AusNet Transmission Group Pty Ltd

Transmission Revenue Review 2017-2022

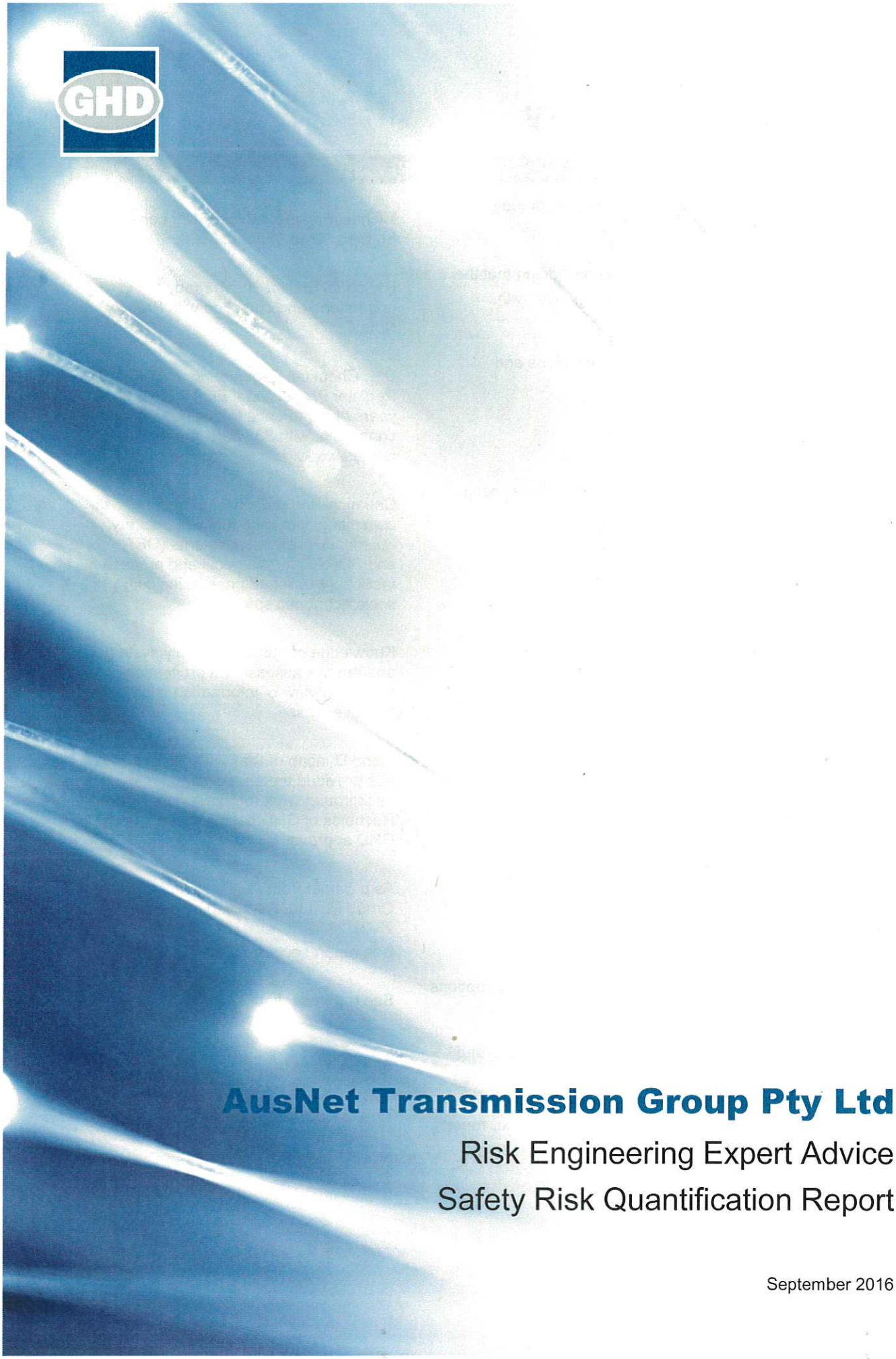
Revised Revenue Proposal

Appendix 3A: Report from GHD

Public Version

Submitted: 21 September 2016

missionzero



AusNet Transmission Group Pty Ltd

Risk Engineering Expert Advice

Safety Risk Quantification Report

September 2016

Executive summary

		Expert
1.	The name and address of the expert:	Michael Erskine, Level 8, 180 Lonsdale St, Melbourne Victoria, 3000
2.	A statement acknowledging that the Practice Note is complied with.	I, Michael Erskine, have read, understood and complied with Practice Note CM7.
3.	The expert's qualifications and experience:	B.E. Chemical Engineering, MBA, Register Professional Engineer Qld. 32 years of experience in engineering and consulting, with 23 years in direct risk related work.
4.	A statement identifying the expert's area of expertise:	Chemical and process engineering, risk consulting, including functional safety, quantitative risk assessments (QRA and SQRA®) for chemical and process facilities. Published papers, including socio economic safety risk.
5.	A statement setting out the expert's expertise to make the report:	Knowledge of electrical supply systems and the risk assessment processes through review of information supplied for the exercise.
6.	A statement identifying any other significant contributors to the report:	Fiona Duncan of the GHD risk group has provided the support and background work for this report. Henry Reynolds of GHD has provided internal GHD approval.
7.	The questions asked to be addressed:	As per brief from AusNet Transmission Group Pty Ltd. Received by e-mail 28/07/2016. See report section 2.2 and 2.3.
8.	The facts, matters and all assumptions upon which the report is based:	See report section 2.4.
9.	Reference to those documents and other materials the expert has been instructed to consider or take into account in preparing his or her report and the literature or other material used in making the report:	See report section 7

		Expert
10.	The identity of the person who carried out any tests or experiments upon which the expert relied in making the report and the qualifications of that person:	Derek Postlethwaite, Network Consultant (AusNet Services), Herman De Beer, Principal Engineer, Network Planning (AusNet Services), Electrical Engineer, MSc Eng Business Management.
11.	A summary of the opinion or opinions of the expert and the reasons for each opinion:	See report section 1
12.	A statement confirming opinions are based on specialised knowledge as stated in items 3, 4 and 5:	These opinions are based on knowledge of quantitative risk assessment processes as applicable to the equipment identified by AusNet Services.
13.	A statement identifying any provisional opinions that are not fully researched for any reason (identifying the reason why such opinions have not been or cannot be fully researched):	See report section 2.4. Very detailed analysis would be required of the ballistics of the current transformers insulator material, and the intensity of explosion.
14.	A statement setting out any questions falling outside the expert's expertise and also a statement indicating whether the report is incomplete or inaccurate in any respect:	Underlying project resource size and timing. Data were used for exposure as provided by AusNet Services' strategy and planning group.

"I have made all the inquiries that I believe are desirable and appropriate and that no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel."

Signed

Mike Erskine

Principal Risk Advisor, GHD Pty Ltd

This report is subject to, and must be read in conjunction with, the limitations set out in sections 2.3 and 2.4 and the assumptions and qualifications contained throughout the Report.

Table of contents

Table index

Figure index

1. Summary of Findings

The purpose of this report is to detail opinions in respect of:

- the reasonableness of the safety assumptions made by AusNet Services;
- whether AusNet Services' approach to quantification of safety risk meets the obligations to minimise, as far as practicable, the hazards and risks to the safety of any person;
- improvements that could be made to AusNet Services' risk quantification approach; and
- the reasonableness of the assumptions made by the AER about the safety risks to people.

The findings from investigations is summarised below.

Assumption	Considered Reasonable
AusNet Services: asset failure increases exponentially as it approaches the end of its design life	Yes
AusNet Services: only an asset failure that results in an explosion is considered a safety risk	Yes
AusNet Services: uses an asset failure probability slightly lower than the average CIGRE industry failure rate data	Yes
AusNet Services: an explosion will result in a fatality	Yes
AusNet Services: AusNet Services' employees (or contractors) will be in the vicinity of the explosion hazard zone	Yes, but it is also reasonable to include members of the public
AusNet Services: average occupancy on site is 100% and includes all replacement activities	Yes, although replacement activities can result in an average occupancy greater than 100%
AusNet Services: the cost of a statistical life is C-1-C	Yes, although a higher number may be more reasonable when considering all costs associated with an explosive failure
AER: existing controls designed to mitigate safety risk to employees and the public are not effective	No, replacement is the control that will effectively mitigate risk
AER: occupancy is during normal operational activities (over the 50-year life of an asset) and does not consider replacement / decommissioning activities	No, risk exposure during replacement activities is higher than normal operating activities

Whilst the overall quantitative risk assessment used by AusNet Services is sound, improvements could be made in the future. These improvements are:

- considering all economic costs associated with an explosive failure, not just the cost of a fatality;
- reviewing other activities conducted on a terminal station, but not included in the calculation, to determine their impact and include if the impact is substantial;
- further refinement of the fatality hazard zones and occupancy rates; and
- contemplating conducting site specific safety risk calculations.

The approach AusNet Services has taken to quantifying the safety risk cost in its Revenue Proposal is reasonable and in compliance with the As Far As Practicable (AFAP) requirement of the regulations.

2. Introduction

2.1 Background

AusNet Transmission Group Pty Ltd (AusNet Services) owns, operates and maintains the Victorian electricity transmission network. This network consists of transmission towers, transmission lines and terminal stations throughout Melbourne and regional Victoria. The prices charged for use of the transmission network are regulated by the Australian Energy Regulator (AER).

As part of the regulatory process, AusNet Services submitted a Revenue Proposal to the AER that includes a forecast of AusNet Services' five-year capital expenditure (capex). Included in this forecast is capex to replace end of life assets at a number of terminal stations. Part of the justification for replacement of assets at terminal stations is based on a quantitative assessment of safety risks.

A Draft Decision response to AusNet Services' Revenue Proposal was issued on 20 July 2016. The Draft Decision rejected AusNet Services' proposed capex, based on questions regarding assumptions used by AusNet Services in the quantitative safety risk assessment, and provided an alternative capex forecast using its own assumptions.

As a result of the AER's Draft Decision, AusNet Services is required to submit a Revised Revenue Proposal on 21 September 2016.

2.2 Purpose of this Report

The purpose of this report is to detail opinions in respect of:

- the reasonableness of the safety assumptions made by AusNet Services;
- whether AusNet Services' approach to quantification of safety risk meets the obligations to minimise, as far as practicable, the hazards and risks to the safety of any person;
- improvements that could be made to AusNet Services' risk quantification approach; and
- the reasonableness of the assumptions made by the AER about the safety risks to people.

This report will be included in documentation submitted to the AER as part of AusNet Services' Revised Revenue Proposal.

2.3 Scope

The scope of this report is to provide an independent expert review in relation to the approach to the quantification assessment of safety risks for terminal stations asset replacement projects. This involved:

- meeting with AusNet Services' staff to understand the approach used to quantify safety risks;
- reviewing AusNet Services' obligations under relevant state and federal law;
- reviewing documents including planning reports, sections of the AusNet Services' regulatory proposal and sections of the AER's Draft Determination;
- reviewing the assumptions made by AusNet Services in the quantification of safety risks;
- reviewing, and providing an opinion on, the reasonableness of the assumptions made by the AER to quantify safety risk;

- providing advice to AusNet Services on its quantification of safety risks including (but not limited to):
  - the reasonableness of the safety assumptions made by AusNet Services;
  - whether the approach used to quantify safety risks could be readily improved; and
  - whether the AusNet Services' approach results in meeting the obligation to minimise, as far as practicable, the hazards and risks to the safety of any person; and
- preparing a report for AusNet Services outlining the findings and recommendations of the review. The report will be included in the documentation submitted to the AER with AusNet Services' Revised Proposal and should be prepared in accordance with the Federal Court Practice Note on Expert Witnesses in Proceedings in the Federal Court of Australia (CM 7).

2.4 Limitations and Assumptions

This report: has been prepared by GHD for AusNet Transmission Group Pty Ltd and may only be used and relied on by AusNet Transmission Group Pty Ltd for the purpose agreed between GHD and the AusNet Transmission Group Pty Ltd as set out in section 2.2 and 2.3 of this report.

GHD otherwise disclaims responsibility to any person other than AusNet Transmission Group Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by AusNet Transmission Group Pty Ltd , which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this section, and those outlined in the remainder of this report. GHD disclaims liability arising from any of the assumptions being incorrect, including (but not limited to):

- did not include a detailed review of the ballistics or pressure modelling used for the determination of the hazardous zone; and
- the information provided by AusNet Services' (as per sections 3 and 4) relating to the terminal stations is accurate and up to date at the time of report preparation.

3. AusNet Services' Approach

3.1 Overview

There are a number of regulatory obligations and requirements that are required to be met by AusNet Services. The regulations, standards, and acts relating to safety are:

- National Electricity Rules;
- Electricity Safety Act;
- Electrical Safety (Management) regulations;
- Australian Standard (AS) 5577 – 2013 Electricity Network Safety Management Systems; and
- Victorian Occupational Health and Safety Act and Regulations.

In essence, AusNet Services has a requirement to minimise as far as practicable (AFAP) the hazards and risks to the safety of any person arising from the supply network[1] and where reasonably practicable, the elimination of the source of risk and where elimination is not reasonably practicable, the identification of treatments or controls so that residual risks are reduced to as low as practicable.

To assist in managing their assets, AusNet Services assess the risk using the equation shown in Figure 1. The total expected cost of an asset failure incorporates four components:

- Safety Cost,
- Collateral Damage Cost;
- Environmental Cost, and
- Power Outage Cost.

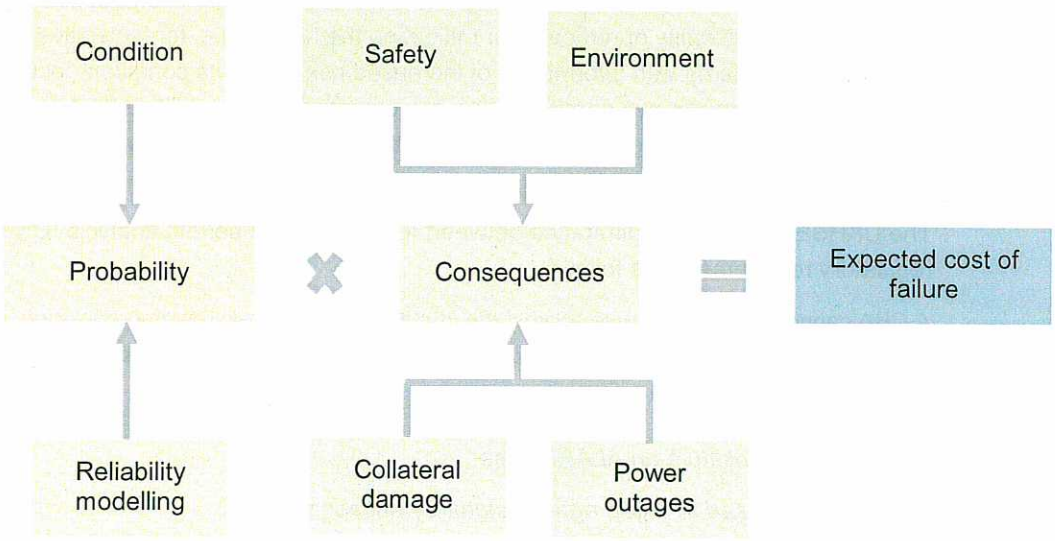


Figure 1 AusNet Services' Risk Quantification Equation

[1] Electricity Safety Act, Part 10 Division 1 Section 98

When considering Safety Cost, AusNet Services applies the following assumptions:

- asset failure rates are based on current and projected condition;
- asset failure remains low during the early stages of its lifecycle, but increases exponentially as it approaches the end of its design life;
- only the probability that an asset failure results in an explosion is considered a safety risk, and uses a slightly lower probability compared to industry data (CIGRE);
- only older technology assets are considered an explosion risk as new technology assets do not exhibit explosive failure characteristics;
- an explosion will result in a fatality;
- AusNet Services' employees (or contractors) are impacted by an explosive equipment failure;
- When considering explosion risks, safe occupancy on site involves all activities requiring personnel to be on site, including replacement activities, at all times, making it 100%; and
- the calculated cost of a fatality is C-1-C, which is based on Australian Government guidance[2].

With respect to safety regulations, the Safety Cost is used to determine if hazards and risks are minimised to AFAP. In previous Revenue Proposals, where the calculation of the safety risk cost has been the same as current, the AER has not questioned AusNet Services on its assumptions.

3.2 Opinion on Obligations

The principle of as low as reasonably practicable (ALARP) is fundamental in risk management. By definition ALARP considers the financial capacity in applying risk management actions and controls i.e. what is financially reasonable to be done to manage a hazard. AFAP, as defined in the Victorian Electricity Safety Act, is a practicality based process which focuses partially on financial capacity, but also on the severity and state of knowledge of a hazard as well as the availability and suitability of removing or mitigating the hazard. i.e. for legislative purposes, high consequence hazards with information of increased risk due to its condition, focusses on what ought to be done to remove or mitigate the risk considering availability, suitability and cost. AFAP is generally what legislation requires i.e. the regulatory mandate and takes precedence over ALARP.

The UKHSE[3] clarifies the difference between risk based cost benefit analysis (CBA) and regulatory requirements as follows.

A CBA cannot be used to argue against the implementation of relevant good practice, unless the alternative measures are demonstrated unequivocally to be at least as effective.

A CBA on its own;

- *does not constitute an ALARP case;*
- *cannot be used to argue against statutory duties; and*
- *cannot justify risks that are intolerable, or justify what is evidently poor engineering.*

[2] Best Practice Regulation Guidance Note – Value of statistical life, Department of Finance and De-regulation, Australian Government, November 2008
[3] UKHSE, ALARP Justification, accessed 18/09/2016 http://www.hse.gov.uk/risk/theory/alarpcheck.htm

AusNet Services is required to reach AFAP for safety requirements as mandated by legislation. In other words, AusNet Services must minimise the explosion risk from aged equipment to AFAP through cost effective replacement of said equipment.

3.3 Opinion on Assumptions

3.3.1 Asset Failure rates and Probability

The use of current condition and industry data on explosion probability is appropriate and using a slightly lower probability compared to industry data does not over-state the risk.

Using an exponential curve to show that the probability of an asset failure rate increases as it ages is also appropriate and consistent with observations in other industries.

3.3.2 Asset Explosion Fatality

The fatality exposure potential for people is a factor of the nature of the event in question, as well as the distance from the source of the event, and the number of people and frequency of time spent within this zone of influence. In the case of the older style current transformer, the explosion is a result of the internal arcing, forming hydrogen and acetylene from the transformer oil, causing rapid rise in pressure, and disintegration of the porcelain into small pieces. These pieces have been measured up to 100 metres away from the source[4]. The mixture of the blast pressure, porcelain missiles and hot oil spray, the potential for fatality and major injury is considered highly credible.

3.3.3 Occupancy

As regulatory requirements require that safety be considered for any person throughout the whole life cycle of the asset, it is appropriate to include decommissioning / replacement activities when considering occupancy. AusNet Services has provided details of two different levels of decommissioning projects. They are listed below.

- Worker site occupancy rates for large, complex replacement projects e.g. West Melbourne (WMTS) and Springvale (SVTS):
  - 4-year site works;
  - Average of 45 to 50 people on site on weekdays from 7:00 am to 3:30 pm; and
  - About a third of weekends with between 20 to 25 people on site from 7:00 am to 3:30 pm.
- Worker site occupancy rates for less complex replacement projects e.g. Fisherman's Bend (FBTS) and Templestowe (TSTS):
  - 18-month site works;
  - Average of 20 people on site on weekdays from 7:00 am to 3:30 pm; and
  - About a third of weekends with 10 people on site from 7:00 am to 3:30 pm.

AusNet Services has also indicated that when equipment reaches the end of its life, it is decommissioned and generally replaced in situ i.e. on brownfield sites and in the vicinity of other live equipment (for power supply purposes) of a similar age.

With the number of people on site during replacement projects and the proximity to live equipment of a similar age, more than one person is expected to be in an explosion hazard

C-1-C

zone. This results in an average occupancy during replacement activities being greater than 100%.

3.3.4 General Public Considerations

Public exposure to the hazardous zone created by a safety related failure (i.e. an explosion) has not previously been explicitly included by AusNet Services. Given the potential for shrapnel from an asset explosion can travel up to 100 meters from the source (as discussed in Section 3.3.2), it is appropriate that public exposure is included in occupancy considerations.

Potential public exposure assumptions are provided below, with the corresponding details of exposure summarised in Table 1.

- In general;
  - on average, there is a constant presence of five people around the boundary of a terminal station on weekdays (this takes into account pedestrians, vehicles and trains as well as peak hour conditions);
  - on average, there is a constant presence of two people around the boundary of a terminal station on weekends (this takes into account pedestrians, vehicles and trains);
  - it takes three minutes to move through the hazard zone;
  - the activity occurs for 50 weeks (to account for holidays and sickness); and
  - being located outside the boundary of a terminal station and the presence of a mesh-wire fence offer some protection from the hazard zone.

Table 1 Public Exposure Rates

	Weekdays	Weekends	Total
Number of people	5	2	
Frequency of activity per year	250	100	
Activity hours per day	0.05	0.05	
Hazard zone protection factor	0.25	0.25	
Number of days needed for activity	250	100	
Length of time near to site (hours)	12.5	5	
Hazard zone exposure (hours per year)	3,906	250	4,156
Hazard zone exposure per year (%)	44.59%	2.85%	47.44%

3.3.5 Cost

The overall method used by AusNet Services for calculating the cost of a fatality is suitable, however, if public exposure is included, the cost may need to be increased to take into account a higher disproportion factor for a public fatality as opposed to a worker fatality.

When quantifying risk to represent the economic costs of an explosive failure of a terminal station asset, it is prudent to consider the flow-on cost effects from the failure.

These additional costs include:

- unserved energy during the post event investigation, when site access is restricted and normal restoration activities are not possible;
- post event investigations;
- counselling;
- industrial relations;
- legal; and
- reputational.

The above mentioned aspects are not currently included in the determination of the Fatality Cost used by AusNet Services. These aspects could be investigated to further refine the quantification of safety risk in the future.

3.4 Opinion on Areas of Improvement and Recommendations

Whilst the basis of AusNet Services' quantitative risk assessment is sound, AusNet Services' calculation of Safety Risk is basic. A more refined calculation could include an analysis of the hazard zone occupancy and a site specific public impact factor. This approach is consistent with risk quantification for major hazard facilities in the oil and gas, water, chemical and mining industries and more fully embraces the AFAP principle.

At this stage only a general public exposure rate is proposed. In the future, AusNet Services could further refine the quantification of safety risk by including site specific public exposure rates to differentiate between sites that are not as exposed to the public e.g. Heywood terminal station that is buffered by significant vegetation, from those that are e.g. Thomastown terminal station which is opposite a train station. Each terminal station site could include consideration of public exposure separate to onsite occupancy.

4. Australian Energy Regulator Approach

4.1 Overview

Following review of AusNet Services' Revenue Proposal, the AER raised concerns with two of AusNet Services' assumptions; namely:

- existing controls designed to mitigate safety risk to employees and the public are not effective; and
- someone is, at all times, in the immediate vicinity of a safety related asset failure.

The result of these two assumptions is that the AER believe that AusNet Services has been overly conservative in its quantification of risk.

A number of controls, generally around condition monitoring, inspection, fire protection and safe work practices / training, are listed by the AER as further reasons why the exposure rate has been over estimated by AusNet Services. However, the AER has not made any further adjustments to the exposure rates based on existing controls.

The AER proposed an alternate equation for quantifying safety risk, as shown in Figure 2.

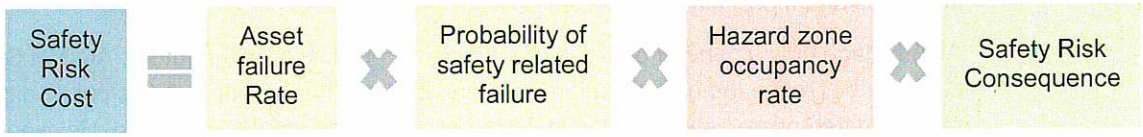


Figure 2 AER Proposed Risk Quantification Equation

The AER provided alternative exposure rates for being in the immediate vicinity of a safety related asset failure i.e. the hazard zone occupancy rate. The proposed exposure rates are general for all sites and take into account, operational activities, routine inspections, maintenance and refurbishment. The frequency of the activity takes into account most aspects of the asset's life cycle; decommissioning being the exception. A summary of the AER's proposed exposure rates[5] are provided in Table 2. The result is that the AER assume that someone is in the immediate vicinity of a safety related asset failure for about 1% of the time.

The following formulas were used in the calculations:

1. Length of time on site (hours) = activity hours per day x the number of days needed for activity;
2. Total yard exposure (hours per year) = number of people x the frequency of activity per year x length of time (hours) on site x a hazard zone proximity factor; and
3. Total yard exposure (%) = Total yard exposure (hours per year) ÷ 8760 (hours in one year)

[5] AER, Draft decision AusNet Services' transmission determination, Attachment 6, Capital expenditure, page 48, July 2016

Table 2 AER Proposed General Exposure Rates

	Operations	Routine inspection	Maintenance	Refurbishment	Total
Number of people	2	2	6	10	
Frequency of activity per year	1	2	0.2	0.02	
activity hours per week	0.5	1	36	36	
number of weeks needed for activity	0.2	0.2	1	12	
hazard zone proximity factor	1	0.5	0.7	0.7	
Length of time on site (hours)	0.5	1	25	300	
In yard exposure (hours per year)	1	4	30.2	60.5	95.7
In yard exposure per year (%)	0.01%	0.05%	0.35%	0.69%	1.1%

4.2 Opinion on Differences Compared to AusNet Services

The AER consider occupancy during normal operational activities (over the 50-year life of an asset), and does not consider replacement / decommissioning activities. This is different compared to AusNet Services' approach. As mentioned in Section 3.3.1, the age of equipment, in reference to its intended design life, impacts on the likelihood of failure. AusNet Services currently has multiple pieces of equipment that are approximately ten-years past their original design life, which is within acceptable ranges based on asset condition testing and monitoring, as permitted by regulatory legislation. It is this aged equipment that is the focus of the safety risk.

It is appropriate to consider occupancy during replacement activities when calculating the Safety Risk Cost for aged equipment. This is consistent with other industries, such as the Oil and Gas Industry, which looks at replacement / rebuild activities as an increase to risk exposure compared to normal operational activities. For the Oil and Gas industry, if time based risk exposure exceeds a certain level, key decisions are made about schedule duration and adjacent operations to minimise exposure risk to acceptable annualised levels.

4.3 Opinion on Reasonableness of Approach

4.3.1 Control Effectiveness

The AER's assumption, that AusNet Services considers existing controls designed to mitigate safety risk to employees and the public are not effective, is inappropriate. AusNet Services assumes that their existing controls are effective. The controls, such as condition monitoring programs and replacement programs, are in place to minimise the likelihood of a safety related event occurring, and are reflected in their failure rates. These controls are critical in mitigating safety related events and preventing and mitigating human factor impacts (operator error).

However, in order to eliminate a hazard or risk to AFAP, as obligated by legislative requirements, replacement of aged equipment, as asserted by AusNet Services, is an effective method to eliminate their explosive failure risk. Equipment that is approaching, or at the end of its life span is inherently more likely to fail. The result is that the asset failure rate will continue to

increase during the next five years, therefore increasing the safety risk until the asset actually fails or is replaced.

The aging equipment, coupled with the fact that the equipment is now technologically outdated, means that replacement is the control option that will mitigate risk and that will minimise the source of safety risk to AFAP.

4.3.2 Exposure Rates

The assumptions made by the AER, particularly when considering the frequency of activities performed on site and the time required to complete them, appear to be low. AusNet Services has provided information based on actual activity on all of their sites. Examples of the actual activities conducted by AusNet Services' personnel during operation are listed below.

- General inspections – 1 person, 12 times a year (4 hrs per inspection)
- Non-invasive inspections – 2 people, once a year (8 hrs per inspection)
- Oil sampling inspections – 1 person, once in 6 years for circuit breakers plus twice a year for current transformers (8 hrs per inspection)
- Secondary asset inspections – 1 person, 5 times a year (6 hrs per inspection at 50% hazard zone exposure)
- Circuit breakers (CB) maintenance – 2 people, once in 3 years (8 hrs per CB) plus 4 hrs per asset for switching & permitting
- Disconnectors maintenance – 2 people, once in 3 years (4 hrs per disconnector) plus 4 hrs per asset for switching & permitting
- Transformers oil change – 1 person, once a year (1 hr per transformer)
- Transformers Tap changer maintenance. – 3 people, once in 2 years (8 hrs for 2 days per transformer)
- Transformers Overall maintenance. – 2 people, once in 4 years (8 hrs for 2 days per transformer)
- Transformers Condition monitoring – 2 people, once in 6 years (12 hrs for 2 days per transformer)
- Secondary assets maintenance – 2 people, 3 times a year (8 hrs per station)

Additionally, other distribution businesses require access to terminal stations for operation and maintenance where they own assets within the site boundary e.g. Ringwood Terminal Station.

This indicates that even for normal operational activities, a 1% exposure rate is considered to be too low.

It should also be noted that there are additional activities that occur on a terminal station site, particularly during planning and preparation for refurbishment and decommissioning activities. These, whilst listed below, have not been included in the current process. However, these activities could be used to further refine the quantification of safety risk in the future:

- emergency works;
- project Initiators to prepare project scopes;
- project development team to prepare option estimates;
- design team to prepare BC estimate;
- design team to prepare detailed design;

- external parties such as AER, AEMO, ESV; and
- unauthorised persons (public) etc.

4.4 Opinion on Compliance Implications

The replacement of aging equipment to minimise the hazards and risks to the safety of any person arising from the supply network to AFAP is appropriate.

5. Conclusions

Using established risk analysis approaches, the initial approach and assumptions made by AusNet Services appear to be simple but reasonable. In fact, if more detailed analysis is completed, considering occupancy information provided by AusNet Services for all aspects of an asset's life cycle and the general public, the total exposure rate is expected to be above 100%. This is due to the fact that multiple people are present for significant time periods during replacement projects.

There is a legislative requirement imposed on AusNet Services that where high consequence risk events are credibly identified they must be eliminated or minimised to AFAP. Part 10 Division 1 Section 98 of The Electricity Safety Act has requirements to minimise as far as practicable the hazards and risks to the safety of any person arising from the supply network for full life cycle operation.

In order to achieve AFAP, AusNet Services would need to replace aged equipment with an identifiable safety issue such as explosion potential. This is especially the case when AusNet Services' work groups are working for long durations near live equipment in switch yards that have this hazard potential.

Therefore, the AusNet Services' approach to quantifying the safety risk cost in its Revenue Proposal is reasonable and in compliance with the AFAP requirement of the regulations.

6. Recommendations

The initial values proposed by AusNet Services in their Revenue Proposal are justifiable and should therefore be used to ensure safety of all people is kept within acceptable limits.

Whilst the overall quantitative risk assessment used by AusNet Services is sound, improvements could be made in the future. These improvements are:

- considering all economic costs associated with a fatality, not just the cost of a fatality;
- reviewing other activities conducted in a terminal station, but not included in the calculation, to determine their impact and include if the impact is substantial;
- further refinement of the fatality hazard zones and occupancy rates; and
- contemplating conducting site specific safety risk calculations.

"I, Michael Erskine, have made all the inquiries that I believe are desirable and appropriate and that no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel."

signed

Michael Erskine

Executive Risk Advisor, GHD Pty Ltd

7. References

1. UKHSE, ALARP Justification, accessed 18/09/2016 http://www.hse.gov.uk/risk/theory/alarpcheck.htm
2. AER, Draft decision AusNet Services' transmission determination, Attachment 6, Capital expenditure, page 48, July 2016
3. Victorian Electricity Safety Act, 1998
4. Victorian Electricity Safety (Management) Regulation, 2009
5. AS 5577 – 2013 Electricity network safety management systems
6. AMS 10-24 Asset Renewal Planning Guideline, issue 4, AusNet Services', October 2015
7. AMS 10-22 Risk Management, issue 9, AusNet Services', October 2015
8. AMS 10-11 Asset replacement and refurbishment, issue 9, AusNet Services', October 2015
9. Application of SFAIP in project specification, AusNet Services', October 2015
10. AusNet Transmission Revenue Proposal, AusNet Services', October 2015
11. FBTS Transformer and CB Replacement Planning Report, AusNet Services', October 2015
12. WMTS Hazard Profiles, AusNet Services', August 2016

8. Acronyms and Abbreviations

In this document, the following definitions apply.

Term	Definition
ALARP	"ALARP" is short for "as low as reasonably practicable". At the core is the concept of "reasonably practicable"; this involves weighing a risk against the trouble, time and money needed to control it (UKHSE).
Assumption	A statement, quantity or formula accepted to be true, but without proof.
Exposure	The amount of time that a person is in a region where they can be affected by an event.
Reliability Risk	Reliability and security of electricity supply to customers
Safety Risk	Safety of all people from the electricity network
AFAP	"AFAP" is short for "as far as practicable"

In this document, the following acronyms and abbreviations apply.

Acronym / Abbreviation	Meaning
AER	Australian Energy Regulator
AFAP	As Far As Practicable
AusNet Services	AusNet Transmission Group Pty Ltd
CBA	Cost Benefit Analysis
ESV	Energy Safe Victoria
FBTS	Fishermans Bend Terminal Station
GHD	GHD Pty Ltd
QRA	Quantitative Risk Assessment
SQRA	Semi Quantitative Risk Assessment
SVTS	Springvale Terminal Station
TSTS	Templestowe Terminal Station
UKHSE	United Kingdom Health and Safety Executive
WHS	Workplace Health and Safety
WMTS	West Melbourne Terminal Station

GHD

Level 8
180 Lonsdale Street
T: 61 3 8687 8000 F: 61 3 8687 8111 E: melmail@ghd.com

9110134-38650/https://projects.ghd.com/oc/Advisory/ausnetriskengineerin/Delivery/Documents/9110134-REP-1_QRA expert witness report.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	F. Duncan / M. Erskine	R. Mills	R.C. Mills	H. Reynolds		19/08/2016
B	F. Duncan	M. Erskine		H. Reynolds		29/08/2016
C	F. Duncan	M. Erskine		H. Reynolds		07/09/2016
0	F. Duncan	M. Erskine		H. Reynolds		12/09/2016
1	F. Duncan	M. Erskine		H. Reynolds		16/09/2016

www.ghd.com