loading and operating conditions of SP AusNet transformers, the failure rate would be higher than the calculated minimum range of 0.57% from scenario 2 in Table 3-1 and Table 3-2.

Our belief is that an accurate failure rate needs to take into account both the aging asset profile, which provides an expected failure rate of at least 0.57% per annum, and loading/operating conditions of a transformer. In order to obtain the impact of loading and operating conditions on the failure of transformers the global trends in the electricity power transformers failure rates were examined, especially with reference to the information from an insurance company in the United States that specialises in transformers and had conducted detailed studies into the major failures of transformers[9]. The United States is one of the few countries in the world that can provide a large enough sample where results can be used as an indicative measurement of failure trend. In addition to this document, the International Council on Large Electric Systems (CIGRE) quoted an overall failure rate of 2% per annum on a study of transformers not more than 20 years old. The failure rate quoted by CIGRE is 100% more than the United States measurement of 1%, had aged equipment been included, these figures would likely be higher given the probability of failure curve.

As both of these reports suggest a higher failure rate and involve analysis of the loading conditions on transformer failures, SP AusNet may also see an increase in failures due to the higher loading conditions prevalent in their transformers. As can be seen in the

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[7] SP AusNet's distribution system planning report 2007-2011 (Section 13, Attachment 1: SP AusNet's Zone Substation Demand Forecast)

[8] SP AusNet's distribution system planning report 2007-2011 (Section 14.1, Attachment 2: Part 1 – Summary of Energy at Risk)

[9] "Analysis of Transformer Failures", Bartley, W.H. (2003), a paper presented to the 36th Annual Conference of the Association of Engineering Insurers in Stockholm. William Bartley works for a leading transformer insurance company in the United States – The Hartford Steam Boiler Inspection and Insurance Co.

planning reports prepared by SP AusNet, Vencorp and the distribution businesses[10], there is an increase in demand and loading on some of SP AusNet's transformers and the augmentation of the network is dependent on the prudent capital expenditure as determined by Vencorp, the distribution businesses and the regulator. This leaves SP AusNet being dependent on others to determine the work that needs/can be undertaken to ensure the transformers are not overloaded for long periods of time in the future. Without the appropriate levels of expansion of the network the existing assets will continue to be run harder and consequently have premature aging of transformers. This in turn leads to a higher failure potential as experienced in Queensland and reported in the "Somerville report".[11]

SAHA believe the failure rate estimated for power transformers in this section is therefore a conservative estimate based only on the age of assets but recommend the minimum amount of self-insurance allowed for power transformers be **$657,689**. However if the capital expenditure for transformers is left at the level of the draft decision then the prudent level of self-insurance for SP AusNet would be **$691,087**.

3.2 Current Transformers

The original report used a failure rate for power transformers which was higher than the historical rate and it was therefore assumed that it included implicit allowance for failure of current transformers. With the improved data and methodology for estimating the risk premium for power transformers, no such implicit allowance is included. Accordingly a separate analysis of the current transformer self-insurance risk premium is required. A review of the initial information provided to SAHA by SP AusNet has shown that there is significantly more information available on the current transformers than initially provided. This additional information incorporates the probability of failure curve versus the age of the asset, reference to more failures in the previous regulatory period, and the initial data provided by SP AusNet has since been shown to be incomplete.

SAHA has therefore conducted a similar analysis to the power transformers for the current transformers with this updated information to highlight the level of self-insurance in the original report was lower than necessary to cover the risk of current transformer failure.

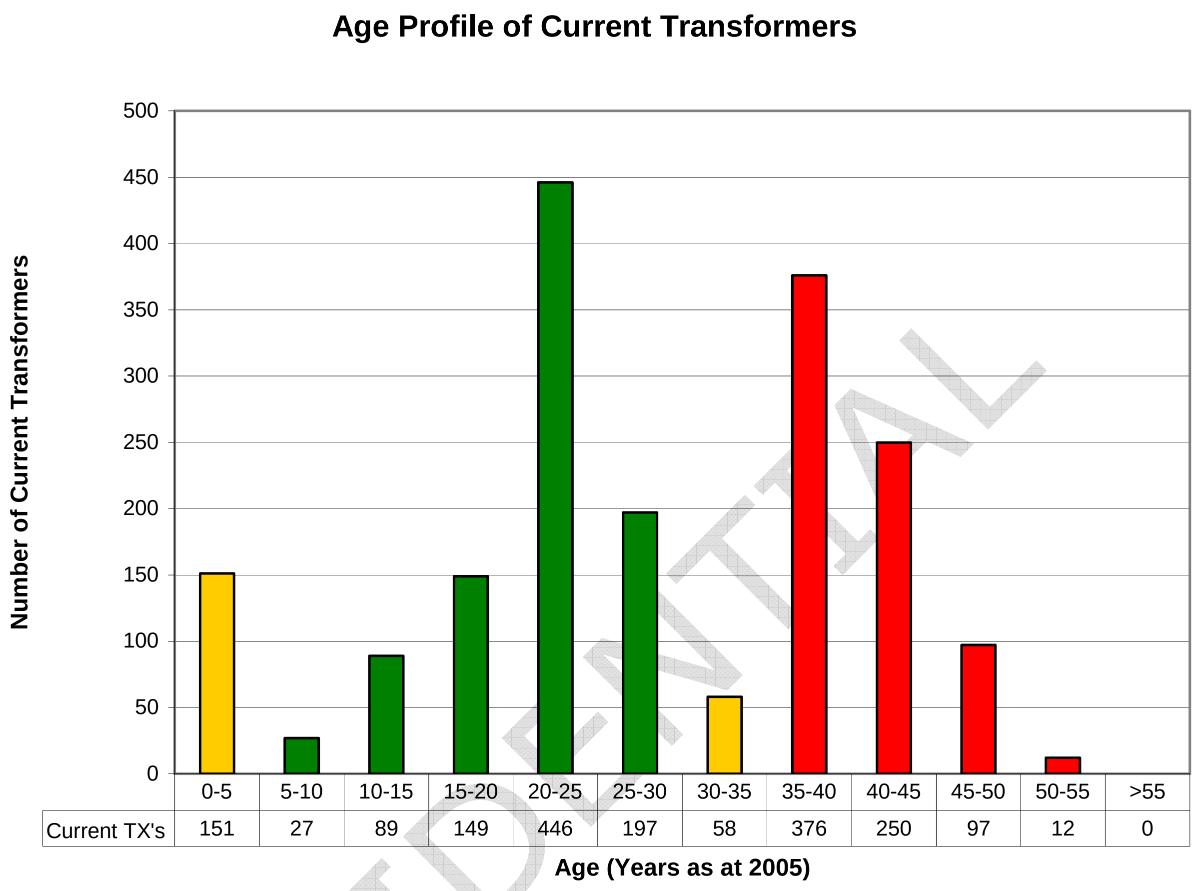
Similar to the power transformers the two key causes of failure for current transformers are:

- The age of the asset; and
- The operating condition/loading of the current transformer.

In relation to the age of the asset, Figure 3-3 below shows the age profile of SP AusNet's current transformers as at 2005. Unlike power transformers, the current transformers have an asset age profile similar to circuit breakers, and therefore are at a critical age 10 years earlier than the power transformers. Meaning assets around 40 years are reaching the end of their expected life for current transformers.

[10] SP AusNet's distribution system planning report 2007-2011
[11] Detailed Report of the Independent Panel, "Electricity Distribution and Service Delivery for the 21st Century", Queensland, July 2004

Figure 3-3 – Age Profile of Current Transformers (CTs) as at 2005



	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	>55
Current TX's	151	27	89	149	446	197	58	376	250	97	12	0

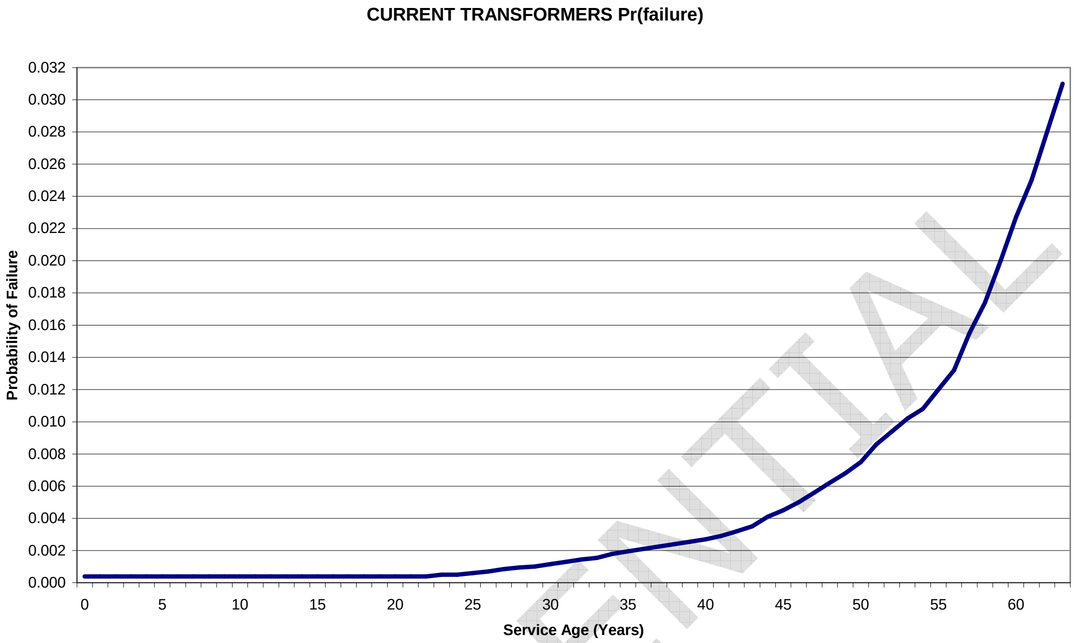
Legend for Age Profile Charts

(red)	Assets Reaching or Above Expected Asset Life
(yellow)	Assets Encroaching on Higher Failure Expectation Periods
(green)	Assets Operating in Lower Failure Expectation Periods – Smooth operation period

As can be seen from Figure 3-3, there is a large proportion of assets at the tail of the chart, showing a high number of assets reaching the industry standard current transformer asset life of greater than 40 years.

According to SP AusNet, there were a total of 5 incidents recorded from 2002 to 2006 (5 years). Originally SP AusNet had indicated to SAHA that the probability of failure was one incident in the next six years for a 220kV current transformer and one incident for a 500kV current transformer, which was based on two reported incidents to SAHA for the 2002-2006 regulatory period. Once the complete data was provided to SAHA by SP AusNet including the engineering data, this new data highlighted there were actually 5 incidents in the 2002 to 2006 regulatory period which significantly impacts on the original estimations of risk calculated by SAHA. This new information translates to a historical failure rate of 0.054% per annum from a current transformer population of 1852 for the last regulatory period. Similar to power transformers, SP AusNet engineering data shows that the failure rate of current transformers increases exponentially with age[12] and is shown in Figure 3-4.

Figure 3-4 – Probability of Failure of Current Transformers by Age of Asset



It is our understanding that by the start of the next regulatory period, SP AusNet will have 735 current transformers at or above the age of 35. Furthermore, it should be noted that a further 58 assets that are currently in the 30-35 year age bracket will be reaching 36-41 years during the next regulatory period. SP AusNet has proposed 201 three phase current transformers (equivalent to 603 single phase) to be replaced during the next regulatory period, which will result in 132 remaining aged assets plus an extra 58 aged assets by the end of the next regulatory period. However, the AER recommended 136 three phase current transformers (equivalent to 408 single phase) replacements as opposed to the 603 equivalent current transformers proposed by SP AusNet for the next regulatory period.

Similar to the power transformer, the methodology did not take into account the age profile of the current transformer population which SAHA believes to be critical with the additional information provided by SP AusNet. From our understanding, the two key causes of current transformer failures are (1) The age of the asset; and (2) The operating condition/loading of the current transformer. Supporting our statements are the engineering data provided by SP AusNet that shows an exponential rate of failure for current transformers aged between one and 60 plus years of age.

Consistent with the methodology adopted for power transformers, we have calculated the probability of failure of current transformers using the probability of failure curves provided by SP AusNet and the asset age profile of the current transformers under 3 scenarios:

[12] The engineering data shows the higher failure rate of transformers for aging assets, however the failure rates for asset curves typically have a bathtub curve showing higher failures due to installation issues. For this analysis the engineering data from SP AusNet has been used ignoring the potential for installation issues. The age profile chart reflects the typical bathtub curve with the potential for transformers to be at risk in the installation and commissioning phase.

1. Estimated failure rate per annum under AER replacement recommendation;

2. Estimated failure rate per annum under SP proposed replacement regime; and

3. Number of aged transformers at risk assuming no replacements are carried out during the next regulatory period

All 3 scenarios take into account the asset age profile of SP AusNet's current transformers under different replacement regimes, assuming the oldest current transformers are replaced first for all scenarios. The analysis is shown in Table 3-3, which has the probability of failure analysed for each year of the next regulatory period and then averaged to determine the annual expected failure rate and number of current transformers expected to fail each year. To determine the overall requirement of self-insurance risk, this probability is multiplied by the consequence which we have left unchanged at the excess for a current transformer. Thus purely based on SP AusNet's specific age profile for current transformers would see an annual self insurance requirement of **at least $499,862**, instead of the $61,679 submitted by PB and accepted by the AER in the draft decision. This analysis is undertaken in Table 3-4 for the 3 scenarios.

Table 3-3 – Estimated Failure Rate for Current Transformers Accounting for Aged Assets

CURRENT TRANSFORMERS (CT)

2002 - 2006 (5 years)	
No. of CT incident during regulatory period	5
Total CT population ending 2007	1852
Failure rate (%)	**0.054%**
Regulatory Period 2008 - 2013	
No of CT > 35 and over starting 2008	735
No. of CT to be replaced (AER recommendation)	408
No. of CT to be replaced (SP AusNet proposal)	603
No. of transformers to be replaced (worst case scenario)	0
AER (PB) Recommendation	
Failure rate estimated for 2008 (assume 68 replacements)	0.176%
Failure rate estimated for 2009 (assume 68 repalcements)	0.160%
Failure rate estimated for 2010 (assume 68 replacements)	0.147%
Failure rate estimated for 2011 (assume 68 replacements)	0.136%
Failure rate estimated for 2012 (assume 68 repalcements)	0.126%
Failure rate estimated for 2013 (assume 68 repalcements)	0.115%
Estimated (average) failure rate	**0.143%**
Estimated number of incident pa	**2.65**
SP AusNet Proposal	
Failure rate estimated for 2008 (assume 100 replacements)	0.165%
Failure rate estimated for 2009 (assume 100 replacements)	0.151%
Failure rate estimated for 2010 (assume 100 replacements)	0.139%
Failure rate estimated for 2011 (assume 100 replacements)	0.129%
Failure rate estimated for 2012 (assume 100 replacements)	0.119%
Failure rate estimated for 2013 (assume 103 replacements)	0.108%
Estimated (average) failure rate	**0.135%**
Estimated number of incident pa	**2.50**
Worst Case Scenario	
Failure rate estimated for 2008 (assume nil replacement)	0.208%
Failure rate estimated for 2009 (assume nil replacement)	0.228%
Failure rate estimated for 2010 (assume nil replacement)	0.252%
Failure rate estimated for 2011 (assume nil replacement)	0.279%
Failure rate estimated for 2012 (assume nil replacement)	0.309%
Failure rate estimated for 2013 (assume nil replacement)	0.342%
Estimated (average) failure rate	**0.270%**
Estimated number of incident pa	**4.99**

Table 3-4 – Risk Premium Estimated Taking into Account Age Profile of Current Transformers

		Failure Rate (%)	No. of Incident (pa)	Average Excess per Incident ($)	Risk Premium (pa)
Scenario 1	AER recommendation of 408 replacement	0.143%	2.65	200,000	**$530,272**
Scenario 2	SP AusNet proposal of 603 replacement	0.135%	2.50	200,000	**$499,862**
Scenario 3	Assume nil, 0 replacement	0.270%	4.99	200,000	**$998,895**

Similar to power transformers, SAHA would like to reiterate that in addition to this age related risk, the condition/loading of the assets will also impact on the failure rate, with higher loaded assets aging at a faster rate and reaching the end of their effective life sooner. Meaning, if we are to also consider the loading and operation conditions of SP AusNet current transformers, the failure rate would be higher than the calculated minimum range of 0.135% from scenario 2 in Table 3-3 and Table 3-4.

We believe that an accurate failure rate needs to take into account both the aging asset profile and loading/conditions of a transformer (power or current).

3.3 Combined Power and Current Transformer Failure Recommendation

Based on our calculations, the combined minimum risk premiums for both power and current transformers taking into account asset age and replacement schedule is **$1,157,551**. This amount is very close to the original estimation by SAHA for Power Transformer and Current Transformer self-insurance risk of **$1,154,300**.

With reference to international failure rates, SP AusNet's aging asset base, and the additional loading that has been placed on many of SP AusNet's current stock of power and current transformers, SAHA believes that it's original estimate of a 1% failure rate should be accepted by the regulator. This would result in its original self insurance risk premium of **$1,154,300** per annum being maintained.

4. RISK OF CIRCUIT BREAKER FAILURE

The AER wrote in their draft decision the following comment regarding the basis for reducing the self-insurance risk component for Circuit Breakers.

> *"SAHA's calculation of the circuit breaker (CB) failure rate has been based on data from the International Council on Large Electric Systems (CIGRE), which indicated a rate of major failures of 0.72%'. PB notes that the last two years of historical data provided by SP AusNet[308] indicate a failure rate of 0.15%. Given the limited availability of data, PB again considers it appropriate to double the historical failure rate to take account of the absence of a longer, and more reliable, sample period. Using the resultant expected failure rate of 0.3%, and taking into consideration SP AusNet's expected work plan over the next regulatory control period, PB recommends a self-insurance risk premium of $353 100, or a reduction of $494 340.*
>
> *As in the case of transformer failure, the AER agrees with PB's conclusion that, while it is realistic to base the risk premium on historical data and SP AusNet's forward work program, data from a two year period is insufficient to determine a failure rate for these purposes. The AER has therefore adopted the expected failure rate of 0.03%, and the proposed reduction of $494 340 to SP AusNet's circuit-breaker failure risk premium."*[13]

The issue with this analysis is in fact highlighted by the AER, in that a two year period is insufficient to determine a failure rate for any long lived asset. Unfortunately, the AER have in fact implicitly used this as the basis for informing the failure rate of circuit breakers, by accepting PB's doubling of the historic failure rate, which in turn was only based on two years of evidence. Moreover, SP AusNet have informed SAHA that the three incidents provided previously represented only a sample of the circuit breaker failures they experienced, and therefore, it was not reflective of the total incident count for the last regulatory period. The data provided by SP AusNet to SAHA was to provide an indication of the costs incurred as a result of circuit breaker failure, not the total number of incidents.

As such, to better reflect the total incident count for SP AusNet, a record of circuit breakers failure incidents spanning 10 years was traced as shown in Table 4-1 below:

[13] "Draft Decision – SP AusNet Transmission Determination 2008-09 to 2013-14", AER, August 2007.

Table 4-1 – Failure Rate Record of Circuit Breakers from 23/07/1997 – 15/07/2007

No.	Location	Voltage	Date of Failure	Description
1	ROTS	220kV	15/07/2007	JW419 Bushing oil low unable to repair
2	BETS	66kV	22/08/2007	AREVA DT1-72.5 F1 internal fault
3	ERTS	66kV	10/10/2006	ABB EDF SKS1-1 explosive failure
4	DDTS	220kV	28/08/2006	ASEA HPL failed mechanism/failed interrupters
5	DDTS	220kV	25/08/2006	JW419 internal flashover
6	RWTS	66kV	14/08/2005	OS10 explosive failure
7	BETS	66kV	27/06/2005	S&S HPF509K/2E mechanism fail
8	SVTS	220kV	15/05/2005	S&S HPF514P/6A broken drive rod
9	EPS	220kV	12/05/2005	ABB LTB explosive failure
10	RCTS	220kV	23/07/2004	BB DCFQ/DCVFQ failure of latching mechanism
11	SMTS	500kV	23/07/2004	BROWN BOVERI ELKSH interrupter failure
12	SYTS	500kV	4/10/2004	MERLIN GERIN DHB4 (failure of internal resistor drive)
13	ROTS	220kV	5/11/2003	GEC/AEI JW419 BUSHING FAIL (low oil)
14	WOTS	330kV	8/08/2003	ASEA HPL362 failure of red and blue phase heads
15	SMTS	500kV	11/06/2003	BROWN BOVERI ELKSH failure in interrupter chamber
16	HOTS	66kV	21/05/2003	S&S HPF 509K/2AS (pole failure FIRE)
17	SYTS	500kV	4/02/2003	MERLIN GERIN DHB4 (internal flashover)
18	SHTS	66kV	5/02/2003	Failed phase
19	WOTS	330kV	2/07/2002	ASEA HPL362 failure head (hot spot)
20	KTS	220kV	18/04/2002	S&S HPF514P/4F shattered insulator drive rod
21	KTS	66kV	12/09/2002	GEC/AEI LG4C red phase drive rod failure
22	WOTS	330kV	18/10/2002	ASEA HPL362 defect in an interrupter module
23	SYTS	500kV	10/10/2002	MERLIN GERIN DHB4 (failure of internal resistor drive)
24	WMTS	220kV	8/09/2001	ASEA HPL245 head and arching contacts damaged
25	JLTS	220kV	9/06/2001	ASEA HLR 245/2504B (contacts failed to close properly)
26	TTS	220kV	3/09/2001	GEC/AEI JW419 BUSHING FAIL (explosive)
27	RWTS	220kV	20/04/2000	S&S HPFC409K (white phase contact was welded close)
28	EPS	220kV	6/07/2000	BROWN BOV DCFQ/DCVFQ (CB head failed)
29	RTS	66kV	10/11/2000	ASEA HKEYC (mechanical failure of the porcelain)
30	HTS	220kV	18/06/1999	S&S HPF514P/6A fractured red phase drive insulator
31	TTS	220kV	28/11/1999	SIEMENS 3AQ1EE (pole failure)
32	TTS	220kV	13/01/1998	SIEMENS 3AQ1EE (head replacement)
33	HWPS	220kV	19/10/1998	GEC/AEI JW419 BUSHING FAIL (low oil)
34	HWPS	220kV	13/12/1997	GEC/AEI JW419 BUSHING FAIL (explosive)
35	HOTS	66kV	18/05/1997	S&S HPF 509K/2AS Opening dash pots (fire)
36	HWTS	500kV	9/10/1997	BROWN BOVERI DMF Head malfunctioned
37	RTS	220kV	23/07/1997	GEC/AEI LG4C internal mechanism hot spot

The initial failure rate of 0.15% calculated by PB was based on a sample of 3 failures experienced by SP AusNet in 2 years. A more reflective failure record traced by SP AusNet shows 37 failures in 10 years, which indicates a failure rate of 0.37%. If the PB methodology of estimating the future probability of failure due to the aging of assets is to double the historical failure rate based on SP AusNet recorded incidents[14], then the historical failure rate should reflect the full historical data instead of the sample provided

[14] "Draft Decision – SP AusNet Transmission Determination 2008-09 to 2013-14", AER, August 2007, Power Transformer self-insurance risk.

to understand the cost implications. On this basis, the failure rate of 0.37% should be used as the initial failure rate and utilising PB's methodology for power transformers we have doubled this to take into account the aging asset profile which would result in a forecast probability of failure of 0.74% for the next regulatory period.

Included in the SP AusNet submission to the AER, SAHA sought information from international industry bodies in particular the International Council on Large Electric Systems (CIGRE) and has adopted a failure rate of 0.72%. This figure from CIGRE matches closely with the expected failure rate, using PB's methodology and the actual historical data, of 0.74% and supports our argument that a higher than 0.72% failure rate can be expected given the aging asset profile of SP AusNet's circuit breakers.

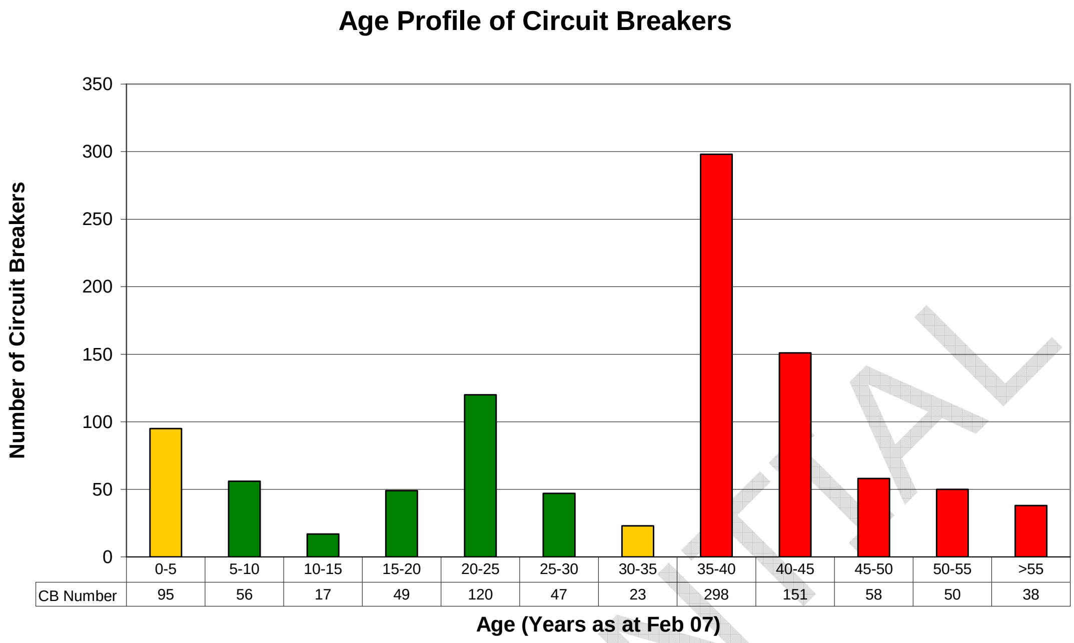
The CIGRE data that SAHA used specifically stated that it excludes aged assets from the failure rate calculations:

> *"Fig. 5 shows failure rates calculated by the combined age-condition model for MTBF of PCA in the range 2 to 10 years, across a wide range of maintenance effectiveness values. Comparison with published information data suggests that the failure rates represented here are of the right order for transmission equipment. For instance a CIGRE study of transformers (not more than 20 years old) found an overall failure rate of 2% per annum [8]. An international study of circuit breaker reliability [9] found rate of major failures of 0.72 % per year and rate of minor failures of 4.49 % per year. Both these studies* ***excluded aged equipment****. Had aged equipment been included these figures would probably have been higher."*[15]

On this basis the 0.72% used by SAHA is conservative, as the aged asset profile for SP AusNet is significant and therefore a higher failure rate than that provided from the CIGRE report could be expected. The aged assets considered in this paper were 30-39 years and the very aged assets were 40 years plus. As can be seen from the asset age profile for circuit breakers (Figure 4-1), SP AusNet has over half its total circuit breakers (approx. 60%) in the aged or very aged assets categories.

[15] "System Dynamics Modelling: Application to Electricity Transmission Network Asset Management", Jennifer Crisp and David Birtwhistle, NEMMCO and QUT, AUPEC, 2004.

Figure 4-1 – Age Profile of Circuit Breakers



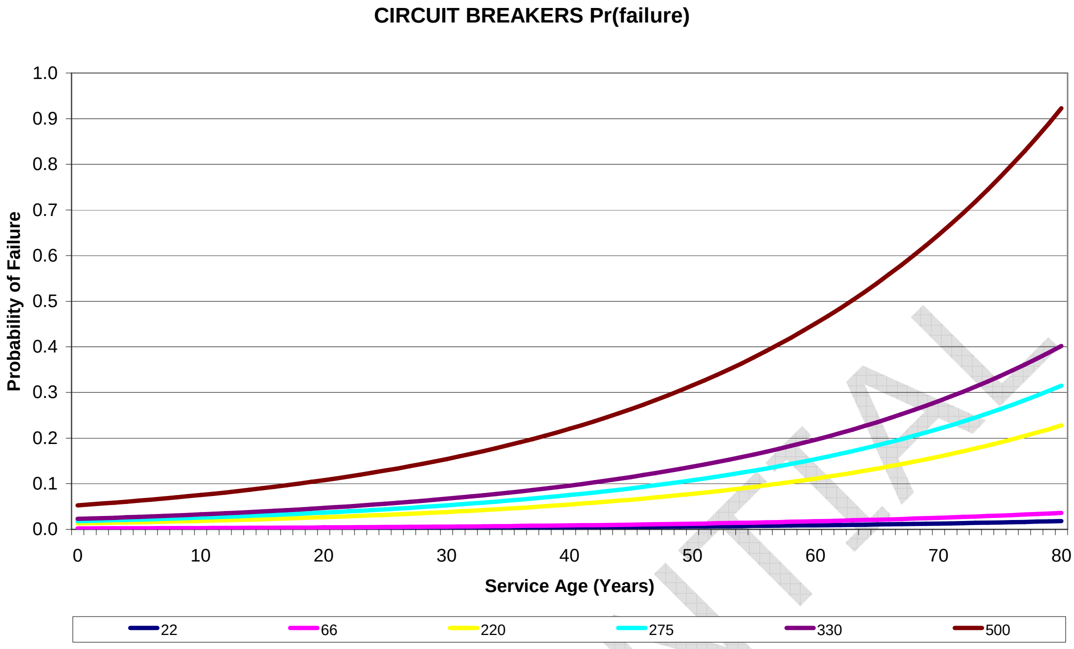
Legend for Age Profile Charts

(red)	Assets Reaching or Above Expected Asset Life
(yellow)	Assets Encroaching on Higher Failure Expectation Periods
(green)	Assets Operating in Lower Failure Expectation Periods – Smooth operation period

SAHA therefore recommends that if the 0.72% (from CIGRE) and 0.74% (based on SP AusNet detailed incident reports and PB's methodology) failure rate estimates are not accepted by the regulator then a better understanding of the age profile (Figure 4-1) should be used to factor the adjustment to historical failure. Similar information to the information provided for power and current transformers was presented to SAHA for analysis in terms of a probability of failure chart with respect to the circuit breaker age profile and voltage level. Utilising this information (Figure 4-2) a similar analysis to power and current transformers could be conducted for circuit breakers, except the exact age profile of the circuit breakers was not known so a beginning and end of regulatory period analysis was undertaken to infer the annual average failures to be expected under the following three scenarios:

- AER recommended replacements;
- SP AusNet proposed replacements; and
- Worst case scenario assuming no replacements over the next regulatory period.

Figure 4-2 – Probability of Failure of Circuit Breakers by Age of Asset



Another approach investigated by SAHA that provides similar results to the probability of failure curves was to use the probability of failure method proposed by SP AusNet in their regulatory submission (MTBF, Mean Time Between Failure Analysis) and summarised in PB's report to the AER chapter 5.10.1[16]. According to our calculation, using this method, the failure rate of circuit breakers taking into account age profiles and the estimated probability on each age profile derived from MTBF (Mean Time Between Failure), would be around 0.503%, as can be seen from the analysis in Table 4-2 the failure rates for the three scenarios and the probability curve equate to 0.427% to 0.504%. This shows the two methods provided by SP AusNet for analysis of circuit breakers provide similar failure rates and therefore would be reasonable approximations to the failure rate of circuit breakers for the coming regulatory period. Calculating this out the self insurance premium would need to be at least $502,579 instead of the $353,100 currently allowed in the draft determination.

In summary, three cases are considered and six failure rates have been calculated, however the MTBF failure rate has been excluded from the table as it provides a similar failure rate to the scenarios based on the probability of failure curves. The resulting failure rates and self-insurance risk calculations are shown in Table 4-3. SAHA believe there is support for using the CIGRE data (Case 2), on the basis that using the PB methodology with the actual historical failure rate (Case 1) produces a similar failure rate.

[16] "SP AusNet Revenue Reset – An Independent Review", PB, 16 August 2007.

Table 4-2 – Estimated Failure Rate of Circuit Breakers Accounting for Aged Assets and Utilising SP AusNet Probability of Failure Curves

CIRCUIT BREAKERS (CB)	
Previous Regulatory Period	
No. of CB incidents during regulatory period	23
Total CB population as at Feb 2007	1002
Failure rate (%)	**0.459%**
Regulatory Period 2008 - 2013	
No of CB's > 35 and over starting 2008	595
No. of CB's to be replaced (AER recommendation)	157
No. of CB's to be replaced (SP AusNet proposal)	247
No. of CB's to be replaced (worst case scenario)	0
AER (PB) Recommendation	
Failure rate estimated for 2008 prior to CB replacement	0.459%
Failure rate estimated for 2013 after CB replacements	0.452%
Estimated (average annual) failure rate	**0.455%**
Estimated number of incident pa	**4.56**
SP AusNet Proposal	
Failure rate estimated for 2008 prior to CB replacement	0.459%
Failure rate estimated for 2013 after CB replacements	0.395%
Estimated (average annual) failure rate	**0.427%**
Estimated number of incident pa	**4.28**
Worst Case Scenario	
Failure rate estimated for 2008 (assume nil replacement)	0.459%
Failure rate estimated for 2013 (assume nil replacement)	0.549%
Estimated (average annual) failure rate	**0.504%**
Estimated number of incident pa	**5.05**

The probability of failure curves for the circuit breakers were not as readily applicable to the data provided to SAHA and therefore some rounding of numbers has been undertaken to determine the failure rates. The actual age profile was provided in a bar chart with 5 year bands which meant the data was based on the average age in the band by the average probability of the band, as the probability of failure becomes exponential this reduces the effectiveness of the probability of failure as the assets reach a greater age. Therefore SAHA recommends retaining the CIGRE data as the best representation of what SP AusNet could expect for circuit breakers in the coming regulatory period.

It is important to highlight that the CIGRE study has removed aged assets which are a leading cause of circuit breaker failures. Therefore the 0.72% from the CIGRE report could potentially be lower than the failure rate for SP AusNet's assets over the upcoming regulatory period. The result is SAHA recommend the self-insurance risk premium that should be adopted for circuit breakers is $847,440 per annum.

Table 4-3 – Risk Premium Estimated Based on Case Conditions

	Case Conditions	Failure Rate	Risk Premium pa
Case 1	Using SP AusNet 10 years incident records and PB methodology	0.740%	$ 870,980
Case 2	Adopting CIGRE failure rate experience	0.720%	$ 847,440
Case 3	Using SP AusNet Probability of Failure Curves for 3 Scenarios		
Scenario 1	AER Recommended Replacements	0.455%	$ 535,535
Scenario 2	SP AusNet Proposed Replacements	0.427%	$ 502,579
Scenario 3	Worst Case (No Replacements)	0.504%	$ 593,208

5. KEY PERSON RISK

In SAHA's original report on self-insurance risks for SP AusNet there was an error identified in the key person risk, when management reviewed the average salary for the General Management. After review of the spreadsheet it was found that although the nine GM's had been identified in the table, only six of the GM's salary information had been provided. The calculations by SAHA involved looking at the titles to ensure the classifications were correct and then used the classification to determine which cells to sum, average and multiply. As there was title information but not cost information, the classification was created and the calculation picked up the zero values for the costs and therefore lowered the average salary for a GM.

After this error was identified SP AusNet requested that SAHA reinvestigate the key person risk and rectify the error, this involved providing SAHA with additional data on the other three GM's. The revised information for the Key Person risk is provided in the sections below, along with the original methodology applied by SAHA for this risk.

5.1 Quantification of Self-Insurance Risk Premium for Key Person Risk

The calculation of a self-insurance risk premium associated with each identified key employee is based on the simple formula shown below:

Key Person Risk Premium = *{Financial Exposure x Probability of Leaving Service}*

Given that the SP AusNet executive management team is responsible for the management of the three separate businesses of the SP AusNet group, the calculated risk premium has to be proportioned between the different businesses. Based on our discussions with SP AusNet, the key personnel and the business that they worked in was identified, however for those personnel that worked across the businesses an allocation based on the average time spent in each of the businesses was provided by SP AusNet on the following basis:

SP AusNet (Electricity Transmission) 30%

SP AusNet (Electricity Distribution)	49%
SP AusNet (Gas Distribution)	21%

5.1.1 Identification of Key Persons

Employees should be regarded as key people to the extent that their sudden departure or death would adversely affect the financial position of the company due to the following reasons:

- Their replacement in the short-term is not likely due to the level of expertise or experience required;
- Their replacement is likely to be from overseas or interstate due to the limited availability of specialised expertise locally;
- It is expected that considerable additional expenses would be incurred in respect of recruitment, relocation and settlement costs; and
- Loss of income would follow from the disruption to the company's core business and the time required for the replacement to understand the company's processes and strategies.

By reference to the general criteria described above, it is our expectation that SP AusNet would be able to identify key employees within its executive management team as well as a number of other skilled employees such as senior engineers and operations managers. In the absence of such information being received from SP AusNet, we have identified, from public documentation, the members of SP AusNet's executive management team but we are not in an appropriate position to identify any other key employees within the organisation.

SP AusNet Executive Management

Pursuant to a Management Services Agreement, the Boards of Directors of each of SP AusNet Transmission, SP AusNet Distribution and the Responsible Entity have engaged SPI Management Services Pty Ltd (SP AusNet Management) (and through it, its employees) to provide administrative, managerial and other assistance in relation to SP AusNet's transmission and distribution businesses. The current executive management of SP AusNet Management are considered key personnel along with selected individuals from the business across core activities, e.g. specialist engineers, operators and senior technicians. A summary of SP AusNet's identified key personnel can be found in Table 5-1, including the average age profile for the key groupings.

Table 5-1 – Summary of SP AusNet Key Personnel

TYPE OF POSITION	Number of People	Average Age
General Management	9	44.89
Team Leader	11	54.82
Manager	16	48.49
Specialist Engineer	11	55.87
Lead Engineer	6	51.57
Other Senior Officers	20	50.61
Total Key People	**73**	**50.94**

5.1.2 Exposure to Key Person Risk

The methodology used to determine the adverse financial affect on SP AusNet of the sudden departure or death of a key person considers three cost components:

- **Standard Replacement Cost** – an estimate of the typical, or average, cost of replacing an employee locally. It is considered that these costs should be captured within the administrative and/or operations and maintenance costs within the general cost of service framework and, therefore, have not been included in the calculation of the self insurance risk premium;

- **Additional Replacement Cost** – any additional costs, in excess of typical recruiting costs, involved with recruiting a replacement employee from abroad, from senior management or from candidates within a very specialised area of expertise; and

- **Business Disruption Cost** – an estimate of the specific costs related to the replacement employee's expected salary and any loss/reduction of business income in the initial period of employment when they are not fully operational, including any lost business opportunities

Using this methodology, the financial exposure of key person risk is calculated as follows:

Financial Exposure = *{Additional Replacement Cost + Business Disruption Cost}*

Based on the above information and assumptions, Table 5-2 below shows our estimate of SP AusNet's exposure to key person risk.

Table 5-2 – Estimated SP AusNet Financial Exposure to Key Person Risk

TYPE OF POSITION	Average Salary	Average Recruitment Costs	Business Disruption Costs	Number of People	Estimated Financial Exposure
General Management	$ 387,767	$ 116,330	$ 277,778	9.00	$ 3,546,970
Team Leader	$ 97,947	$ 28,075	$ 28,396	11.00	$ 621,178
Manager	$ 178,906	$ 43,936	$ 41,613	16.00	$ 1,368,781
Specialist Engineer	$ 135,908	$ 37,254	$ 36,045	11.00	$ 806,290
Lead Engineer	$ 155,254	$ 40,508	$ 38,757	6.00	$ 475,591
Other Senior Officers	$ 107,657	$ 29,712	$ 29,760	20.00	$ 1,189,434
Total Key People	**$ 164,513**	**$ 45,286**	**$ 64,416**	**73.00**	**$ 8,008,245**

5.1.3 Probability of a Key Person Leaving SP AusNet

The probability of a key person leaving the service of SP AusNet can be calculated based on a combination of information relating to probabilistic rates of resignation, mortality and disablement. These rates are dependent on and vary with the age of each person.

We have derived the average probability of each member of the SP AusNet key person list leaving the service of SP AusNet using resignation, mortality and disablement factors referenced in an Actuarial Review of the Victorian Energy Industry Superannuation Fund (prepared by William M Mercer). These are shown in Table 5-3 below. Another risk that is harder to quantify for key personnel is the risk of staff being poached by other utilities, this risk is a reality for all the electricity companies as there are shortages of resources in key areas. Due to the difficulty in determining the rate of poaching amongst the utilities the probability used for this risk analysis is conservatively based on the resignation, mortality and disablement factors mentioned above.

Table 5-3 – Key Person Risk - Probability of Leaving Service

TYPE OF POSITION	Average Age	Probability of Leaving Service
General Management	44.89	1.86%
Team Leader	54.82	1.96%
Manager	48.49	1.92%
Specialist Engineer	55.87	2.15%
Lead Engineer	51.57	1.87%
Other Senior Officers	50.61	1.86%
Total Key People	**50.94**	**1.93%**

5.1.4 Estimated Self-Insurance Premium - Key Person Risk

Based on the above information, we estimate the total self-insurance premium for SP AusNet's key person risk to have a value of $137,464. The detailed results are shown in Table 5-4 below.

Table 5-4 – Estimated SP AusNet Financial Exposure to Key Person Risk

TYPE OF POSITION	Estimated Financial Exposure	Estimated Total Risk Premium	Allocation of Total Risk Premium		
			Electricity Transmission	Electricity Distribution	Gas Distribution
General Management	$ 3,546,970	$ 66,274	$ 19,882	$ 32,474	$ 13,918
Team Leader	$ 621,178	$ 13,634	$ 13,634	-	-
Manager	$ 1,368,781	$ 27,781	$ 11,991	$ 10,022	$ 5,768
Specialist Engineer	$ 806,290	$ 18,594	$ 5,578	$ 9,111	$ 3,905
Lead Engineer	$ 475,591	$ 9,604	$ 2,461	$ 4,019	$ 3,124
Other Senior Officers	$ 1,189,434	$ 24,183	$ 16,660	$ 5,703	$ 1,819
Total: Annual	**$ 8,008,245**	**$ 160,070**	**$ 70,207**	**$ 61,330**	**$ 28,534**
Total: 6-Year Period	$ 48,049,467	$ 960,419	$ 421,240	$ 367,977	$ 171,202

Using the parameters shown earlier in section 5.1 we have allocated the risk premium across the three main business groups as shown below.

SP AusNet (Electricity Transmission)	**30%**	**$**	**70,207**
SP AusNet (Electricity Distribution)	49%	$	61,330
SP AusNet (Gas Distribution)	21%	$	28,534

As the original self-insurance risk calculation resulted in $63,425 and this is not much different to the self-insurance risk resulting from the inclusion of the additional management costs, it is recommended that the original self-insurance risk estimate which has been accepted in the draft decision by the AER be retained in the final decision.